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The Usability of Management Information Systems Applications

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ABSTRACT

Many management information systems applications can be used to support businesses. One example is platforms that support electronic commerce, so retailers can sell products and services online. The use of electronic commerce applications is so common that virtually every smartphone owner has used them. In this research, the author evaluates the usability of mobile applications for electronic commerce in the Kingdom of Saudi Arabia and introduces a measure with which developers and organizations can evaluate the usability of their mobile applications. Applying quantitative research methods, including structural equation modeling, the research shows that three constructs—application design, application utility, and user interface structure—are the strongest predictors of both continued intention to use a mobile application and loyalty to the mobile application.

KEYWORDS

Electronic Commerce, Management Information Systems, Mobile Application, Saudi Arabia, Smartphone Use, Structural Equation Modeling, Usability

INTRODUCTION

The use of management information systems is widespread, and many applications support businesses in operating and managing their processes. A common application of information systems in the business sector is platforms for selling products and services online. Many large online retailers, such as Amazon, use these platforms to support electronic commerce (e-commerce). These huge platforms have a number of access channels, including company websites and mobile applications, and can handle many tasks (i.e., taking orders and payments, performing supply chain management activities and customer relationship management tasks, and handling logistics). According to the International Monetary Fund (IMF (2019), e-commerce is the engine for economic growth in Asia. Certainly, according to Communications and Information Technology Commission (CITC), the global e-commerce industry is constantly reshaping in response to growing demand and competition by offering new products and services, new ways of engaging customers, new business models, and new approaches to supply chain operations (CITC, 2017).

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This study focuses on the e-commerce market in the Kingdom of Saudi Arabia (KSA). The Saudi economy has been growing, and developing its e-commerce sector will add fuel to the country's economic development (CITC, 2017). E-commerce can contribute to the Saudi Vision 2030 in many ways, including economic diversification, increasing investment in the market, creating new jobs, and adding new channels for trade (CITC, 2017). One large project that could provide the needed infrastructure for the KSA is the Saudi Cloud Computing Company, which launched in 2022 (Arabnews, 2022). The e-commerce market has recently had some interesting news, such as the acquisition of Souq.com by Amazon, as well as the KSA's Public Investment Fund invested in Noon.com (CITC, 2017). In addition, in late 2020, the Saudi Aramco Development Company, a subsidiary of Aramco, formed an alliance with Google Cloud to provide cloud services to Saudi enterprises (Aramco, 2020). Other initiatives in the KSA aimed at increasing the adoption of e-commerce, including developing the connectivity infrastructure, enhancing electronic payments, improving the logistics ecosystem, and raising buyer confidence and awareness (CITC, 2017). The e-commerce market has significant growth potential, and consumers' huge demand for using mobile applications to buy products and services online is only growing. According to CITC (2021) recent report, almost 98% of smartphone users in the KSA access the Internet from these devices, and 70% of their online activities are related to buying goods and services. The mobile retail applications that are downloaded most frequently in KSA include Noon, Amazon, and Alibaba Express (CITC, 2021).

The objective of this research is to confirm and validate Hoehle and Venkatesh (2015) model and research instrument that companies can use to evaluate the usability of their e-commerce mobile applications, as application usability affects consumers' intention to continue using the application and consumers' loyalty to those applications. Hoehle and Venkatesh (2015) stated that research should develop norms for proposed models and instruments by testing them on data from other countries to understand cross-cultural differences. This paper's contribution can also help developers to design more effective mobile applications and overcome usability problems, as usability issues can be one of the criteria to evaluate these applications. According to Dwivedi et al. (2022), no information technology can be described as successful unless people use it. The next section presents a review of the literature, followed by the research method and results.

