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POST-IMPLEMENTATION ANALYSIS OF A B2B E-MARKETPLACE

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SUMMARY: *The advent of Business-to-Business (B2B) e-Marketplaces gave the AEC (Architecture, Engineering and Construction) firms the opportunity to conduct more efficient and effective commercial interaction with their supply chain partners. Despite the large body of literature in generic Information Systems (IS) domain, there has been a very little work done to-date to investigate the B2B e-Marketplace systems implementation by AEC firms. By adopting a case study research method with a longitudinal approach to data collection, the study on which this paper is based explored the challenges in the adoption and on-going use of a large UK contractor firm's e-Marketplace systems from the perspective of end-users. Utilising a well-established theoretical model from the IS body of knowledge, the analysis revealed several important challenges related to system (functionality and usability), information (content quality) and service (training and support) dimensions of e-Marketplace systems implementation. Through incorporating the case study findings to the conceptual model, the study offers several suggestions for AEC firms to take on board during implementation of the B2B e-Marketplace systems.*

KEYWORDS: *e-commerce, e-marketplace, adoption, evaluation, AEC, B2B case study*

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1. INTRODUCTION

The evolution of Inter-Organisational Information Systems (IOIS) has provided the AEC (Architecture, Engineering and Construction) firms with the opportunity to build a closely integrated relationship with their supply chain partners. The term Inter-Organisational Information System (IOIS) describes the environment which mediates the inter-connection between enterprise information systems to facilitate boundary spanning business (and in the case of this paper construction project related) activities. Within AEC industry, the IOIS has been implemented at various forms. The IOIS environments generally support business and project collaboration and its early definitions include 'collaboration environments' (Erdogan et al. 2008), 'web-based project management systems' (Nitithamyong and Skibniewski 2004), and 'project extranets' (Wilkinson 2005). According to Skibniewski and Zhang (2005) the solutions provided by such environments are often offered in the form of Software-As-a-Service (SaaS). Another type of IOIS is the B2B e-Marketplace systems which facilitate the cross-firm procurement activities between two or more trading firms with the added functionality of back-end system integration (Dai and Kauffman 2002). Mediated by the surge in Internet technologies, B2B e-Marketplace systems represent a second wave of e-commerce propagation (Brunn et al. 2002). The terms e-commerce and e-Marketplace are used interchangeably within the article to refer to the same phenomenon.

Although e-commerce has experienced some setbacks, it has maintained its potential in becoming an industry-wide norm (including the AEC industry) for facilitating the Business-to-Business (B2B) commercial interactions (Xu 2015). The manufacturing and retail industries are recognised as flagship bearer in adopting B2B e-commerce systems across their supply chains (Xu 2015). The main drive for introducing e-commerce system is the automation of commercial information exchange which eliminates the 'waste' processes in cross-organisational procurement operations (Dai and Kauffman 2002). Historically, firms relied on Electronic Data Interchange (EDI) to facilitate the automation of their procurement activities. The resultant benefits of EDI use are less paper and administrative work, greater order accuracy, reduced or no data re-keying errors and improved purchasing process (Cole 2008). However, with the developments in Internet and web-based services, the role of B2B e-commerce have extended to encompass a number of value-adding business functions including supplier aggregation and matching, supply chain integration, and collaboration (Xu 2015). Therefore, as a result of its implementation, it is recognised that firms not only benefit from streamlined commercial processes but also reap the rewards of improved communications, reduced cost of operations, lower inventory, reduced lead times, increased control over spend, faster invoice processing and increased bilateral relationships (Xu 2015).

In this study, the term implementation is taken as a set of activities which consists of three phases: (i) pre-implementation activities such as technology vendor selection and requirements specification, (ii) implementation which is concerned with the development activities and the actual delivery of the technology, and (iii) post-implementation where the focus turns to adoption and on-going use of the technology until the solution becomes fully diffused into an organisation's core business and information systems strategy (Linton 2002). Gallivan (2001) has proposed that the decision to implement a new technology can be made at the corporate level and then either (i) mandated for adoption throughout the organisation at once, or (ii) allow voluntary adoption and diffusion whilst providing the necessary infrastructure and support, or (iii) set up pilot projects and observe the processes and outcomes for company-wide roll-out strategy. Regardless of the chosen strategy however, there is general consensus in the literature that post-implementation evaluation is of primary relevance for understanding the factors that determine the success or failure of information systems development and implementation projects (Beynon-Davies et al. 2004; Standing and Lin 2007; Williams et al. 2009).

The post-implementation stage is crucial for driving the user acceptance and continuance use. There are different perspectives in the literature to the question of how to overcome resistance to technology adoption. For example, top management support and commitment, organisational culture, appointing technology champion, training and change management, are some of the key points discussed in the literature which are also considered to be applicable to the B2B e-Marketplace implementation (Lu et al. 2014). Although AEC firms' use and adoption of the IOIS is researched and documented extensively in the literature, past studies primarily focused on web-based collaboration and project management technologies (Arnold and Javernick-Will 2013; Becerik and Pollalis 2006; Erdogan et al. 2008; Hjelt and Björk 2007; Lee and Yu 2012; Nitithamyong and Skibniewski 2006, 2011; Peansupap and Walker 2006; Ruikar et al. 2005; Samuelson and Björk 2013; Sargent et al. 2012; Wong 2007; Wong and Lam 2010). Drawing extensively from IS and IT implementation literature there has been a particular

interest in the management aspects of implementation projects such as documenting the best practices and critical success factors for IS/IT implementation (Nitithamyong and Skibniewski 2011; Tatari and Skibniewski 2011), innovation diffusion (Miller et al. 2009), e-readiness (Goulding and Lou 2013) and change management (Hartmann and Fischer 2009). On the other hand, a number of authors have conducted studies on intra-firm ERP (Enterprise Resource Planning) systems implementation to identify the success factors and the perceived benefits of ERP implementation (Chung et al. 2008, 2009; Gajic et al. 2014; Kwak et al. 2012; Ozorhon and Cinar 2015; Tatari et al. 2008; Yang et al. 2007). Whilst the prior research discusses the conditions necessary for successful IS/IT implementation projects, it offers limited understanding of the B2B e-Marketplace systems implementation projects, and in particular, fails to address the evaluation of actual or on-going use of systems once they are fully deployed and ready to use.

Although there are myriad of studies on generic (and sector-specific) e-commerce systems evaluation in the IS literature, their applicability to AEC context is seen as problematic since e-commerce systems are generally shaped by different technological, organisational and environmental factors amongst the different industries (Teo et al. 2003; Turban et al. 2002). Furthermore, evidence from generic e-commerce studies show that the industrial context within which e-commerce systems are adopted vary considerably from one another (Gibbs and Kraemer 2004; Teo et al. 2006). Thus, there is a strong justification for an AEC sector-specific study to complement the current knowledge and understanding of B2B e-Marketplace systems adoption.

The aim of the current study is to contribute to this research gap. Through a longitudinal case study research design, the purpose of this study is to investigate the post-implementation phase of a Cloud-based B2B e-Marketplace system. The system— which comprise of Cloud-based front-end interface and back-end integration with contractor and suppliers' ERP systems, was initiated by a large UK contractor firm to streamline its procurement operations with three of its key supply chain firms. The focus of the research is on the post-implementation stage; covering the first year of going live with the implementation where the use was not fully mandated across the case study organisation. There were two questions which the research sought to address: (i) the extent of the e-Marketplace adoption and acceptance at user, project and business unit levels, and (ii) post-implementation challenges that the users face during on-going use of an B2B e-Marketplace system. The variables which were used to measure the user adoption and acceptance was borrowed from a previously tested and validated theoretical model developed in the IS literature.

The paper is organised as follows. First, along with a background on Cloud-based Software-as-a-Service, the review of literature on e-Marketplaces is presented. Second, the theoretical framework which guides the empirical part of the study is given. Third, the rationale for the case study approach, the background to the case study organisation, and the method of data collection is introduced to provide the context for the study. The findings and discussion are presented next, followed by limitations of the research and recommendations for further study, and finally conclusion.

2. BACKGROUND ON B2B E-MARKETPLACE SYSTEMS AND INFORMATION SYSTEMS ADOPTION

The purpose of this section is to provide background into the research on B2B e-Marketplace systems and theories on IS adoption (which is specific to AEC organisations context). The Cloud-based Software-as-a-Service is introduced briefly, since it is considered as the backbone of the B2B e-Marketplace system reported in this study.

