

# Factors Influencing the Acceptance of Online Mobile Auctions using User-Centered Agile Software Development: An Early Technology Acceptance Model

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**Abstract**—e-Commerce is booming everywhere, and Saudi Arabia is no exception. However, the adoption and prevalence of online mobile auctions (aka m-auction) remain unsatisfying in Saudi Arabia and the MENA region. This paper uncovers the enabling factors and hindering barriers against the use of mobile auctions by online consumers. To this end, a multiphase mixed methods design is applied to acquire an in-depth understanding of online mobile bidding or auctioning attitudes and practices of the Saudi auctioneers and bidders. Initially, an interactive mobile auction app was developed by applying the principles of user-centered agile software development (UCASD) methodology, which incorporated several design iterations based on feedback from 454 real users. The mobile auction requirements were collected using a mix of research methods, including a survey, focus groups, prototyping, and user testing. The UCASD methodology positively influenced the early evidence-based adoption and use of mobile auctions in the Saudi market. Subsequently, three consecutive focus groups were conducted with another 22 participants to induce further insights regarding the antecedents impacting the intention to embrace online auctions using mobile phones. A taxonomy of requirements coupled with thematic analysis of the discussions gave rise to 13 influential factors of mobile auctions, namely risk, quality of products, trust, ubiquity, usefulness, access to valuable products, ease of use, age, social influence, monetary costs, enjoyment, past experience, and facilitating conditions. Our inductive approach resulted in an early technology acceptance model of mobile auctions. We conclude by reflecting on the challenges observed to suggest some practical guidelines to pave the way for other researchers in this promising area to carry out experimental studies to ameliorate the proposed model.

**Keywords**—Online auction; mobile auction; technology acceptance model; eBay; human-centered design; agile software development; factors

## I. INTRODUCTION

e-Commerce revenues in Saudi Arabia have approximated 10.44 billion USD in 2022, with projections that its value will surpass 23.46 billion USD by the end of 2027 [1]. Moreover, the number of Saudi consumers who indulged in e-commerce

activities reached approximately 25.6 million users in 2020, and this number is prognosticated to surpass 34.5 million users with 92.5% user penetration by 2025 [2]. Although e-commerce websites in Saudi Arabia are gaining unprecedented popularity, their actual adoption and use by consumers are still below par compared to the world. e-Commerce takes various forms and includes many activities. In this paper, we shed light on one specific type of e-commerce, that is, online auctions performed using mobile devices (i.e., m-auction) for several motifs. Firstly, online shopping using mobile phones (i.e., mobile e-commerce) is constantly increasing. A Saudi Communications and Information Technology Commission report revealed that 93% of online shoppers use their smartphones to make online purchases in Saudi Arabia [3]. Secondly, the online auction market growth rate is anticipated to increase by 7.2% in 2022 [4], with global sales of art and antiques already exceeding 26 billion USD in 2021 [2]. However, the USA, China, and the UK hold 86% of the global auction market share leaving only 14% to the rest of the world.

Hence, our main intriguing research question is straightforward. Why does Saudi Arabia, despite its recent major digital transformations, still lag in the use of online mobile auctions? We believe that our findings about online mobile bidding attitudes and practices may be generalized to similar developing countries in the Middle East and North Africa (MENA) region. Software solutions often face critical challenges that lead to their failure. In fact, a weak understanding of user views and requirements and failure to engage users throughout the design process is deemed to be among the common reasons that lead to software failure [5][6]. However, developing easy to use software applications does not always guarantee successful adoption and use by the final users. Technology acceptance models have been proposed for decades as theoretical stipulations to understand the motivations and critical factors that must be present before users would start using a new technology [7]. This is the case for Saudi Arabia and the gulf region, where online auctions in general and mobile bidding in particular are still not being used

despite the high technological penetration levels experienced in these countries.

Studies investigating the adoption of mobile commerce have recently gained momentum worldwide [8][9][10][11] and in Saudi Arabia [12][13]. For example, Alkhunaizan and Love proposed a mobile commerce acceptance model where performance expectancy, cost, and effort expectancy were perceived as significant factors for user adoption [14]. However, to the best of our knowledge, there are no studies related to mobile auction adoption in Saudi Arabia. Moreover, the literature does not offer comprehensive studies exploring the critical success factors and challenges impacting the adoption of mobile bidding by Saudi consumers. In line with the above motivations, our research offers several crucial contributions.

1) The design of an interactive mobile auction app (which we call iBid) by applying an integrated user-centered design and agile development process [15][16]. We contribute a participative methodology that shows how to capture and apply user feedback in an ongoing process to improve software artifacts until an acceptable version is reached quickly. At the end of the design process, a real mobile application is produced and introduced to Saudi consumers to gauge their acceptance and capture genuine feedback.

2) The conceptualization of the factors that impact user attitudes, behavior, and adoption of live auctions using mobile devices. Such in-depth understanding was captured through a series of qualitative studies in the form of focus groups with real users. This phase induced a solid theoretical foundation elaborating the factors and potential influence on the intention to use online mobile auctions.

We organized the rest of the paper into five sections. Section II elaborates on the concept of mobile auctions and technology acceptance models that predict shoppers' intention to bid on products. Section III presents the UCASD research methodology that was applied to create our mobile auction app. Section IV presents the key results of the iterative development process along with the m-auction requirements. Section V reports on the theoretical observations concerning the factors influencing Saudi consumers' mobile bidding perceptions and behavior. Section VI discusses the practical implications and suggests a research roadmap for online mobile auctions in MENA countries.

## II. RELATED WORKS

### A. e-Commerce and Mobile Auction

This research revolves around online mobile auctions (aka m-auction), which can be conceived as a form of electronic commerce (e-commerce). e-Commerce is a type of business that incorporates the activities and operations of selling and/or buying services or goods/products online [17]. Payments may also take place using dedicated payment gateways, like PayPal. Various technologies and frameworks, such as transaction processing and inventory systems, were developed to achieve seamless e-commerce. e-Commerce prevails in various shapes. Nowadays, C2C and B2C e-commerce are offered through online auction channels. For instance, eBay reported a net

revenue of 10.27 billion US dollars in the year 2020 [18]. Moreover, online C2C e-commerce usage in 2021 by the European Union reached 20% of its population [19].

Mobile commerce (m-commerce) was coined in the late 90s to refer to purchasing and selling goods or services using mobile devices [20]. The pervasiveness of mobile devices enabled quick access to various services, including, but not limited to, mobile banking, mobile marketing, mobile money transfer, and mobile auctions [21]. A Delphi study involving experts has revealed that the factors leading to m-commerce success included ease of use, convenience, trust, and ubiquity (real-time) [22].

Online auctions refer to online marketplaces where sellers display their services or products for sale through bidding [23]. The selling price is usually not determined at the start of the auction, and buyers compete for a particular item, which is won by the highest bidder [24]. This e-commerce model offers various advantages, such as access to services and products irrespective of the geographic location, accessibility to a large pool of customers, and lower prices compared to other traditional marketplaces. Online mobile bidding refers to the auction activities that take place within e-marketplaces using mobile devices. In mobile auctions, customers are empowered to watch live auctions directly from their phones and bid on the displayed services and goods [25].

### B. Online Auction and Mobile Bidding Acceptance

Technology acceptance literature proposes and examines information systems theories and models to predict how people adopt and eventually use new technologies [26]. A variety of technology acceptance models were proposed for different electronic services, like e-commerce [27], e-government [28], e-payment [29], m-banking [30], and mobile learning [31]. These studies augmented the original technology acceptance model (TAM) with several key success factors, including perceived trust, perceived risk, cost, security, lifestyle, and compatibility. However, research efforts in online auctions / mobile bidding are limited despite their growing penetration among e-commerce customers [32]. Among the notable studies of online auction acceptance is that of Turel et al., [33]. Results of two surveys with eBay users showed that addiction toward online auctions impacts perceived enjoyment, usefulness, and usability, which consequently influence intentions to use online auction systems. Chang identified that the use of autonomous agents for online auctions is positively correlated with well-known technology acceptance factors such as usefulness, ease of use, and enjoyment [34]. This is an example of the unconventional factors that must be considered in modern technologies.