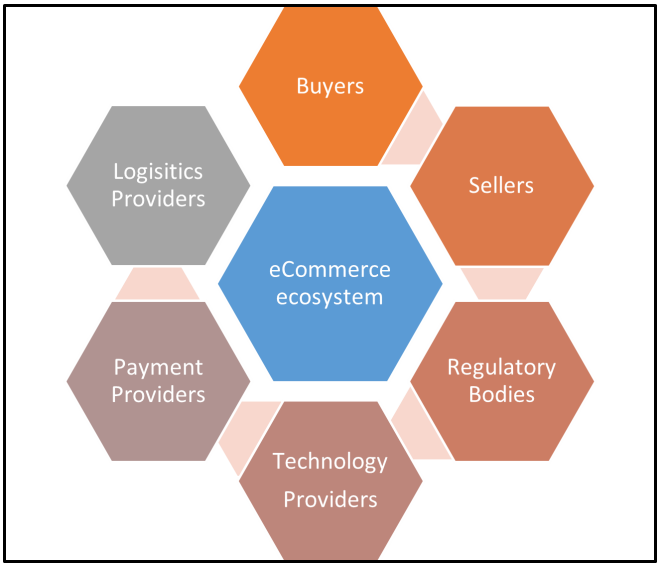
LITERATURE REVIEW

The Saudi economy is growing, and many new government initiatives that are underway relate to the country's Vision 2030, which focuses on diversifying sources of income for the Saudi government to include certain small sectors, such as the e-commerce sector. In 2016, e-commerce spending in the KSA exceeded US$7.92 billion (CITC, 2017), but spending is projected to reach US$13.71 billion in 2023 and US$23.46 billion by 2027, when the number of users is expected to reach 28.5 million (statista.com, 2022). Key drivers of the global e-commerce sector are rapid increases in Internet penetration, growth in smartphone use, increased personalization of services, growth in e-commerce investment, disruption in electronic payments industry, and improvements in the logistics and distribution sectors (CITC, 2017).

The KSA's e-commerce market has grown significantly as a consequence of rapid changes in consumer behavior and the country's economic growth and diversification agenda that has emerged from the National Transformation Program (CITC, 2017). Technological savvy is also growing as a result of high levels of mobile and Internet use, accompanied by a gradual drop in the use of desktop and traditional websites for shopping. Twenty-one percent of desktop and laptop users make online purchases, compared to 93% of smartphone users (CITC, 2017). The Saudi e-commerce sector is still growing and steadily maturing. As Figure 1 shows, all of the players in the e-commerce ecosystem contribute to such growth (CITC, 2017).

Hoehle and Venkatesh (2015) looked at the usability of mobile applications based on their performance and argued that theoretical and practical clarity on the overall usability of mobile applications is lacking. They also argued for the need to establish instruments that are based on theory

Figure 1.
E-Commerce ecosystem (CITC, 2017)



and can be used to measure comprehensively the usability of mobile applications. In addition, some research suggests that the lack of usability is the most significant factor in consumers' decisions to reject mobile applications (Forrester Research, 2010; Hoehle & Venkatesh, 2015; Youens, 2011). Ramos et al. (2019) and Tang (2019) suggested investigating the usability of mobile applications and validating the factors that may affect it. In addition, Attah et al. (2021) and Weichbroth (2020) noted that, since creating a usable mobile application is a challenge, determining a common ground for theory and practice related to assessing their usability is needed. This critical issue can be addressed by means of an instrument that reveals the usability of mobile applications in the Saudi context, thus supporting developers and organizations efforts to evaluate their existing applications' usability. According to Attah et al. (2021) and Khowaja et al. (2019), the usability of mobile applications should be evaluated, especially in their local contexts and domain-specific situations. Usability may be one of the most significant quality factors of applications and should be strictly monitored during development of the application (Attah et al., 2021).

This section provides definitions of terms that the author applied in this paper. E-commerce refers to using the Internet to buy, sell, and deliver products or services (IMF, 2019), whether business-to-business or business-to-consumer. Business-to-consumer e-commerce is defined as selling physical goods or services to consumers through digital channels via desktop computers and through mobile devices via mobile applications (statista.com, 2022). A mobile application is defined as "an information technology software artifact that is specifically developed for mobile operating systems installed on handheld devices, such as smartphones or tablets" (Hoehle & Venkatesh, 2015). According to International Organization for Standardization (ISO), usability refers to a mobile application "can be used by specified users to achieve specified goals with effectiveness, efficiency, and satisfaction in a specified context of use" (ISO, 2011).

Albashrawi and Motiwalla (2020) explored the acceptance and use of mobile banking using subjective and objective measures and established models by combining them into an integrative behavioral framework. They evaluated the integrative framework's robustness and used objective and subjective measures to determine the system's success (Albashrawi & Motiwalla, 2020). AL-Tayyar et al. (2021) studied the barriers and challenges, such as cultural issues, business factors, and technical

aspects, that face Saudi small and medium-sized enterprises in their attempts to adopt e-commerce in the KSA. They also identified the facilitators of e-commerce adoption as including awareness programs, government support, a strong information technology infrastructure, and awareness programs.