2.1 Cloud-based Software-as-a-Service and e-Marketplace Systems

The Cloud-based Software-as-a-Service (SaaS) is an evolutionary software delivery model whereby companies buy subscription licences to use the software online via a web-browser, rather than locally deploying software on premises (Marinescu, 2013). The 'Cloud' metaphor used in this article refers to the computing architecture which comprise of platform and infrastructure to support the delivery and use of software on the web. In the early days, SaaS solutions began to surface in the form of so-called 'project extranets' which were primarily used by large firms to manage their project documentation and information (Becerik and Pollalis 2006). With the advancements in internet technologies and transformation of web-facilitated services, the number of SaaS solutions for the AEC industry has grown significantly in the last fifteen years to serve the wide-ranging needs of the industry (Shen et al. 2010). Indeed, over the years many AEC-specific collaboration solutions have been developed. For example, Liu *et al.,* (2011) cite between 200 and 250 vendors (providing predominantly isolated systems and technologies)

targeting a specific industry problem such as management of project documents and drawings. On the other hand, some vendors built sophisticated multifaceted solutions to coordinate, manage and collaborate on project and inter-enterprise information needs (Wilkinson 2005). Besides the effectiveness and efficiency gains from implementing these systems (Becerik and Pollalis 2006; NCCTP 2006), there are several other factors which are believed to spur the Cloud-based SaaS's uptake. For example, Cloud-computing solutions has several significant advantages over traditional software delivery methods including: (i) rapid deployment- it does not require any forefront development meaning that deployment is a matter of user training and migration from previous/existing system, (ii) scalability- subscription based use means companies only pay for the features they use and how much they use (e.g.: number of users), and (iii) cost-efficiency- it does not require capital expenditure or consume any resource regarding development and version upgrade which is undertaken by the SaaS vendors (iv) ubiquitous network access- can be accessed from standard internet-enabled devices at any time and from any place (Marinescu, 2013).

Prior to Cloud-based collaboration technologies, traditional e-commerce systems relied on EDI technology which facilitates exchange of transactional data between two firms (buyers and suppliers). The concept of EDI is based on the Application-to-Application data exchange between the trading parties for sending and receiving transactional data such as e-orders and e-invoices (McIvor and Humphreys 2004; Xu 2015). EDI implementation can be direct (B2B) or through Value Added Network (VAN) providers who provide the connection, translation and transition of the transactional messages. Despite its long history, the reported usage of EDI is limited within the AEC industry, with builders' merchants and contractor firms being the most notable users (Samuelson and Björk 2013). Lewis (1998) reported that the unwillingness to change, lack of awareness and lack of clear business case with little apparent benefits from its application deferred many AEC firms' decision to invest in EDI, whilst Kong *et al.,* (2004) reasoned that the initial cost of setup and complexity of standards were the main reasons of low levels of adoption by the construction organisations.

Although the automation of transactional data is acknowledged as the most important aspect of EDI, its implementation is most rewarding when coupled with e-Marketplace systems since end-to-end purchase cycle can be completed without any manual intervention (Cole 2008; Dai and Kauffman 2002; Eng 2004; Standing et al. 2006; Xu 2015). An e-Marketplace can be defined as an online market in which business operations (such as tendering and procurement activities) between buyer and seller firms are conducted (McIvor and Humphreys 2004). In a review of literature on e-Marketplace systems Balocco *et al.,* (2010) show that there is a lot of confusion about the roles and functions of e-Marketplace systems where many studies often exhibit overlapping definitions and interpretations of the different e-Marketplace concepts. However, the ownership model is often used to distinguish between different types of e-Marketplace systems. There are three types of ownership generally associated with the e-Marketplace systems: Public, Intermediate, and Private. To give few examples from the AEC industry; Public marketplaces are owned and managed by public authorities to publish contract opportunities for subcontractors and suppliers. Public marketplaces in the construction industry are largely oriented towards sourcing for projects, for example tenders for subcontractors and aggregate commodities. An independent e-Marketplace provides an online platform for communities of buyers and suppliers to either transact or share product information (such as price and technical specifications) with each other. In the latter transactional form of e-Marketplace systems one of the parties (usually buyers) setup a private 'one-to-many' trade link with their suppliers either directly or via an intermediary Hub Provider (such as Ariba.com, Asite.com and Coins-Global.com). The focus of this study is on the latter, private e-Marketplace type (also labelled as e-Hubs by some authors) (Cole 2008).

The review of literature indicates that there is very little research on AEC specific e-Marketplace systems where majority of the studies proposed or developed e-Marketplace prototypes for the industry. For example, Kong *et al.,* (2004) proposed the e-Union framework where suppliers' trading sites are joined together by a web-based application, whilst Ren *et al.,* (2008) proposed the e-Hub concept which includes both collaboration and procurement functions within its core service. In another study, Cheng *et al.,* (2010) reported the development of a web-based portal (Supply Chain Collaborator) for use between contractor firms and suppliers/manufacturers. Although the concept behind the development is the coordination and management of the supply chains, the authors describe that with the use of the e-procurement layer the application could potentially function as a private e-Marketplace system. Similarly, Ren *et al.,* (2012) and Grilo and Jardim-Goncalves (2013) proposed frameworks for the development of Building Information Modelling (BIM) integrated e-Marketplace in the Cloud. Many of the concepts reported in these studies are highly abstract and lack application in real life (that is, they are not implemented beyond the cases reported by the authors themselves), which limits their relevancy to this study.

In another stream of research, Alarcón *et al.*, (2009) examined the perceived benefits of an independent e-Marketplace of Chilean construction companies. Their findings revealed a number of individual, organisational and industry wide challenges to the wider adoption of e-Marketplace systems. Some of these include lack of trust in the e-Marketplace, absence of technical infrastructure, lack of highly-trained workforce, behavioural issues, high degree of fragmentation in the industry, and lack of investment in technology. Ibem and Laryea (2014) more recently conducted a literature review on digital technologies used in construction procurement. Concurring with earlier studies by Brandon *et al.*, (2005) and Anumba and Ruikar (2002), they noted that despite the reported value propositions and benefits of adoption, e-Marketplace uptake by AEC firms is scant, and research is yet to proliferate. Hence, it is argued that AEC firms have little or no experience to draw upon for successful e-Marketplace implementation.

2.2 Theories on Information Systems Adoption

The IS and generic e-commerce stream of knowledge (which e-Marketplace systems fall under); where much of the theoretical models are developed and empirical testing is conducted, is abundant with frameworks on evaluating IS adoption. The Technology Acceptance Model (TAM), originally proposed by Davis (1989), is one of the most widely utilised theoretical models to measure IS adoption (Williams et al. 2009). Based on the theories in social psychology, including the Theory of Reasoned Action (TRA) and Theory of Planned Behaviour (TPB), the aim of TAM is to provide a general framework for the measurement of user acceptance *behaviour* across different technologies and user populations (Davis 1989). The TAM model posits that IS acceptance is directly influenced by perceived usefulness (the extent to which using the system will enhance the person's job performance) and perceived ease of use (the extent to which a person believes using the system will be free of effort) (Davis 1989). In the revised version (TAM2) of the model, the main determinants of perceived usefulness are described as social (subjective norm, voluntariness, and image) and cognitive (job relevance, output quality and result demonstrability) influence processes (Venkatesh et al. 2000).

Although the behavioural acceptance is a necessary precondition to adoption, there is a large body of literature which suggests other external factors (including climate for the implementation, top management support, organisational structure and project management and so on) that play a key role in technology adoption and the subsequent performance and success of IS implementation (Petter et al. 2008). With this shortcoming in mind, and in an attempt to integrate the fragmented theories on user acceptance, Venkatesh *et al.*, (2003) proposed the Unified Theory of Acceptance and Use of Technology (UTAUT) which incorporate the measures developed in eight previously established theoretical models. Simply put, the UTAUT model hypothesises that together with behavioural intention (which is influenced by performance expectancy, effort expectancy, and social influence) the facilitating conditions (for example, organisational and technical infrastructure) determine the level of usage (Venkatesh et al. 2003). The effects of these variables are found to be moderated by age, voluntariness, gender and experience of the users.

Another well-known model for evaluating the IS adoption is the DeLone and McLean's Information Systems Success Model (DeLone and McLean 1992) (referred to as DM Model hereafter). The DM Model, which is based on TAM, posits that there are five variables (system, information and service quality, and user satisfaction and use or intention to use) which influence the level of adoption and, ultimately the success of IS implementation. The model has been tried and tested in a large number of studies and has gone through revision by the authors in 2003 to take into account critiques noted in previous studies (DeLone and McLean 2003). The updated version of the DM Model proposes three dimensions for evaluating the IS itself (system, information and service quality) and the use of the system (that is, user satisfaction, and intended or actual usage) as shown in Figure 1. Arrows in Figure 1 indicate the inter-relationship between these dimensions where the system usage and user satisfaction has direct impact on net-benefits of adoption. DeLone and McLean explain how each of the DM Model variables relates to IS in e-commerce context in below points (DeLone and McLean 2003):

(1) System features which are valued by the user and have a direct impact on user experience (such as usability, availability, reliability, adaptability and response time).
(2) Information or content quality which is personalised, complete, relevant and easy to understand.
(3) Quality of support services provided such as training and availability of resources for self-learning.
(4) User satisfaction with the e-commerce.

(5) Where the use of the system is voluntary, behavioural information related to usage including visits to the site, navigation within the site and number of transactions made (or, if the system is not yet implemented or mandated to be used, the attitude towards intention to use the system).

