INFLUENCES ON ADOPTION OF CLOUD-BASED ERP SYSTEMS IN SMEs: THE TECHNOLOGICAL-ORGANIZATIONAL-ENVIRONMENTAL FRAMEWORK

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Abstract

This paper examines the factors affecting adoption of cloud-based enterprise resource planning (ERP) systems by UAE SMEs using one of the theories of Diffusion of Innovation (DOI). The technology-organization-environment (TOE) framework used in this study integrates factors in the technological, environmental and organizational contexts of organizations. Data were collected from a random sample of 105 SMEs from UAE. Descriptive and inferential techniques were used to analyze the data. The results identified relative advantage, top management support, technology readiness, competitive pressure and trading partner pressure as key determinants that influence the adoption of cloud-based ERP systems by SMEs. The findings can be useful to service providers and cloud computing providers to better understand what affects cloud-based ERP system adoption and to develop marketing strategies to improve their interaction with enterprises.

Keywords: Cloud-Based ERP, SMEs, TOE, UAE

1. INTRODUCTION

There has been a global increase in the use of cloud computing services as more people use the internet to access, transfer, and store electronic information (Ratten, 2013). The use of cloud computing is increasing among consumers and organizations because it reduces upfront costs (Salim *et al.,* 2015) Cloud computing delivers IT services in the form of software, platform, and infrastructure using internet technologies. It is defined by the US National Institute of Standards and Technology as "a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and service) that can be rapidly provisioned and released with minimal management effort or service provider interaction" (Mell and Grance, 2011, p2).

The use of information and communication technologies (ICT) has provided a competitive advantage to small and medium-sized enterprises (SMEs). It is widely acknowledged that SMEs are the driving engines of most economies. It is estimated that SMEs account for more than 90% of economic projects in the UAE, provide employment to over 60% of the workforce, and contribute more than 70% to the UAE's GDP (Siddique, 2015). SMEs are entrepreneurially oriented, willing to take risks, to be innovative and to initiate competitive actions. Therefore, their survival and growth is imperative. Despite their importance, there is a dearth of literature focusing on SMEs in the Information Systems (IS) research field (Jain *et al.,* 2010).

An ERP (enterprise resource planning) system is a management information system that consists of a single comprehensive database, accomplishes real-time dissemination of data throughout an organisation, and makes available relevant information for decision-making to the appropriate level of management. An essential characteristic of ERP systems is integration. All departments and

functions across a company are combined into a single, integrated software program that runs off a single database so that the various departments can more easily share information and communicate with each other. Information systems researchers have studied the adoption of ERP systems by large organizations, but few have looked at ERP adoption within small to medium-sized enterprises (Salim *et al.,* 2015).

Advances in ICT enable firms to provide high quality, diversified and yet customized services more easily and affordably than ever (Thong, 2011). Indeed, organizations in the ICT industry are transforming themselves from technology vendors to service providers.

The adoption of ERP systems has been of great interest to many researchers and practitioners, but most findings are based on the study of large organizations, and very little attention has been given to ERP use in SMEs. Adopting ERP systems is costly and prone to difficulties during the implementation process; SMEs don't want to invest heavily in traditional ERP systems anymore. The advent of software-as-a-service through cloud computing has offered many opportunities to embrace corporate-wide systems (Sedera *et al.,* 2014). Cloud vendors have promoted the suitability of cloud ERP for SMEs to address the lack of IT capabilities and resources within SMEs (Salleh *et al.,* 2012). Saini *et al.,* (2011) state that cloud-based ERP helps SMEs concentrate on their core business by reducing their IT maintenance, software upgrade, and licensing costs. SMEs can have access to a full-fledged ERP system without the need to run their own IT department or hire an expensive IT consultant (Sharif, 2010). Cloud computing empowers SMEs to move large parts of their business IT from their premises into the cloud, offering them efficient, flexible and scalable processing power (Salleh, 2012).

The purpose of this study is to investigate the factors that affect the adoption of cloud-ERP systems by SMEs. This study develops and tests a theoretical model including factors which influence cloud-ERP adoption by the SMEs.

