

2018-11

# Mobile wallet inhibitors: Developing a comprehensive theory using an integrated model

Sharma, SK

<http://hdl.handle.net/10026.1/12405>

---

10.1016/j.jretconser.2018.08.008

Journal of Retailing and Consumer Services

Elsevier

---

*All content in PEARL is protected by copyright law. Author manuscripts are made available in accordance with publisher policies. Please cite only the published version using the details provided on the item record or document. In the absence of an open licence (e.g. Creative Commons), permissions for further reuse of content should be sought from the publisher or author.*

## Manuscript Details

<b>Manuscript number</b>	JJRC_2018_474_R1
<b>Title</b>	Mobile wallet inhibitors: developing a comprehensive theory using an integrated model
<b>Article type</b>	Full Length Article

### Abstract

The concept of the mobile wallet is increasingly adopted in developed and developing countries for improving the scale, productivity, and excellence of banking services. Oman is one of the most growing countries of the Middle Eastern economies. Acceptance of mobile wallets in Oman is being hindered by various inhibitors. There is no study in the Middle Eastern countries that addressed the concerns of probable inhibitors influencing mobile wallet acceptance from expert's perspective. In this study, eleven key inhibitors to mobile wallet adoption are identified from the literature and expert's feedback. This study employed Interpretive Structural Modelling (ISM) in conjunction with fuzzy MICMAC to reveal the intricate relationship among inhibitors to mobile wallet acceptance. To the end, an integrated hierarchical model is developed to understand the influence of a particular inhibitor on others. 'Anxiety towards new technology', 'Lack of new technology skills', 'Lack of awareness of mobile wallet benefits' and 'Complexity of new technology' have been reported as key inhibitors to promote mobile wallets in Oman. This study also suggests several recommendations for banking organizations and policymakers in developing the effective model to popularize mobile wallets in Oman.

<b>Keywords</b>	Mobile Wallets; Inhibitors,; Gulf Cooperation Council; ISM; Fuzzy MICMAC; Integrated model
<b>Corresponding Author</b>	Sujeet Kumar Sharma
<b>Order of Authors</b>	Sujeet Kumar Sharma, Sachin K Mangla, Sunil Luthra, Zahran Al-Salti
<b>Suggested reviewers</b>	Dinesh Sharma, Sanjay Tyagi

## Submission Files Included in this PDF

### File Name [File Type]

Response Sheet JRCS 30.07.2018.docx [Response to Reviewers (without Author Details)]

Title page.docx [Title Page (with Author Details)]

Final version Mobile Wallet Paper.docx [Manuscript (without Author Details)]

To view all the submission files, including those not included in the PDF, click on the manuscript title on your EVISE Homepage, then click 'Download zip file'.

## Research Data Related to this Submission

There are no linked research data sets for this submission. The following reason is given:  
Data will be made available on request

## **Response Sheet**

**Title:** Mobile wallet inhibitors: developing a comprehensive theory using interpretive structural modelling and fuzzy MICMAC analysis

**Journal:** Journal of Retailing and Consumer Services

**Submission ID:** JJRC\_2018\_474

*Dear Editor,*

*Journal of Retailing and Consumer Services*

At the outset, we would like to thank you for the opportunity to resubmit our manuscript. We have done our level best to understand, analyse and respond to each of suggestions/comments by the reviewer(s), and modified the paper accordingly. We greatly appreciate the time you have taken to provide the feedback on this manuscript. As, you will find, the revised manuscript incorporates the desired changes.

We have provided brief responses to reviewer(s) suggestions. Below, we reproduce reviewer's suggestions in plain font, with intended italics response with different colours. In the manuscript also the added material is shown in different colours.

Once again thank you for highlighting the key improvement/changes needed to give us a clear direction. We are looking forward to hearing from you with high spirit.

Yours sincerely,

Dr. Sujeet Kumar Sharma

## Comments from The Editors and Reviewers

### **Reviewer #1:**

This paper attempts to identify and develop a hierarchical model to understand eleven key inhibitors to mobile wallets adoption on the basis expert's feedback. Further, this paper employed an innovative research methodology namely Interpretive Structural Modelling (ISM) in conjunction with fuzzy MICMAC to reveal the intricate obstructions to mobile wallet acceptance. Overall this paper is well written and includes all appropriate sections required for a good journal article. I would recommend the authors to make amendments and updates in the following areas for the paper to be improved to the high standard of this journal:

1. Title of the article is slightly longer; it is suggested to shorten it.

**Response –** Thank you very much for valuable suggestion. Title has been revised as per your valuable feedback. The revised title is: *“Mobile wallet inhibitors: developing a comprehensive theory using an integrated model”*

2. Introduction is well written. However, it is recommended to cite some latest articles, it will add value to the paper.

**Response –** Thank you very much for your encouragement and support. We totally agree with you on this point. Some recent references from ‘Journal of Retailing and Consumer Services’ and other relevant journals have been cited in the Introduction section.

The mobile wallet is a comparatively novel area of investigation, relatively less investigated when compared to similar domains namely, e-commerce, m-commerce or phone banking, where investigation has been made extensively (Oliveira et al. 2016). Mobile payment is a relatively recent innovation in its early stages of development and growth, yet they are widely extended in our society (Dahlberg et al. 2015; Liébana-Cabanillas et al. 2017). Shaw (2014) reported that mobile wallet technology is growing, but has not yet been significantly exploited by retailers or consumers due to the existence of multiple inhibitors.

In recent years, the technologies are on the higher priorities in Gulf Cooperation Council (GCC) countries. In Oman, as there is a massive increase in the mobile users, but transactions using mobile devices are still very limited. A thorough understanding of inhibitors to the acceptance of mobile wallets in Oman is thus needed to develop mobile payment services efficiently. The rise of mobile banking may be seen as an innovative method of doing business in the Arab

region, and so far, limited research has been undertaken on actual users from this region (Ramadan & Aita 2018). There is no study in the Middle Eastern countries that addressed the concerns of key inhibitors influencing mobile wallet acceptance from the user's perspective. The key research question to be addressed in the present study is "what are the key inhibitors that influence the decision of using a mobile wallet by users".

3. In section 2.1 Mobile wallet concept and related models, arguments provided by authors are not enough. It is recommended to enrich this section.

**Response** – We really appreciate your valuable feedback. Section 2.1 has been thoroughly revised and enriched by with stronger arguments and very specific references.

Researchers have adopted a number of models like Diffusion of innovation (DOI) theory (Rogers 1995; Zhao & de Pablos 2011), Theory of Reasoned Action model (Ajzen and Fishbein 1988), Theory of Planned Behaviour model and TAM (Davis et al. 1989; Madden et al. 1992), TAM3 (Faqih & Jaradat 2015), Unified theory for acceptance and use of technology (UTAUT) (Venkatesh et al. 2003; Dwivedi et al. 2017) among others. However, Venkatesh et al. (2012) argued that the commonly adopted/modified TAM has a number of limitations related to acceptance of the advanced technology. Zhao & de Pablos (2011) suggested that innovation is a vital component influencing the acceptance of a new technology. Furthermore, Faqih & Jaradat (2015) investigated the implementation of mobile commerce in Jordan and developed a theoretical framework based on the TAM3. The findings suggested that 'perceived usefulness' and 'perceived ease of use' are significant elements in elucidating the users' intention to accept mobile commerce. Oliveira et al. (2016) identified the key determinants of mobile payment acceptance combining the strengths of UTAUT2 and DOI theory and found that 'Compatibility', 'perceived technology security', 'performance expectations', 'innovativeness', and 'social influence' played important role in the acceptance of mobile payment. Patil et al. (2017) conducted a literature review on digital payment adoption. They observed that majority of studies used TAM, UTAUT and their extensions to comprehend customer acceptance of mobile payment services. Janssen et al. (2017) in their study developed a model of factors linked to citizens' viewpoints towards trustworthiness in the services provided through government portals. The findings revealed that the influence of citizens' trust remains at the macro-level in the online services. This implies that there is a clear void of research available in the literature to explore and understand the intricacies of the relations

among key decision variables influences the customers' willingness towards to the new and innovative technology such as mobile wallet.

4. Section 2.2 Key inhibitors to mobile wallet acceptance is well written.

**Response** – Thank you very much for your encouragement and support.

5. Section 4 deals with survey development and data collection. It is suggested to provide more details about background of experts.

**Response** – Thank you very much for your valuable feedback. Some more details about background of experts have been provided in Section 4.

In order to collect data, 20 experts dealing with digital financial services from Oman were contacted using some references. The modes of contact with experts were the telephone, email and direct visits. There were three IS professor (of seven approached) who are teaching and doing research in the domain of e-commerce/m-commerce/mobile banking participated in the data collection process. Among 17 remaining experts, there were 5 digital financial services professionals (2 Omani and 3 expatriates) working in the banking sector and 12 mobile users. These experts had more than ten years' experience dealing with financial services and are respected in their sectors.

6. In section 4.4, the concept of transitivity is used, it is suggested to explain it in simple words for readers in business domain.

**Response** – We really appreciate your valuable feedback. As per your valuable feedback, the concept of transitivity has been explained in the simple words for readers in business domain.

It was then transformed into a final RM by considering the “transitivity rule”. Transitivity rule states if any variable E shows relation to variable F and variable F shows relation to variable G, then variable E must have relation to variable G. For example in Table 3, variable 8 is having relation with variable 1 and variable 1 is having relation with variable 10, then variable 8 and must have relation with variable 10.

7. Implications for decision makers are inadequate, it is strongly recommended to include new insights.

**Response** – We totally agree with this point. An attempt has been made to thoroughly revise Implications section to include new insights for decision makers.

### *Implications for the practice*

This section provides several noticeable implications to accept mobile wallet concepts in Oman, a leading economy in GCC countries. The findings of this research facilitate decision making in public and private organizations from the strategic point of view by providing key inputs in multiple domains where mobile users perceive that mobile wallet is directly associated with what and by providing key inputs to system analysts. In addition, the findings will provide strategic inputs to the telecommunication and financial service providers who are planning to invest their capital in the growing technology. This research will also help policymakers in banking organizations and government bodies to eradicate the problematic issues and understand benefits by adopting mobile wallet models in practice.

This is the first study focusing on the examination of inter-relationships among key inhibitors of mobile wallet acceptance in one of the prominent Gulf countries namely Oman. As the Government of Oman is investing a huge amount of money on developing e-infrastructure to provide cost-effective, convenient, customer-centric, and secure e-commerce transactions to minimize digital divide and empower Omani resident's life for better, so understanding key inhibitors provides better insights to the top management to develop appropriate strategies to overcome them. Furthermore, the integration of mobile wallet will help multiple stakeholders namely businesses, residents, expatriates and others to save time as well as money with the help of such smart and innovative technologies.

“Omanuna” is the official Oman e-Government services portal and one of its key objectives is e-payment implementation across the country. According to the findings, security, privacy, trust, and risk are key inhibitors of mobile wallet acceptance. The main concerns related to the aforementioned inhibitors are validation and concealment of online transactions. In addition, unauthorized access and third party usage of personal data provided by users are also serious concerns. Therefore, many researchers have highlighted the significance of trust in mobile transactions in general and mobile wallet in particular as mobile number as well as other personal details are shared with the merchant. Lin & Wang (2006) have validated that trust is one of the key predictors of satisfaction as well as customer loyalty in the context of mobile transactions. Government agencies need to pay more attention to developing regulations aligned with recent ICT developments, which ensures higher security and privacy and minimum risk in mobile wallet transactions. In addition, trust plays a very crucial role in the acceptance of advanced technology in the Omani society (Sharma 2017). Decision makers should give higher priority to trust building measures by minimizing errors in mobile wallet transactions such as wrong public keys, invalid Merchant Identification Number (MIN), unable

to pair, decryption failure, invalid element data, among other possible errors. Therefore, it is important for systems analysts and developers to strengthen trust among users by avoiding the aforementioned technical errors in the newly launched mobile wallet in Oman.

The findings also suggest that low awareness of the benefits of the mobile wallet in the context of Oman is another key inhibitor. Therefore, decision-makers in banking systems need to pay attention to formulate an appropriate strategy to spread awareness about the key benefits of the mobile wallet. For example, it should be regularly published through print and social media that no personal information, as well as transactional logs, are stored with the seller. In addition, the residents may be educated as to how mobile wallet can be used for online shopping, bill payments, fund transfer to family members, relatives and others as well without necessitating the need of carrying multiple cards in physical wallet. Mobile wallet subscribers can deposit and withdraw money from a bank by visiting a branch of the bank where they do not have account. Furthermore, it can also be mentioned in advertisements that the Central Bank of Oman (CBO) monitors key policies related to financial transactions in the mobile wallet. Spreading awareness in this manner will boost the confidence of customers towards the higher usage of the mobile wallet in Oman.

Finally, it was revealed that anxiety towards new technology, lack of new technology skills and complexity of new technology are also the key inhibitors to mobile wallet acceptance in Oman. The possible reason for these inhibitors among Omani residents is the lower penetration of mobile wallet. Anxiety towards new technology can be minimized by a number of ways. For example, by publishing short paragraph in local language about benefits of mobile wallet and demonstrating working of mobile wallet at public places. Lack of new technology skills and complexity of new technology are the key inhibitors to people who are not tech-savvy. Specialized and targeted programs on required skills sets and ease of operations of mobile wallet can be developed for non tech-savvy people specially in semi-urban areas of Oman. Overall, these recommendations with more innovative ways may minimize the impact of inhibitors of mobile wallet acceptance in a GCC country.

8. Check language consistency throughout the manuscript.

**Response** – Thank you very much for your valuable suggestion. Language consistency has been checked throughout the manuscript.

9. verify references

**Response** – Thank you very much for your valuable suggestion. The references have been cross checked.

10. Cite some relevant articles from JRCS.

**Response** – Thank you very much for your valuable suggestion. Some recent references from ‘Journal of Retailing and Consumer Services (JJRC)’ have been cited in the revised manuscript.

1. De Kerviler, G., Demoulin, N. T., & Zidda, P. (2016). Adoption of in-store mobile payment: Are perceived risk and convenience the only drivers?. *Journal of Retailing and Consumer Services*, 31, 334-344.
2. Faqih, K. M., & Jaradat, M. I. R. M. (2015). Assessing the moderating effect of gender differences and individualism-collectivism at individual-level on the adoption of mobile commerce technology: TAM3 perspective. *Journal of Retailing and Consumer Services*, 22, 37-52.
3. Natarajan, T., Balasubramanian, S. A., & Kasilingam, D. L. (2017). Understanding the intention to use mobile shopping applications and its influence on price sensitivity. *Journal of Retailing and Consumer Services*, 37, 8-22.
4. Shaw, N. (2014). The mediating influence of trust in the adoption of the mobile wallet. *Journal of Retailing and Consumer Services*, 21(4), 449-459.