In Saudi Arabia, the acceptance, adoption, and use of e-commerce [35], online banking [36] and mobile commerce have been explored to a limited degree. Eid showed that e-commerce intention to use is influenced by the satisfaction of customers but not trust. The satisfaction, in turn, was influenced by the quality of the user interface and the quality of information [35]. Moreover, the use of e-shopping in Saudi Arabia was influenced by enjoyment, usefulness, and personal norms [37]. However, the level of education, resistance to change, and perceived trust were found to impact customers'

readiness to adopt online banking [36]. Alkhunaizan and Love suggested that successful customer adoption of mobile commerce in Saudi Arabia is strongly linked to perceived performance expectancy and incurred costs [14]. However, social influence and perceived trust were not found to impact mobile commerce usage intention.

In light of the above, we identify several challenges and unanswered questions that motivate our research agenda in this paper. Firstly, mobile bidding is a relatively new technology still yet to be explored in the Saudi context. Secondly, previous studies are confirmatory in nature (i.e., statistical), assuming links between constructs concerning online auctions and e-commerce theories. The aim here is to build a user-centered mobile app and explore the mobile features, characteristics, and context that truly influence consumers' intention to use mobile bidding and formulate those in a preliminary theoretical model of mobile bidding adoption, which can be confirmed in a subsequent confirmatory study.

### C. Significance of Mobile Auction

Consumer behavior research has generated considerable attention, especially with the abundance of modern technologies in our daily life. Online auction is spreading rapidly amongst technology enthusiasts; for example, the number of eBay active users increased dramatically from 89 million users to 138 million active users in 2022 [38], with the annual bidding sales exceeding 10.42 billion US dollars in net revenue in 2021 [2]. These figures emphasize the importance of investigating mobile auctions for Saudi Arabia's economy and e-shopping customers within the Kingdom. There are other qualifying motivations for selecting this research topic, including the arguments below.

- e-Commerce is accelerating in Saudi Arabia, with more than 25 million users [1]; hence, it is worth investigating trendy e-commerce topics, such as mobile auctions, which is a promising C2C e-commerce model.
- There are conflicting findings in the literature regarding the specific factors that encourage or inhibit the use of e-commerce technologies among customers.
- Existing adoption models were introduced for non-Arab cultures (i.e., the developed countries), thus restricting these technology acceptance models to those environments and raising serious questions about their applicability in Saudi Arabia, a culture with unique characteristics and user needs. The literature has already demonstrated that different cultures perceive technologies differently (e.g., US vs. Korean) [39]. Such findings necessitate the development of m-auction models that fit the Saudi society.
- Existing technology acceptance models cannot continue to predict the correct use and adoption of modern technologies such as mobile bidding. For example, Röcker argues that as new technologies are introduced to support use in personal and specific contexts, old factors like perceived ease of use may not accurately predict technology use [40].

To the best of our knowledge, no explicit and systematic study explored the acceptance of online mobile auctions by Saudi e-shoppers. This is the first study in this direction, and its contributions will give real practical implications for e-commerce in the gulf region.

### III. THE UCASD RESEARCH METHODOLOGY

Generally, a research methodology refers to the set of procedures to be followed to investigate a particular research problem scientifically, leading to reliable and valid results [41]. Creating theoretical models that accurately predict the acceptance and use of new technology has attracted significant attention [42] and usually follows a purely quantitative approach, which applies statistical tests to establish new constructs and relationships. However, such a deductive approach is practical only when a set of critical success factors have been identified a priori.

We argue that the topic of mobile auctions in Saudi Arabia and MENA is under-explored and Saudi e-shoppers are yet to adopt and use mobile bidding. In our view, the first step necessitates developing an in-depth understanding of the factors impacting mobile auction attitudes and use. Therefore, we opted for a qualitative approach to pave the way, through inductive reasoning, to suggest a tentative model that is ready for quantitative confirmation in future studies.

Fig. 1 depicts the integrated UCASD methodology that we applied to develop a mobile auction app and collect mobile auction requirements. Our methodology combined UCD and agile development processes, with focused system refinements emerging from the iterative testing of the 'm-auction' concept with real users [43]. Salah et al., argue that this complementary integration empowers the developers to 1) create a deep understanding of user needs, 2) consider user interface (UI) design and user experience (UX) during the development process and produce software quickly while reducing costs [44]. Although combining UCD activities with agile software development during software creation is no easy task [43], UCD, if implemented correctly, can strengthen the agile values [45], as presented in the next section. Table I summarizes the research methods used and the number of participants in each study. The details of each study are provided in the following sections.

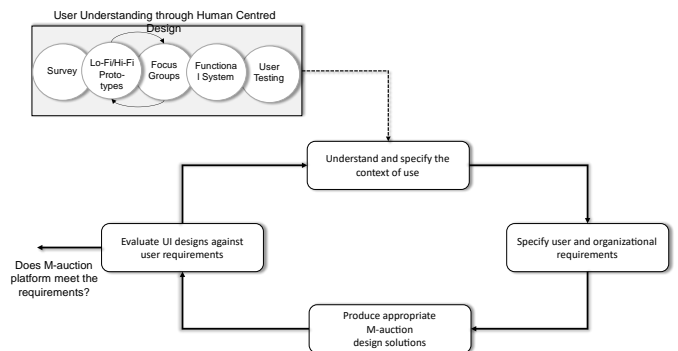


Fig. 1. Our Integrated User-Centered agile Software Development Methodology (UCASD).

TABLE I. RESEARCH METHODS USED AND NUMBER OF USERS SOLICITED

Research Method	Type	No. of Users
Online Survey	Mixed	417
Focus Groups	Qualitative	9
Lo-Fi and Hi-Fi Prototyping	Qualitative	NA
User Testing	Mixed	28
Focus Groups	Qualitative	22

#### IV. THE USER-CENTERED DESIGN (UCD) OF THE iBID MOBILE APPLICATION

We argue that adopting a user-centered design philosophy is crucial to ensure various benefits ranging from rapid development, reduction in requirement changes, and high user satisfaction and acceptance. According to Wever et al., the User Centered Design (i.e., UCD) puts the final user at the center of the whole design process, where the user actively contributes his perceptions, requirements, and feedback so that a highly usable solution is created [41]. The added value of UCD in agile software development is further emphasized by Zorzetti et al., [46]. During our UCD, we captured the real requirements of bidders and introduced the mobile app for actual use. Subsequently, we held two focus groups and a user testing to discuss users' thoughts, perceptions, and reactions toward the designs of mobile auctions.

As a first contribution, this paper aims to showcase how it is possible to create a modern mobile app while applying the User-Centered Agile Software Development (UCASD) methodology. We closely followed and applied the principles suggested by Brhel et al., to realize the UCASD benefits [45]. The specific recommendations that were integrated during our development include:

- Principle One: the separation of 'product discovery' and 'product creation'.
- Principle Two: the design and development of systems through 'short, iterative, and incremental' software activities.
- Principle Three: parallel design and development tasks
- Principle Four: continuous stakeholder involvement from start to end.
- Principle Five: use tangible artifacts to facilitate communication of concepts to stakeholders.

##### A. Mobile Auction Discovery Through a Survey Study

Our research quest started by gathering and defining the requirements for mobile auctions. To this end, a survey was administered and distributed to university students via the university mailing lists. Surveys are cost-effective, enable access to a large pool of users quickly, and assist in capturing unique requirements [47][48][49]. In this first study, a total of 417 users responded to our online survey, which incorporated 59 quantitative and qualitative questions spanning across three different sections, namely (1) past e-shopping practices, (2) desired auction functions and features, and (3) respondents' demographic information, as shown in Fig. 2.

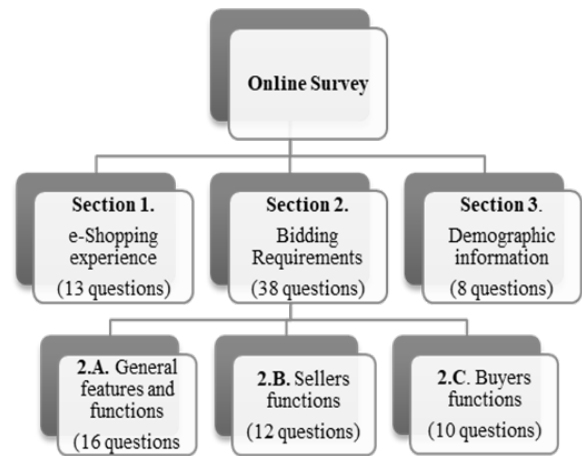


Fig. 2. Distribution of Online Survey Questions.