This paper is organized as follows: The second section discusses the literature on cloud computing, cloud ERP, and organizational-level information technology adoption theories. In the third section, our conceptual model is presented. The fourth section describes the research method, and section five discusses the main findings which result from the analysis. Finally, in the sixth section, conclusions are drawn, limitations are discussed, and directions for future research are suggested.

2. LITERATURE REVIEW

Cloud computing is an online form of computing in which users can access applications over the internet. IT-related capabilities are provided "as-a-service" to multiple external customers, using interconnected and virtualized computers that allocate resources based on service-level agreements negotiated between the service provider and the end user (Anabel, 2015; Oliveria, 2014). The characteristics that differentiate cloud computing from other forms of shared computing (Mell and Grance, 2011) are: on-demand self-service, accessibility, elasticity, pay-per-use and resource pooling, ease of implementation, service reliability, easier maintenance, scalability, and security.

Cloud computing technologies have enabled vendors to offer resources such as infrastructure-as-a-service, platform-as-a-service and software-as-a-service (SaaS) on a pay-per-use basis (Gangwar, 2014). Users can install the software and use the application anytime and anywhere they have access to the network. SaaS has become the dominant solution for SMEs and many of them are in the process of moving their core applications, including ERP, to the cloud (Knorr, 2012). Large vendors like SAP and Oracle are trying to compete in the SME market with smaller competitors like Microsoft, Infor, Sage Group, Lawson, and Epicor, but are not having much success as they are traditionally oriented towards large enterprises (Karnukaran, 2015).

Cloud ERP solutions are provided via the software-as-a-service model. Many ERP systems offered in the market are cloud based (Ali, 2017; Scavo, 2012). An ERP system is considered to be cloud based when it has the characteristics of cloud computing. The major benefits of cloud-based ERP systems include lower upfront costs, lower operating costs, mobility, rapid implementation, and rapid updates and upgrades. However, these benefits come with challenges, some of which are major, including security risks, difficulty with customization and integration, performance risks, and loss of control over the cloud ERP database. Zaltman et al. (1973); Ettlie (1980); Fichman and Kemerer (1997). Therefore, the adoption process must consist of multiple stages, beginning with awareness stage and ending at the implementation stage.

Many preceding studies in the field of cloud computing have addressed the areas of new technologies, security requirements and future expectations in these emerging environments. A contemporary survey found that, because of many factors, cloud computing is highly suitable for small and medium-sized firms (Misra and Mondal, 2010).

SMEs adopt ERP because of their business needs: competition, market survival, and customer retention. Many studies on ERP have discussed ERP adoption drivers in SMEs from different perspectives. A few studies (Ramdani and Kawalek, 2008; Raymond, 2007) used the technology-organization-environment (TOE) framework to predict which SMEs are likely to become adopters of ERP systems. The researchers concluded that ERP adoption within SMEs is more influenced by internal organizational factors than by industry or market-related factors.

The adoption and diffusion of information systems have been extensively studied and is considered to be one of the most mature areas within the IS discipline (Hirschheim, 2007; Venkatesh *et al.,* 2007; Williams *et al.,* 2009). The dominant paradigm in studying IT innovation adoption involves identifying contingency factors that facilitate or hinder adoption decisions in organizations (Ficain, 2004; Troshani *et al.,* 2011). Given that technology adoption is complex and context-sensitive, different factors in technological, organizational and environmental contexts can vary across different innovations (Baker, 2011; Troshani *et al.,* 2011). Cloud-based ERP is still emerging as a set of technologies and business models. Discussions of cloud computing have not reached the level of clarity or shared conceptions seen in

more mature areas of computing (Kushida *et al.,* 2010).

3. MODEL DEVELOPMENT

Various theoretical frameworks have been developed over the years to evaluate the influencing factors that facilitate successful information systems adoption; these include the Theory of Reasoned Action (Ajzen & Fishbein, 1975), the Technology Acceptance Model (Davis, 1989), the Diffusion of Innovations (Rogers, 1962), the Theory of Planned Behaviour (Ajzen, 1991), the Unified Theory of Acceptance and Use of Technology (Venkatesh, Morris, Davis, & Davis, 2003), the Tri-Core Model (Swanson, 1994), and the Technology-Organisation-Environment (TOE) framework (Tornatzky and Fleischer, 1990). These theories present a collection of factors that influence individual or organizational-level innovation adoption. Researchers (Hsu, Ray & Li-Hsieh, 2014; Oliveira & Martins, 2011) have identified the TOE as the most widely used innovation-adoption theory in organizational-level adoption studies.