**Reviewer #2:**

In the present work, eleven key inhibitors to mobile wallets adoption are identified from the literature and expert’s feedback. The study employs Interpretive Structural Modelling (ISM) in conjunction with fuzzy MICMAC to reveal the intricate obstructions to mobile wallet acceptance. The subject is appropriate and interesting. Though, the paper is well written, but I would recommend the authors to improve the grammatical presentation of the article. Moreover, there are few grey areas which need to be addressed before publication:

1. Title needs to be revised for reducing the number of words. Too big in the current form.

**Response:** Thank you very much for valuable suggestion. Title has been revised as per your valuable feedback. The revised title is: “*Mobile wallet inhibitors: developing a comprehensive theory using an integrated model*”.

2. Abstract should include major findings and indicate clearly the contributions of the research.

**Response** – We really appreciate your concern. Abstract have been revised to include major findings and contributions of the research.

This study employs Interpretive Structural Modelling (ISM) in conjunction with fuzzy MICMAC to reveal the intricate obstructions to mobile wallet acceptance. To the end, **an**

**integrated hierarchical model** is developed to evaluate the influence of a particular inhibitor on others. ‘Anxiety towards new technology’, ‘Lack of new technology skills’, ‘Lack of awareness of mobile wallet benefits’ and ‘Complexity of new technology’ have been reported as key inhibitors to promote mobile wallets in Oman. This study also suggests several recommendations for banking organizations and policy makers to assist in efficient implementation of mobile wallets in Oman.

3. Introduction section should clearly highlight the research questions.

**Response** – Thank you very much for your valuable feedback. In the revised version of manuscript, ‘Introduction’ section is clearly highlighting the research questions.

The mobile wallet is a comparatively novel area of investigation, relatively less investigated when compared to similar domains namely, e-commerce, m-commerce or phone banking, where investigation has been made extensively (Oliveira et al. 2016). Mobile payment is a relatively recent innovation in its early stages of development and growth, yet they are widely extended in our society (Dahlberg et al. 2015; Liébana-Cabanillas et al. 2017). Shaw (2014) reported that mobile wallet technology is growing, but has not yet been significantly exploited by retailers or consumers due to the existence of multiple inhibitors.

In recent years, the technologies are on the higher priorities in Gulf Cooperation Council (GCC) countries. In Oman, as there is a massive increase in the mobile users, but transactions using mobile devices are still very limited. A thorough understanding of inhibitors to the acceptance of mobile wallets in Oman is thus needed to develop mobile payment services efficiently. The rise of mobile banking may be seen as an innovative method of doing business in the Arab region, and so far, limited research has been undertaken on actual users from this region (Ramadan & Aita 2018). There is no study in the Middle Eastern countries that addressed the concerns of key inhibitors influencing mobile wallet acceptance from the user’s perspective. The key research question to be addressed in the present study is "what are the key inhibitors that influence the decision of using a mobile wallet by users".

4. The application of fuzzy theory is much appreciated. However, some tables illustrating application of ISM and fuzzy ISM may be moved to appendix for higher readability.

**Response** – We really appreciate your valuable suggestion. As per your valuable suggestion, some tables have been moved to Annexure-2 for higher readability.

5. The traditional MICMAC analysis considers only a binary interaction (Duperrin & Godet 1973), could you please provide some latest studies instead?

**Response** – Thank you very much for your valuable feedback. Some recent citations on MICMAC have also been provided in the revised manuscript.

6. Section 2.3 - From the best of our knowledge, this paper is an original effort in understanding inhibitors to the acceptance of mobile wallets in Oman perspective using integrated ISM–fuzzy MICMAC approach. Thus, discussions and practical implications of the research needs to be discussed explicitly.

**Response** – Thank you very much for your encouragement and support. An attempt has been made to thoroughly revise discussions and practical implications of the research to include new insights for decision makers.

## **Discussion and Implications**

### *Discussion on comparisons of ISM and ISM-Fuzzy MICMAC Based Models*

The ISM model shown in Fig. 2 shows the contribution of ‘Lack of awareness of mobile wallet benefits ( $I_9$ )’ comes at level 7 form the foundation of the hierarchical structure for mobile wallet acceptance. Therefore, the inhibitor  $I_9$  is significantly limiting the recognition of mobile wallets among users in Oman. On the other hand, according to the integrated ISM based model, the inhibitor,  $I_9$  comes at level 5. It means that ‘Lack of awareness of mobile wallet benefits ( $I_9$ )’ is the key inhibitor to the acceptance of mobile wallets in Oman. **The mobile wallet is a relatively new concept in Oman. At first glance, it is a general practice in Oman from the perspective of buyers as well as sellers that a large section of society prefers transactions in cash as well as face to face banking for fund transfers. This reason behind could be identified as the lack awareness of the number of advantages of mobile wallets usage (Turki, 2017).**

The developed model (Fig. 2 and Fig. 4), ‘Perceived image ( $I_{11}$ )’ inhibitor approaching towards the utmost level 1 in both the ISM and integrated ISM based model. Thus, an inhibitor positioned at level 1 will not contribute to removing other inhibitor positioned at the level below it. From integrated ISM based model (Fig. 4), the inhibitors, ‘Anxiety towards new technology ( $I_1$ )’, ‘Lack of new technology skills ( $I_8$ )’, ‘Lack of awareness of mobile wallet benefits ( $I_9$ )’, and ‘Complexity of new technology ( $I_{10}$ )’ have higher effectiveness and come at level 5 collectively. These four inhibitors will influence mutually and perform as an important inhibitor for adopting the mobile wallet. On the other hand, the inhibitors  $I_1$ ,  $I_8$ , and  $I_{10}$  come

at level 6 in the ISM model, they also affect each other mutually in adopting mobile wallet concepts. Normally, people are interested but due to lack of knowledge about new technology and technological complexity, a large segment of the population is not comfortable with the use of mobile wallets. It means that lack of awareness of the customer, still the challenge of gaining the trust of customers is one of the key challenges facing the acceptance of mobile wallets in Oman.

The inhibitors related to technology (new technology, technology skills, the complexity of technology etc.) would lead to 'Privacy concerns (I<sub>4</sub>)' and 'Security concerns (I<sub>5</sub>)' for the users. At the moment, the regulatory framework for financial transactions via mobile wallets is currently not well developed. Mallat (2007) suggested that the 'lack of consumer perceived security' and 'trust in payment systems' are among the key problematic issues to e-commerce/m-commerce transactions. Privacy and security concerns (I<sub>4</sub> and I<sub>5</sub>) affecting each mutually and recognized as the leading inhibitors for the users for mobile wallet acceptance. From ISM based model, privacy concerns and security concerns would support 'Lack of trust (I<sub>6</sub>)' and 'Risk issues (I<sub>7</sub>)'. Ramadan & Aita (2018) reported in their study that service providers of mobile wallets should strive to improve technology issues especially those concerning privacy protection which, in turn, could enhance customers' experience and trust towards mobile wallet applications. The inhibitors, lack of trust and risk issues affecting each mutually and play a significant role in limiting the use of mobile wallet concept in Oman. Shin (2009) suggested that trust is more important for users compared to financial risks, such as account hacking, frauds etc. The financial loss is also a limiting factor among users to accept the mobile wallet concept. These two inhibitors I<sub>6</sub> and I<sub>7</sub> are affecting 'Higher cost (I<sub>2</sub>)' and 'Device inefficiency (I<sub>3</sub>)', which are lying at level 2 in mobile wallets acceptance. Notably, the inhibitors, higher cost, and device inefficiency are affecting mutually each other and inhibiting mobile wallet process adoption among users.

Next to this level be level 1 i.e. topmost level in both the ISM and integrated ISM based developed model, which contains inhibitor related to 'Perceived image (I<sub>11</sub>)'. This inhibitor is highly driven by other inhibitors in process of mobile wallet concepts among users in Oman.

#### *Implications for the practice*

This section provides several noticeable implications to accept mobile wallet concepts in Oman, a leading economy in GCC countries. The findings of this research facilitate decision making in public and private organizations from the strategic point of view by providing key inputs in multiple domains where mobile users perceive that mobile wallet is directly associated with what and by providing key inputs to system analysts. In addition, the findings will provide

strategic inputs to the telecommunication and financial service providers who are planning to invest their capital in the growing technology. This research will also help policymakers in banking organizations and government bodies to eradicate the problematic issues and understand benefits by adopting mobile wallet models in practice.

This is the first study focusing on the examination of inter-relationships among key inhibitors of mobile wallet acceptance in one of the prominent Gulf countries namely Oman. As the Government of Oman is investing a huge amount of money on developing e-infrastructure to provide cost-effective, convenient, customer-centric, and secure e-commerce transactions to minimize digital divide and empower Omani resident's life for better, so understanding key inhibitors provides better insights to the top management to develop appropriate strategies to overcome them. Furthermore, the integration of mobile wallet will help multiple stakeholders namely businesses, residents, expatriates and others to save time as well as money with the help of such smart and innovative technologies.

“Omanuna” is the official Oman e-Government services portal and one of its key objectives is e-payment implementation across the country. According to the findings, security, privacy, trust, and risk are key inhibitors of mobile wallet acceptance. The main concerns related to the aforementioned inhibitors are validation and concealment of online transactions. In addition, unauthorized access and third party usage of personal data provided by users are also serious concerns. Therefore, many researchers have highlighted the significance of trust in mobile transactions in general and mobile wallet in particular as mobile number as well as other personal details are shared with the merchant. Lin & Wang (2006) have validated that trust is one of the key predictors of satisfaction as well as customer loyalty in the context of mobile transactions. Government agencies need to pay more attention to developing regulations aligned with recent ICT developments, which ensures higher security and privacy and minimum risk in mobile wallet transactions. In addition, trust plays a very crucial role in the acceptance of advanced technology in the Omani society (Sharma 2017). Decision makers should give higher priority to trust building measures by minimizing errors in mobile wallet transactions such as wrong public keys, invalid Merchant Identification Number (MIN), unable to pair, decryption failure, invalid element data, among other possible errors. Therefore, it is important for systems analysts and developers to strengthen trust among users by avoiding the aforementioned technical errors in the newly launched mobile wallet in Oman.

The findings also suggest that low awareness of the benefits of the mobile wallet in the context of Oman is another key inhibitor. Therefore, decision-makers in banking systems need to pay attention to formulate an appropriate strategy to spread awareness about the key benefits of the

mobile wallet. For example, it should be regularly published through print and social media that no personal information, as well as transactional logs, are stored with the seller. In addition, the residents may be educated as to how mobile wallet can be used for online shopping, bill payments, fund transfer to family members, relatives and others as well without necessitating the need of carrying multiple cards in physical wallet. Mobile wallet subscribers can deposit and withdraw money from a bank by visiting a branch of the bank where they do not have account. Furthermore, it can also be mentioned in advertisements that the Central Bank of Oman (CBO) monitors key policies related to financial transactions in the mobile wallet. Spreading awareness in this manner will boost the confidence of customers towards the higher usage of the mobile wallet in Oman.

Finally, it was revealed that anxiety towards new technology, lack of new technology skills and complexity of new technology are also the key inhibitors to mobile wallet acceptance in Oman. The possible reason for these inhibitors among Omani residents is the lower penetration of mobile wallet. Anxiety towards new technology can be minimized by a number of ways. For example, by publishing short paragraph in local language about benefits of mobile wallet and demonstrating working of mobile wallet at public places. Lack of new technology skills and complexity of new technology are the key inhibitors to people who are not tech-savvy. Specialized and targeted programs on required skills sets and ease of operations of mobile wallet can be developed for non tech-savvy people specially in semi-urban areas of Oman. Overall, these recommendations with more innovative ways may minimize the impact of inhibitors of mobile wallet acceptance in a GCC country.

7. Could you please elaborate more on future directions for research?

**Response** – Thank you very much for your feedback. Future directions for research have been elaborated as per your valuable feedback.

8. Authors should try to include some references from ‘JRCS’.

**Response** – Thank you very much for your valuable suggestion. Some recent references from ‘Journal of Retailing and Consumer Services (JRCS)’ have been cited in the revised manuscript.

1. De Kerviler, G., Demoulin, N. T., & Zidda, P. (2016). Adoption of in-store mobile payment: Are perceived risk and convenience the only drivers?. *Journal of Retailing and Consumer Services*, 31, 334-344.

2. Faqih, K. M., & Jaradat, M. I. R. M. (2015). Assessing the moderating effect of gender differences and individualism-collectivism at individual-level on the adoption of mobile commerce technology: TAM3 perspective. *Journal of Retailing and Consumer Services*, 22, 37-52.
3. Natarajan, T., Balasubramanian, S. A., & Kasilingam, D. L. (2017). Understanding the intention to use mobile shopping applications and its influence on price sensitivity. *Journal of Retailing and Consumer Services*, 37, 8-22.
4. Shaw, N. (2014). The mediating influence of trust in the adoption of the mobile wallet. *Journal of Retailing and Consumer Services*, 21(4), 449-459.

The revised manuscript as per reviewers' feedback and 'Journal of Retailing and Consumer Services' Journal requirement is submitted for your kind consideration.

We look forward to your positive response.