(6) The resultant net benefits which includes both positive and negative impact of implementation.

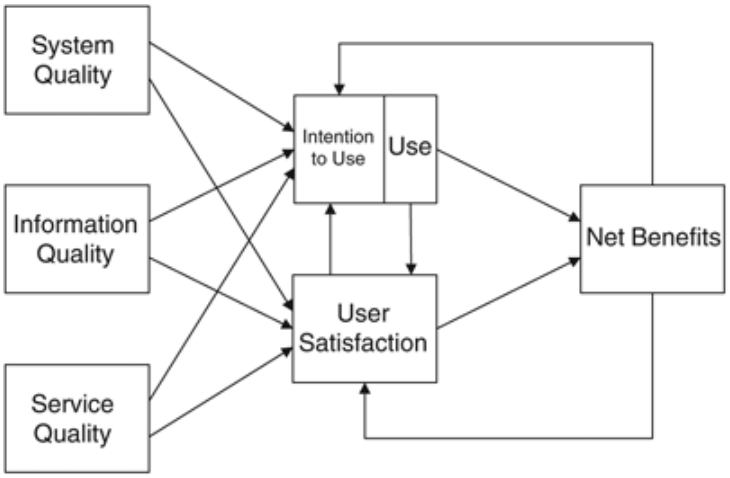

FIG. 1: The DM Model for IS success (adapted from DeLone and McLead, 2004).

The most difficult aspect of measurement in the DM Model by far is the latter variable (Wong 2007), that is, the perceived benefits by the users which ultimately influence the level of IS success (DeLone and McLean 2003). There are two complexities surrounding the measurement of IS success. First, as shown by Thomas and Fernández (2008) and Dwivedi et al. (2015), the notion of success is a complex and contested phenomenon as it is perceived differently at different stages of the IS implementation and amongst the different stakeholders. For example, in e-commerce implementation projects, Standing *et al.*, (2006) point out that e-Marketplace success can be classified according to its economic, relational, service or community implications. The second issue relates to the measurement of each of these aspects, where the outcome from IS implementation is largely intangible and indirect, and therefore cannot be easily quantified and measured in practical sense (Standing and Lin 2007). This study considers the role and purpose of B2B e-Marketplace implementation as the key enabler of supply chain integration. At a very broad context, achieving supply chain integration requires combination of actor, processes and technology integration. Actor integration refers to the inter-connecting of individuals in construction projects and organisations to undertake their job function. Process integration refers to the adjustments and alignments that organisations make to integrate their business processes. Technology is the facilitator that enables the integration of actors, systems and processes. Having insufficient space available here to further discuss supply chain integration, this study views and measures the IS success as the extent to which the B2B e-Marketplace system impact on these three key components of supply chain integration.

With respect to validation of above theories/models on AEC-specific IS literature, a number of studies have applied and validated the above-mentioned theories/models with two specific aims: (i) to test and measure the correlation between IS implementation and their impact on project success, or (ii) to evaluate the IS implementation from user acceptance and adoption perspective. Within the former stream of research, using the DM Model theory as their frame of reference, Raymond and Bergeron (2008) and Lee and Yu (2012) conducted large scale questionnaire surveys to determine the extent to which project management information systems (PMIS) assist certain project roles for fulfilling their tasks as well as investigating the impact of these systems on project success. Their findings reveal that perceived information, service and system quality of PMISs are highly correlated with project success and, effective and efficient construction management.

The research on the latter stream describe the degree to which various factors influence the technology adoption within an organisation. Several studies in the literature utilised the TAM to study the user acceptance of IOIS and intra-firm ERP systems. Adriaanse *et al.*, (2010) adopted the TAM framework to study the user acceptance and

adoption of a web-based document management and collaboration system in a single case study project. Their findings reveal a number of 'dynamic' factors, which include personal motivation, external motivation, knowledge and skills, and acting opportunities, that determine the system use. Similarly, Hjelt and Björk (2007) combined the DM Model and UTAUT, and investigated the electronic document management systems (EDM) acceptance and adoption amongst the group of end-users in a large construction project in Finland. One of the important finding from their study is the need for high levels of training and support for first time users. In addition, drawing on DM Model and UATAT theories as well as findings from their own research, the authors postulate that, along with end-user specific properties, four factors; system quality (functionality and usability), information accessibility, information quality (up-to-datedness, completeness and structure), and support quality (training and guidelines) highly influence the 'acceptance factors', which in turn impact the level of EDM use and adoption. Meanwhile, Chung *et al.*, (2008, 2009) incorporated the TAM2 and the DM Model, and developed a conceptual framework to analyse ERP systems implementation by contractor firms. Based on the survey data collected from ERP end-users they identified that the ERP adoption is determined by a number of user related (output, image, compatibility, result demonstrability and system reliability) and project related (internal support, consultant support and function) factors. In order to increase the ERP systems' usefulness and the level of adoption, they suggest that ERP implementation projects should consider the system functions (and functionalities), subjective norm, output, perceived ease of use, and result demonstrability (that is, the benefits of using ERP should be explicit). More recently, Kwak et al. (2012) used the TAM framework to investigate the factors that determine user acceptance and intention to use in ERP systems implementation projects. Although their study suffers from a narrow focus (that is, it only considers user acceptance as a success measure), one of the key finding of their study is that the customisation of ERP functionality is a key determinant of perceived usefulness; albeit with a negative impact on the success of the ERP implementation projects.

3. RATIONALE FOR THE CASE STUDY APPROACH

The case study approach is one of the most widely adopted research methods in the IS literature (Davison and Martinsons 2015; Williams et al. 2009). Information systems are purposeful artefacts built to address an important organisational problem and thus, they are difficult to separate from the context of an organisation and its processes (Hevner et al. 2004). This implies that the evaluation of IS cannot be independent of the organisational context in which it is designed, implemented and used (Stockdale et al. 2006). Hence, the case study approach naturally finds its way in IS evaluation research. Furthermore, the case study research design not only makes a good instance of documentation and analysis of rare cases (implementation and use of IOIS by AEC firms) but it also provides detailed insight into 'how' and 'why' certain outcomes occur, or have occurred, in a particular context (Yin 2014). This in our case is the user adoption (or conversely non-adoption) of a private e-Marketplace by a large contractor firm which is not commonly reported or investigated in the AEC domain.

A shortcoming of the prior research studies is that, in majority of the cases, the conclusions are drawn from cross-sectional surveys which fail to account for the dynamic and evolving nature of the ex-post implementation process. In recognition of this gap, Samuelson & Björk (2013) advocate the use of longitudinal approach for IS/IT adoption studies. Accordingly, the longitudinal perspective provides rich and dynamic insight into the width and depth of technology adoption where the "width is the spread of the use in companies and projects, and where the depth is about how developed and mature this use has become" (Samuelson and Björk 2013 185). However, Oates (2006) warns that the case study method imposes limitations on generalisability of findings as the study is bound to the 'case study firm only'. Nevertheless, Stockdale *et al.*, (2006) suggests that generalisability can be increased if the existing frameworks or theories are used and a detailed account of context is provided. This is so that future studies can follow the same process, allowing them to conveniently compare and contrast the findings with their own (Benbasat and Zmud 1999).

Since the focus of the evaluation is on systems dimension, the theories that were considered appropriate for the study were the TAM and DM Model. The intensive focus on prediction or explanation of the relationship between TAM constructs (including TAM variants) and IS adoption has been heavily criticised by Benbasat and Barki (2007), partly for directing the research away from exploring 'what makes a system useful'. Concurring with this point, Lee *et al.*, (2003) argue that the TAM model is of little value in assisting the design and development of systems with high levels of acceptance. With these shortcomings in mind, the DM Model was chosen as it extends beyond user acceptance: it covers the full life-cycle of IS implementation from creation and use to the consequences of IS deployment.

4. CASE STUDY

The concept of the B2B e-Marketplace system was based on end-to-end integration of contractor firm and suppliers' ERP systems (more details of the pre-implementation phase can be found in another study by the authors, (Pala *et al.*, 2016). A number of validation and business rules were implemented to ensure highly accurate data exchange and seamless interaction between the trading parties. Both services (the e-Marketplace system and ERP integration) were delivered through a Cloud-based Software-as-a-Service (SaaS) model by a third-party Hub Provider (HP). The HP's platform provided the front-end interface to the e-Marketplace system and was integrated with the suppliers' electronic catalogue through a service known as the PunchOut connection method (which is also referred to as RoundTrip, CommerceOne, OracleExchange, or Open Buying over the Internet (OBI) by different software providers implementing the same concept). With the PunchOut functionality, the end-users (buyers) are transferred into the suppliers' webstore where they fill their shopping cart, and, once finished transferred back onto the e-Marketplace platform for confirming and communicating the order to the supplier. The main benefit of the PunchOut method is that it gives the suppliers the ability to host live and interactive catalogues within their own webstores. From buyer's perspective, however, it results in a lack of consistent and standardized catalogues as well as loss of control and management of supplier catalogues.