The past e-shopping experiences section explored users' practices regarding e-commerce, e-shopping and online bidding that resulted in selling or buying products or services using the Internet or mobile applications. The bidding requirements section identified users' needs with respect to the general features of mobile bidding and functions supporting the seller and buyer. The requirements' questions were rated on a seven-point Likert scale (where 1=not necessary at all and 7=very important). The demographic section collected users' age, study level, mobile subscription package, smartphone brands, etc.

369 (88%) of our respondents were students, while the remaining respondents (i.e., 51 users) were professionals. 254 (60.9%) were males, and 163 (39.1%) were females. More than 75% of the respondents indicated they had an excellent experience using smartphones. Furthermore, 363 (87%) respondents in the past indulged in some sort of e-commerce activities using online websites or mobile apps. 51% of the respondents owned Apple smartphones, while the rest owned Android smartphones (e.g., Samsung and Huawei). Regarding mobile auctions, we succinctly summarize the key features and requirements desired by our respondents as follows.

- RQ1. Localization of platform: support of the local language.
- RQ2. Search functionality: availability of search functionality to look for products and services.
- RQ3. Information quality: adding photos and videos to the products or services.
- RQ4. Auction details: setting price limits for products and services on bidding.
- RQ5. Trustworthiness: displaying reviews about sellers, products, and bidding experience.
- RQ6. Live customer support via instant messaging.

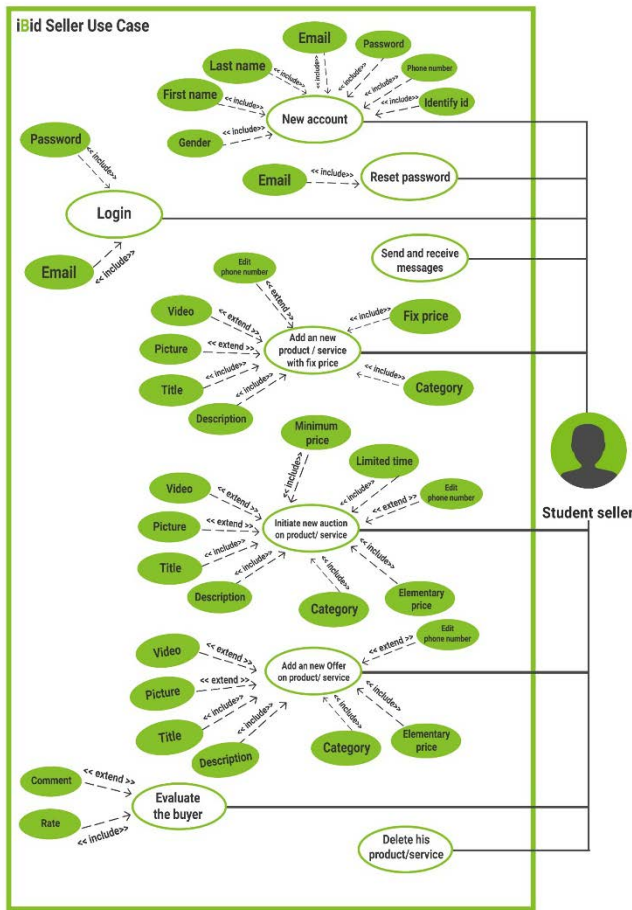


Fig. 3. A Use Case Diagram for a Seller using the Mobile Auction System.

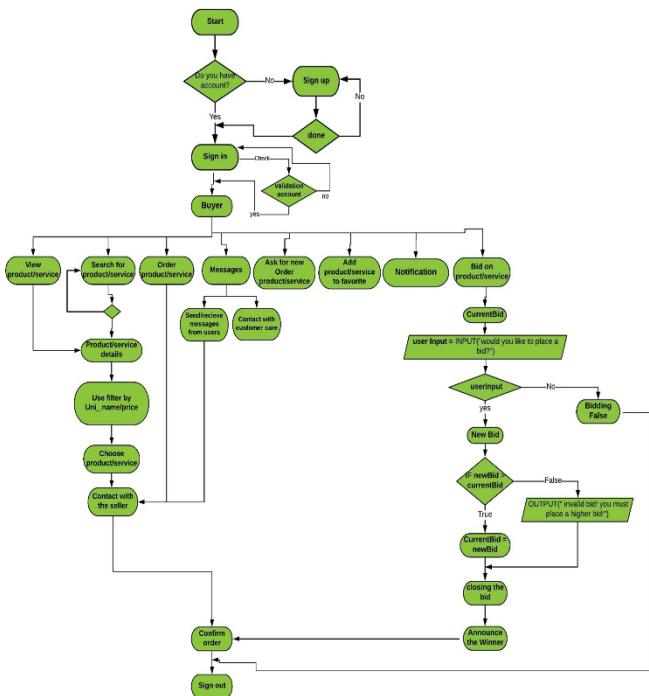


Fig. 4. A Flow Chart of a Mobile Bidding Buyer.

We separated the concept discovery and product development tasks, as recommended by Brhel et al., [45], by carrying out an up-front analysis. The online survey helped us conceptualize the design models, such as, the use case and flow chart diagrams, of the main stakeholders of our mobile auction system. For the sake of brevity, we include only two exemplary UML diagrams derived from the user suggestions (as depicted in Fig. 3 and Fig. 4). Fig. 3 shows the use case diagram of the seller. Fig. 4 shows the flow chart of the bidder.

### B. Low-Fidelity Prototypes of the Mobile Auction App

Next, we applied the second principle of effective UCASD, stipulating to design and develop the mobile app using iterative and incremental software activities. To this end, we created early prototypes of the intended mobile auction application. Low-fidelity prototyping is the process of converting product concepts and visions into simple visual representations using pen and paper [50]. The tangible benefits are well-known, ranging from cost-effectiveness, ability to inflict quick changes, and validation of requirements [51]. In this phase, we created eight low-fidelity screens to showcase the most prominent functionalities and requirements of mobile bidding, as depicted in Fig. 5. These functionalities and features were extracted from the results of an online survey study.

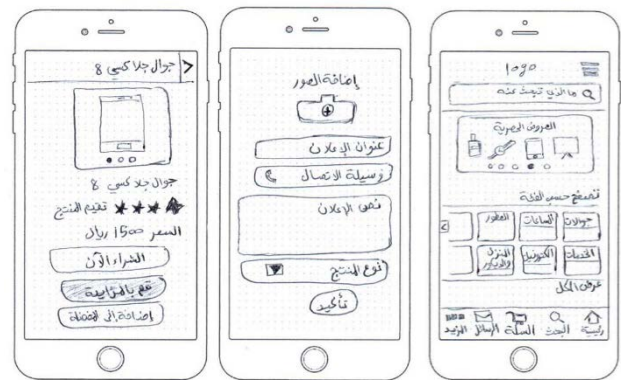


Fig. 5. Early Prototypes of the Mobile Auction Concepts and App.

### C. Mobile Auction Creation through Focus Group

Subsequently, we conducted three separate focus groups, including a total of 10 participants, to reflect on the mobile bidding requirements and early prototypes (depicted in Fig. 5). In each focus group, we mixed participants from different backgrounds and specialties to diversify the views and enrich the discussion. Focus groups are well-known methods for generating in-depth views and insights about the users' feelings and opinions about a particular technology [52].

However, to achieve the highest level of engagement and communication with our participants, we created high-fidelity interactive artifacts, as shown in Fig. 6. This empowered us to realize principles three, four, and five of Brhel et al. [45]. As we kept continuously collecting feedback from the participants, we augmented our mobile bidding platform with new requirements. High-fidelity prototypes are interactive visuals that exhibit various real functionalities, such as navigation and information architecture, of the software at hand [53].