With Warm Regards

Dr. Sujeet Kumar Sharma

Corresponding author

The name(s) of the author(s): **Sujeet Kumar Sharma, Sachin Kumar Mangla, Sunil Luthra, and Zahran Al-Salti**

A concise and informative title: **Mobile wallet inhibitors: developing a comprehensive theory using **an integrated model****

The affiliation(s) and address(es) of the author(s):

MIS Area, Indian Institute of Management Tiruchirappalli, India

Plymouth Business School, Plymouth University, United Kingdom.  
Email: [sachinmangl@gmail.com](mailto:sachinmangl@gmail.com)

Department of Mechanical Engineering,  
State Institute of Engineering & Technology (Formerly known as Government Engineering College), Nilokheri-132117, Haryana, India.  
**Email:** [sunilluthra1977@gmail.com](mailto:sunilluthra1977@gmail.com)

Department of Information Systems, Sultan Qaboos University, Oman  
Email: [alsalti@squ.edu.om](mailto:alsalti@squ.edu.om)

The e-mail address, telephone and fax numbers of the corresponding author:  
[sujeet@iimtrichy.ac.in](mailto:sujeet@iimtrichy.ac.in) +91 431 2505080

# Mobile wallet inhibitors: developing a comprehensive theory using **an integrated model**

**Abstract** The concept of the mobile wallet is increasingly adopted in developed and developing countries for improving the scale, productivity, and excellence of banking services. Oman is one of the most growing countries of the **Middle Eastern economies**. Acceptance of mobile wallets in Oman is being hindered by various inhibitors. There is no study in the Middle Eastern countries that addressed the concerns of probable inhibitors influencing mobile wallet acceptance from expert's perspective. In this study, eleven key inhibitors to mobile wallet adoption are identified from the literature and expert's feedback. This study employed Interpretive Structural Modelling (ISM) in conjunction with fuzzy MICMAC to reveal the **intricate relationship among inhibitors** to mobile wallet acceptance. To the end, **an integrated hierarchical model** is developed to understand the influence of a particular inhibitor on others. **'Anxiety towards new technology', 'Lack of new technology skills', 'Lack of awareness of mobile wallet benefits' and 'Complexity of new technology' have been reported as key inhibitors to promote mobile wallets in Oman. This study also suggests several recommendations for banking organizations and policymakers in developing the effective model to popularize mobile wallets in Oman.**

**Keywords:** Mobile Wallets, Inhibitors, Gulf Cooperation Council, ISM, Fuzzy MICMAC, Integrated model

## 1 Introduction

The integration of Information and Communication Technology (ICT), payment methods and smartphones are providing new opportunities and mobile wallet is considered as one of these opportunities (Kapoor et al. 2015; Qin et al. 2017). Mobile wallet replaces the physical wallet and allows users to pay online by means of a mobile device at a merchant's location (Chen 2008; Ramadan & Aita 2018). This is considered as a big revolution in the digital world, which will replace the traditional wallets with multiple credit and debit cards. In today's era of the technology revolution, organizations have resolved the problems of

speed, interactivity, and security of the first generation mobile technologies from the early 2000's. Today the online banking services offered by mobile channels are comparable to the Internet-based services offered through a personal computer (Akinici et al. 2004). Banking firms across the globe are investing in mobile technologies for reducing risk and cost, enhancing customer time- and place- convenience and achieving effective customization. At the same time mobile wallet is also receiving huge recognition, owing to the high penetration of mobile devices around the globe, for improving the scale, productivity and quality of banking services (Dwivedi et al. 2014; Dahlberg et al. 2015; Dauda & Lee 2015; Faqih & Jaradat 2015; Slade et al. 2015; Liébana-Cabanillas et al. 2017). The concept of making payment through mobile has achieved a mixed response in the market, so as it has been greatly influencing several factors, such as trust and security, technology reliability, among others (Dahlberg et al. 2008; Amoroso & Magnier-Watanabe 2012; Slade et al. 2013). Payment through mobile devices allows customers to manage several scenarios, such as mobile commerce, customer-to-merchant commerce, merchant-to-merchant commerce among others. The understanding of mobile wallet inhibitors in Oman is quite important mainly because of a number of reasons: 1) Mobile devices penetration in Oman is quite higher compared to personal computers 2) personal computer-based internet provides anytime banking convenience, whereas mobile-based banking technologies provide anytime and anywhere banking options and 3) online banking technologies both internet and mobile are expected to be the banking industry's primary approach for improving customer base, reducing cost and risk, enhancing quality and personalization and may drive the competitive trends in the next decade. In 2011, Google has pointed out the importance of Google Wallet in its vision document "In the past few thousand years, the way we pay has changed just three times—from coins to paper money, to plastic cards. Now we're on the brink of the next big shift". And the next big shift is in the form of mobile wallet.

Mobile payments are increasing substantially in the Asia-Pacific countries. Capgemini (2017) reported that the total digital payments using mobile devices worldwide were recorded \$500 billion in 2017 and \$321 billion in 2016. In Gulf countries, Smartphone penetration has increased significantly in recent years and was observed 83 percent Smartphone adoption rate in the United Arab Emirates (UAE) alone and highest in the

world. In the case of Oman, Smartphone adoption rate was 70 percent (GSMA 2016). Furthermore, NCSI (2017) reported that the population of Oman was 4,642,521 in November 2017 and total mobile phone subscription was 6,975,757 which results in the penetration rate of the mobile phone in Oman is about 150 percent. Oman Observer (2017) reported that Bank Muscat, the leading bank in Oman has launched first mobile wallet, a state-of-the-art “cash on mobile” in mid of 2017. The introduction of mobile wallet which is a secure and convenient payment channel considered as an important step in the e-Government initiative of Oman. Furthermore, it does not store any personal information on the mobile phone, and hence, becomes more secure. The services provided by mobile wallet are available in both the English and Arabic languages, and mobile applications are easily downloadable at no cost. At present, Omani residents can avail mobile wallet facility with a maximum loaded money 300 Omani Rials (\$780).

The mobile wallet is a comparatively novel area of investigation, relatively less investigated when compared to similar domains namely, e-commerce, m-commerce or phone banking, where investigation has been made extensively (Oliveira et al. 2016). Mobile payment is a relatively recent innovation in its early stages of development and growth, yet they are widely extended in our society (Dahlberg et al. 2015; Liébana-Cabanillas et al. 2017). Shaw (2014) reported that mobile wallet technology is growing, but has not yet been significantly exploited by retailers or consumers due to the existence of multiple inhibitors.

In recent years, the technologies are on the higher priorities in Gulf Cooperation Council (GCC) countries. In Oman, as there is a massive increase in the mobile users, but transactions using mobile devices are still very limited. A thorough understanding of inhibitors to the acceptance of mobile wallets in Oman is thus needed to develop mobile payment services efficiently. The rise of mobile banking may be seen as an innovative method of doing business in the Arab region, and so far, limited research has been undertaken on actual users from this region (Ramadan & Aita 2018). There is no study in the Middle Eastern countries that addressed the concerns of key inhibitors influencing mobile wallet acceptance from the user’s perspective. The key research question to be addressed in the present study is "what are the key inhibitors that influence the decision of using a mobile wallet by users".

This research seeks to address the following objectives:

- i. To identify inhibitors of the acceptance of mobile wallets in Oman perspective;
- ii. To investigate the contextual relationships between the identified inhibitors;
- iii. To categorize identified inhibitors based on their dependence and driving power;
- iv. To generate an integrated model to understand the dynamics of inhibitors for eradicating these inhibitors and encouraging mobile wallets in Oman.

This research aims to identify the mobile wallet inhibitors and explores how these are interlinked. A methodical literature review and feedback from known experts were utilized to precisely identify the mobile wallet focused inhibitors in Oman. To analyze these inhibitors, the Interpretive Structural Modelling (ISM) approach integrated with fuzzy MICMAC was employed. The ISM method helps to know the relationships within a set of factors in a system (Sage 1977; Janssen et al. 2017). Therefore, we attempted to employ ISM to develop a theory for understanding inhibitors to the acceptance of mobile wallets in Oman. Further, fuzzy MICMAC provides a deeper explanation of the relationships between identified inhibitors. The ISM-MICMAC has limited capability of revealing the hidden relationship, so as it does not offer a facility of incorporating some in-between value for evaluating the power of inter-relationship among the factors (Khan & Haleem 2015). The amalgamation of ISM and fuzzy MICMAC enhances the understanding and segregation of the inhibitors (Sindhu et al. 2016). These are classified as driving, linkage, dependence and autonomous forms of inhibitors. Finally, this research suggests several noticeable implications to help users and policymakers in bank organizations in developing a thorough understanding and effective implementation of mobile wallet in Oman.

The remainder of this article is arranged as follows: Section 2 provides the related literature on mobile wallet concepts and identification of inhibitors to the mobile wallet. Section 3 describes a solution methodology. Data analysis and related results are presented in Section 4. Discussion of the research findings with implications for practice is provided in Section 5. Finally, Section 6 provides research conclusions, limitations and the scope for future research.

## **2 Literature Review**

This section covers the literature on mobile wallet concept, identifies the key inhibitors to mobile wallets acceptance and highlights the gaps in the research.

## 2.1 Mobile wallet concept and related models

The mobile wallet is the latest mode of m-commerce that allows users to make transactions, online shopping, bookings and share the available services. A user needs to have a mobile device or any device compatible with mobile communication networks, to conduct mobile payments (Au & Kauffman 2008). Mobile wallet could also be understood as the second revolution followed by e-wallet concepts. In this sense, organizations in developed nations, such as in Japan, enables both the mobile and electronic options to users to complete their payment (Amoroso & Magnier-Watanabe 2012). In addition, the mobile wallet has become the current buzzword in the telecom industry, due to a rapid increase in the information and communication technology and exponential increase in numbers in mobile phone users (Au & Kauffman 2008). In general, secure mobile wallet involves four functions: (1) generation of user identity and verification for authenticity, (2) various options for making financial transactions, (3) provision of for making m-commerce transactions, and (4) security provisions.

Researchers have adopted a number of models like **Diffusion of innovation (DOI) theory (Rogers 1995; Zhao & de Pablos 2011)**, Theory of Reasoned Action model (Ajzen and Fishbein 1988), Theory of Planned Behaviour model and TAM (Davis et al. 1989; Madden et al. 1992), **TAM3 (Faqih & Jaradat 2015)**, Unified theory for acceptance and use of technology (UTAUT) (Venkatesh et al. 2003; Dwivedi et al. 2017) among others. However, Venkatesh et al. (2012) argued that the commonly adopted/modified TAM has a number of limitations related to acceptance of the advanced technology. **Zhao & de Pablos (2011) suggested that innovation is a vital component influencing the acceptance of a new technology. Furthermore, Faqih & Jaradat (2015) investigated the implementation of mobile commerce in Jordan and developed a theoretical framework based on the TAM3. The findings suggested that ‘perceived usefulness’ and ‘perceived ease of use’ are significant elements in elucidating the users’ intention to accept mobile commerce. Oliveira et al. (2016) identified the key determinants of mobile payment acceptance combining the strengths of UTAUT2 and DOI theory and found that ‘Compatibility’, ‘perceived technology security’, ‘performance expectations’, ‘innovativeness’, and ‘social**

influence' played important role in the acceptance of mobile payment. Patil et al. (2017) conducted a literature review on digital payment adoption. They observed that majority of studies used TAM, UTAUT and their extensions to comprehend customer acceptance of mobile payment services. Janssen et al. (2017) in their study developed a model of factors linked to citizens' viewpoints towards trustworthiness in the services provided through government portals. The findings revealed that the influence of citizens' trust remains at the macro-level in the online services. This implies that there is a clear void of research available in the literature to explore and understand the intricacies of the relations among key decision variables influences the customers' willingness towards to the new and innovative technology such as mobile wallet.

## 2.2 Key inhibitors to mobile wallet acceptance

The identification of key inhibitors is important in the effective mobile wallet acceptance. In this sense, a literature survey was conducted using critical words search e.g. key inhibitors to mobile wallets; barriers to mobile wallets; hurdles to mobile wallets, and some similar group of words. The prominent search engines namely the Google and its research product "Google Scholar" were utilized to download a number of articles from commonly accessed research databases such as Web of Science, Scopus, ScienceDirect, Emerald, Springer, Taylor & Francis, Wiley and EBSCO. The corresponding downloaded papers were then reviewed and coded using data displays. As a results of the comprehensive literature review, a total of 11 variables were chosen as key inhibitors to the acceptance of mobile wallet in Oman (see Table 1). The identified inhibitors were authenticated through inputs received from experts. Further, the information regarding data collection is provided in Section 4.

**Table 1** Key inhibitors to the acceptance of mobile wallet in Oman

S. No.	Key inhibitors to mobile wallet	Simplified meaning of Inhibitors	References
1	Anxiety towards new technology (I <sub>1</sub> )	Users are generally anxious towards a new technology, which further influences the decision, whether to accept it or not. Therefore, it is important to comprehend a thought process, which otherwise may become an inhibitor to accept mobile wallet payments.	Dahlberg et al. (2008); Yang & Forney (2013); Shaw (2014)

---

2	Higher cost (I <sub>2</sub> )	Customers always a trade-off between cost and benefits offered by a new technology. Thus, it is worthy to know the impact of the cost involved in Internet services on mobile devices.	Shin (2009); Van der Boor et al. (2014)
3	Device inefficiency (I <sub>3</sub> )	Low screen resolution of mobile devices demotivates users to perform mobile financial transactions because of confusion in the understanding information displayed on the screen.	Carlsson & Walden (2002); Khan et al. (2015)
4	Privacy concerns (I <sub>4</sub> )	A number of researchers have argued that data security and privacy is a significant factor affecting acceptances of mobile technologies related to financial transactions. Privacy is critical in adopting location-based services for m-commerce.	Zhang et al. (2012); Khan et al. (2015); De Kerviler et al. (2016)
5	Security concerns (I <sub>5</sub> )	Security as “the extent to which one believes that the web is secure to transmit sensitive information.” In this sense, perceived security is the opinion of users towards financial institutions, which perform financial transactions and maintain confidential information. Security issues are important inhibitors influencing the decision to adopt internet technologies for financial transactions.	Salisbury et al. (2001); Wang et al. (2016); Jin et al. (2017); Patel & Patel (2017)
6	Lack of trust (I <sub>6</sub> )	Trust can be understood as the willingness to use another party service with the expectations with good behavior in the future. Trust played a significant role in determining users' behavior towards mobile banking in Iran. It meant that higher trust in banking systems and mobile technology implies higher acceptance of mobile banking. In other words, low trust means low acceptance of mobile banking. Mobile wallets have some similar features to mobile banking so trust can play as the inhibitor.	Hanafizadeh et al. (2014); Hew et al. (2015); Slade et al. (2015); Sharma et al. (2017)
7	Risk issues (I <sub>7</sub> )	There is a risk component to use mobile phones for financial transactions because privacy and security of users' information are at risk. Risk issues in the mobile wallet transactions on mobile phones are risky.	Au & Kauffman (2008); Shin (2009); Zhao & Muftic (2011); Khan et al. (2015); Patil et al. (2017)