The case study reports the findings on purchasing of indirect (non-production) goods and services where the prices were determined on pre-negotiated contracts. In terms of the purchasing process adopted, the contractor firm implemented a de-centralised approach to purchasing whereby a vast majority of the purchases were done locally at projects and by the purchasing department of individual Business Units.

5. ORGANISATION STUDIED

The case study organisation reported in this article is one of the top 20 contractor firms in the United Kingdom (UK) in terms of turnover. It has operations in a range of sectors and markets including engineering, construction, utilities, infrastructure, healthcare and facilities services. In addition to sole project ownership, the company has undertakings in Joint Venture (JV), Public-Private-Partnership (PPP) and Private-Finance-Initiative (PFI) projects. The business model of the company comprises of a number of vertically integrated businesses, including civil engineering, construction, facilities management and specialist subcontracting services such as Mechanical and Electrical, Ground Engineering, and Building Interior Solutions.

The decision to implement the B2B e-Marketplace system was made at the organisational level by the senior level management. Following a short trial period with one of the Business Units (BUs), the e-Marketplace system was rolled live across the three BUs (construction, facilities management and infrastructure), five specialist subcontracting businesses (Civil Engineering, Custodial, Groundwork Engineering, Interiors and, Mechanical and Electrical) (collectively referred as BUs hereafter) and 42 projects of which five were Joint-Venture projects (See Table 1).

TABLE 1: Types of projects which implemented the e-Marketplace

Industry	Market Sector	Number of Projects	Number of JV, PFI or PPPs	Total
Construction:				**(16)**
	- *Commercial Offices*	2	1	**3**
	- *Healthcare*	2	-	**2**
	- *Mixed Use*	1	-	**1**
	- *Transport*	7	2	**9**
	- *Infrastructure*	-	1	**1**
Facilities Management:				**(26)**
	- *Commercial Offices*	14	1	**15**
	- *Healthcare*	8	-	**8**
	- *Mixed Use*	3	-	**3**

Typically, 80% to 85% of the costs of the projects relate to the purchases of goods and services from supply chain firms. Prior to the e-Marketplace implementation, orders raised with the three suppliers on-board the e-Marketplace accounted just over 10% of the total number of orders across the whole organisation. Suppliers represent three different sectors and primarily supply (i) office equipment and stationary products, (ii) construction tools and equipment, and (iii) safety and workplace commodities. For the reasons of commercial confidentiality, all identity information is anonymised in the article.

6. DATA COLLECTION AND ANALYSIS

A number of qualitative and quantitative data resources were utilised when conducting the research. First, two electronic questionnaire surveys were issued to capture end-users' perceptions about (i) system, information and service qualities of the e-Marketplace, (ii) overall satisfaction and, (iii) perceived significance of suppliers participating in e-Marketplace. The first survey was issued towards the end of 2013 which was about 6 months into the system roll-out. Using a Likert-scale type questions respondents were asked to indicate their level of satisfaction/dissatisfaction with the first two items in the DM Model: that is, (i) look and feel, speed and, ease of use, (ii) supplier catalogue content and information provided (iii) the training and technical support provided, and finally (iv) overall satisfaction with the e-Marketplace. Respondents were also given the option to add any further comments at the end of each question to provide a detailed reflection on their choice of selection. A total of 30 responses were received from a potential of 135 system users, representing 22% response rate. The second survey attempted to gather information about the perceived importance of suppliers for the case study contractor firm's supply chain integration strategy in order to determine whether the e-Marketplace adoption accrued the same level of benefits with each supplier. The second survey was issued towards the end of first year in implementation and received a similar response rate. In order to encourage participation (and to reduce the observer bias) both surveys were anonymised.

In addition to above, detailed records of all issues logged to the HP's Customer Relationship Management (CRM) system were extracted in an effort to identify the technical issues encountered within the first year. Any non-relevant data such as RFIs, general queries and administrative requests were filtered out to reveal only the system related issues. A total of 48 issues were identified which helped to pinpoint the root cause of the issues when analysing the *system quality* variable.

The last stage in data collection focused on the B2B e-Marketplace usage. Following the suggestions of Lee *et al.*, (2003) and Petter *et al.*, (2008) who claim that actual usage is more reliable measure of system use (as opposed to self-reported usage data which may contain high levels of end-user bias), the study gathered statistical information at three levels: user, project and business unit. The level of use during the first year of implementation was captured through three main datasets: user attraction, interaction and transactions made through the e-Marketplace system. According to Molla and Licker (2001) the website 'hits' and 'visits' can be used as a valuable source of information to understand the actual level of use. Through the capture of user logins (unique visits to the e-Marketplace), the study identified the degree of actual usage (attraction to the e-Marketplace) by each user per project or BU. The allocated spend for each project and BU (which is gathered from the Blanket Order data) is the value set aside relative to the projects' contract value or the BU's spending volume. The BO data is considered as an indication of the *potential interaction* with each supplier. Lastly, the transactional data exchanged through the e-Marketplace is evidence of the system utilisation where the number of orders (and their values) were considered as an indication of the depth of use.

Together with the questionnaire surveys, the collected data, such as the *issue log* and *usage statistics* provided a detailed cross-analysis of system performance and adoption. Given that the e-Marketplace was already implemented, *intention to use* was not relevant for the study. Table 2 shows the collected data in relation to the variables in the DM Model.

Data analysis primarily involved descriptive statistics. The questionnaire survey results were analysed through measuring the frequency of the responses. In addition, the commentary information provided in the questionnaire surveys were used to either support the findings, or in some cases, highlight the contradictory statements given by the respondents. The actual usage information was tabulated in an electronic spreadsheet at multiple levels (user, project and business units) and consisted of a large data set which contained monthly usage statistics of the number of logins (4,323), the number and value of transactions (2,106 and £415k respectively), and value of BOs generated through the system (over £2.7m). Frequency distribution, arithmetic mean, and time-series analysis methods were

used to evaluate the attraction, interaction and transactions made through the B2B e-Marketplace system. Lastly, information collected from the issue logs were extracted into another excel spreadsheet for thematic analysis of the system and non-system related issues reported by the end-users.

TABLE 2: Overview of data sources versus the DM Model variables.

Data Sources:	**Survey 1**	**Survey 2**	**Usage Data**	**Issue Log**
DM Model variables:	*(30 responses)*	*(31 responses)*	*(12 months)*	*(48 issues)*
System Quality	✓			✓
Information Quality	✓			
Service Quality	✓			✓
Use			✓	
User Satisfaction	✓			
Net Benefits		✓		

The profiles of users assigned to the system show that majority of the users belonged to the Administrator role (48%), followed by the Project/BU role (36%). Supplier management or senior roles concerned with strategic management of suppliers represented 9% of the total user base. The remaining percentile of users (7%) belong to IT support team roles. The response to the questionnaire surveys reflects a similar distribution of these roles, indicating that the collected data represents a balanced view of the main users concerned with the system.

7. RESULTS OF CASE ANALYSIS

7.1 System Quality

System quality is one of the important considerations influencing the degree and level of adoption. DeLone and McLean (2004) state that users' perception of usability, availability, reliability and responsiveness can be measured to determine the system quality and performance in the eyes of users. Findings from questionnaire survey revealed that, overall; users were satisfied with the B2B e-Marketplace system: that is ease of use, look and feel, and speed. However, the comments received in both questionnaires and the issue logs revealed a number of concerns which seemed to have considerable impact on some users' experience with usability of the e-Marketplace.

Although, in general, users agreed with the ease of use, multiple comments were received in relation to the graphical user interface (GUI) and user-friendliness of the HP's system. In addition to this, issue logs revealed that system errors related to the PunchOut interface (that is, when users navigate in-and-out of HP and suppliers' systems) have plagued the user experience for some users. The received commentary in the survey questionnaire evidently supports this. For example, several users have questioned the usability and reliability of the system during large purchase orders where the end-users' browsers crashed and cancelled the transaction. However, when each case was investigated in an in-depth manner it was found that the some of the issues were due to local user settings and unsupported browsers. Although the contractor firm implemented a corporate IT policy on each user's computer (which satisfied the minimum system requirements for the e-Marketplace), not all hardware and software were completely standardised across the whole organisation. Besides this, some users customised the browser and computer settings in accordance to their specific needs, or for other behavioural reasons. As a consequence, the e-Marketplace in general and the PunchOut interface in particular, did not always function as expected. In addition to this, several users who were accessing the system from the projects' site office also mentioned issues with the speed and response time. However, as the up-time of the e-Marketplace was almost 99.99%; this could be due to the internet connectivity issues experienced by the project sites rather than the system itself.