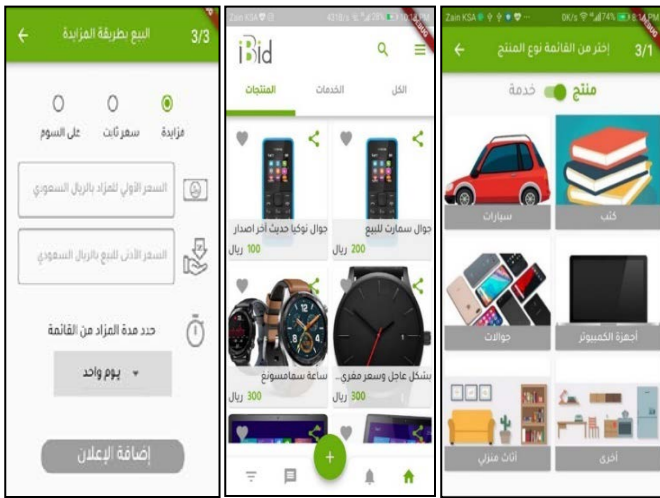


Fig. 6. High-Fidelity Prototypes of the Mobile Bidding Concepts and App.

We applied consistent procedures in each focus group, where we first presented the idea of mobile auctions to the participants, followed by a discussion about their general impressions. Next, we presented the high-fidelity prototypes and tested various interactive functionalities to capture feedback from the participants. The results helped us hone the requirements and user interface designs of the iBid app. Overall, the focus groups gave rise to 33 new requirements, spanning the following concepts:

- RQ7. Social media sharing of products and services.
- RQ8. Consideration for culture-specific information, such as the gender.
- RQ9. Diverse payment methods, including E-payment systems.
- RQ10. Clarify of terms and conditions of auctions.
- RQ11. Measures to add trust factors, such as sellers' history and ratings.
- RQ 12. Preview products before committing to the auction.
- RQ13. Availability of a dispute process in case of auction frauds or complaints.
- RQ14. Logistic services to support the buying process (e.g., packaging and shipping).

**D. Mobile Auction Implementation Decisions**

Since we aimed to explore and promote online auctions using mobile devices, we first decided to create a mobile-friendly and cross-platform app. We selected robust and well-supported mobile development frameworks to expedite the implementation process. Moreover, our mobile bidding architecture implemented the three-tier client-server architecture [54], namely the presentation layer, business layer, and data management layer. E-bidders issue requests and events on the mobile interface, representing the presentation layer. The business logic layer is responsible for managing and executing the business processes and functionalities of the

bidding system. The data management layer handles product inventory, auctions, user profiles, and so on.

We used the Flutter framework [55] to develop the user interfaces of the aforementioned mobile bidding app (i.e., the presentation layer). Flutter is an open-source UI framework for creating high-performant native interfaces for Android and iOS applications. It offers plenty of ready-made and customizable widgets enabling fast development and production. Moreover, we used Google Firebase [56] to implement the business logic and database layers to achieve the architecture depicted in Fig. 7. There are several qualifying reasons for choosing Firebase. Firebase is a back-end-as-a-service web and mobile development framework, offering a wide range of functionalities, such as user authentication, real-time database, cloud storage, cloud functions and messaging, and ready-to-use API/HTTP requests, API/Authentication, among others.

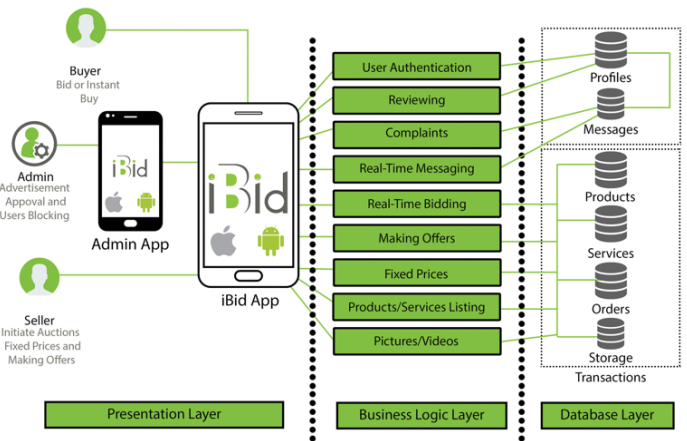


Fig. 7. A Three Tier Architecture of our Mobile Auction App.

For the Database layer, NoSQL database [57] was preferred to store information about user profiles, messages, products and services, and orders and make them accessible through native mobile SDKs. The entities of these data were implemented in the Cloud Firestore Database, which empowers the creation of document databases that are stored as nested JSON objects. This choice was motivated by the fact that data are updated and synchronized in real-time to the devices of millions of connected clients, thus achieving the goal of real-time bidding. Moreover, Cloud Firestore Realtime Database enables scalability easily, which is critical to growing the concept of mobile bidding. Data are organized in the form of collections, where each collection contains a set of documents that can store simple or complex hierarchical data structures. Moreover, Cloud Firestore can protect and secure access to the data using Cloud Firestore security rules and firebase authentication.

**E. Live Deployment of the Mobile Auction System**

The primary API services and infrastructure for our live mobile auction system were implemented on Firebase, as shown in Fig. 8.

- Cloud Firestore: enables the real-time storage and access of auction collections (e.g., products, orders, etc.).

- **Firestore Authentication:** enables users (auctioneers and bidders) verification through a valid email and password.
- **Cloud Storage:** enables the storage of complex media such as videos and pictures.
- **Real-time Database:** enables the storage of real-time messages between the system's auctioneers and bidders.

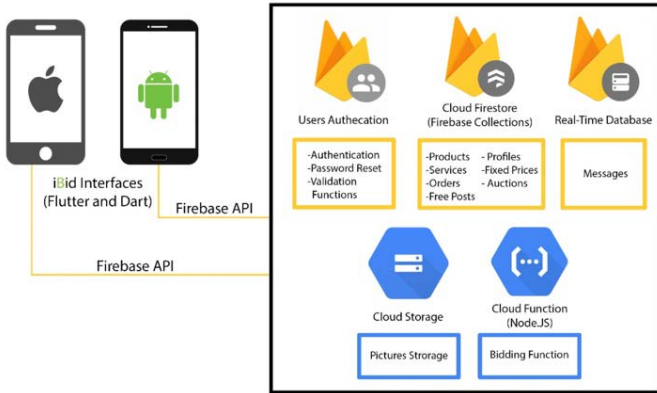


Fig. 8. The Infrastructure of our iBid Mobile Auction App.

We deployed our bidding app on Google PlayStore to gauge users' real reactions and collect market-specific requirements. Within seven days, 103 real users downloaded our auction app (see Fig. 9). Next, we communicated directly to those registered users asking for feedback and suggestions upon their actual use of the iBid app, resulting in the below requirements:

- RQ15. Emphasis on allowing cash payment
- RQ16. Filter options to find specific products/services
- RQ17. Enforce user identities using phone numbers (e.g., OTP registration)



Fig. 9. iBid App Installs during the Testing Period.

#### F. User Testing of the Mobile Auction App

In the subsequent phase of the UCASD methodology, we conducted an acceptance testing to confirm users' attitudes and perceptions toward the use of e-auctions using mobile phones. Therefore, we distributed an evaluation survey to the users who had installed and used our m-auction app. In total, 38 users responded to our survey. However, only 28 respondents

(approximately 73%) had actually used our app to bid for products and services. Therefore, we discarded the answers of the other ten users. The respondents rated the questions measuring their satisfaction with various aspects of mobile auctions. In doing so, they rated their agreement with the evaluation statements on a 5-point Likert scale, ranging from 1= strongly disagree to 5= strongly agree. In general, the rating questions assessed two main aspects; the first aspect is related to the usability of the mobile bidding app, and the second aspect is related to user acceptance and intention to continue using the app.

24 (85.71%) real users rated our mobile bidding app as 'easy to use' (4 or 5/5), while only two users disagreed (Fig. 10). 20 (71.42%) users agreed that 'learning to use iBid app is quick' (Fig. 11). On the other hand, 22 users (78.57%) disagreed that iBid app is cumbersome to use (Fig. 12).