According to this framework, the process of technology adoption and diffusion can be understood in the organizational, environmental and technological contexts. The TOE framework is based on an organizational-level theory and incorporates technological, organizational and environmental contexts as the most important determinants of cloud-based ERP adoption. The TOE is used in this study because it incorporates the environmental context, and has more robust empirical support and a firmer theoretical basis (Al Shamaila *et al.,* 2013). Table 1 shows the definitions of each construct used in this study.

Table 1. Definitions of the TOE framework constructs (adopted from Al Shamaila *et al.,* 2013)

Construct	*Definition*
Relative advantage	"The degree to which an innovation is perceived as being better than the idea it supersedes" (Rogers, 2003, p.229)
Compatibility	"The degree to which an innovation is perceived as consistent with the existing values, past experiences, and need of potential adopters" (Rogers, 2003, p.257)
Complexity	"The degree to which an innovation is perceived as difficult to understand and use" (Rogers, 2003, p.257)
Size	The size of the company
Top management support	Devoting time to the cloud-based ERP in proportion to its cost and potential, reviewing plans, following up on results and facilitating the management problems involved with integrating cloud ERP with the management process of the business (Young and Jordan, 2008).
Technology readiness	Technological infrastructure and IT human resources; (Kuan and Chau, 2001; To and Ngai, 2006; Oliveria and Martins, 2010; Wang *et al.,* 2010)
Competitive pressure	The degree of pressure felt by the firm from competitors within the industry (Oliveria and Martins, 2010)
Trading partners	Trading partner activities that can significantly influence the probability that an innovation will be adopted (Farmbach *et al.,* 1998)

3.1. Technological context

It refers to the internal and external technologies that are related to the organization. These include technologies that are available in the marketplace but also currently used at the organizations (Oliveria, 2014, Anabel, *et al.,* 2015).

Relative advantage is the degree to which using the innovation is perceived as being better than using its precursor (Moore and Benbasat, 1991). Cloud-based ERP advantages over traditional ERP include lower upfront costs, low operating cost, rapid implementation, scalability and rapid updates and upgrades. The impact of relative advantage has been widely researched in previous studies (Ramdani & Kawalek, 2007; Lee, 2004). It has been demonstrated that when managers or owners perceive a relative advantage in an innovation, the probability of adoption will increase (Gallego, 2016).

H1: Relative advantage influences the adoption of cloud-based ERP systems in SMEs.

Rogers (1995) defines complexity as the degree to which an innovation is perceived as being difficult to use. It has been found in many research studies that complexity is a significant factor in the decision to adopt an innovation (Chaduhry & Bharati, 2008). Cloud-based ERP systems are easier to use and therefore have a greater chance of being accepted and used by SMEs (Agrawal and Prasad, 1997). In contrast to other innovation characteristics, this factor is negatively linked with the probability of adoption.

H2: Complexity is negatively correlated with the adoption of cloud-based ERP systems in SMEs.

Compatibility refers to the degree to which an innovation is perceived as being consistent with the existing values and past experiences of potential adopters (Rogers, 2003). It is considered to be an essential determinant of IT innovation adoption (Wang et al, 2010). In the case of cloud-based ERP systems, owners or managers of SMEs need to understand that the new technology or service is compatible with the existing technological architecture within the organization.

H3: Compatibility is positively correlated with the adoption of cloud-based ERP systems in SMEs.

3.2. Organizational context

Organizational context refers to the resources and the characteristics of the firm such as size, quality of human resources, and complexity of the firm's managerial structure (Oliveira and Martins, 2010, Hong and Zhu, 2006).

Top management support is critical for creating a supportive climate and for providing adequate resources for the adoption of new technologies (Lin and Lee, 2005; Wang *et al.,* 2010). Some empirical studies have indicated that there is a positive relationship between top management support and adoption of new technology (Pan and Jang, 2008; Zhu *et al.,* 2004). Top management support plays an important role because cloud computing implementation may involve the integration of resources and re-engineering of processes.