---

8	Lack of new technology skills (I <sub>8</sub> )	Researchers have observed that a lack of skills in new technology demotivates people to use it. Lack of new technology skills plays a significant role in inhibiting users from mobile technology used for financial transactions. So, it may act as inhibitor in case of mobile wallet.	Riquelme & Rios (2010); Dauda & Lee (2015); Khan et al. (2015)
9	Lack of awareness of mobile wallet benefits (I <sub>9</sub> )	Many users are using the mobile wallet in Oman first time so low awareness about its benefits may influence the decision to adopt mobile wallet. Lack of awareness of online transactions and its gains are recognized as the key hurdles behind the reluctance to use mobile wallet transactions.	Howcroft et al. (2002); Al-Somali et al. (2009)
10	The complexity of new technology (I <sub>10</sub> )	New technology is considered an inhibitor because there is a paucity of synchronization between the capacity of mobile devices and speed of data transfer. Limited knowledge of mobile and Internet usage may prevent users to use mobile wallet transactions.	Anckar & Walden (2003); Au & Kauffman (2008); Slade et al. (2013); Liu et al. (2015)
11	Perceived image (I <sub>11</sub> )	If some users (non-tech-savvy) perceive that the use of new technology is difficult, they normally develop a negative impression of innovation in services due to new technology. Some non-users of online banking services had a negative image of the internet as a service. Perceived image may be considered as one of the key inhibitors to mobile wallet usage in Oman.	Kuisma et al. (2007); Shaw (2015); Laukkanen (2016); Natarajan et al. (2017)

### 2.3 Research Gaps

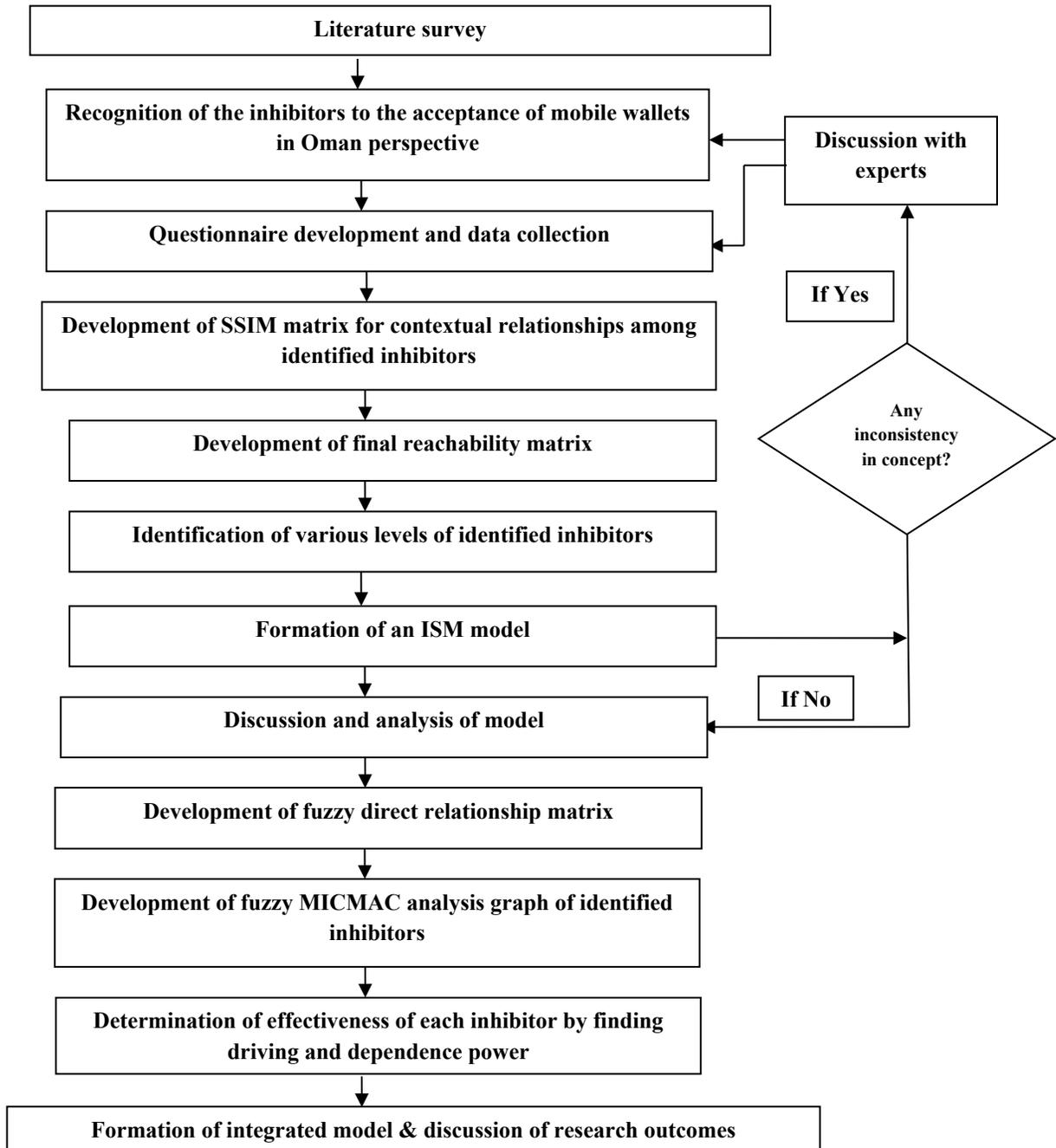
In recent years, the mobile phone has become a preferred mode of e-commerce and other online financial activities. The greater usage of mobile devices for online payments using mobile wallets have shown the great potentials to transform the society at large extent especially in emerging economies. However, the concept of the mobile wallet or payment through mobile still lacks in developing economies (Patil et al. 2017). On the one side, mobile payments are in its development and growing stage, whereas on the other side, their mobility and accessibility show huge potentials for both the customers and mobile industry from the future perspectives. There is a substantial shortage of the research in the domain of mobile wallets inhibitors in Middle Eastern countries, especially in Oman. This

motivates authors to explore key inhibitors of the mobile wallet in Oman. **The commonly adopted theories to examine mobile wallet and related domains available in the literature are DOI, TAM, Modified TAM and UTAUT and modified UTAUT.** There is a need to conduct more qualitative and quantitative studies to understand some new determinants influencing the adoption/rejection of new technologies (Patil et al. 2017). **On the basis of aforementioned arguments, it can be summarized that there is a necessity to propose and test a framework** for the key inhibitors so as to present a holistic understanding of the mobile wallet. This work seeks to recognize the key inhibitors to mobile wallet adoption through literature and feedback received from experts. Further, this work uses an integrated ISM–fuzzy MICMAC approach for understanding the inter-relationships among the recognized inhibitors. This study attempts to develop a novel research framework to understand inhibitors of the acceptance of mobile wallets in Oman perspective using integrated ISM–fuzzy MICMAC approach.

### **3 Solution Methodology**

This research proposed an ISM and fuzzy MICMAC based approach to develop an integrated ISM model. ISM is a technique utilized for identifying contextual relationships (among definite elements). It was first developed in 1974 by J. Warfield (Warfield 1974). ISM is a methodology, which manages the intricacy of ‘a system’ and decomposes it into a simple and in understandable form (Ansari et al. 2013; Mangla et al. 2013). MICMAC as an addition facilitates the exploration of variables and their significance to expose how certain variables influence others (Diabat & Govindan 2011). The drawback of a conventional ISM approach considers only inter-relationships between variables. However, the inter-relationships between variables may not always be the same (Khan & Haleem 2015; Sindhu et al. 2016). The integrated ISM-fuzzy MICMAC analysis based model (Gorane & Kant 2013) is designed to offer a better sympathetic of the interactions among the recognized inhibitors of mobile wallets in Oman. To reveal the interactions and decision hierarchy of the variables, several techniques are available in the literature, given as AHP, ANP, and DEMATEL. AHP does not show any interdependencies among the identified variables, mainly used for ranking of the identified variables and somewhat utilized to draw the hierarchical arrangement of the identified variables (Jakhar & Barua

2014; Luthra et al. 2016; Luthra et al. 2017). ANP can help in evaluating interdependencies between the listed variables, but ANP is comparatively less accepted by the researchers because of its complexity (Mangla et al. 2015). DEMATEL methodology assists to discover the causal relationships among the listed variables on the basis of their cause and effect groups (Luthra et al. 2016; Mangla et al. 2016).



**Fig. 1** ISM-fuzzy MICMAC based integrated flowchart

The integrated ISM-fuzzy MICMAC analysis based model uncovers hidden interactions among variables and allows the addition of intermediate values for determining the power of inter-relationships among the variables. The ISM-fuzzy MICMAC based integrated flowchart has been shown in the Figure 1. For better understanding and clarity, the steps in the formation of an integrated ISM-fuzzy ISM model are presented as follows:

**Step 1:** Identify the variable related to the objective of the research. In this work, the inhibitors to the acceptance of mobile wallets in Oman perspective are identified through literature and expert's inputs.

**Step 2:** Develop structural self-interaction (SSIM) matrix to identify contextual relationships amongst the identified inhibitors;

**Step 3:** Develop a final reachability matrix (FRM) from SSIM and check transitivity (transitivity is assumed to be present, which is the basic step for applying the ISM technique);

**Step 4:** Distinguish between various levels of recognized inhibitors;

**Step 5:** Establish directed graph and eliminate transitivity to convert diagraph into ISM based model;

**Step 6:** Formation of direct relationship matrix (DRM) and fuzzy direct relationship matrix (FDRM) among the recognized inhibitors;

**Step 7:** Carry out fuzzy MICMAC analysis of the inhibitors;

**Step 8:** Calculate the effectiveness for each inhibitor to develop integrated ISM hierarchical model.

#### **4. Data analysis and results**

The integrated interpretive structural modelling (ISM) - fuzzy MICMAC methodology was employed to understand the dynamics of inhibitors to the acceptance of mobile wallets in Oman. The purpose was to understand and determine the conditions that would support the acceptance and proliferation of mobile wallets in one of the emerging economies in Middle Eastern countries. The details of the data analysis and findings are presented in the following subsections.

##### **4.1 Survey development and data collection**

In order to collect data, 20 experts dealing with digital financial services from Oman were contacted using some references. The modes of contact with experts were the telephone,

email and direct visits. There were three IS professor (of seven approached) who are teaching and doing research in the domain of e-commerce/m-commerce/mobile banking participated in the data collection process. Among 17 remaining experts, there were 5 digital financial services professionals (2 Omani and 3 expatriates) working in the banking sector and 12 mobile users. These experts had more than ten years' experience dealing with financial services and are respected in their sectors. The research problem was discussed in details and analyzed by the reference group, and consequently, the integrated ISM - fuzzy MICMAC based methodology was employed (achieved in two phases with the expert groups).

The data collection process for this research study was done in two phases with the help of emails and personal visits to the aforementioned experts in Muscat, the capital city of Oman. In the first phase, research team and experts selected the key inhibitors to the acceptance of mobile wallets by taking Oman perspective. To achieve this objective, the summary prepared after extensive literature review was used. The reference group experts were referred so as to rank the importance of a number of inhibitors shortlisted on the basis of above discussion using a 5 point Likert scale from no relevance to very high relevance. All the inhibitors to the acceptance of mobile wallets were marked with a reasonable importance through a rating of 3 or above provided by the experts. In this sense, we selected eleven key inhibitors to the acceptance of mobile wallets by taking Oman perspective. In the second phase, experts were asked to discuss and provide the understanding of the mutual impact all inhibitors to the acceptance of mobile wallets by taking Oman perspective and research team employed integrated ISM-fuzzy MICMAC method for further analysis. The relevant details for applicability of ISM-fuzzy MICMAC are provided in the subsequent sub-sections.

#### **4.2 Developing the Structural Self Interaction matrix (SSIM)**

The interpretive structural modelling (ISM) relies on the opinion of experts for developing the Structural Self Interaction matrix (SSIM). After finalizing the key inhibitors to the acceptance of mobile wallets in Oman perspective, the contextual relationships among them were made using the feedback of decision group. To represent these contextual relationships, an SSIM matrix was constructed and validated (see Table 2). Four symbols

were used to indicate the direction of interaction between any two inhibitors to the acceptance of mobile wallets by taking Oman perspective (say, i and j).

V - Inhibitor i will dominate to inhibitor j in its removal;

A - Inhibitor j will dominate to inhibitor i in its removal;

X - Inhibitors i and j will dominate to each other in its removal; and

O - Inhibitors i and j are not connected in its removal.

**Table 2** SSIM for the key inhibitors to the acceptance of mobile wallets in Oman

S. No.	Key inhibitors to the acceptance of mobile wallets in Oman	Contextual Relations									
		I <sub>11</sub>	I <sub>10</sub>	I <sub>9</sub>	I <sub>8</sub>	I <sub>7</sub>	I <sub>6</sub>	I <sub>5</sub>	I <sub>4</sub>	I <sub>3</sub>	I <sub>2</sub>
1.	Anxiety towards new technology (I <sub>1</sub> )	V	X	A	X	V	V	V	V	V	V
2.	Higher cost (I <sub>2</sub> )	V	A	A	A	A	A	A	A	X	
3.	Device inefficiency (I <sub>3</sub> )	V	A	A	A	A	A	A	A		
4.	Privacy concerns (I <sub>4</sub> )	V	A	A	A	V	V	X			
5.	Security concerns (I <sub>5</sub> )	V	A	A	A	V	V				
6.	Lack of trust (I <sub>6</sub> )	V	A	A	A	V					
7.	Risk issues (I <sub>7</sub> )	V	A	A	A						
8.	Lack of new technology skills (I <sub>8</sub> )	V	A	A							
9.	Lack of awareness of mobile wallet benefits (I <sub>9</sub> )	V	V								
10.	Complexity of new technology (I <sub>10</sub> )	V									
11.	Perceived image (I <sub>11</sub> )										

### 4.3 Reachability Matrix (RM)

During the next stage of the research, an initial reachability matrix (RM) using the SSIM was constructed. The initial RM comprised of binary numbers (0 and 1), and was prepared using some definite rules (see Mangla et al., 2013 for more details), as below:

Write 1 for (i, j) and 0 (j, i) in RM on the place of every entry  $\square$  (i, j) in the SSIM;

Write 0 for (i, j) and 1 for (j, i) in RM on the place of every entry  $\bar{A}$  (i, j) in the SSIM;

Write 1 for (i, j) and 1 for (j, i) in RM on the place of every entry  $\square$  (i, j) in the SSIM;

Write 0 for (i, j) and 0 for (j, i) in RM on the place of every entry  $\square$  (i, j) in the SSIM.