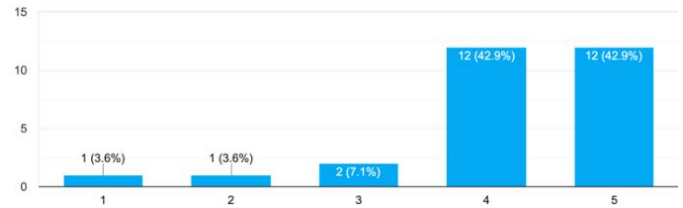


Fig. 10. Rating Distribution of: "iBid App is Easy to Use."

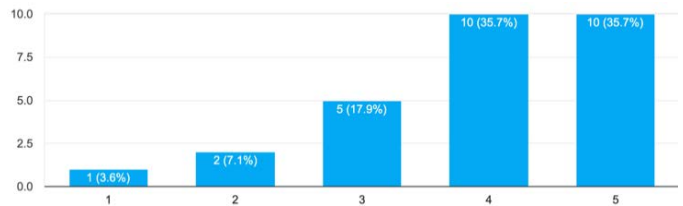


Fig. 11. Rating Distribution of: "Most Users will Learn to use iBid App Quickly."

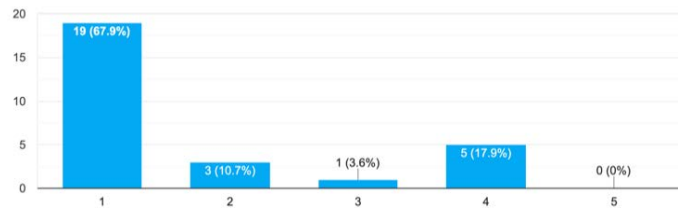


Fig. 12. Rating Distribution of: "iBid App is Cumberse to Use."

However, when it came to user intention to use mobile auctions, the ratings were quite encouraging. 19 (67.85%) users indicated their intention to use mobile bidding regularly, while only three users did not like the m-auction concept (Fig. 13). 18 (64.28%) users planned to reuse mobile auctions in the near future; however, five users did not show interest in auctioning again (Fig. 14). Approximately 20% of the respondents were neutral about the future use of m-auctions.

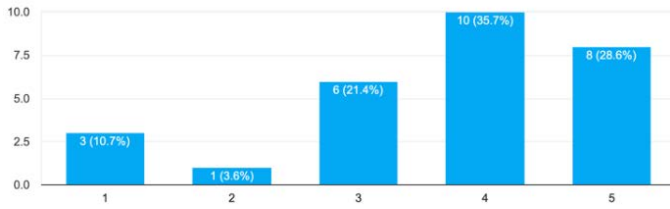


Fig. 13. Rating Distribution of: "I Intend to Use Mobile Auctions Regularly."

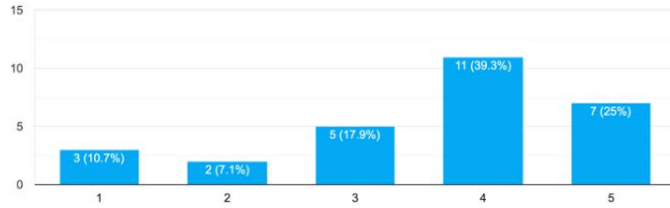


Fig. 14. Rating Distribution of: "I Plan to Reuse Mobile Auctions in the near Future."

With respect to the qualitative feedback, we received a total of 46 positive comments and 20 negative comments from our users about the mobile bidding experience. We applied inductive thematic analysis [58] to identify potential m-auctions enabling drivers and deterrents. The emerging themes emphasized the following aspects:

- RQ24. Simplicity and aesthetics of bidding app
- RQ18. Time-constrained auctions
- RQ19. Transparency in showing sellers' details
- RQ20. Variety of products and services
- RQ21. Competitive pricing of offerings
- RQ22. Support of multi-languages (Internationalization of platform)
- RQ23. Platform quality and reliability (Free of glitches and errors)
- RQ24. Quality of products descriptions
- RQ25. Authenticity and seriousness of sellers
- RQ26. Consistency between product description and product received.

### G. Card Sorting of m-Auction Requirements

In this phase, we applied card sorting to categorize the collected requirements into meaningful groups. Card sorting is a well-tested technique used in user experience research to create a structured taxonomy of concepts [59]. We applied open card sorting (i.e., with no pre-determined groups) to establish a hierarchy of factors emerging from the UCASD activities. Fig. 15 depicts the final taxonomy of m-auctions requirements.

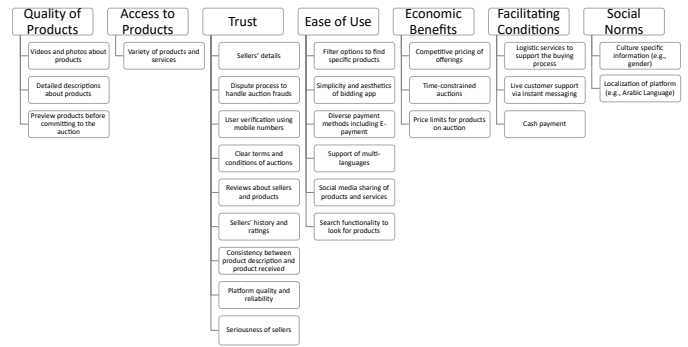


Fig. 15. Final Taxonomy of Mobile Auctions Requirements and Factors.

## V. ENABLING AND INHIBITING FACTORS OF MOBILE AUCTIONS

Following the UCASD activities, we held three consecutive focus groups to establish an in-depth understanding of the factors that may influence consumers' acceptance of online mobile bidding in Saudi Arabia.

### A. Focus Groups as a Means of Theory Formation

Qualitative research is adopted to develop theoretical explanations [60] that underpin users' attitudes toward mobile auctions. Focus groups are chosen as the method of exploration since they enable focused discussions with the selected participants on a particular topic [61], [62]. We organized three focus groups consecutively, where the outputs of one focus group were used to motivate the discussions of the next focus group. Overall, 22 undergraduate students participated in our focus groups (7, 8, and 7, respectively), with each focus group lasting approximately one hour and a half.

The focus groups' discussions were fully transcribed, and the data was anonymized and analyzed using thematic analysis. 156 high-level codes emerged, distributed across 28 major themes, as depicted in Table II. The comments are divided into enabling and inhibiting m-auction factors.

TABLE II. STATISTICS OF THE HIGH-LEVEL CODES AND THEMES EMERGING FROM THE FOCUS GROUPS

	Enabling	Inhibiting
High Level Codes	81	75
Themes	14	14

The below sub-sections summarize the classification of the key positive and negative factors that may impact the acceptance of mobile bidding by e-shoppers in Saudi Arabia.

### B. Enablers of Mobile Auctions

The focus groups participants gave a total of 81 positive perceptions and 75 negative perceptions. These perceptions were classified into 13 critical factors: risk, quality of products, trust, ubiquity, usefulness, access to valuable products, ease of use, age, social influence, monetary costs, enjoyment, past experience, and facilitating conditions. Table III summarizes the key factors, themes, and occurrence percentage of each theme.