As also mentioned by Wong and Lam (2010) and Ruikar *et al.*, (2005), the web-browser aspect and internet connectivity/speed issues are the two important determinants of the web-based IS quality. In order for the Cloud-

based B2B e-Marketplace systems to appeal to all users it must be flexible enough to function in different internet browsers, that is; users should not have to switch to a specific, and sometimes disliked web-browsers. Developing and maintaining functional consistency in-and-across multiple browser/versions would not only eliminate the issues around access to the system but it would also improve the system quality. In relation to the GUI, both the suppliers' webstore and intermediaries' front-end interface needs to be well adapted to the users' requirements. The intermediaries' role here is pivotal. As well as providing a user-friendly interface, intermediaries must provide a seamless integration and end-user experience across multiple supplier catalogues/web-stores. After all, it can be challenging for the buyers to use and be accustomed with multiple supplier catalogues with varying functionality and interface.

Issues with the internet speed pertain to the most of the web-based collaboration systems and, frequently reported in the literature as a major drawback for systems use (Nitithamyong and Skibniewski 2011). Since the B2B e-Marketplace system relies on Internet to function, it is important that project sites are provided with adequate network facilities to connect to e-Marketplace as-and-when required. A reliable and high-speed internet connection would not only ensure user satisfaction with the system but also prevent users reverting to the traditional methods of manual, paper-based purchasing.

7.2 Information Quality

Information or the content available within the e-commerce system is of prime concern for users to adopt e-commerce. Molla and Licker (2001) point to two aspects of content quality, (i) the attributes associated with the catalogue content, such as the accuracy, up-to-datedness, comprehensiveness, understandability, completeness, timeliness, reliability, relevancy, currency and preciseness of the goods/services provided, and (ii) presentation and the layout of the information content. Through the use of the PunchOut functionality the B2B e-Marketplace system users were securely transferred to the suppliers' own commerce website which was configured (for buyer-specific content) for the case study buyer company. The suppliers' commerce website provided search functionality (for example, for product code, name, and item description) and displayed information about the goods/services. At the checkout users were transferred back to the main e-Marketplace platform and presented with the order details to confirm the order before sending it to the supplier.

The questionnaire approached the information/content quality from a broad perspective and asked user's perception on whether: (i) suppliers' catalogue was easy to browse and contained the items they were looking for, and (ii) they were able to check-out quickly and efficiently. Majority of the respondents (25 out of 31) echoed their satisfaction in both areas however the questionnaire also captured a number of negative experiences regarding the information/content quality of the overall e-Marketplace facility. From the feedback received, users commonly reported (i) lack of information provided after a transaction is completed (ii) difficulty of tracing an order, (iii) "products showing as 'in stock' when ordered then not being delivered because they're out of stock", (iv) not being able to attach additional information to purchase orders, and (v) not being able to save favourite products for future purchase orders.

The aforementioned points reveal the importance of adequate interaction mechanisms for facilitating the engagement between e-Marketplace system users and suppliers. More specifically, it points to the need for e-Marketplace to encompass the post-purchasing process within its scope. In order to improve the information quality, use relevant functionalities should be considered to enhance system-user interaction. A number of suggestions can be made here, including detailed product/item specifications; more relevant and customised content (based on, for example, buyers' purchasing behaviour); option for goods/materials to be forwarded onto or to be picked-up from a particular supplier branch (due to proximity to delivery address and stock availability, and so on); and information on supplier activities in other projects (Ren et al. 2008). Going one step further, as also suggested by Wang and Archer (2007), collaborative functionalities should be considered in order to support other inter-organisational business processes, for example: demand and forecast planning, workflow integration, quality control, contract management, marketing intelligence and supply chain management (Chen et al. 2007; Cheng 2009; Ren et al. 2008; Xu 2015). Development of the new e-commerce process (which may require profound changes in internal and external business processes) should not be designed or configured separately from system development tasks, as for example, some of the functionalities would be dependent on the technical and operational capabilities of the suppliers (Balocco et al. 2010; Eng 2004).

7.3 Service Quality

DeLone and McLean (2004) argue that the level of support and training provided greatly influence the degree of satisfaction and user attitude towards the e-commerce systems. They suggest measuring the responsiveness and technical competence of the support services provided. Within the case studied, in-house and hands-on training was delivered to system users; however, as the user base was geographically dispersed it was largely available to users within the regional proximity of the contractor firm's head office. For those users who could not be given one-on-one training, interactive self-learning and training materials were made available online.

The need for training was apparent in the case studied mainly due to the fact that the system had a complex commerce process embedded within its structure. In addition to this, there were many business rules and logic (for example; transaction limits, monthly limits, items which are restricted, and so on) incorporated into the B2B e-Marketplace system. Mixed responses were received when asked if the training was adequate. Around half of the respondents indicated that they were happy with the training and support materials provided, whereas the other half appealed for more helpful user guidance documents, demonstration videos and one-on-one session. One user rightly pointed to the fact that "*the user guide does not prepare you for errors*", suggesting that '*how-to*' documents should provide fool proof guidance for all the use case scenarios throughout the purchasing process. It follows that, since e-Marketplace implementation brings many change (in terms of process and the technology), users must be trained on both aspects, and given multiple learning and training opportunities including self-learning materials, interactive learning, and hands on one-to-one training. Indeed, many studies recognise these as a critical failure/success factor for the adoption and use (Alarcón et al. 2009; Hjelt and Björk 2007; Nitithamyong and Skibniewski 2011; Peansupap and Walker 2006; Tatari et al. 2008; Tatari and Skibniewski 2011; Wong and Lam 2010), however, as rightly pointed out by Peansupap and Walker (2006), overemphasis on the technical aspects can lead to a poor perception of the potential benefits of use. Therefore, users should also be provided with the information on value derived from e-Marketplace adoption (at personal and organisational levels) to justify the need for adoption.

With regards to the technical issue resolution process, the investigation was first carried out by the case study firm's IT department to identify the cause of the issue and then elevate it to HP if it was found to be a non-local issue. Amongst those who have contacted the HP's helpdesk (19 users), 78% indicated that quality of service received was satisfactory whilst the remaining indicated otherwise and noted several cases where the HP's correspondence was slow and the queries were not fully resolved. However, it seems that the technical support process was not well understood by the users as considerable number of users contacted HP (who merely acts as an intermediary between the contractor firm and suppliers) for late and wrong deliveries, order queries, and so on. Nonetheless, one user pointed out that "*there doesn't appear to be a structure within {HP Support} which allows them to pass on the query if they are unsure themselves*". As the concept of B2B e-Marketplace is built on integration of multiple back-end systems, this implies the need for appropriate resolution processes between all the parties; including buyer, intermediary, and each supplier, to solve both, technical and non-technical issues and queries. As also suggested by Nitithamyong and Skibniewski (2011), along with a collaborative issue resolution process, dedicated support team members who are equipped with detailed knowledge of the system functionality should take care of the queries being raised in order to ensure swift turn-around on issue resolution. Without these support mechanisms in place users may perceive the system as a black hole; making them ever more reluctant to use the e-Marketplace system in the first place.

7.4 Use

DeLone and McLean (2004) argued that the level of use has a significant impact on realisation of operational benefits of e-commerce, therefore system use is considered as one of the main determinants of implementation success or failure (Yeo 2002). Based on review of past studies Petter *et al.*, (2008) provide strong evidence on the relationship between use and organisational benefits of e-commerce implementation. Following section describes the nature and extent of the e-Marketplace usage at three levels: user, project and business unit (BU).

7.5 User Level

The red line in Figure 2 shows that, in general, user adoption of the e-Marketplace has been on an upward trend. Nevertheless, there was a slow progress towards routinisation and acceptance amongst the users within each role and across the whole of the user base. Out of the 135 users, only a small share (15%) of the users (n=20) who were

predominantly Administrators used the system frequently and somewhat regularly (the black line in Figure 2). On average 40% of the end-users actively used the system (that is, logged in at least once a month). This figure was slightly higher amongst the Administrator group of users (46%). On the other hand, comparison of the number of logins against the number of purchases completed suggests a purely transactional use of the system (that is, the informational use was not significant).

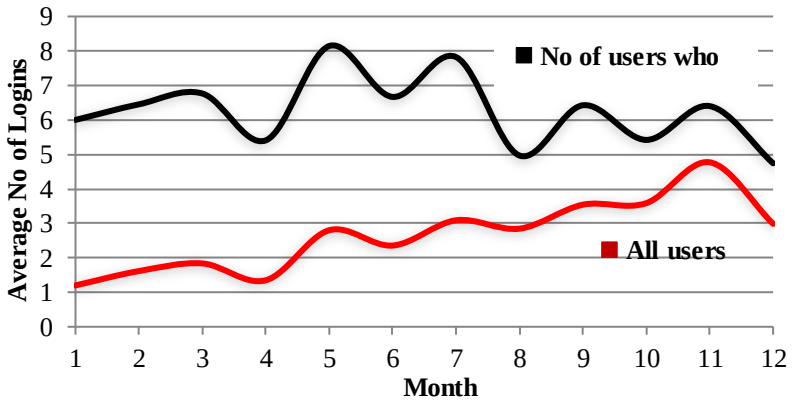

FIG. 2: Average number of logins

Furthermore, Figure 3 shows clearly that Administrators conduct most of the purchasing followed by project/company roles. The average value of orders placed by this group was around £1,100 per month which, compared with the rest of the user groups, was much regular and consistent in terms of their purchasing behaviour. It must be pointed out that this is primarily attributed to the structure and hierarchy in the case study organisation whereby Administrators undertook a large proportion of the purchasing activities under the order of other project/BU roles. The remaining user base was primarily responsible for project/company related activities where purchasing was their secondary job function. Nevertheless, an increase in undertaking of the high value purchasing through the B2B e-Marketplace system indicates that Administrators have adopted and adapted the laborious purchasing operations around the new system.