Based on the above rules, the initial RM is formed and reviewed (see Table 3).

**Table 3** Initial RM for the key inhibitors to the acceptance of mobile wallets in Oman

S. No.	Key inhibitors of mobile wallet in Oman	I <sub>1</sub>	I <sub>2</sub>	I <sub>3</sub>	I <sub>4</sub>	I <sub>5</sub>	I <sub>6</sub>	I <sub>7</sub>	I <sub>8</sub>	I <sub>9</sub>	I <sub>10</sub>	I <sub>11</sub>
1.	Anxiety towards new technology (I <sub>1</sub> )	1	1	1	1	1	1	1	1	0	1	1
2.	Higher cost (I <sub>2</sub> )	0	1	1	0	0	0	0	0	0	0	1
3.	Device inefficiency (I <sub>3</sub> )	0	1	1	0	0	0	0	0	0	0	1
4.	Privacy concerns (I <sub>4</sub> )	0	1	1	1	1	1	1	0	0	0	1
5.	Security concerns (I <sub>5</sub> )	0	1	1	1	1	1	1	0	0	0	1
6.	Lack of trust (I <sub>6</sub> )	0	1	1	0	0	1	1	0	0	0	1
7.	Risk issues (I <sub>7</sub> )	0	1	1	0	0	0	1	0	0	0	1
8.	Lack of new technology skills (I <sub>8</sub> )	1	1	1	1	1	1	1	1	0	0	1
9.	Lack of awareness of mobile wallet benefits (I <sub>9</sub> )	1	1	1	1	1	1	1	1	1	1	1
10.	The complexity of new technology (I <sub>10</sub> )	1	1	1	1	1	1	1	1	0	1	1
11.	Perceived image (I <sub>11</sub> )	0	0	0	0	0	0	0	0	0	0	1

It was then transformed into a final RM by considering the “transitivity rule”. Transitivity rule states if any variable E shows relation to variable F and variable F shows relation to variable G, then variable E must have relation to variable G. For example, in Table 3, variable 8 is having relation with variable 1 and variable 1 is having relation with variable 10, then variable 8 and must have relation with variable 10. Final RM for the key inhibitors to the acceptance of mobile wallets in Oman is depicted in Table 4.

**Table 4** Final RM for the key inhibitors to the acceptance of mobile wallets in Oman

S. No.	Key inhibitors of mobile wallet in Oman	I <sub>1</sub>	I <sub>2</sub>	I <sub>3</sub>	I <sub>4</sub>	I <sub>5</sub>	I <sub>6</sub>	I <sub>7</sub>	I <sub>8</sub>	I <sub>9</sub>	I <sub>10</sub>	I <sub>11</sub>	Driving Power
1.	Anxiety towards new technology (I <sub>1</sub> )	1	1	1	1	1	1	1	1	0	1	1	10
2.	Higher cost (I <sub>2</sub> )	0	1	1	0	0	0	0	0	0	0	1	03
3.	Device inefficiency (I <sub>3</sub> )	0	1	1	0	0	0	0	0	0	0	1	03
4.	Privacy concerns (I <sub>4</sub> )	0	1	1	1	1	1	1	0	0	0	1	07
5.	Security concerns (I <sub>5</sub> )	0	1	1	1	1	1	1	0	0	0	1	07
6.	Lack of trust (I <sub>6</sub> )	0	1	1	0	0	1	1	0	0	0	1	05
7.	Risk issues (I <sub>7</sub> )	0	1	1	0	0	0	1	0	0	0	1	04
8.	Lack of new technology skills (I <sub>8</sub> )	1	1	1	1	1	1	1	1	0	1*	1	10
9.	Lack of awareness of mobile wallet benefits (I <sub>9</sub> )	1	1	1	1	1	1	1	1	1	1	1	11
10.	The complexity of new technology (I <sub>10</sub> )	1	1	1	1	1	1	1	1	0	1	1	10
11.	Perceived image (I <sub>11</sub> )	0	0	0	0	0	0	0	0	0	0	1	01
<b>Dependence Power</b>		04	10	10	06	06	07	08	04	01	04	11	71/71

\* means values after incorporating transitivity

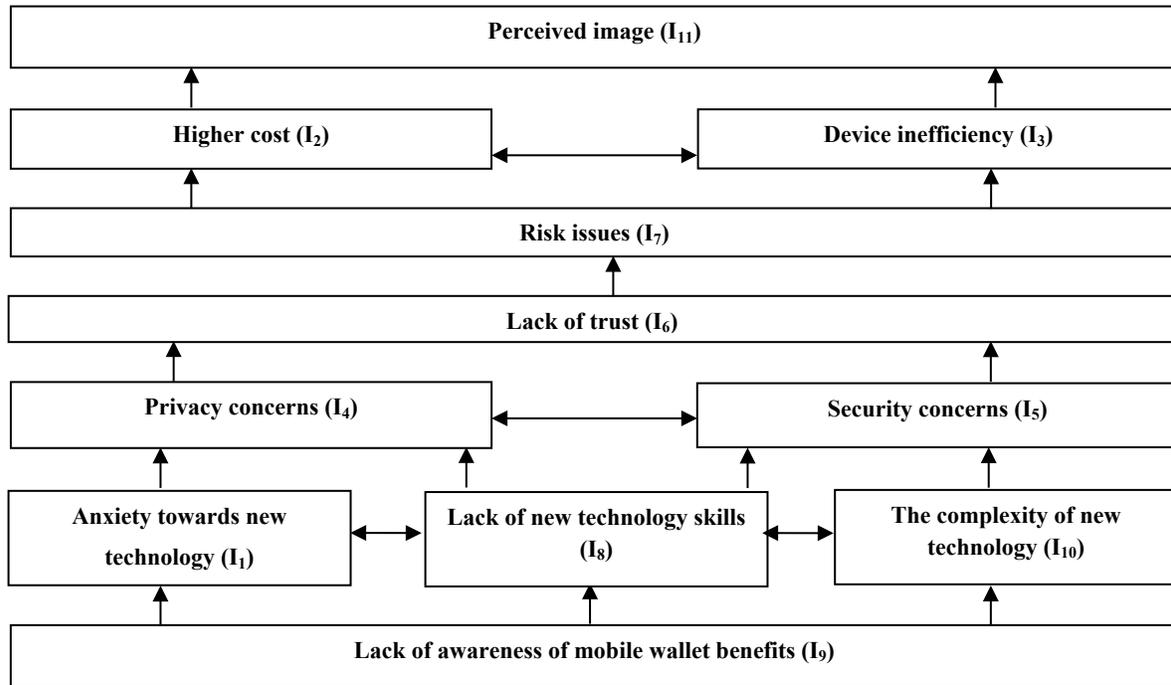
#### 4.4 Partitioning of levels

The “reachability set” for every inhibitor to the acceptance of mobile wallets consisted of the inhibitor and all other inhibitors which it might resist to remove. In parallel, the antecedent set consisted of the inhibitor and the other inhibitors, which may also provide support in its removal. The intersection set for the reachability and antecedent was therefore established for all inhibitors. Subsequently, on analyzing the reachability and antecedent set, if they were having same values for a given inhibitor, then the research team positioned those inhibitors on the 1<sup>st</sup> level in the interpretive structural modelling (ISM) model and it is discarded from further analysis process. The complete and detailed iterative process to obtain the level of each inhibitor is shown in Annexure-1 and the summary of the obtained levels is depicted in Table 5.

**Table 5** Obtained levels of key inhibitors to the acceptance of mobile wallets in Oman

S. No.	Key inhibitors to the acceptance of mobile wallets in Oman	Level number
1	<ul style="list-style-type: none"><li>• Perceived image (I<sub>11</sub>)</li></ul>	I
2	<ul style="list-style-type: none"><li>• Higher cost (I<sub>2</sub>)</li><li>• Device inefficiency (I<sub>3</sub>)</li></ul>	II
3	<ul style="list-style-type: none"><li>• Risk issues (I<sub>7</sub>)</li></ul>	III
4	<ul style="list-style-type: none"><li>• Lack of trust (I<sub>6</sub>)</li></ul>	IV
5	<ul style="list-style-type: none"><li>• Privacy concerns (I<sub>4</sub>)</li><li>• Security concerns (I<sub>5</sub>)</li></ul>	V
6	<ul style="list-style-type: none"><li>• Anxiety towards new technology (I<sub>1</sub>)</li><li>• Lack of new technology skills (I<sub>8</sub>)</li><li>• The complexity of new technology (I<sub>10</sub>)</li></ul>	VI
7	<ul style="list-style-type: none"><li>• Lack of awareness of mobile wallet benefits (I<sub>9</sub>)</li></ul>	VII

**4.5 ISM based model:** With regard to the final reachability matrix (FRM) shown in the Table 4 and final levels of key inhibitors presented in the Table 5, an interpretive structural model (ISM) based model for the better understanding of the key inhibitors and their intricate relationship to the acceptance of mobile wallets in Oman was developed, and is presented in the Figure 2.



**Fig. 2** ISM based model for key inhibitors to the acceptance of mobile wallets in Oman

#### 4.6 Fuzzy direct relationship matrix

A fuzzy direct relationship matrix (FDRM) was constructed by putting a diagonal series of zero values into the correlation matrix, and by ignoring the transitivity rule of the initial RM. The traditional MICMAC analysis considers only a binary interaction (Duperrin & Godet 1973; Sindhu et al. 2016) and therefore to improve the sensitivity of traditional MICMAC analysis, an innovative application of fuzzy set theory was adopted. The investigation is enhanced as it considered the "possibility of reachability/achievement" along with the simple deliberation of reachability used thus far. According to the theory of fuzzy set, the possibilities of additional interactions between the challenges on the scale 0-1 (Khan et al. 2018) are constructed (see Table 6).

**Table 6** Crisp values of the reachability

Possibility of reachability	No	Negligible	Low	Medium	High	Very High	Full
Fuzzy values	0, 0, 0	0, 0.1, 0.3	0.1, 0.3, 0.5	0.3, 0.5, 0.7	0.5, 0.7, 0.9	0.7, 0.9, 1	1, 1, 1
Crisp Value	0	0.1	0.3	0.5	0.7	0.9	1

By using values provided in above Table 6, again the judgments of same experts as mentioned in 'survey development and data collection' subsection is considered to rate the

relationship between combinations of the two recognized inhibitors to the decision of mobile wallets acceptance by Omani residents. The fuzzy direct relationship matrix (FDRM) for recognized inhibitors to towards the mobile wallets acceptance was obtained and provided in Annexure-2.

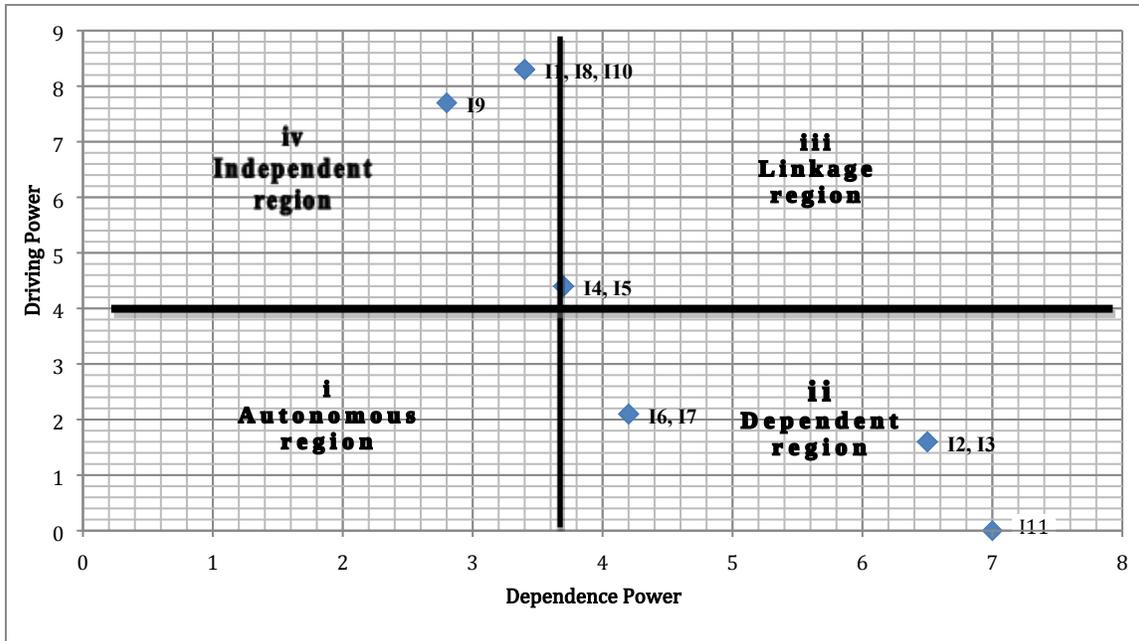
#### 4.7 Fuzzy MICMAC

Duperrin & Godet (1973) first introduced the notion of a very useful MICMAC method, and here it is a crucial exercise to categorize key inhibitors to the acceptance of mobile wallets in Oman. The fuzzy MICMAC derived from fuzzy direct relationship matrix (FDRM) is of great significance as there may be several important indirect relationships for any given challenge irrespective of its direct relationships. According to fuzzy MICMAC, initially, the FDRM was formed and the concept of fuzzy multiplication was used for stabilization. This helps in stabilizing the driving and dependence powers (Khan & Haleem 2015; Sindhu et al. 2016). The stabilized matrix for the acceptance of mobile wallets in Oman is provided in Table 7.