TABLE III. THE PROMINENT FACTORS PERCEIVED TO INFLUENCE THE USE OF MOBILE AUCTIONS; PERCENTAGE OF POSITIVE (+) AND NEGATIVE (-) COMMENTS

Factor (%)	Themes	Positive (%)	Negative (%)
Risk (15.38%)	(-) Non-seriousness of bidders	-----	18.67%
	(-) Bid rigging and underpricing products and services	-----	5.33%
	(-) Non-eagerness of sellers	-----	6.67%
	(-) Monopolistic markets	-----	1.33%
Quality of Products (13.46%)	(+) Guarantees about products quality	6.17%	12%
	(-) Uncertainty about products quality		
	(+) Clear Information about products	8.64%	-----
Trust (12.82%)	(+)(-) Trust of the platform and sellers	17.39%	5.33%
	(+) Sense of being secure using online transactional platforms	2.47%	-----
Ubiquity (12.18%)	(+) No geographic restrictions	12.36%	-----
	(+) Availability of auctions any time	3.70%	8%
	(-) Auctions are restricted to specified time windows		
Usefulness (9.62%)	(+) Functional benefits	11.07%	-----
	(+) Economic benefits	7.41%	-----
Access to Products (8.33%)	(+) Access to valuable products	12.28%	4%
	(-) Unavailability of products		
Ease of Use (7.69%)	(-) Technical issues	-----	8%
	(+) Easiness of communication	3.70%	-----
	(+) Easiness of bidding	3.70%	-----
Moderating factors (6.41%)	(-) Age	-----	10.67
	(+) Past experience using e-commerce platforms	2.47%	-----
Social Influence (5.13%)	(-) Community readiness and awareness	-----	8%
	(+) Marketing and advertisement	2.47%	-----
Monetary costs (5.13%)	(-) High prices	-----	8%
	(-) Platform commissions and charges	-----	2.67%
Enjoyment (3.21%)	(+) Experience of mobile auction	4.94%	-----
	(+) Excitement	1.23%	-----
Facilitating Conditions (0.64%)	(-) Slow delivery of products	-----	1.33%

Risk (15.38%): potential risk was perceived as the major concern during the use of mobile auctions by our participants. The fears were centered on the non-seriousness of auctioneers and bidders when committing to selling and buying decisions, bid rigging when merchandises are over-valued or under-valued by the platform users, and the monopolization of markets regarding specific products (see Table IV).

Quality of products (13.46%): participants indicated that the quality of products available in the auctions would highly influence their attitudes towards mobile bidding. The factors that determine their judgment include the availability of clear information about products (8.64%) and the guaranteed quality of the products (6.17%). However, concerns about the products' quality could be a major deterrent to indulging in bidding (12%), as shown in Table V.

Trust (12.82%): trust came out as the third important m-auction factor that our participants discussed. The high-level themes included trust of the auction platform and sellers

(22.61%) and the feeling of being secure using online systems because of the Corona pandemic (2.47%); see examples in Table VI.

TABLE IV. EXAMPLES OF PARTICIPANTS' EXCERPTS ABOUT THE RISK FACTOR

Risk Themes (Frequency in Percent)	Evidence
(-) Non-seriousness of bidders (18.67%)	(-) Participant 2, Focus Group 3 " It is difficult to prevent interferences from bid/product owners." (-) Participant 3, Focus Group 2 " Many people don't participate on some mobile bidding websites because is impossible to enter a bid which goes with higher and higher prices so you might suspect that bidders are same people as sellers."
(-) Non-eagerness of sellers (6.67%)	(-) Participant 4, Focus Group 3 " The owner of the item cancels the sale." (-) Participant 2, Focus Group 2 " The seller's lack of seriousness by displaying pictures of the fake item, and when the sale is done, he does not send the item to you"
(-) Auction rigging and underpricing products and services (5.33%)	(-) Participant 3, Focus Group 3 " I guess bidder might don't give the product its fair price." (-) Participant 1, Focus Group 1 " Undervalued of goods that means you bid and give a lower price gives the commodity its value"
(-) Monopolistic markets (1.33%)	(-) Participant 6, Focus Group 1 " Actually, some applications provide a monopolized auctions on certain products." (-) Participant 2, Focus Group 3 " Some buyers buy all the quantity so once the bidding is over, they sell it at double its price"

TABLE V. EXAMPLES OF PARTICIPANTS' EXCERPTS ABOUT THE PRODUCTS QUALITY FACTOR

Quality of Products Themes (Frequency in Percent)	Evidence
(+) Clear information about the products (8.64%)	(+) Participant 2, Focus Group 1 " A bidder can search on the Internet for the items that he is bidding on to learn more details about them on the web, where the person has a wide field to search for what is bidding on." (+) Participant 2, Focus Group 3 " Mobile bidding should provide a live show feature so that the seller can display his products clearly"
(-) Uncertainty about products quality (12%)	(-) Participant 5, Focus Group 3 " If I bid on a product, and once I got the product it appeared that it wasn't the same product, I mean it came out of with different specifications. How do I get my rights back? A solution to this point must be (product return guarantee)" (-) Participant 1, Focus Group 1 " If you are bidding on artifacts and goods, you don't know its exact specifications. It's best to inspect it personally so I feel there is less guarantee than the traditional bidding."
(+) Guarantees about products quality (6.17%)	(+) Participant 1, Focus Group 1 " Mobile bidding can provide a solution to this point (i.e., product return and guarantee); this will be the supporting factors to use the auction app." (+) Participant 4, Focus Group 3 " Sellers can also provide a warranty if the product, for example, has a defect. The whole process will be safe."

TABLE VI. EXAMPLES OF PARTICIPANTS' EXCERPTS ABOUT THE TRUST FACTOR

Trust Themes (Frequency)	Evidence
(+) Trust of the bidding platform and auctioneers (22.61%)	(+) Participant 6, Focus Group 3 " Through mobile auctions, you can register the seller's name so if you are confident in them, you can visit their shops and buy from them." (+) Participant 1, Focus Group 1 " I expect that a trusted party that can see the product and inspect what its defects are, and present it to us." (-) Participant 6, Focus Group 3 " Because what is happening now is that there are many biddings mobile applications that you feel it's kind of a fraud and manipulation." (-) Participant 1, Focus Group 1 "Online auction sites sometimes contain scam sellers"
(+) Feeling of being secure (2.47%)	(+) Participant 2, Focus Group 1 " If you want to spread the culture of electronic bidding, this is the best time. This is the right time, especially after the Corona pandemic people will feel secure right now." (+) Participant 6, Focus Group 1 " It will succeed especially after the current crisis in Corona, people feel more secure delaying with online transactions, there is no longer this freedom of movement"

Ubiquity (12.18%): participants' views were appreciative concerning the time and location freedom auctioneers, and bidders enjoy while using mobile auctions. The critical themes under ubiquity were no geographic barriers (12.36%) and availability of bidding all the time (3.7%). However, participants were worried about the timed auctions (8%), which could only make commodities available for certain time frames (see Table VII). In other words, mobile auctions must be available 'anytime from anywhere'.

TABLE VII. EXAMPLES OF PARTICIPANTS' EXCERPTS ABOUT THE UBIQUITY FACTOR

Ubiquity Themes (Frequency in Percent)	Evidence
(+) No geographic restrictions (12.36%)	(+) Participant 4, Focus Group 3: " It is great there is no compulsion about the geographic location; a person in one country can bid in an auction in another country, as it is considered as facilitating the bidding process. "
(-) Limited to specific times (8%)	(-) Participant 5, Focus Group 3 " I think mobile bidding is almost limited at a certain time, so it is not flexible like the traditional bidding." (-) Participant 1, Focus Group 1 " The time difference might be a problem imagine if the commodity is offered in faraway country, and you are bidding on it in your country."
(+) Availability of auctions any time (3.7%)	(+) Participant 2, Focus Group 1: "Facilitates meeting of buyers and sellers, it is possible to save time and effort, for seller and buyer there are no time obstacles." (+) Participant 1, Focus Group 1: " The auctions should be long and continuous. It does not stop, that means it should be available 24 hours."

Usefulness (9.62%): our participants emphasized that indulging in mobile auctions is motivated by two benefits: functional and economical. Examples of functional gains include convenience and saving time and effort. However, economic gains often refer to cost savings through bidding

activities. References were made mainly to the competitive pricing strategies that auctioneers set to win new bidders for their goods and services. See participants' comments in Table VIII.

TABLE VIII. EXAMPLES OF PARTICIPANTS' EXCERPTS ABOUT THE USEFULNESS FACTOR

Usefulness Themes (Frequency in Percent)	Evidence
(+) Functional benefits (11.07%)	(+) Participant 2, Focus Group 1 " You can do the bidding while you are relaxed at your home." (+) Participant 1, Focus Group 1 " Mobile bidding is a fascinating idea to bid on products and save your time and effort"
(+) Economic benefits (7.41%)	(+) Participant 7, Focus Group 3 " With mobile bidding you can buy the goods you want. For example, a specific device, you can get it used for a cheaper price." (+) Participant 6, Focus Group 3 " You also can find special prices I mean like special offers."

Access to products (9.88%): participants highlighted that m-auctions would enjoy a wider acceptance if they were to provide access to unique and rare merchandise, as demonstrated in Table IX. However, they should also act as a marketplace for other regular products (4%).