Fu et al. (2019), who used a case study to show how users and designers view the user interfaces on mobile shopping applications, found significant differences between users and designers in this regard. Users' perceptions tend to be influenced by user interfaces' functions and colors, whereas designers tend to be influenced by the interface's overall visual impression—that is, its holistic layout (Fu et al., 2019). Xiao et al. (2022) proposed a distributed e-commerce system using blockchain technology and designed a multicriteria decision-making evaluation model that avoids biases, is reliable, and has a low communication cost (Xiao et al., 2022).

THE RESEARCH MODEL AND HYPOTHESES

Hoehle and Venkatesh (2015) developed a mobile application usability model using the user experience guidelines for mobile applications that Apple suggests. The suggested model can be used for evaluating and designing useful mobile applications (Guler, 2019; Hoehle et al., 2016). Table 1 shows the definitions of the six constructs of the proposed model as determined by Hoehle and Venkatesh (2015). Figure 2 shows the research model that Hoehle and Venkatesh (2015) presented and that the author used in this study to measure mobile applications' usability. Table 2 shows the 35 items of the research questionnaire.

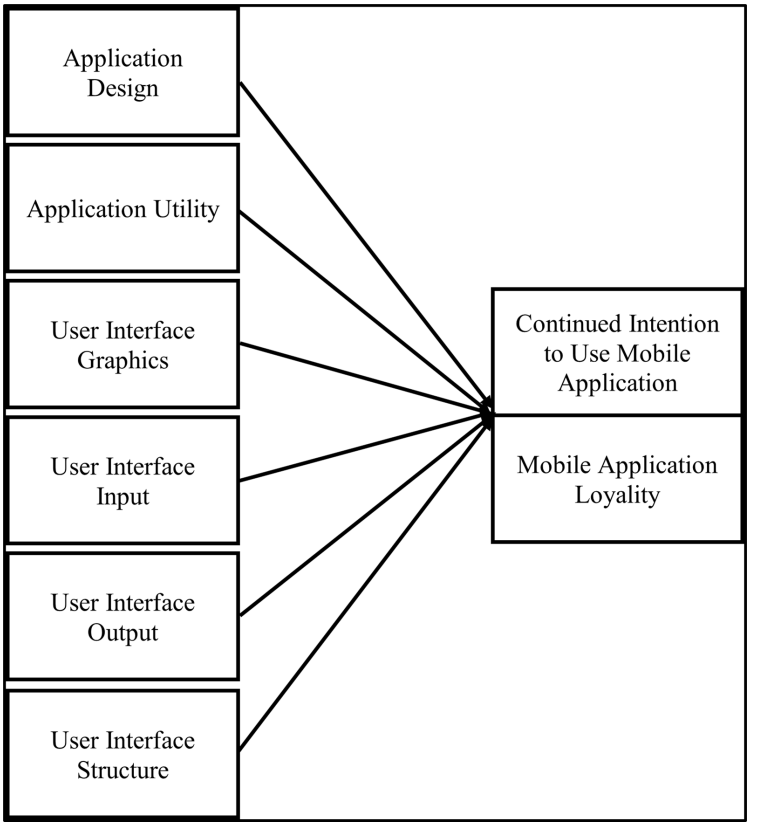
The research hypotheses the author developed to test the model presented in Figure 2 are:

Hypothesis One (H1): Application design has a positive effect on continued intention to use a mobile application.
Hypothesis Two (H2): Application design has a positive effect on mobile application loyalty.
Hypothesis Three (H3): Application utility has a positive effect on continued intention to use a mobile application.
Hypothesis Four (H4): Application utility has a positive effect on mobile application loyalty.
Hypothesis Five (H5): User interface graphics have a positive effect on continued intention to use a mobile application.
Hypothesis Six (H6): User interface graphics have a positive effect on mobile application loyalty.
Hypothesis Seven (H7): User interface input has a positive effect on continued intention to use a mobile application.