**Table 7** Stabilized matrix for key inhibitors to the acceptance of mobile wallets in Oman

<b>Key inhibitors</b>	<b>I<sub>1</sub></b>	<b>I<sub>2</sub></b>	<b>I<sub>3</sub></b>	<b>I<sub>4</sub></b>	<b>I<sub>5</sub></b>	<b>I<sub>6</sub></b>	<b>I<sub>7</sub></b>	<b>I<sub>8</sub></b>	<b>I<sub>9</sub></b>	<b>I<sub>10</sub></b>	<b>I<sub>11</sub></b>	<b>Driving Power</b>
I <sub>1</sub>	0.9	0.7	0.7	0.7	0.7	0.7	0.7	0.9	0.7	0.9	0.7	8.3
I <sub>2</sub>	0	0.9	0	0	0	0	0	0	0	0	0.7	1.6
I <sub>3</sub>	0	0	0.9	0	0	0	0	0	0	0	0.7	1.6
I <sub>4</sub>	0	0.7	0.7	0.9	0	0.7	0.7	0	0	0	0.7	4.4
I <sub>5</sub>	0	0.7	0.7	0	0.9	0.7	0.7	0	0	0	0.7	4.4
I <sub>6</sub>	0	0.7	0.7	0	0	0	0	0	0	0	0.7	2.1
I <sub>7</sub>	0	0.7	0.7	0	0	0	0	0	0	0	0.7	2.1
I <sub>8</sub>	0.9	0.7	0.7	0.7	0.7	0.7	0.7	0.9	0.7	0.9	0.7	8.3
I <sub>9</sub>	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	7.7
I <sub>10</sub>	0.9	0.7	0.7	0.7	0.7	0.7	0.7	0.9	0.7	0.9	0.7	8.3
I <sub>11</sub>	0	0	0	0	0	0	0	0	0	0	0	0.0
<b>Dependence power</b>	<b>3.4</b>	<b>6.5</b>	<b>6.5</b>	<b>3.7</b>	<b>3.7</b>	<b>4.2</b>	<b>4.2</b>	<b>3.4</b>	<b>2.8</b>	<b>3.4</b>	<b>7.0</b>	<b>48.8/48.8</b>

On the basis of the analysis presented in the Table 7, research team has presented fuzzy MICMAC analysis in the Fig. 3 for better understanding of key inhibitors influencing the decision of Omani residents towards the mobile wallets acceptance.



**Fig. 3** Fuzzy MICMAC analysis for key inhibitors of mobile wallets in Oman

According to the fuzzy MICMAC analysis, key inhibitors were divided into four categories on the basis of their driving and dependence powers. The four regions were:

#### 4.7.1 Autonomous region: Nil

In this category, the inhibitors have low driving and dependence power. The position of inhibitors remains close to the origin (see Figure 3) and in general remains disconnected from the whole system. Figure 3 reports no inhibitor present in this range. Consequently, among the recognized eleven inhibitors, all the inhibitors have enormous influence in the acceptance of mobile wallets in Oman.

#### 4.7.2 Dependent region: $I_6$ , $I_7$ , $I_2$ , $I_3$ , and $I_{11}$

In this category, there are inhibitors of high dependence and less driving power. These inhibitors appear at highest level of the structural model. The strong dependence of inhibitors signifies that they need all the other inhibitors to diminish the effect of these inhibitors during acceptance of mobile wallets in Oman. For this reason, practitioners must pay particular attention to these five inhibitors ( $I_6$ ,  $I_7$ ,  $I_2$ ,  $I_3$ , and  $I_{11}$ ) as they have been identified as dependent inhibitors. Their strong dependence indicates that they need countermeasures to manage them effectively. Thus, practitioners and policymakers should prioritize investments to remove/reduce these inhibitors.

#### 4.7.3 Linkage region: $I_4$ and $I_5$

In this category, inhibitors are high driving as well as holding high dependence power. Inhibitors falling in this region are not stable. These inhibitors will come in the middle of the structural model. Two inhibitors ( $I_4$  and  $I_5$ ) have been identified as the ‘linkage’ inhibitors. Careful attention will be required to remove these inhibitors.

#### 4.7.4 Independent region: $I_1, I_8, I_{10}$ , and $I_9$

In this category, the inhibitors are less dependent and high in driving power. These are therefore termed as key inhibitors. These inhibitors will come at bottom of the structural model as they represent foundations. Four inhibitors ( $I_1, I_8, I_{10}$ , and  $I_9$ ) have been reported as key inhibitors. Thus, practitioners and policymakers need to concentrate on these inhibitors more carefully.

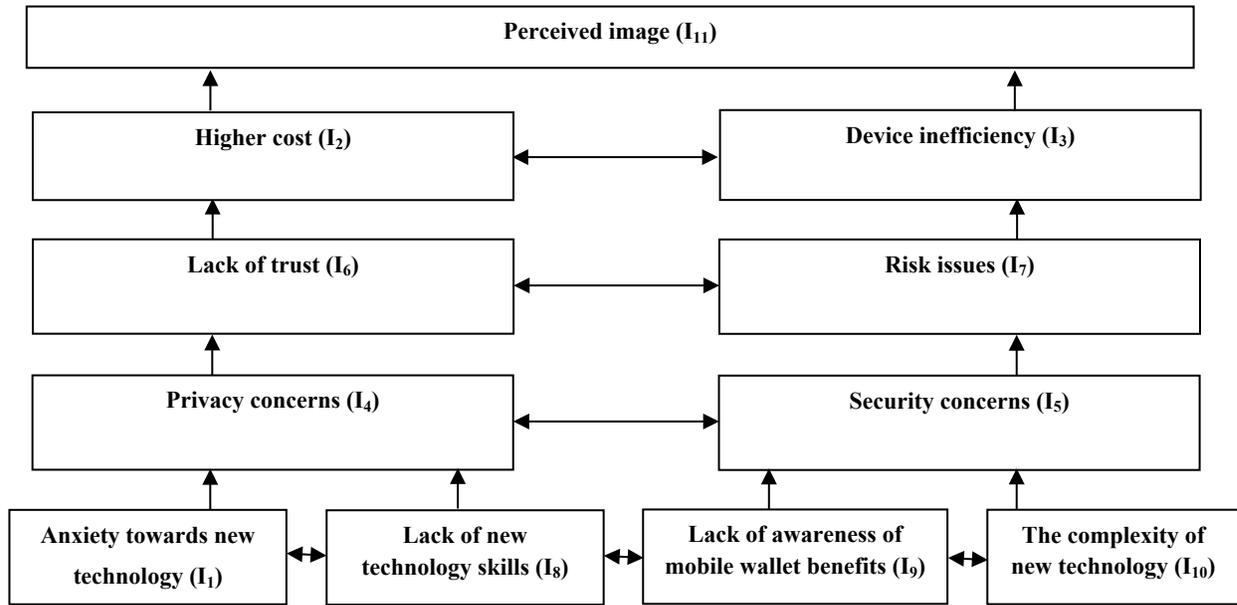
### 4.8 Integrated model

Using the driving as well as dependence powers, derived from the fuzzy stabilized matrix, an integrated model was developed. To obtain the effectiveness of each inhibitor, subtraction of driver power and dependence power is taken and is depicted in [Table 8](#).

**Table 8.** Effectiveness and ranking for key inhibitors to the acceptance of mobile wallets

Key inhibitors	Driving Power	Dependence Power	Effectiveness (Driving power- Dependence power)	A level in the integrated model
$I_1$	8.3	3.4	4.9	V
$I_2$	1.6	6.5	-4.9	II
$I_3$	1.6	6.5	-4.9	II
$I_4$	4.4	3.7	0.7	IV
$I_5$	4.4	3.7	0.7	IV
$I_6$	2.1	4.2	-2.1	III
$I_7$	2.1	4.2	-2.1	III
$I_8$	8.3	3.4	4.9	V
$I_9$	7.7	2.8	4.9	V
$I_{10}$	8.3	3.4	4.9	V
$I_{11}$	0.0	7.0	-7.0	I

The inhibitors described with low value of effectiveness are positioned at the higher levels in the model and vice versa. Based upon their effectiveness, the integrated model for key inhibitors is developed and depicted in Fig. 4.



**Fig. 4** Integrated model for key inhibitors to the acceptance of mobile wallets in Oman

## 5 Discussion and Implications

### 5.1 Discussion on comparisons of ISM and ISM-Fuzzy MICMAC Based Models

The ISM model shown in Fig. 2 shows the contribution of ‘Lack of awareness of mobile wallet benefits (I<sub>9</sub>)’ comes at level 7 from the foundation of the hierarchical structure for mobile wallet acceptance. Therefore, the inhibitor I<sub>9</sub> is significantly limiting the recognition of mobile wallets among users in Oman. On the other hand, according to the integrated ISM based model, the inhibitor, I<sub>9</sub> comes at level 5. It means that ‘Lack of awareness of mobile wallet benefits (I<sub>9</sub>)’ is the key inhibitor to the acceptance of mobile wallets in Oman. **The mobile wallet is a relatively new concept in Oman. At first glance, it is a general practice in Oman from the perspective of buyers as well as sellers that a large section of society prefers transactions in cash as well as face to face banking for fund transfers. This reason behind could be identified as the lack awareness of the number of advantages of mobile wallets usage (Turki, 2017).**

The developed model (Fig. 2 and Fig. 4), ‘Perceived image (I<sub>11</sub>)’ inhibitor approaching towards the utmost level 1 in both the ISM and integrated ISM based model. Thus, an inhibitor positioned at level 1 will not contribute to removing other inhibitor positioned at the level below it. From integrated ISM based model (Fig. 4), the inhibitors, ‘Anxiety

towards new technology (I<sub>1</sub>)', 'Lack of new technology skills (I<sub>8</sub>)', 'Lack of awareness of mobile wallet benefits (I<sub>9</sub>)', and 'Complexity of new technology (I<sub>10</sub>)' have higher effectiveness and come at level 5 collectively. These four inhibitors will influence mutually and perform as an important inhibitor for adopting the mobile wallet. On the other hand, the inhibitors I<sub>1</sub>, I<sub>8</sub>, and I<sub>10</sub> come at level 6 in the ISM model, they also affect each other mutually in adopting mobile wallet concepts. Normally, people are interested but due to lack of knowledge about new technology and technological complexity, a large segment of the population is not comfortable with the use of mobile wallets. It means that lack of awareness of the customer, still the challenge of gaining the trust of customers is one of the key challenges facing the acceptance of mobile wallets in Oman.

The inhibitors related to technology (new technology, technology skills, the complexity of technology etc.) would lead to 'Privacy concerns (I<sub>4</sub>)' and 'Security concerns (I<sub>5</sub>)' for the users. At the moment, the regulatory framework for financial transactions via mobile wallets is currently not well developed. Mallat (2007) suggested that the 'lack of consumer perceived security' and 'trust in payment systems' are among the key problematic issues to e-commerce/m-commerce transactions. Privacy and security concerns (I<sub>4</sub> and I<sub>5</sub>) affecting each mutually and recognized as the leading inhibitors for the users for mobile wallet acceptance. From ISM based model, privacy concerns and security concerns would support 'Lack of trust (I<sub>6</sub>)' and 'Risk issues (I<sub>7</sub>)'. Ramadan & Aita (2018) reported in their study that service providers of mobile wallets should strive to improve technology issues especially those concerning privacy protection which, in turn, could enhance customers' experience and trust towards mobile wallet applications. The inhibitors, lack of trust and risk issues affecting each mutually and play a significant role in limiting the use of mobile wallet concept in Oman. Shin (2009) suggested that trust is more important for users compared to financial risks, such as account hacking, frauds etc. The financial loss is also a limiting factor among users to accept the mobile wallet concept. These two inhibitors I<sub>6</sub> and I<sub>7</sub> are affecting 'Higher cost (I<sub>2</sub>)' and 'Device inefficiency (I<sub>3</sub>)', which are lying at level 2 in mobile wallets acceptance. Notably, the inhibitors, higher cost, and device inefficiency are affecting mutually each other and inhibiting mobile wallet process adoption among users.

Next to this level be level 1 i.e. topmost level in both the ISM and integrated ISM based developed model, which contains inhibitor related to ‘Perceived image ( $I_{11}$ )’. This inhibitor is highly driven by other inhibitors in process of mobile wallet concepts among users in Oman.

### *5.2 Implications for the practice*

This section provides several noticeable implications to accept mobile wallet concepts in Oman, a leading economy in GCC countries. The findings of this research facilitate decision making in public and private organizations from the strategic point of view by providing key inputs in multiple domains where mobile users perceive that mobile wallet is directly associated with what and by providing key inputs to system analysts. In addition, the findings will provide strategic inputs to the telecommunication and financial service providers who are planning to invest their capital in the growing technology. This research will also help policymakers in banking organizations and government bodies to eradicate the problematic issues and understand benefits by adopting mobile wallet models in practice.

This is the first study focusing on the examination of inter-relationships among key inhibitors of mobile wallet acceptance in one of the prominent Gulf countries namely Oman. As the Government of Oman is investing a huge amount of money on developing e-infrastructure to provide cost-effective, convenient, customer-centric, and secure e-commerce transactions to minimize digital divide and empower Omani resident’s life for better, so understanding key inhibitors provides better insights to the top management to develop appropriate strategies to overcome them. Furthermore, the integration of mobile wallet will help multiple stakeholders namely businesses, residents, expatriates and others to save time as well as money with the help of such smart and innovative technologies.

“Omanuna” is the official Oman e-Government services portal and one of its key objectives is e-payment implementation across the country. According to the findings, security, privacy, trust, and risk are key inhibitors of mobile wallet acceptance. The main concerns related to the aforementioned inhibitors are validation and concealment of online transactions. In addition, unauthorized access and third party usage of personal data provided by users are also serious concerns. Therefore, many researchers have highlighted the significance of trust in mobile transactions in general and mobile wallet in particular as

mobile number as well as other personal details are shared with the merchant. Lin & Wang (2006) have validated that trust is one of the key predictors of satisfaction as well as customer loyalty in the context of mobile transactions. Government agencies need to pay more attention to developing regulations aligned with recent ICT developments, which ensures higher security and privacy and minimum risk in mobile wallet transactions. In addition, trust plays a very crucial role in the acceptance of advanced technology in the Omani society (Sharma 2017). Decision makers should give higher priority to trust building measures by minimizing errors in mobile wallet transactions such as wrong public keys, invalid Merchant Identification Number (MIN), unable to pair, decryption failure, invalid element data, among other possible errors. Therefore, it is important for systems analysts and developers to strengthen trust among users by avoiding the aforementioned technical errors in the newly launched mobile wallet in Oman.

The findings also suggest that low awareness of the benefits of the mobile wallet in the context of Oman is another key inhibitor. Therefore, decision-makers in banking systems need to pay attention to formulate an appropriate strategy to spread awareness about the key benefits of the mobile wallet. For example, it should be regularly published through print and social media that no personal information, as well as transactional logs, are stored with the seller. In addition, the residents may be educated as to how mobile wallet can be used for online shopping, bill payments, fund transfer to family members, relatives and others as well without necessitating the need of carrying multiple cards in physical wallet. Mobile wallet subscribers can deposit and withdraw money from a bank by visiting a branch of the bank where they do not have account. Furthermore, it can also be mentioned in advertisements that the Central Bank of Oman (CBO) monitors key policies related to financial transactions in the mobile wallet. Spreading awareness in this manner will boost the confidence of customers towards the higher usage of the mobile wallet in Oman.