TABLE IX. EXAMPLES OF PARTICIPANTS' EXCERPTS ABOUT ACCESS TO PRODUCTS FACTOR

Access to Products Themes (Frequency in Percent)	Evidence
(+) Access to valuable products (9.88%)	(+) Participant 4, Focus Group 2 " If you want to buy from online mobile auctions, you must find a rare product or something special you need that is not available in the market." (+) Participant 5, Focus Group 1 " There is a possibility of finding a competition, but it will be for certain rare products."
(-) Unavailability of Products (4%)	(-) Participant 3, Focus Group 3 " There is no bidding mobile application that provides you with all the products that you may need it."

Ease of use (7.69%): 'ease of use' fared into the middle of the table with respect to frequency of occurrence, but it was still perceived to impact intentions to use m-auctions. The themes of ease of use included ease of communication (3.7%) and simplicity of the bidding process (3.7%). Moreover, the platform should have no technical failures and glitches (8%). In other words, the auction platform should be technically sound and reliable, as shown in Table X.

Control factors (6.41%): first, participants were quite doubtful that mobile auctions are suitable for the aging population (10.67%); second, there were indications that prior experience using e-commerce and transactional platforms would encourage users to place bids (2.47%), as listed in Table XI.

Social influence (5.13%): social influence, in the form of marketing, was expected to have a mass effect on the adoption of mobile bidding positively. As demonstrated in Table XII, there is an absolute necessity to improve awareness to ensure that society is ready to accept the concept (8%).

TABLE X. EXAMPLES OF PARTICIPANTS' EXCERPTS ABOUT THE EASE OF USE FACTOR

Ease of Use Themes (Frequency in Percent)	Evidence
(-) Technical issues (8%)	(-) Participant 6, Focus Group 3 " Technical reasons, because the site might be out of service and the product bidding available only for a short time." (-) Participant 4, Focus Group 2 " There might be some problems with the mobile application which prevent some users from bidding in a timely manner"
(+) Easiness of communication (3.7%)	(+) Participant 1, Focus Group 3 " Of course, there will be a certain number of sellers and buyers. The buyer can browse hundreds of items at the same time and communicate with their sellers through the app." (+) Participant 3, Focus Group 1 " the platform will provide easy communication between the seller and buyer"
(+) Easiness of bidding (3.7%)	(+) Participant 6, Focus Group 2 " I tried an online bidding auction, I found it ease without any difficulties." (+) Participant 2, Focus Group 13" The mobile bidding application must have a button to go back and unbid if I have done a mistaken bidding"

TABLE XI. EXAMPLES OF PARTICIPANTS' EXCERPTS ABOUT THE AGE AND PAST EXPERIENCE FACTORS

Themes (Frequency in Percent)	Evidence
Age (10.67%)	(-) Participant 2, Focus Group 3 "Older people do not prefer to use mobile bidding. Older people prefer to go by themselves to the site and see the product for themselves." (-) Participant 5, Focus Group 2 " The elderly are very important part of our communities. How you can communicate with the elderly when they do not have a broad background in technology:"
(+) Past Experience (2.47%)	(+) Participant 2, Focus Group 1 "I can say that this is the right time, 85 percent of population have a background in electronic auctions." (+) Participant 3, Focus Group 1 "These days most people are using electronic ways of selling and buying"

TABLE XII. EXAMPLES OF PARTICIPANTS' EXCERPTS ABOUT THE SOCIAL INFLUENCE FACTOR

Social Influence Themes (Frequency in Percent)	Evidence
(-) Community readiness and awareness (8%)	(-) Participant 6, Focus Group 3 "I guess people here in Saudi Arabia are not comfortable with mobile bidding, so we need to raise awareness about the concept of electronic bidding in general." (-) Participant 4, Focus Group 1 "Some communities don't have experience in electronic bidding. Individuals must be educated so they understand the electronic bidding process"
(+) Marketing and advertisement (2.47%)	(+) Participant 7, Focus Group 3 " It is necessary to intensify the advertisement about m-auctions in the targeted areas." (+) Participant 2, Focus Group 2 " The platform for mobile bidding must be free and offer gifts; Also, advertisement must be extensive about the concept."

Monetary costs (5.13%): concerns were raised about setting high prices in certain auctions and any platform charges, as exemplified in Table XIII.

TABLE XIII. EXAMPLES OF PARTICIPANTS' EXCERPTS ABOUT THE MONETARY COSTS FACTOR

Monetary Costs Themes (Frequency in Percent)	Evidence
(-) High Prices (8%)	(-) Participant 6, Focus Group 2 " Sometimes in an auction the seller says this product, for example, starts from 100 riyals. Many buyers say we won't participate and withdraw from the auction." (-) Participant 2, Focus Group 1 " Celebrities can use these mobile bidding and the prices go high because of them and their fans."
(-) Platform commission (2.67%)	(-) Participant 4, Focus Group 3 " The commission must be at a symbolic price." (-) Participant 5, Focus Group 1 " The owner of the product might delay or even hesitate to display their goods because the platform raises the commission price"

Enjoyment (3.21%): one interesting motif, albeit infrequent, for e-shoppers to carry out m-auction was perceived enjoyment. The themes under enjoyment included the sense of excitement and auction experiences, as shown in Table XIV.

TABLE XIV. EXAMPLES OF PARTICIPANTS' EXCERPTS ABOUT THE ENJOYMENT FACTOR

Enjoyment Themes (Frequency in Percent)	Evidence
(+) Experience of mobile auction (4.94%)	(+) Participant 2, Focus Group 1 " I want to try it after the current crisis of covid-19; there is no longer freedom of movement." (+) Participant 3, Focus Group 2 " We can go to the physical environment of such auctions; we can go to auctions and ask the bidders to see how they carry out the bidding"
(+) Excitement (1.23%)	(+) Participant 6, Focus Group 3 " I had seen this live bidding before which was on precious stones, and the situation was in which there was a competition and enthusiasm among bidders."

Facilitating conditions (0.64%): lastly the participants mentioned some comments about the logistic services supporting the after-sale activities (e.g., delivery) which could impact mobile auctions, as stated in Table XV.

TABLE XV. EXAMPLES OF PARTICIPANTS' EXCERPTS ABOUT THE FACILITATING CONDITIONS FACTOR

Facilitating Conditions Themes (Frequency in Percent)	Evidence
(-) Slow delivery of products (1.33%)	(-) Participant 6, Focus Group 3 " I believe that a slow delivery of goods will be the main challenge in using the mobile bidding application."

## VI. DISCUSSION, PRACTICAL IMPLICATIONS, AND LIMITATIONS

To the best of our knowledge, our research is the first work to quest for the enablers and deterrents of using mobile auctions in Saudi Arabia. Two reasons inspired the selection of

this topic. First, despite the recent e-commerce boom and high user penetration, the adoption of online auctions is almost non-existent in the Saudi e-commerce market. Second, the online global auction industry is expanding year-on-year, with an estimated 7.2% yearly growth [4]. As such, the findings of our studies offer a foundational comprehension of the current attitudes and practices of Saudi auctioneers and bidders.

When coupled with user-centered design, agile development of software helps achieve numerous benefits [45] [63] In our case, the adoption of the User-Centered Agile Software Development (UCASD) empowered us to build a user-driven mobile application through a series of quick improvement cycles. The emerging design features were gathered from potential users (i.e., user-centered philosophy) and added to the m-auction platform in an incremental fashion (i.e., agile practices), thus reducing user frustration and improving customer traction. We demonstrate the procedures we followed and the lessons from applying UCASD. We were able to develop a user-validated m-auction platform since our design decisions were mainly based on user research. To this end, our focus was not to develop a feature-rich application but rather to create an excellent user experience by keeping our users at the center of the design and development activities. On another positive aspect, the short design iterations enabled us to tackle the tangible issues early, identify new relevant requirements, and quickly produce a functional mobile application to gauge users' attitudes toward mobile auctions. Another strong aspect of our research is the delivery and deployment of mobile bidding in the real world, where real bidders used the mobile platform and provided valuable feedback.