Table 1.
Definitions of the research constructs and dependent variables (Hoehle & Venkatesh, 2015)

Construct	Definition
Application design (AD)	"The degree to which a user perceives that the mobile application is generally designed well."
Application utility (AU)	"The degree to which a user perceives that the mobile application generally serves its purpose well."
User interface graphics (UIG)	"The degree to which a user perceives that the mobile application's user interface graphics are effectively designed."
User interface input (UII)	"The degree to which a user perceives that the mobile application allows users to input data easily."
User interface output (UIO)	"The degree to which a user perceives that the mobile application presents content effectively."
User interface structure (UIS)	"The degree to which a user perceives that the mobile application is structured effectively."
Continued intention to use (CIU)	"The degree to which a user feels he or she will keep using a mobile application."
Mobile application loyalty (MAL)	"The degree to which a user has a deeply held commitment to rebuy or repatronize a mobile application."

Figure 2.
The proposed model (Hoehle and Venkatesh (2015)



Hypothesis Eight (H8): User interface input has a positive effect on mobile application loyalty.
Hypothesis Nine (H9): User interface output has a positive effect on continued intention to use a mobile application.
Hypothesis Ten (H10): User interface output has a positive effect on mobile application loyalty.
Hypothesis Eleven (H11): User interface structure has a positive effect on continued intention to use a mobile application.
Hypothesis Twelve (H12): User interface structure has a positive effect on mobile application loyalty.

RESEARCH METHOD

The author used a quantitative research method using structural equation modeling based on Hair et al. (2010) guidelines. The author used Google Forms to obtain participants' responses to the questionnaire presented in Table 2; the researcher developed the questionnaire by modifying an instrument from Hoehle and Venkatesh (2015) research to achieve the current research objectives. The participants used a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree) to indicate their level of agreement with statements of the research questionnaire. The author distributed the link to the survey through WhatsApp to online consumers in the KSA. Respondents provided 139 valid responses. After screening the collected data for errors, the author analyzed the responses using SPSS and AMOS software packages. The next section presents the research steps and results.

Table 2.
The research questionnaire proposed by Hoehle and Venkatesh (2015)

Construct	Item
Application Design (AD)	"Overall, I think the mobile application is designed well".
	"In general, I believe that the mobile application has a great design".
	"Generally speaking, the mobile application is well designed".
	"I am very satisfied with the overall design of the mobile application".
Application Utility (AU)	"To me, the mobile application is very functional".
	"Overall, I think that the mobile application is useful".
	"Generally speaking, the mobile application serves its purpose well".
	"In general, the mobile application is of value to me".
User Interface Graphics (UIG)	"Overall, I think that the graphics displayed on the mobile application are designed effectively".
	"In general, the interface graphics of the mobile application are designed well".
	"Generally speaking, I like the graphics displayed on the interface of the mobile application".
	"Overall, the mobile application has very good user interface graphics".
User Interface Input (UII)	"In general, the mobile application allows me to input data easily".
	"Overall, the user input mechanisms are designed effectively on the mobile application".
	"I am very satisfied with the input mechanisms of the mobile application".
	"Generally speaking, it is easy to type in data into the mobile application".
User Interface Output (UIO)	"In general, the content of the mobile application is presented effectively".
	"Overall, I believe that the mobile application presents content very well".
	"Overall, I think that the mobile application presents content effectively".
	"I am very satisfied with the way that the mobile application presents content".
User Interface Structure (UIS)	"Overall, I think the mobile application structures information effectively".
	"In general, the mobile application is structured very well".
	"I am very satisfied with the way the mobile application is structured".
	"Generally speaking, the mobile application is structured nicely".
Continued Intention to Use (CIU)	"I intend to continue using the mobile application".
	"I want to continue using the mobile application rather than discontinue".
	"I predict I will continue using the mobile application".
	"I plan to continue using the mobile application".
	"I don't intend to continue using the mobile application in future".
	"Chances are high that I will continue using the mobile application in future".
Mobile Application Loyalty (MAL)	"I encourage friends and relatives to be customers of the mobile application".
	"I say positive things about the mobile application to other people".
	"I will use more services offered by the mobile application in the next few years".
	"I would recommend the mobile application to someone who seeks my advice".
	"I consider the mobile application to be my first choice".

RESULTS

This section presents the results of the statistical analysis. Statistical tests included descriptive analysis, exploratory factor analysis (EFA), confirmatory factor analysis (CFA), and path analysis. The researcher performed descriptive analysis and EFA using SPSS, and CFA and path analysis using AMOS. Table 3 shows the participants' demographic information.