Finally, it was revealed that anxiety towards new technology, lack of new technology skills and complexity of new technology are also the key inhibitors to mobile wallet acceptance in Oman. The possible reason for these inhibitors among Omani residents is the lower penetration of mobile wallet. Anxiety towards new technology can be minimized by a number of ways. For example, by publishing short paragraph in local language about benefits of mobile wallet and demonstrating working of mobile wallet at public places.

Lack of new technology skills and complexity of new technology are the key inhibitors to people who are not tech-savvy. Specialized and targeted programs on required skills sets and ease of operations of mobile wallet can be developed for non tech-savvy people specially in semi-urban areas of Oman. Overall, these recommendations with more innovative ways may minimize the impact of inhibitors of mobile wallet acceptance in a GCC country.

## **6 Conclusions, Limitations, and Future Work**

The integration of information and communication technology, payment methods and smartphones are providing new opportunities for business. The mobile wallet is considered as one of these opportunities for users and policymakers despite its proposed impact on data security and privacy issues, on new higher flexibility and satisfaction in such models by GCC countries. The present research aims to identify and evaluate the inhibitors linked to mobile wallet acceptance especially in countries such as Oman. We have identified 11 key inhibitors from the literature and expert engagement. This work seeks to recognize the contextual relationships between numerous identified inhibitors and develop a hierarchical structure of inhibitors to adopt the mobile wallet in Gulf countries especially in Oman context.

This work employs an ISM - Fuzzy MICMAC based integrated approach to achieve the desired objective of this work. 'Lack of awareness of mobile wallet benefits ( $I_9$ )', 'Anxiety towards new technology ( $I_1$ )', 'Lack of new technology skills ( $I_8$ )', and 'Complexity of new technology ( $I_{10}$ )' inhibitors have been found higher effectiveness and placed the bottom of the developed hierarchical model. 'Awareness and knowledge of mobile wallet benefits' would encourage users to accept this concept. The findings of this work would be important for understanding the difference between independent and dependent inhibitors and improving the mobile wallet acceptability in gulf countries by knowing their mutual relationships. This research can serve as a benchmarking study to guide users, banking organizations, and vendors to diffuse mobile payment concepts in Oman or GCC region in a most effective way.

This research has a few limitations as well. The developed model uses expert's feedback, which may be biased. The identification of inhibitors was quite tricky. **Further, a Total Interpretive Structural Model (TISM) and Structural Equation Modelling (SEM) may also**

be applied to validate the current model. Further, a DEMATEL technique may be used to segment recognized inhibitors in to cause and effect group. Multi-Criteria Decision Making (MCDM) approaches such as AHP, ANP, VIKOR, and TOPSIS may be used to rank identified inhibitors. The findings of the study may be adopted in other GCC countries by marginal modifications.

## References

1. Ajzen, I., & Fishbein, M. (1988). Theory of reasoned action-Theory of planned behaviour. *University of South Florida*.
2. Akinci, S., Aksoy, Ş., & Atilgan, E. (2004). Adoption of internet banking among sophisticated consumer segments in an advanced developing country. *International Journal of Bank Marketing*, 22(3), 212-232.
3. Al-Somali, S. A., Gholami, R., & Clegg, B. (2009). An investigation into the acceptance of online banking in Saudi Arabia. *Technovation*, 29(2), 130-141.
4. Amoroso, D. L., & Magnier-Watanabe, R. (2012). Building a research model for mobile wallet consumer adoption: the case of mobile Suica in Japan. *Journal of Theoretical and Applied Electronic Commerce Research*, 7(1), 94-110.
5. Ankar, B., & Walden, P. (2003). Factors affecting consumer adoption decisions and intents in mobile commerce: Empirical insights. *BLED 2003 Proceedings*, 28.
6. Ansari, M. F., Kharb, R. K., Luthra, S., Shimmi, S. L., & Chatterji, S. (2013). Analysis of barriers to implement solar power installations in India using interpretive structural modelling technique. *Renewable and Sustainable Energy Reviews*, 27, 163-174.
7. Au, Y. A., & Kauffman, R. J. (2008). The economics of mobile payments: Understanding stakeholder issues for an emerging financial technology application. *Electronic Commerce Research and Applications*, 7(2), 141-164.
8. Capgemini (2017). "Top 10 Trends in Payments- 2017." Retrieved from [https://www.capgemini.com/wpcontent/uploads/2017/07/top\\_10\\_payments\\_trends\\_2017\\_0.pdf](https://www.capgemini.com/wpcontent/uploads/2017/07/top_10_payments_trends_2017_0.pdf)
9. Carlsson, C., & Walden, P. (2002, June). Mobile commerce: a summary of quests for value-added products and services. In *Proceedings of the 15th Bled Electronic Commerce Conference* (pp. 17-19).
10. Chen, L. D. (2008). A model of consumer acceptance of mobile payment. *International Journal of Mobile Communications*, 6(1), 32-52.
11. Dahlberg, T., Guo, J., & Ondrus, J. (2015). A critical review of mobile payment research. *Electronic Commerce Research and Applications*, 14(5), 265-284.

12. Dahlberg, T., Mallat, N., Ondrus, J., & Zmijewska, A. (2008). Past, present and future of mobile payments research: A literature review. *Electronic Commerce Research and Applications*, 7(2), 165-181.
13. Davis, F. D., Bagozzi, R. P., & Warshaw, P. R. (1989). User acceptance of computer technology: a comparison of two theoretical models. *Management science*, 35(8), 982-1003.
14. Dauda, S. Y., & Lee, J. (2015). Technology adoption: A conjoint analysis of consumers' preference on future online banking services. *Information Systems*, 53, 1-15.
15. De Kerviler, G., Demoulin, N. T., & Zidda, P. (2016). Adoption of in-store mobile payment: Are perceived risk and convenience the only drivers?. *Journal of Retailing and Consumer Services*, 31, 334-344.
16. Diabat, A., & Govindan, K. (2011). An analysis of the drivers affecting the implementation of green supply chain management. *Resources, Conservation and Recycling*, 55(6), 659-667.
17. Duperrin, JC, & Godet, M. (1973). Method of hierarchizing the elements of a system. *Economic report of the CEA*, 1 (2), 49-51.
18. Dwivedi, Y. K., Tamilmani, K., Williams, M. D., & Lal, B. (2014). Adoption of M-commerce: examining factors affecting intention and behaviour of Indian consumers. *International Journal of Indian Culture and Business Management*, 8(3), 345-360.
19. Dwivedi, Y. K., Rana, N. P., Jeyaraj, A., Clement, M., & Williams, M. D. (2017). Re-examining the unified theory of acceptance and use of technology (UTAUT): Towards a revised theoretical model. *Information Systems Frontiers*, 1-16.
20. Faqih, K. M., & Jaradat, M. I. R. M. (2015). Assessing the moderating effect of gender differences and individualism-collectivism at individual-level on the adoption of mobile commerce technology: TAM3 perspective. *Journal of Retailing and Consumer Services*, 22, 37-52.
21. Gorane, S. J., & Kant, R. (2013). Modelling the SCM enablers: an integrated ISM-fuzzy MICMAC approach. *Asia Pacific Journal of Marketing and Logistics*, 25(2), 263-286.
22. GSMA (2016). "THE MOBILE ECONOMY MIDDLE EAST AND NORTH AFRICA-2016". Retrieved from <https://www.gsmainelligence.com/research/?file=9246bbe14813f73dd85b97a90738c860&download>
23. Hanafizadeh, P., Behboudi, M., Koshksaray, A. A., & Tabar, M. J. S. (2014). Mobile-banking adoption by Iranian bank clients. *Telematics and Informatics*, 31(1), 62-78.
24. Hew, J. J., Lee, V. H., Ooi, K. B., & Wei, J. (2015). What catalyses mobile apps usage intention: an empirical analysis. *Industrial Management & Data Systems*, 115(7), 1269-1291.
25. Howcroft, B., Hamilton, R., & Hower, P. (2002). Consumer attitude and the usage and adoption of home-based banking in the United Kingdom. *International Journal of Bank Marketing*, 20(3), 111-121.
26. Jakhar, S. K., & Barua, M. K. (2014). An integrated model of supply chain performance evaluation and decision-making using structural equation modelling and fuzzy AHP. *Production Planning & Control*, 25(11), 938-957.

27. Janssen, M., Rana, N. P., Slade, E. L., & Dwivedi, Y. K. (2017). Trustworthiness of digital government services: deriving a comprehensive theory through interpretive structural modelling. *Public Management Review*, 1-25.
28. Jin, Y., Wang, S., Qu, Y., Guo, Q., & Li, J. (2017, May). Study on Security of Mobile Payment. In *International Conference on Mechatronics and Intelligent Robotics* (pp. 123-127). Springer, Cham.
29. Kapoor, K. K., Dwivedi, Y. K., & Williams, M. D. (2015). Examining the role of three sets of innovation attributes for determining adoption of the interbank mobile payment service. *Information Systems Frontiers*, 17(5), 1039-1056.
30. Khan, H., Talib, F., & Faisal, M. N. (2015). An analysis of the barriers to the proliferation of M-Commerce in Qatar: A relationship modelling approach. *Journal of Systems and Information Technology*, 17(1), 54-81.
31. Khan, S., Haleem, A., Khan, M. I., Abidi, M. H., & Al-Ahmari, A. (2018). Implementing traceability systems in specific supply chain management (SCM) through Critical Success Factors (CSFs). *Sustainability*, 10(1), 204.
32. Khan, U., & Haleem, A. (2015). Improving to Smart Organization: An integrated ISM and fuzzy-MICMAC modelling of barriers. *Journal of Manufacturing Technology Management*, 26(6), 807-829.
33. Kuisma, T., Laukkanen, T., & Hiltunen, M. (2007). Mapping the reasons for resistance to Internet banking: A means-end approach. *International Journal of Information Management*, 27(2), 75-85.
34. Laukkanen, T. (2016). Consumer adoption versus rejection decisions in seemingly similar service innovations: The case of the Internet and mobile banking. *Journal of Business Research*, 69(7), 2432-2439.
35. Liébana-Cabanillas, F., Marinković, V., & Kalinić, Z. (2017). A SEM-neural network approach for predicting antecedents of m-commerce acceptance. *International Journal of Information Management*, 37(2), 14-24.
36. Lin, H. H., & Wang, Y. S. (2006). An examination of the determinants of customer loyalty in mobile commerce contexts. *Information & Management*, 43(3), 271-282.
37. Liu, J., Kauffman, R. J., & Ma, D. (2015). Competition, cooperation, and regulation: Understanding the evolution of the mobile payments technology ecosystem. *Electronic Commerce Research and Applications*, 14(5), 372-391.
38. Luthra, S., Govindan, K., Kannan, D., Mangla, S. K., & Garg, C. P. (2017). An integrated framework for sustainable supplier selection and evaluation in supply chains. *Journal of Cleaner Production*, 140, 1686-1698.
39. Luthra, S., Govindan, K., Kharb, R. K., & Mangla, S. K. (2016). Evaluating the enablers in solar power developments in the current scenario using fuzzy DEMATEL: An Indian perspective. *Renewable and Sustainable Energy Reviews*, 63, 379-397.

40. Madden, T. J., Ellen, P. S., & Ajzen, I. (1992). A comparison of the theory of planned behaviour and the theory of reasoned action. *Personality and social psychology Bulletin*, 18(1), 3-9.
41. Mallat, N. (2007). Exploring consumer adoption of mobile payments—A qualitative study. *The Journal of Strategic Information Systems*, 16(4), 413-432.
42. Mangla, S. K., Govindan, K., & Luthra, S. (2016). Critical success factors for reverse logistics in Indian industries: a structural model. *Journal of Cleaner Production*, 129, 608-621.
43. Mangla, S. K., Kumar, P., & Barua, M. K. (2015). Risk analysis in green supply chain using fuzzy AHP approach: A case study. *Resources, Conservation and Recycling*, 104, 375-390.
44. Mangla, S., Madaan, J., & Chan, F. T. (2013). Analysis of flexible decision strategies for sustainability-focused green product recovery system. *International Journal of Production Research*, 51(11), 3428-3442.
45. Natarajan, T., Balasubramanian, S. A., & Kasilingam, D. L. (2017). Understanding the intention to use mobile shopping applications and its influence on price sensitivity. *Journal of Retailing and Consumer Services*, 37, 8-22.
46. NSCI -National Center for Statistics and Information. (2017). Enhancing Knowledge Sultanate of Oman. Retrieved from [https://www.ncsi.gov.om/Elibrary/LibraryContentDoc/bar\\_bar\\_Dec%202017\\_79a640b1-a2ca-436a-89f1-816fd68dbe21.pdf](https://www.ncsi.gov.om/Elibrary/LibraryContentDoc/bar_bar_Dec%202017_79a640b1-a2ca-436a-89f1-816fd68dbe21.pdf)
47. Oliveira, T., Thomas, M., Baptista, G., & Campos, F. (2016). Mobile payment: Understanding the determinants of customer adoption and intention to recommend the technology. *Computers in Human Behavior*, 61, 404-414.
48. Oman Observer (2017), <http://www.omobserver.om/bank-muscat-launches-omans-first-e-payment-bm-wallet/>
49. Patel, K. J., & Patel, H. J. (2017). Adoption of internet banking services in Gujarat: An extension of TAM with perceived security and social influence. *International Journal of Bank Marketing*, (just-accepted), 00-00.
50. Patil, P. P., Dwivedi, Y. K., & Rana, N. P. (2017, November). Digital Payments Adoption: An Analysis of Literature. In *Conference on e-Business, e-Services and e-Society* (pp. 61-70). Springer, Cham.
51. Qin, Z., Sun, J., Wahaballa, A., Zheng, W., Xiong, H., & Qin, Z. (2017). A secure and privacy-preserving mobile wallet with outsourced verification in cloud computing. *Computer Standards & Interfaces*, 54, 55-60.
52. Ramadan, R., & Aita, J. (2018). A model of mobile payment usage among Arab consumers. *International Journal of Bank Marketing*, <https://doi.org/10.1108/IJBM-05-2017-0080>
53. Riquelme, H. E., & Rios, R. E. (2010). The moderating effect of gender in the adoption of mobile banking. *International Journal of bank marketing*, 28(5), 328-341.
54. Rogers, E.M. (1995) *Diffusion of Innovations*, 4th edition. The Free Press, New York.
- 55.