Moreover, previous research has found that the size of a firm is one of the major determinants of IT innovation (Dholakia and Kshetri, 2004; Hong and Zhu, 2006; Pan and Jang, 2008). Consequently, firm size is an important factor that affects the perceived strategic importance of cloud computing in innovative technological development. It is often argued that larger firms have more resources, skills, experience, and ability to survive failures than smaller firms (Pan and Jang, 2008; Zhu *et al.,* 2004). On the other hand, because of their size, small firms can be more innovative: they are flexible enough to adapt their actions to changes in their environment (Damanpour, 1992; Jambekar and Pelc, 2002), compared to larger firms, which have multiple levels of bureaucracy which can slow down decision-making processes (Oliveira and Martins, 2011). Finally, IT adoption often needs coordination, which may be relatively easier to achieve in small firms (Premkumar, 2003). While cloud computing was initially reported to be more attractive to SMEs (Sultan, 2011), recent industry reports suggest that larger organisations have a higher likelihood of adopting cloud services than smaller organizations (Goodwin, 2013).

H4. Top management support influences the adoption of cloud-based ERP systems in SMEs.
H5. Firm size influences the adoption of cloud-based ERP systems in SMEs.

The technological readiness of organizations, meaning their technological infrastructure and IT human resources, influences the adoption of new technology (Kuan and Chau, 2001; To and Ngai, 2006; Oliveira and Martins, 2010; Pan and Jang, 2008; Wang *et al.,* 2010; Zhu *et al.,* 2006). Organizations with high technological readiness are aware of current IT infrastructure potential and limitations and are willing to provide adequate training to enable the cognitive capability required to adopt cloud computing. Organizations with technological readiness are better primed for the adoption of cloud-based ERP systems. These considerations lead to the following hypothesis:

H6. Technological readiness influences the adoption of cloud-based ERP systems.

3.3. Environmental context

Environmental context is the macro area in which a firm conducts its business; it can refer to surrounding elements such as industry, competitors and the presence of technology service providers. These three contexts present both constraints and opportunities for technological innovation (Tornatzky and Fleischer, 1990, p. 154), and therefore influence the firm's level of technological innovation.

Competitive pressure refers to the level of pressure experienced by organisations from their "same industry" competitors (Laforet, 2011). Previous studies have suggested that the experience of intense competition is an important determinant of IT adoption (Kuan and Chau, 2001; Zhu *et al.,* 2004). The high-tech industry is characterized by rapid changes and firms face pressure to become increasingly aware of and follow their competitors' adoption of new technologies (Al Shaimaala, 2012). By adopting cloud technology, firms benefit greatly from a better understanding of market visibility, greater operation efficiency, and more accurate data collection (Misra and Mondal, 2010). Additionally, many organizations adopt cloud technology services that allow them more accurate data collection and a better understanding of market visibility to create new products and services (Low *et al.,* 2011).

Additionally, many firms rely on trading partners for their IT design and implementation tasks (Pan and Jang, 2008). Some empirical research studies have suggested that trading partner pressure is an important determinant for IT adoption and use (Chong and Ooi, 2008; Lai *et al.,* 2007; Lin and Lin, 2008; Pan and Jang, 2008; Zhu *et al.,* 2004). The marketing activities, targeted communications and past projects completed by these trading partners can have a significant impact on a potential client's decision about whether to adopt IT innovations. More specifically, managers will consider aspects of a trading partner such as regulatory support (Alshamaila *et al.,* 2013; Oliveira *et al.,* 2014), IT product co-creation and customization (Gupta *et al.,* 2013), service linkage (Chang *et al.,* 2013) and vendor locking (Sultan, 2011).

Thus, we propose the following two hypotheses for the adoption of cloud computing:

H7. Competitive pressure influences the adoption of cloud-based ERP systems by SMEs

H8. Trading partner pressure influences the adoption of cloud-based ERP systems by SMEs.

The *TOE* framework is considered an extension of the Diffusion of Innovation (*DoI*) theory. Most studies using the DoI and *TOE* framework divide the factors influencing cloud adoption into Technological, Organizational and Environmental factors (Ray, 2016).