The use of UCASD, albeit beneficial in multiple ways [64], has caused us several challenges. We enumerate and suggest ways to remedy these challenges. The first challenge we faced was to fit usability studies, which typically take a long time, within quick development cycles. The second challenge was to accommodate some of the conflicting principles of UCD and agile development (e.g., up-front user research in UCD vs. reduction of up-front planning to produce working software in agile quickly). We found that building flexible team compositions, containing the necessary design, development, and testing skills, helped to minimize this challenge. We devised a cross-functional team to work on different tasks and processes, with the possibility of re-location if required. Using an online survey enabled us to reach a vast number of users within a short time, thus reducing up-front planning activities. We also found that considering user experience from the start of the project helps incorporate user views. Moreover, we had to adapt the complexity of our user-centered design activities to accommodate the agile sprints. In this sense, we shortened the usability studies and conducted them with fewer participants. We also employed low-fidelity prototyping to engage our users in a cost-effective manner. Finally, we found that planning our reasonably timed sprints (4/5 weeks) to embed design, implementation, and usability testing activities quite fruitful.

Now let us attempt to answer the main question of our research; why does Saudi Arabia, despite its recent major digital transformations, still lags regarding the use of online mobile auctions? The acceptance of new technologies is well-

known to be triggered by the existence and amalgamation of several factors [65][66]. Our research is no exception. The qualitative inspection of a new phenomenon (e.g., the use of emerging technologies) is advocated by several studies [67][68]. Applying an inductive approach in our research, 13 distinct factors emerged as the key determinants of mobile bidding activities in Saudi Arabia (see Fig. 16).

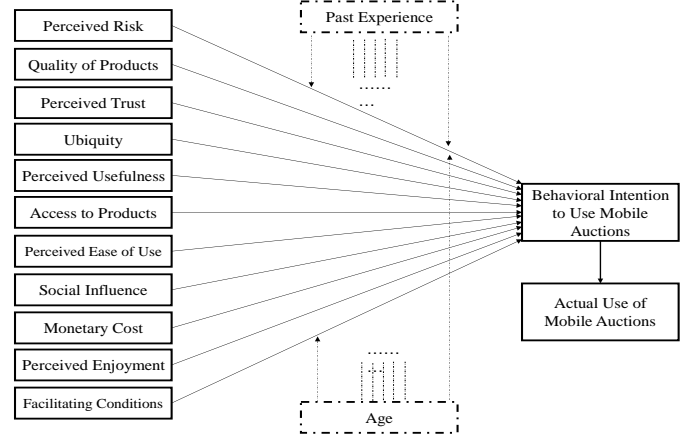


Fig. 16. Preliminary Online Mobile Auctions Technology Acceptance Model. Dashed Rectangles Represent the Moderating Factors, Which Influence all other Factors (Listed on Left Hand Side).

Perceived risk and trust were the dominant m-auction themes from our qualitative inspection, accounting for nearly a third (28.2%) of the concerns. Bidders were particularly worried about the genuineness of sellers, potential frauds, and auction rigging during the live mobile auctions, among other fears. Our findings are in line with the previous claims. For instance, Xu et al., demonstrated that perceived risk impacts the buyer's intentions to participate and engage in online consumer-to-consumer buy-it-now auctions [69]. Perceived risk, in return, was influenced by the buyer's risk attitude, the seller online reputation, and the product's price and type. Gull et al. showed that online shoppers are still concerned about their security in Saudi Arabia [70]. A recent laboratory study demonstrated that shill bidding remains a serious threat in mobile auction platforms [71].

The quality of products was the second most important factor to our participants in the bidding decision-making process. According to our bidders, products' quality is determined by clear information and specifications that reduce any uncertainties about the business deal. In a recent study, the authors investigated the behavior of bidders in mystery auctions where products' information was purposefully concealed [72]. The results showed that if information about the products' quality has not been provided, the seller's reputation will be greatly influenced. Moreover, when products' quality is unclear, reputation becomes more influential on the trustworthiness of the auctioneers.

Ubiquity refers to the property of being available anytime and anywhere. This is probably a natural factor to emerge as smartphones are characterized by their availability and mobility. Participants valued the possibility of making bids without geographic or time restrictions. Previous works back our findings [73], where ubiquity was found to be a significant

predictor of attitudes toward mobile payment services in Korea.

Perceived usefulness, represented by functional and economic gains, stood out as an influential factor in making online mobile bids. This is no surprise since usefulness has been a foundational construct in almost all types of technology acceptance models [74][75].

Similarly, when Vadovič explored Internet bidding behavior using dynamic auction settings, results showed that bidders with presumably higher search costs tend to offer a higher bid to secure the product [76]. In other words, bidders who are allowed to search for prices during the bidding process from other e-commerce websites are more likely to submit higher bids since they can assure of economic gains.

Interestingly, age and prior experience were discussed in our research to impact consumers' intention to conduct mobile bidding. Other e-commerce studies also found demographic characteristics (i.e., age) to have a moderating effect on technology acceptance [77][78]. However, Hernández et al., found that socioeconomic variables, such as age, gender, and income, do not alter e-commerce shopping intentions in developed countries [79]. Such observations are worth investigating in follow-up studies. Other constructs that arose in our studies include ease of using the mobile bidding platform, social influence, monetary costs, and enjoyment of m-auction activities. Once again, these factors are supported by several studies [80][81][82].

The implications of our results are both theoretical and practical. Theoretically, we developed a solid understanding of the factors that could encourage or inhibit the adoption of mobile auctions in Saudi Arabia. Our evidence-based factors, which were identified through several studies, represent the cornerstone for creating a technology acceptance model for live mobile auctions. The demonstration of applying the user-centered agile development will serve as a roadmap for practitioners and startup companies. Practically, we accumulated a set of m-auction requirements for e-commerce companies that might be interested in embedding bidding processes into their mobile platforms.

Our findings are indeed interesting and, we hope, will pave the way for further research about mobile auctions in developing countries. However, we would like to highlight a few limitations in this research that could restrict the validity of our observations, as follows.

The use of qualitative research empowered us to investigate consumers' behavior and probe their opinions and decision-making in detail; however, our interpretation of the themes and factors impacting mobile auctions might have been influenced by our subjective views. To reduce this bias, we checked the data analysis and themes' classification multiple times by four researchers to ensure the inter-rater reliability and accuracy of our analysis. However, there is also a likelihood that we might have missed some factors or misclassified some comments. Moreover, this type of research does not empower us to draw any causal relationships between the potential factors of m-auctions. More studies need to be conducted to verify any hypothesized relationships.

We used convenience sampling [83] to recruit participants in our user-centered design activities. This type of non-probabilistic sampling technique is subjective and, therefore, may not be representative of the intended population. It is, however, an effective approach when the research is restricted with respect to time and resources. Most of our participants were students, aged between 18 and 30 years, with a good technical background. Our sample lacked representative of elderly users. Moreover, our target group might have different characteristics, views, and behavior. We studied the e-shoppers' reactions to m-auctions in Saudi Arabia. Thus, our findings should be cautiously generalized to other user groups and MENA countries.

## VII. CONCLUDING REMARKS AND FUTURE WORKS

We demonstrated the effectiveness of developing an interactive mobile auction platform through the application of a multi-phased User-Centered Agile Software Development (UCADS) methodology. 454 potential users participated in our mixed research studies, including an online survey, focus groups, prototyping, and user testing. Consequently, a taxonomy of the key mobile bidding requirements is presented. Integrating user-centered design and agile development principles showed that Saudi e-shoppers are ready to embrace mobile bidding activities. However, our follow-up qualitative studies identified 13 prominent factors that might impact consumers' intention to accept mobile auctions in Saudi Arabia. These enabling factors include trust, risk, usefulness, ubiquity, monetary costs, ease of use, merchandise information quality, access to valuable merchandise, enjoyment, social influence, facilitating conditions, age, and past experience. We recommend that these factors merit a profound investigation in upcoming confirmatory studies.

In the future, we plan to propose and test a mobile auction technology acceptance model for the MENA region. Our factors, coupled with evidence from current e-auction research works, will assist in establishing sound mobile auction hypotheses. Moreover, we intend to conduct a cross-sectional study to ensure the validity of the model in other developing countries that currently exhibit similar characteristics (e.g., Emirates, Malaysia, etc.).

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