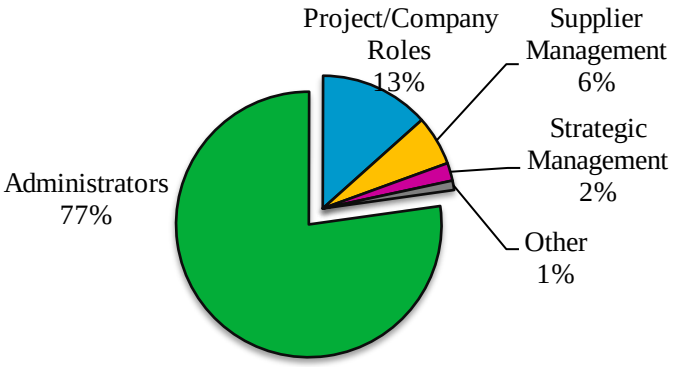

FIG. 3: Users who completed transaction (percentage of overall value of transactions)

7.6 Project Level

Out of the 42 projects only 14 used the B2B e-Marketplace system to create purchase orders above £1k. Overall, 836 purchase orders totalling just over £205k were created from an allocated spend value of £1.3m, which is about 30% utilisation. On average, each project had four users (buyers) assigned to the system. Findings indicate that usage has not been equally spread across different industries and sectors which the projects belong to (see Figure 4). Three projects in the Transport sector (of which one was a Joint Venture) was responsible for the near 60% of

the total spend. Although adoption was much more steady and regular in projects in Facilities Management industry, in terms of the value of the transactions completed, projects within the Construction industry accounted for more than half of the total spend. This could be reasoned to several factors. First, due to the number of suppliers on-board not all projects have the same spend levels with the suppliers connected to the e-Marketplace. As a consequence, the use of the B2B e-Marketplace system was limited for some projects. Secondly, the duration and stages of development for each project vary from one another resulting in different purchasing volumes for different projects. In construction for example, projects which are in earlier phases of development have larger spend allocation/volume than projects which are about to be handed-over. This explains why the uptake was most prominent amongst the projects in the Transport sector, where the duration of its projects spans over a relatively longer period of time with budgets usually over several hundred million.

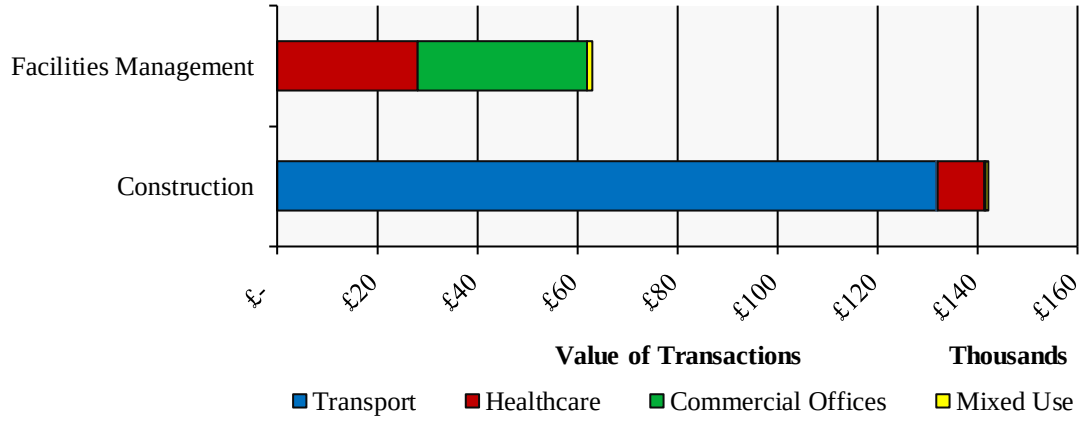

FIG. 4: Project level adoption (including Joint Venture projects)

7.7 Business Unit Level

Moving to a higher level of use, the analysis shows that e-Marketplace adoption differs significantly amongst the different BUs in (see Figure 5).

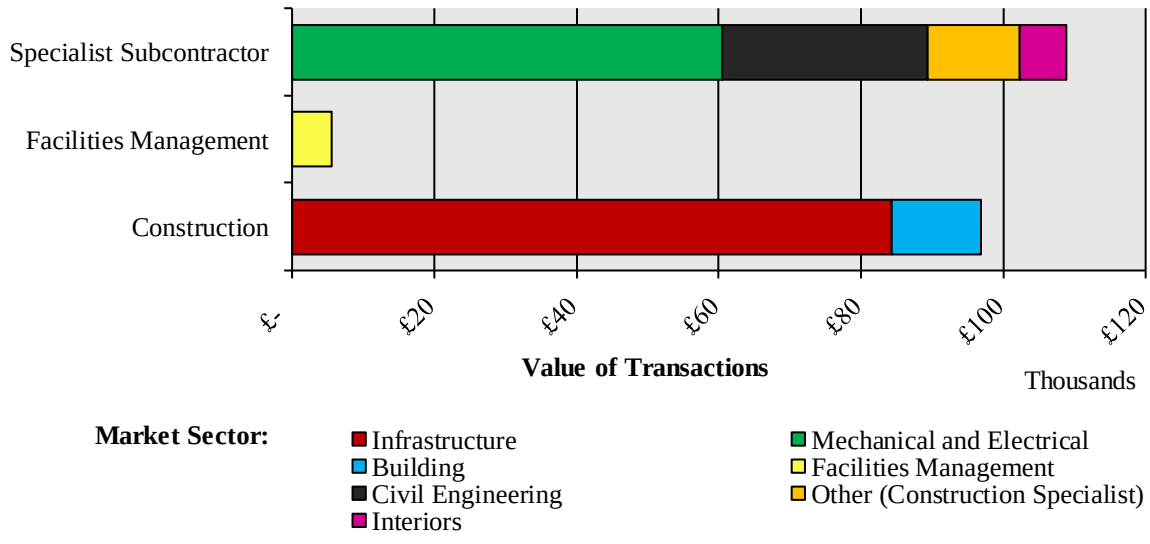

FIG. 5: Adoption by each business unit

It is interesting to note that BUs created almost the same value of transactions as the projects, however the number of purchase orders were considerably higher at 1,270. From a potential £1.45m spend, around £211k were transacted through the B2B e-Marketplace system. The supplier level data reveals that the nature of e-Marketplace use is primarily the repeat purchase of business overheads; that is, the office and stationery items, and safety and workplace commodities, but this finding is treated with caution due to limited number of suppliers on-board the e-Marketplace. Figure 5 shows the Infrastructure arm of the business (which includes Utilities, Highways and Transport) and Mechanical and Electrical subcontractor business contributed more than two thirds of this figure. The depth of adoption amongst the different BUs is thought to be attributed to the differences in company turnover; the size of the contracts they operate within, as well as the commodity/product based purchasing at each BU. In terms of actual transactions conducted, positive trend was identified in number and value of orders, indicating that each BU have gradually began to accept and use the new e-commerce system for trading with the three suppliers on-board the B2B e-Marketplace system.

7.8 User Satisfaction

Based on a review of empirical studies on e-commerce implementation Petter *et al.*, (2008) reported a strong association between user satisfaction and e-commerce benefits. However, Molland and Licker (2001) make an important distinction to refer to two types of user satisfaction to describe one which is related to e-commerce system satisfaction and other in relation to the e-commerce process. The responses to survey indicate that 24% of respondents were dissatisfied with using the system whilst the remaining 76% have said they were either quite or very satisfied. Most of the scepticism about the system was concerned with the usability (e.g. difficult to use) however there were also considerable dissatisfaction with the e-commerce process after a purchase order is completed (most of which are discussed in Information Quality section above). The former issue, which reinforces the importance of end-user participated systems design process, is generally recognised as a critical element for greater adoption and acceptance of new systems development. Although many of the concerns with the usability can be eliminated with a strong focus on a better graphical user interface which follows the principles and guidelines of human-centred design approaches, this is no easy task. Furthermore, it must be highlighted that besides the functional/non-functional design features, the post-purchasing process forms an essential constituent of e-commerce use and user satisfaction. It is therefore suggested that the entire purchasing cycle is taken into account and end-users are consulted and considered early in the systems development process in order to ensure user satisfaction with both digital and physical aspects of e-commerce systems design.