4. RESEARCH METHOD

The objective of this study is to identify the factors influencing the adoption of cloud-based ERP systems in SMEs using the TOE framework. A questionnaire-based survey method was used along with Global Entrepreneurship Monitor reports from the organizations that are using cloud-based ERP services. The study sample consisted of 300 SMEs that are currently using ERP systems in their organizations. It is believed that all firms have adopted or were in the process of adopting cloud-based ERP systems while the study was underway. This study was not restricted to one specific industry; various industries were included to allow the survey results to be more generalizable. The aim of this research was to sample the population of managers or owners who had participated or been involved in adoption of cloud-based ERP systems. The preliminary survey contact list was obtained from the UAE business directory and the Dubai Business Directory from all emirates. Only SMEs which had websites and email addresses were selected. To identify relationships among the variables that lead to the acceptance and adoption of cloud computing technologies, semi-structured interviews were used as the primary data collection method.

Studies that adopt the *TOE* framework draw criticism due to the way they pick and choose from a list of attributes that have been empirically tested on other *IS* innovations. Data used to test the *TOE* framework instrument were obtained from 105 respondents in executive positions at SMEs. The items were framed on seven-point Likert scale. Questionnaires were emailed and this technique was used as a tool for data collection as it would have

been difficult to interview 300 executives. The usable sample consisted of 105 questionnaires with some or no missing data. This represented a response rate of 35%, which is close to the standard expectation. Initially, all data was codified and entered in SPSS version 24.

5. DATA ANALYSIS

The analysis was done on 105 completed questionnaires. The majority of the SMEs were small (65%), non-manufacturing sector (71%) and were in Dubai (51%). The respondents were mostly managers (70%) and were non-Arabs with a Bachelor's degree level of education. Table 2 shows the analysis of the level of agreement towards the factors that influence adoption of cloud-based ERP systems. Per the TOE framework discussed in this study, the ERP adoption factors are eight. The respondents agreed to the existence of six factors, which is evident from their mean ratings but did not find that complexity and compatibility influenced the adoption process. This confirms that respondents agree that the majority of the factors of this study are important for the adoption of cloud-based ERP systems.

Table 2. Constructs descriptive data

Measure	*Items*	*Mean*	*SD*
Relative Advantage (RA)	5	5.90	.90
Compatibility (CM)	7	3.73	1.0
Complexity (CX)	4	3.50	.96
Technological readiness (TR)	4	5.95	1.0
Top management support (TS)	4	6.17	.82
Firm Size (FS)	3	6.07	.72
Trading partner pressure (TP)	1	6.17	.86
Competitive pressure (CP)	5	5.97	.93
Adoption decisions.	2	5.35	.70

Reliability is one of the most critical elements in assessing the quality of construct measures (Churchill, 1979) and it is a necessary condition of scale validity. Tests of the reliability of the constructs were undertaken using Cronbach's alpha (Cronbach, 1951). Estimates greater than .70 are generally considered to meet the criteria for reliability (Nunnally, 1978). Churchill (1979) and Nunnally (1978) claimed that reliabilities of .50 and .60 suffice. Table 3 presents the results of the reliability analysis. All the Cronbach's alpha coefficients were found to be higher than 0.76. This indicated that the final constructs and items developed for this study were reliable.

Table 3. Scale reliability analyses

Construct Scale	*Items*	*Cronbach*
Relative Advantage (RA)	5	.92
Compatibility (CM)	7	.90
Complexity (CX)	4	.87
Technological readiness (TR)	4	.87
Top management support (TS)	4	.92
Firm Size (FS)	3	.83
Trading partner pressure (TP)	1	.90
Competitive pressure (CP)	5	.87
Adoption decision (AD)	2	.76

The factors that influence the adoption of cloud-based ERP systems in SMEs are shown in Table 4. It illustrates that, although all the factors are important, top management support, firm size and competitive pressure are perceived by the respondents to significantly influence the adoption of cloud-based ERP systems by SMEs. The relationship between the factors and adoption is relatively strong (R = .798). It is also observed from the regression model that the influence on adoption of cloud-based ERP systems has been explained to the extent of 63.6%. It is found to be statistically significant.

Table 4. Regression analysis of adoption decision and influencing factors

R	=	.798
R Square	=	.636
Adjusted R Square	=	.550
Standard Error	=	.807
F Statistic	=	7.353
Significance	=	.000
n	=	105

The significance of the regression coefficients of the hypothesized predictors was examined. The results are presented in Table 5.