EXPLORATORY FACTOR ANALYSIS

The author conducted EFA using SPSS to identify the correlations between the constructs of the dataset. The factoring method was the principal component analysis, and the researcher measured the unique relationship between each item and the constructs using Promax with Kaiser normalization rotation. Table 4 presents the EFA results and the item loadings. The results also show that the Kaiser-Meyer-Olkin test, which measures the adequacy of EFA sampling, was 0.994, which is acceptable (Field, 2013; Kaiser, 1974). Moreover, Cronbach's alpha test for reliability was 0.980, which is acceptable (Field, 2013). Therefore, the 35 items and the research questionnaire can be considered reliable measures.

CONFIRMATORY FACTOR ANALYSIS

After building the model using AMOS and after loading the data, the author used CFA to determine the factor structure of the dataset. Table 5 presents the results of the CFA, which show that Chi-square, p-value, and CFI were acceptable. Moreover, convergent and discriminant validity tests that measure the validity of CFA (Table 6) present some concerns about discriminant validity: The square root of the average variance extracted (AVE) for mobile application loyalty is less than the absolute value of the correlations

Table 3.
Participants' demographic information

Demographic profile	Group	Number	Percentage
Preferred application for online purchases	Amazon	42	30.2
	NOON	39	28.1
	Booking	23	16.5
	Ali Express	16	11.5
	Others	19	13.7
The main purpose of using the mobile application for online shopping	Buy products	83	59.7
	Buy services	56	40.3
Age group	21-30	28	20.0
	31-40	51	36.7
	41-50	41	29.5
	51-60	13	9.4
	Over 60	6	4.3
Gender	Male	107	77.0
	Female	32	23.0
Marital status	Married	98	70.5
	Single	41	29.5
Nationality	Resident	6	4.3
	Saudi	133	95.7

Table 4.
EFA results and item loadings

	Constructs					
	1	2	3	4	5	6
AD1		.851				
AD2		.920				
AD3		.910				
AD4		.666				
AU1					.580	
AU2					.874	
AU3					.731	
AU4					.938	
UIG1	.936					
UIG2	.872					
UIG3	.905					
UIG4	.840					
UII1				.906		
UII2				.905		
UII3				.685		
UII4				.696		
UIO1						.570
UIO2						.942
UIO3						.936
UIO4						.599
UIS1			.841			
UIS2			.808			
UIS3			.752			
UIS4			.718			

Table 5.
CFA results

Measure	Value	Threshold and comments
Chi-square/df (CMIN/DF)	1.797	< 3, good; < 5, sometimes permissible
P-value for the model	0.000	> 0.05
CFI	0.931	> 0.95, great; > 0.90 traditional
GFI	0.743	> 0.95
AGFI	0.694	> 0.80
SRMR	0.000	< 0.09
RMSEA	0.076	< 0.05, good; 0.05-0.10, moderate
PCLOSE	0.000	> 0.05

Note: Threshold as advised by (Hair et al., 2010; Hu & Bentler, 1999)

with another factor, the AVE for mobile application loyalty is less than the maximum shared variance (MSV), and the AVE for continued intention to use a mobile application is less than the AVE for MSV.

PATH ANALYSIS

Finally, the author performed a path analysis test to determine whether the proposed hypotheses receive support. Table 7 shows the results of the path analysis and their thresholds (Dion, 2008), whereas Table 8 shows the results of the hypotheses testing. Hypotheses H1, H2, H3, H4, H8, H11, and H12 were accepted, whereas hypotheses H5, H6, H7, H9, and H10 were rejected. The next section discusses these results and is followed by the conclusion.

DISCUSSION

In this section, the author discusses the findings presented in Table 8, with the accepted hypotheses discussed first, followed by those that were rejected. Only two constructs, the user interface graphics and the user interface output, were not significant; the other four constructs were significant, with the application design, the application utility, and the user interface structure the strongest predictors

Table 6.
Results of the research model convergent and discriminant validity

	CR	AVE	MSV	MaxR(H)	MAL	AD	CIU	UII	UIO	UIS	UIG	AU
MAL	0.944	0.772	0.778	0.953	0.878							
AD	0.917	0.786	0.664	0.930	0.635	0.887						
CIU	0.917	0.694	0.778	0.971	0.882							
UII	0.952	0.831	0.745	0.952	0.695	0.765	0.755					
UIO	0.955	0.840	0.773	0.960	0.728	0.743	0.744	0.863				
UIS	0.956	0.845	0.773	0.967	0.772	0.767	0.817	0.848	0.879			
UIG	0.936	0.785	0.551	0.943	0.627	0.719	0.661	0.734	0.742	0.729		
AU	0.926	0.758	0.719	0.930	0.788	0.815	0.801	0.848	0.825	0.832	0.718	