7.9 Net Benefits

Given that the main drive behind the B2B e-Marketplace system implementation was to achieve greater efficiency in supply chain interaction process, the objective here is to describe some of the anecdotal benefits realised with the adoption of the e-Marketplace. Undoubtedly, the introduction of e-commerce brought changes at three levels: actor, process and technology. At the actor level, the B2B e-Marketplace system had shifted the dimension of interaction from individual-individual to individual-firm level. Therefore, one of the resultant benefits of the system for project and BU actors was the reduction in direct and intense human interaction in the purchasing process (at least for the three suppliers who were on-board the e-Marketplace). With the e-Marketplace system, the contractor firm was able to streamline the otherwise manual, paper-based and time-consuming purchasing operations. Consequently, the management of purchasing operations were significantly reduced, resulting in savings in time and labour costs for the contractor firm as well as allowing contractor firm to focus on the value-added aspects of their supplier relationship. In addition, integration of the back-end ERP systems has been at the forefront for automating accurate and timely exchange of transactional information. Only with the help of the HP however, the contractor firm was able to transact with multitude of supplier systems, transforming the physical commercial interactions into virtual relationships.

In an attempt to weigh the above benefits and to determine whether the B2B e-Marketplace system accrued the same level of benefit for all three suppliers, the second survey explored (i) the importance of suppliers for integration, (ii) the level of supplier impact on case study firm's operations, and (iii) the stages in the construction project which would benefit most from integration (e-commerce). Responses given to question one and two indicate that Supplier 1, which is a safety and workplace commodities supplier, and Supplier 2, office equipment and stationary products supplier are very important for supply chain integration (Figure 6), whereas Supplier 3 was considered as comparatively low in terms of integration strategy and the impact on the case study firm's

operations (Figure 7). With regards to the last question, respondents generally agreed that the procurement stage would benefit most from the e-Marketplace implementation. This is perhaps unsurprising since the bulk of purchasing operations are conducted during the procurement stage of a construction project. The construction and FM stages were also deemed to benefit from the e-Marketplace system (albeit at a lesser degree), primarily due to buyers' continuing need to purchase as the projects progresses.

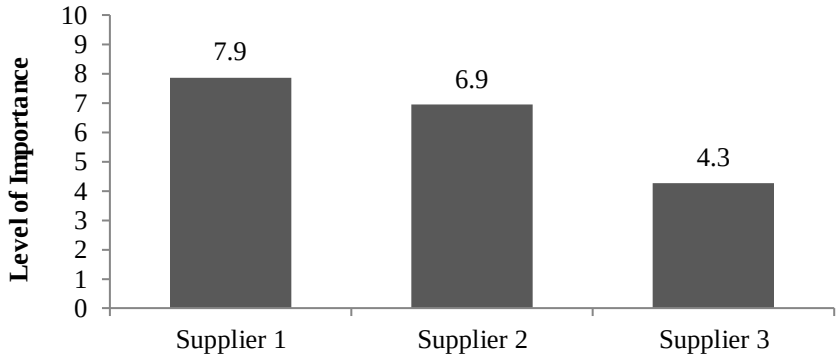

FIG. 6: Importance of suppliers in integration of the supply chain firms (results based on average weighting).

Since the perceived significance of suppliers vary in the eyes of users (Figures 6 and 7), findings indicate that integration and synergy with Supplier 3 did not yield significant advantage for the case study firm (compared with Supplier 1 and 2). This finding implies that choosing the right partners for the B2B e-Marketplace systems implementation does not only lead to benefits being realised but it also increases the opportunity for enticing users to the e-Marketplace; as for example, users who find the suppliers on-board critical for their operations will be more likely to use or continue making use of the system. Conversely, if the chosen suppliers are regarded as unimportant, the B2B e-Marketplace system adoption and use will be less received amongst the user base (Brunn et al. 2002; Grieger 2003). In addition to this, whilst the findings indicate that the B2B e-Marketplace implementation is of more benefit for the procurement stage, construction and facilities management phases must equally guide the implementation for a comprehensive e-commerce solution.

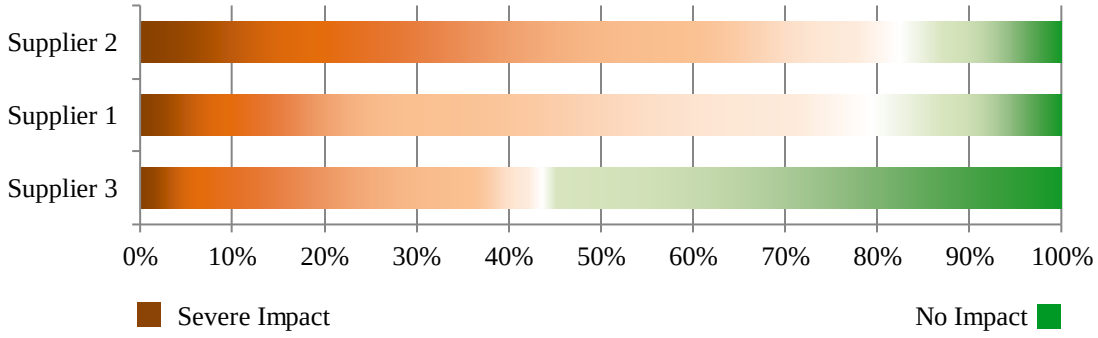

FIG. 7: Suppliers' impact in terms of time, cost and quality on case study firm's operations (responses blended near the average values to aid the interpretation of the results).

8. DISCUSSION ON B2B E-MARKETPLACE SYSTEMS IMPLEMENTATION

The research findings shared above present the specific factors which hindered the B2B e-Marketplace system adoption and use in the case study contractor organisation's context. This section builds from the case study findings to make several suggestions to the implementation of the B2B e-Marketplace systems by AEC organisations. As far as the case study findings are concerned, the results are broadly consistent with the prior

literature on IT/IS adoption. Commonly cited issues which has longstanding history in the work cited in IT/IS adoption literature also appear in the B2B e-Marketplace systems implementation projects. Nevertheless, several distinct challenges were identified owing to the inter-organisational nature of the B2B e-Marketplace systems and the processes implemented.

The findings from the study demonstrate the degree and level of complexity that underlie the implementation of B2B e-Marketplace systems. For instance, the multiplicity of business units and the industry sectors highlight the variety of issues (for example the organisational structure, business process re-design, business strategy and so on) that needs to be considered in the design, development and implementation of the B2B e-Marketplace systems. Added to this complexity is the diversity in the project characteristics, the projects' phase and duration, supplier spend volumes and purchasing characteristics of projects, which not implies that different implementation strategies and decision making is required for acceptance, use, and routinization of the B2B e-Marketplace systems, but also indicate that a one-size-fits-all approach to digitisation of the purchasing and procurement process may not be appropriate in large organisational context. For example, at the user level, the adoption and acceptance of B2B e-Marketplaces is highly correlated with the end-users' job function where people with administrative responsibilities and supplier interfacing roles are the most prominent users of these systems. The system functionality, ease of use, information quality, training strategy and other key dimensions of IS implementation, are therefore required to predominantly appease the demands of this user-base. Akin to this, however, it may also be appropriate to think about different B2B e-Marketplace system configurations for an effective adoption and acceptance at multiple levels.

It is worth to note that post-implementation evaluation is not only crucial for understanding of the challenges that plague acceptance, routinization and continuance use, but equally important for pointing out to what needs to be done at the earlier phases of the implementation. Applying the case study findings to the DM Model, Figure 8 lists the main system and information related features which must be addressed at the earlier stages of the B2B e-Marketplace systems development.

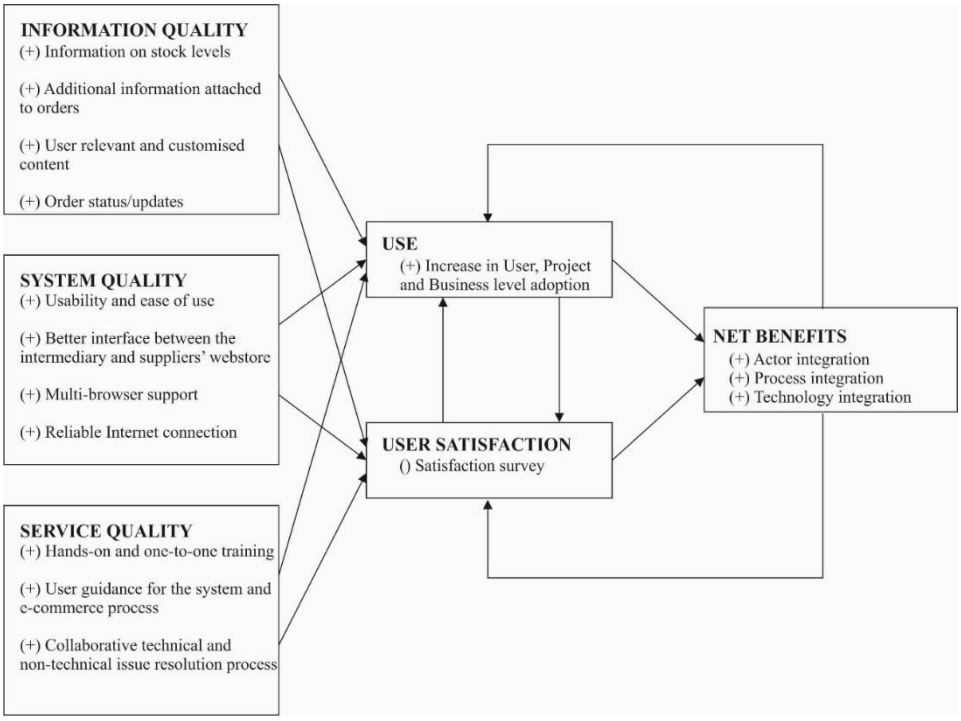

FIG. 8: Factors which must be considered during e-Marketplace implementation (adapted from DeLone and McLean 2004).