Table 5. Results of hypotheses testing

Hypotheses	*Path coefficient*	*p-value*
H1: Relative advantage does influence the adoption of cloud-based ERP systems in SMEs.	.151	< 0.1
H2: Complexity does not influence the adoption of cloud-based ERP systems in SMEs.	.223	0.14
H3: Compatibility does influence adoption of cloud-based ERP systems in SMEs.	.164	0.18
H4. Top management support does influence the adoption of cloud-based ERP systems in SMEs.	.341	< .01
H5. Firm size does influence the adoption of cloud-based ERP systems in SMEs.	.021	< 0.05
H6. Technological readiness does influence the adoption of cloud-based ERP systems in SMEs.	.281	< 0.01
H7. Competitive pressure does influence the adoption of cloud-based ERP systems in SMEs.	.274	< .01
H8. Trading partner pressure does influence the adoption of cloud-based ERP systems in SMEs.	.161	< .01

6. DISCUSSION

This study finds a relative advantage, top management support, firm size, technological readiness, competitive pressure and trading partner pressure to be important factors that influence the adoption of cloud-based ERP systems in SMEs. Relative advantage is found to influence the adoption of cloud-based ERP systems due to the benefits such as lower upfront costs, rapid implementation, scalability, mobility, rapid updates and pay per use (Gangwar, 2014). This finding implies SMEs will shift to a cloud-based ERP system if they perceive that it has more benefits compared to the on-premises ERP. Thus, relative advantage is critical for the adoption of cloud-based ERP systems.

Complexity and compatibility were not found to influence the adoption of cloud-based ERP systems. This finding is consistent with a previous study (Low, 2011). Management and employees of SMEs may find cloud-based ERP systems complex because of the infancy stage. Service providers and vendors should reduce this fear by offering free trials and hands-on workshops of their services. If SMEs' previous experiences are compatible and

match existing information infrastructure, then the changes introduced by cloud-based ERP services will be consistent with existing practices. This implies that lack of compatibility could be a barrier to adoption of the new system.

The adoption of new technology requires top management support. They have an effective role in convincing and motivating their employees to adopt new technology and service (Anabel, 2015). They also need to provide the necessary resources to make the adoption process run smoothly.

Technological readiness has also emerged as a significant driver for cloud-based ERP systems. It also implies that organizational competence may help to leverage existing IS applications and data resources across key processes along the value chain when the SMEs embed the cloud-based ERP system (Low, 2011). This also means that organizations could increase the number of processes, enhance their internet infrastructure, implement mobile technology that can access the cloud, and ensure the compatibility of IT legacy systems (Anabel, 2015).

Finally, trading partner pressure is one of the factors influencing SMEs' decision to adopt cloud-based ERP systems. This finding is consistent with previous studies (Al Shaimala *et al.,* 2013; Oliveria, 2014). Firms adopt cloud-based ERP systems if they are influenced by convincing power (financial incentive) or through compulsory power (bargaining power by the trading partner). Many organizations, and particularly SMEs, rely more on trading partners (such as ERP vendors, cloud vendors or service provider) for their skills, expertise, regulatory support, IT product customization and service linkage (Oliveria, 2014).

7. CONCLUSION

This study empirically tested the TOE framework to explain the determinants of cloud-based ERP system adoption decisions by SMEs in the UAE. Findings show that relative advantage, top management support, firm size, technology readiness, trading partner pressure and competitive pressure were significant factors. The proposed hypotheses were empirically tested and results were discussed. In contrast, this study did not find enough evidence that competitive pressure was a significant determinant of cloud-based ERP system adoption. These findings have important implications and are of great value to the research community, managers, and SaaS providers. Using the research framework in this study can increase understanding of why some SMEs choose to adopt cloud-based ERP systems and others did not. On the other hand, cloud computing providers may need to improve their interaction with SMEs who are involved in the cloud computing experience, to create a healthy environment for cloud computing adoption, and to remove any misunderstandings surrounding this type of technology.

Future research could build on this study by examining cloud-based ERP systems adoption in different sectors and industries, and in different countries using both qualitative and quantitative methods. This study adopted a survey data collection method to explore the decision-making process of SMEs. Although this approach is useful in delving into business-related decision analysis, it limits the ability to generalize.

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