Table 7.
Results of the path analysis

Measure	Value	Threshold and comments
Chi-square/df (CMIN/DF)	1.866	< 3, good; < 5, sometimes permissible
P-value for the model	0.000	> 0.05, acceptable
CFI	0.925	> 0.95, great; > 0.90, traditional
GFI	0.734	> 0.95
AGFI	0.683	> 0.80
SRMR	0.000	< 0.09
RMSEA	0.079	< 0.05, good; 0.05-0.10 moderate
PCLOSE	0.000	> 0.05

Note: Threshold as advised by (Dion, 2008).

Table 8.
Hypotheses testing results

Hypothesis	From	To	S. E.	C. R.	P-value	Hypothesis supported
H1	AD	CIU	0.250	-3.084	0.002	Yes
H2	AD	MAL	0.290	-2.941	0.003	Yes
H3	AU	CIU	0.378	3.892	0.000	Yes
H4	AU	MAL	0.448	3.825	0.000	Yes
H5	UIG	CIU	0.126	1.616	0.106	No
H6	UIG	MAL	0.144	1.333	0.182	No
H7	UII	CIU	0.270	-1.674	0.094	No
H8	UII	MAL	0.327	-2.487	0.013	Yes
H9	UIO	CIU	0.205	-0.403	0.687	No
H10	UIO	MAL	0.230	0.359	0.720	No
H11	UIS	CIU	0.212	2.655	0.008	Yes
H12	UIS	MAL	0.236	2.224	0.026	Yes

of both continued intention to use a mobile application and loyalty to it. The finding that application design and application utility have positive effects on continued intention to use a mobile application and loyalty to it is aligned with those of Hoehle and Venkatesh (2015). Moreover, the user interface structure has a positive effect on continued intention to use a mobile application, which is also aligned with Hoehle and Venkatesh (2015) results. Two of the accepted hypotheses differed from Hoehle and Venkatesh (2015) findings. First, the analyses revealed that a user interface input has a positive effect on mobile application loyalty, perhaps because the perceptions of the users in the KSA are influenced by the input screens and forms that are presented in the mobile applications, which may themselves increase their loyalty to the application. Second, this study shows that the user interface structure has a positive effect on mobile application loyalty, perhaps because users in the KSA prefer the flow and structure of the transactions and services in the mobile application, which may itself increase their mobile application loyalty.

Of the five hypotheses that were rejected, the user interface output does not have a positive effect on mobile application loyalty (H10), a result that is aligned with Hoehle and Venkatesh (2015) findings. However, the remaining four of the rejected hypotheses (H5, H6, H7, and H9) were also unsupported in Hoehle and Venkatesh (2015) research. The results of this study showed that user interface graphics, user interface input, and user interface output do not have positive effects on continued intention to use a mobile application. Perhaps customers in the KSA who are not loyal to an application do not pay much attention to the user interface input and user interface output. Finally, the results reveal that the user interface graphics do not have a positive effect on mobile application loyalty, perhaps because of the low effect of these graphics for customers in the KSA in terms of their loyalty to the application or their continued intention to use it.

CONCLUSION

Many management information systems applications support businesses in managing their processes. One category of these applications is platforms that online retailers use to sell their products and services online. Today, these platforms include mobile applications that can handle many tasks, including orders, payment processing, delivery, and after-sales services. The increased demand for

mobile applications for buying products and services online indicates significant opportunity for the e-commerce market to grow.

The current research proposes a measure with which developers and organizations in the KSA can evaluate their mobile applications' usability. The results show that the application's design and utility as well as the user interface's structure are the strongest predictors of the intention to continue using a mobile application and loyalty to it. The user interface's input also has positive effects on loyalty to the mobile application.

The implications of this research include the importance of these three constructs in increasing the usability of mobile applications, so the results of this study can guide application developers and designers in producing more usable mobile applications that are used continuously by loyal users.

The paper's primary limitation is its sole focus on the Saudi market. Future research can include other markets or tests for validity of other constructs that may affect the intention to use a mobile application and loyalty to it.

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