Since the people in Administrator role are the dominant users it is important that requirements and needs of this user group are not underestimated during development of the B2B e-Marketplace systems. It must be highlighted that technical limitations may hinder some of the development tasks for closely integrated e-commerce systems and processes; for example, the ability of suppliers' systems to support the pre- and post-purchasing process information needs, and the flexibility of intermediary firm to customise its solutions for each user/project/business. Besides the importance of hands-on and one-to-one training and, guidance and self-learning materials, the technical support process forms an essential element for user satisfaction. It is therefore necessary to have a joint issue resolution mechanism between all the parties (that is the buyer firm, supplier and the intermediary B2B e-Marketplace technology provider) so that all technical and non-technical issues are resolved quickly and efficiently.

In terms of the benefits of implementation, akin to the economic, technical, and operational evaluation, the relational aspects of supplier integration must be weighed to ensure that only the value-adding suppliers are incorporated into the e-Marketplace. This requires careful analysis of supply chain relationships to determine whether the chosen suppliers are appropriate for supply chain integration strategy. It may be difficult to create and maintain similar levels of efficiency and synergy with each supplier connected to the B2B e-Marketplace if the end-users do not perceive suppliers as important for the supply chain operations of their projects and business units.

9. LIMITATIONS AND RECOMMENDATIONS

The major weakness of this study lies in the single case-based research method which limits the generalisability of the findings. However, through the use of a previously tested and validated theoretical model (supported by multi-method strategy in data collection and analysis) the study was able to identify and categorise some of the important factors that influence the adoption and on-going use of B2B e-Marketplace systems which had been seldom examined in the prior literature. Such information would be of high value for industry practitioners tasked with implementation; for example, they can learn from the challenges reported in the case study and prepare a risk plan to lessen their impact. Furthermore, the B2B e-Marketplace technology providers (the intermediary Hub Providers) can take on-board some of the suggestions as a guide in pursuit of improved system and service provision in the future.

In contrast with similar studies by Chung *et al.*, (2008) and Hjelt and Björk (2007) which employed the DM Model to explore the correlation between the DM Model variables and user adoption, this study was concerned with the traits of the B2B e-Marketplace system that users perceived as satisfactory or unsatisfactory. Therefore, how much the DM Model variables influenced the adoption or non-adoption could not be quantitively determined in the case study. In addition to this, the transactions conducted through the e-Marketplace needs to be compared with the off-line purchasing data to evaluate the adoption across the whole organisation. Although the Blanket Order data gave an indication of the potential e-Marketplace use, the absence of the supplier spend data limits the findings on the degree of usage. It must be acknowledged that the case study results are limited to the users' experiences with three suppliers connected to the e-Marketplace. Availability of more suppliers connected to the e-Marketplace might have produced different results.

Furthermore, what has been reported in this study is by no means the complete list of the challenges that plague the B2B e-Marketplace systems implementation. As the study topic has been quite neglected in the literature more in-depth research is required to contribute to knowledge on development and implementation of e-Marketplaces within the context of AEC firms and supply chains. A holistic understanding of the circumstances that determine the B2B e-Marketplace systems adoption and use would be particularly useful for academics and industry practitioners. While the DM Model is useful in describing the success and failure indicators in IS implementation projects it is worth recognising that the variables in the DM Model do not provide sufficient explanation alone and future studies rather need to be complemented with the adoption of other theoretical perspectives into its framework. For example, there are a host of other issues concerning business process reengineering, IS strategy, and organisational culture amongst many others, all of which must be further explored in future studies for a better understanding of the B2B e-Marketplace systems implementation projects.

10. CONCLUSION

The purpose of the research presented here was to explore the user adoption of a private B2B e-Marketplace system from the IS perspective with the aim of developing an understanding of the challenges that system users face during its on-going use. A longitudinal case study was conducted, which adopted a multi-level and multi-source data collection approach and followed a previously tested and validated theoretical model from the IS literature. The scope of the IOIS implementation was limited to a private e-Marketplace platform involving a third-party intermediary firm which provided the Cloud-based front-end interface and back-end integration of the ERP systems. The B2B e-Marketplace system studied in the case was live across eight business units and 42 projects of the case study organisation and had 135 users (buyers) assigned to the system.

As experienced in the case study, the diversity in usage and adoption is a real evidence of the degree and level of complexity that underlie the implementation of B2B e-Marketplace systems by the AEC firms. The case study findings show that the organic (non-mandatory) adoption of e-Marketplace systems can be very slow and different adoption rate can be expected even within the same user group and project types. Projects with a long duration and spend budget are more inclined to use the B2B e-Marketplace systems, whereas at the business level, the company turnover, contract size and commodity/product based purchasing influence the level of utilisation. It is worth to note; however, this finding is inferred from the case study organisation's purchasing and procurement operations which is highly context specific, therefore should be interpreted with caution. At the user level, the roles which are tasked with the purchasing operations comprise the primary user base for conduct of commercial transactions. The perceived significance of suppliers for integration could be an important factor which can influence the benefits of implementation as well as the continuance use. Industry firms that intend to implement B2B e-Marketplace, or other IOIS alike, can benefit from the findings of this study by taking proactive measures to reduce the impact or the likelihood of similar challenges arising in their implementation project.

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APPENDIX A

Questionnaire 1

Question 1. Overall, how satisfied are you with the following: (Very Satisfied, Satisfied, Not Satisfied, Not Satisfied at All)

1.1 Ease of Use

1.2 Look and Feel

1.3 Speed

1.4 Other (comments)

Question 2. What is your level of agreement in relation to the following statements: (Strongly Agree, Agree, Disagree, Strongly Disagree)

2.1 I was able to navigate around e-Marketplace system quickly and easily

2.2 The supplier's product catalogue was easy to browse and contained the items I was looking for

2.3 I was able to check-out quickly and efficiently

2.4 The order status was communicated in a timely manner and with the level of detail I required

2.5 My order was delivered on time

2.6 My order was delivered to the right location

2.7 Other (if you have any comments to add please give details here)

Question 3. If you have contacted the Support team, was your query resolved quickly, efficiently and to your complete satisfaction?

Yes, No, Have not dealt with the Support

Please give details.

Question 4. What is your agreement with the following statements? (Strongly Agree, Agree, Disagree, Strongly Disagree)

4.1 e-Marketplace system is user-friendly

4.2 The user guide/demo video is sufficient.

4.3 I required further training on a one-to-one basis

4.4 Other (if you have any comments to add please give details here)

Question 5. Overall, how satisfied are you with using the e-Marketplace? (Please give reasons for your answer)

Very Satisfied, Quite Satisfied, Not Satisfied, Not at All Satisfied

Questionnaire 2

Question 1. Please state your name and Contractor Business Unit you work under.

Question 2. If you are buying for a particular project, please give details about:

2.1 Project's value

2.2 Current stage of the project

2.3 Frequency of orders (daily, weekly, fortnightly, monthly)

Question 3. Number of buyers in the project or Contractor business unit (whichever applies):

1 to 4

5 to 9

10 to 19

20 or more

Question 4. Which of the following best describes your role within the current project or Contractor Business Unit?

I create orders on my behalf

I process orders on somebody else's behalf

I manage the supplier account(s) at my project or Contractor Business Unit

I manage the suppliers at a strategic level

Other (please specify)

Question 5. On a scale of 1 to 5, please indicate the level of impact (time, cost, quality) if something went wrong with the supplier's operations, for example; late delivery, out-of-stock items, sudden increase in unit prices and discontinued products.

Not Impact, Little Impact, Moderate Impact, High Impact, Severe Impact

Question 6. With which suppliers do you require the most integration (in terms of process, technology and people)?

(Please rank from 1 to 10 where 1= most important, 10=the least important)

Supplier 1

Supplier 2

Supplier 3

Question 7. What stage of the project would benefit most from integration with the following suppliers?

Design, Procurement, Construction, Facilities Management

Question 8. Do you have any additional comments that you would like to add?