56. Sage A. P. (1977). *Interpretive structural modelling: methodology for large-scale systems*. McGraw-Hill, New York, 91-164.
57. Salisbury, W. D., Pearson, R. A., Pearson, A. W., & Miller, D. W. (2001). Perceived security and World Wide Web purchase intention. *Industrial Management & Data Systems*, 101(4), 165-177.
58. Sharma, S. K. (2017). Integrating cognitive antecedents into TAM to explain mobile banking behavioural intention: A SEM-neural network modelling. *Information Systems Frontiers*, 1-13.
59. Sharma, S. K., Gaur, A., Saddikuti, V., & Rastogi, A. (2017). Structural equation model (SEM)-neural network (NN) model for predicting quality determinants of e-learning management systems. *Behaviour & Information Technology*, 36(10), 1053-1066.
60. Shaw, N. (2014). The mediating influence of trust in the adoption of the mobile wallet. *Journal of Retailing and Consumer Services*, 21(4), 449-459.
61. Shaw, N. (2015, August). The mediating role of perceived security: An empirical study of mobile wallet adoption in USA. In *International Conference on HCI in Business* (pp. 358-369). Springer, Cham.
62. Shin, D. H. (2009). Towards an understanding of the consumer acceptance of mobile wallet. *Computers in Human Behaviour*, 25(6), 1343-1354.
63. Sindhu, S., Nehra, V., & Luthra, S. (2016). Identification and analysis of barriers in implementation of solar energy in Indian rural sector using integrated ISM and fuzzy MICMAC approach. *Renewable and Sustainable Energy Reviews*, 62, 70-88.
64. Slade, E. L., Dwivedi, Y. K., Piercy, N. C., & Williams, M. D. (2015). Modelling consumers' adoption intentions of remote mobile payments in the United Kingdom: extending UTAUT with innovativeness, risk, and trust. *Psychology & Marketing*, 32(8), 860-873.
65. Slade, E. L., Williams, M. D., & Dwivedi, Y. K. (2013). Mobile payment adoption: Classification and review of the extant literature. *The Marketing Review*, 13(2), 167-190.
66. Turki, A. M. J. (2017). *Adoption and acceptance of mobile commerce in Saudi Arabia: the case of e-ticketing in the airline industry* (Doctoral dissertation, University of Brighton).
67. Van der Boor, P., Oliveira, P., & Veloso, F. (2014). Users as innovators in developing countries: The global sources of innovation and diffusion in mobile banking services. *Research Policy*, 43(9), 1594-1607.
68. Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. *MIS Quarterly*, 425-478.
69. Venkatesh, V., Thong, J. Y., & Xu, X. (2012). Consumer acceptance and use of information technology: extending the unified theory of acceptance and use of technology. *MIS Quarterly*, 157-178.
70. Wang, Y., Hahn, C., & Sutrave, K. (2016, February). Mobile payment security, threats, and challenges. In *Mobile and Secure Services (MobiSecServ), 2016 Second International Conference on* (pp. 1-5). IEEE.
71. Warfield, J. N. (1974). Developing subsystem matrices in structural modelling. *IEEE Transactions on Systems, Man, and Cybernetics*, (1), 74-80.

72. Yang, K., & Forney, J. C. (2013). The moderating role of consumer technology anxiety in mobile shopping adoption: differential effects of facilitating conditions and social influences. *Journal of Electronic Commerce Research*, 14(4), 334-xxx.
73. Zhang, L., Zhu, J., & Liu, Q. (2012). A meta-analysis of mobile commerce adoption and the moderating effect of culture. *Computers in Human Behaviour*, 28(5), 1902-1911.
74. Zhao, H., & Muftic, S. (2011). Design and implementation of a mobile transactions client system: Secure UICC mobile wallet. *International Journal for Information Security Research*, 1(3), 113-120.
75. Zhao, J., & de Pablos, P. O. (2011). Regional knowledge management: the perspective of management theory. *Behaviour & Information Technology*, 30(1), 39-49.

## Annexure-1

### Level Partitioning

#### 2<sup>nd</sup> Iteration

Element P(i)	Reachability Set R(Pi)	Antecedent Set: A(Pi)	Intersection R(Pi) & A(Pi)	Level
I <sub>1</sub>	I <sub>1</sub> ,I <sub>2</sub> ,I <sub>3</sub> ,I <sub>4</sub> ,I <sub>5</sub> ,I <sub>6</sub> ,I <sub>7</sub> ,I <sub>8</sub> ,I <sub>10</sub>	I <sub>1</sub> ,I <sub>8</sub> ,I <sub>9</sub> ,I <sub>10</sub>	I <sub>1</sub> ,I <sub>8</sub> ,I <sub>10</sub>	
I <sub>2</sub>	I <sub>2</sub> ,I <sub>3</sub>	I <sub>1</sub> ,I <sub>2</sub> ,I <sub>3</sub> ,I <sub>4</sub> ,I <sub>5</sub> ,I <sub>6</sub> ,I <sub>7</sub> ,I <sub>8</sub> ,I <sub>9</sub> ,I <sub>10</sub>	I <sub>2</sub> ,I <sub>3</sub>	II
I <sub>3</sub>	I <sub>2</sub> ,I <sub>3</sub>	I <sub>1</sub> ,I <sub>2</sub> ,I <sub>3</sub> ,I <sub>4</sub> ,I <sub>5</sub> ,I <sub>6</sub> ,I <sub>7</sub> ,I <sub>8</sub> ,I <sub>9</sub> ,I <sub>10</sub>	I <sub>2</sub> ,I <sub>3</sub>	II
I <sub>4</sub>	I <sub>2</sub> ,I <sub>3</sub> ,I <sub>4</sub> ,I <sub>5</sub> ,I <sub>6</sub> ,I <sub>7</sub>	I <sub>1</sub> ,I <sub>4</sub> ,I <sub>5</sub> ,I <sub>8</sub> ,I <sub>9</sub> ,I <sub>10</sub>	I <sub>4</sub> ,I <sub>5</sub>	
I <sub>5</sub>	I <sub>2</sub> ,I <sub>3</sub> ,I <sub>4</sub> ,I <sub>5</sub> ,I <sub>6</sub> ,I <sub>7</sub>	I <sub>1</sub> ,I <sub>4</sub> ,I <sub>5</sub> ,I <sub>8</sub> ,I <sub>9</sub> ,I <sub>10</sub>	I <sub>4</sub> ,I <sub>5</sub>	
I <sub>6</sub>	I <sub>2</sub> ,I <sub>3</sub> ,I <sub>6</sub> ,I <sub>7</sub>	I <sub>1</sub> ,I <sub>4</sub> ,I <sub>5</sub> ,I <sub>6</sub> ,I <sub>8</sub> ,I <sub>9</sub> ,I <sub>10</sub>	I <sub>6</sub>	
I <sub>7</sub>	I <sub>2</sub> ,I <sub>3</sub> ,I <sub>7</sub>	I <sub>1</sub> ,I <sub>4</sub> ,I <sub>5</sub> ,I <sub>6</sub> ,I <sub>7</sub> ,I <sub>8</sub> ,I <sub>9</sub> ,I <sub>10</sub>	I <sub>7</sub>	
I <sub>8</sub>	I <sub>1</sub> ,I <sub>2</sub> ,I <sub>3</sub> ,I <sub>4</sub> ,I <sub>5</sub> ,I <sub>6</sub> ,I <sub>7</sub> ,I <sub>8</sub> ,I <sub>10</sub>	I <sub>1</sub> ,I <sub>8</sub> ,I <sub>9</sub> ,I <sub>10</sub>	I <sub>1</sub> ,I <sub>8</sub> ,I <sub>10</sub>	
I <sub>9</sub>	I <sub>1</sub> ,I <sub>2</sub> ,I <sub>3</sub> ,I <sub>4</sub> ,I <sub>5</sub> ,I <sub>6</sub> ,I <sub>7</sub> ,I <sub>8</sub> ,I <sub>9</sub> ,I <sub>10</sub>	I <sub>9</sub>	I <sub>9</sub>	
I <sub>10</sub>	I <sub>1</sub> ,I <sub>2</sub> ,I <sub>3</sub> ,I <sub>4</sub> ,I <sub>5</sub> ,I <sub>6</sub> ,I <sub>7</sub> ,I <sub>8</sub> ,I <sub>10</sub>	I <sub>1</sub> ,I <sub>8</sub> ,I <sub>10</sub>	I <sub>1</sub> ,I <sub>8</sub> ,I <sub>10</sub>	

#### 3<sup>rd</sup> Iteration

Element P(i)	Reachability Set R(Pi)	Antecedent Set: A(Pi)	Intersection R(Pi) & A(Pi)	Level
I <sub>1</sub>	I <sub>1</sub> ,I <sub>4</sub> ,I <sub>5</sub> ,I <sub>6</sub> ,I <sub>7</sub> ,I <sub>8</sub> ,I <sub>10</sub>	I <sub>1</sub> ,I <sub>8</sub> ,I <sub>9</sub> ,I <sub>10</sub>	I <sub>1</sub> ,I <sub>8</sub> ,I <sub>10</sub>	
I <sub>4</sub>	I <sub>4</sub> ,I <sub>5</sub> ,I <sub>6</sub> ,I <sub>7</sub>	I <sub>1</sub> ,I <sub>4</sub> ,I <sub>5</sub> ,I <sub>8</sub> ,I <sub>9</sub> ,I <sub>10</sub>	I <sub>4</sub> ,I <sub>5</sub>	
I <sub>5</sub>	I <sub>4</sub> ,I <sub>5</sub> ,I <sub>6</sub> ,I <sub>7</sub>	I <sub>1</sub> ,I <sub>4</sub> ,I <sub>5</sub> ,I <sub>8</sub> ,I <sub>9</sub> ,I <sub>10</sub>	I <sub>4</sub> ,I <sub>5</sub>	

I <sub>6</sub>	I <sub>6</sub> ,I <sub>7</sub>	I <sub>1</sub> ,I <sub>4</sub> ,I <sub>5</sub> ,I <sub>6</sub> ,I <sub>8</sub> ,I <sub>9</sub> ,I <sub>10</sub>	I <sub>6</sub>	III
I <sub>7</sub>	I <sub>7</sub>	I <sub>1</sub> ,I <sub>4</sub> ,I <sub>5</sub> ,I <sub>6</sub> ,I <sub>7</sub> ,I <sub>8</sub> ,I <sub>9</sub> ,I <sub>10</sub>	I <sub>7</sub>	
I <sub>8</sub>	I <sub>1</sub> ,I <sub>4</sub> ,I <sub>5</sub> ,I <sub>6</sub> ,I <sub>7</sub> ,I <sub>8</sub> ,I <sub>10</sub>	I <sub>1</sub> ,I <sub>8</sub> ,I <sub>9</sub> ,I <sub>10</sub>	I <sub>1</sub> ,I <sub>8</sub> ,I <sub>10</sub>	
I <sub>9</sub>	I <sub>1</sub> ,I <sub>4</sub> ,I <sub>5</sub> ,I <sub>6</sub> ,I <sub>7</sub> ,I <sub>8</sub> ,I <sub>9</sub> ,I <sub>10</sub>	I <sub>9</sub>	I <sub>9</sub>	
I <sub>10</sub>	I <sub>1</sub> ,I <sub>4</sub> ,I <sub>5</sub> ,I <sub>6</sub> ,I <sub>7</sub> ,I <sub>8</sub> ,I <sub>10</sub>	I <sub>1</sub> ,I <sub>8</sub> ,I <sub>10</sub>	I <sub>1</sub> ,I <sub>8</sub> ,I <sub>10</sub>	

#### 4<sup>th</sup> Iteration

Element P(i)	Reachability Set R(Pi)	Antecedent Set: A(Pi)	Intersection R(Pi) & A(Pi)	Level
I <sub>1</sub>	I <sub>1</sub> ,I <sub>4</sub> ,I <sub>5</sub> ,I <sub>6</sub> ,I <sub>8</sub> ,I <sub>10</sub>	I <sub>1</sub> ,I <sub>8</sub> ,I <sub>9</sub> ,I <sub>10</sub>	I <sub>1</sub> ,I <sub>8</sub> ,I <sub>10</sub>	IV
I <sub>4</sub>	I <sub>4</sub> ,I <sub>5</sub> ,I <sub>6</sub>	I <sub>1</sub> ,I <sub>4</sub> ,I <sub>5</sub> ,I <sub>8</sub> ,I <sub>9</sub> ,I <sub>10</sub>	I <sub>4</sub> ,I <sub>5</sub>	
I <sub>5</sub>	I <sub>4</sub> ,I <sub>5</sub> ,I <sub>6</sub>	I <sub>1</sub> ,I <sub>4</sub> ,I <sub>5</sub> ,I <sub>8</sub> ,I <sub>9</sub> ,I <sub>10</sub>	I <sub>4</sub> ,I <sub>5</sub>	
I <sub>6</sub>	I <sub>6</sub>	I <sub>1</sub> ,I <sub>4</sub> ,I <sub>5</sub> ,I <sub>6</sub> ,I <sub>8</sub> ,I <sub>9</sub> ,I <sub>10</sub>	I <sub>6</sub>	
I <sub>8</sub>	I <sub>1</sub> ,I <sub>4</sub> ,I <sub>5</sub> ,I <sub>6</sub> ,I <sub>8</sub> ,I <sub>10</sub>	I <sub>1</sub> ,I <sub>8</sub> ,I <sub>9</sub> ,I <sub>10</sub>	I <sub>1</sub> ,I <sub>8</sub> ,I <sub>10</sub>	
I <sub>9</sub>	I <sub>1</sub> ,I <sub>4</sub> ,I <sub>5</sub> ,I <sub>6</sub> ,I <sub>8</sub> ,I <sub>9</sub> ,I <sub>10</sub>	I <sub>9</sub>	I <sub>9</sub>	
I <sub>10</sub>	I <sub>1</sub> ,I <sub>4</sub> ,I <sub>5</sub> ,I <sub>6</sub> ,I <sub>8</sub> ,I <sub>10</sub>	I <sub>1</sub> ,I <sub>8</sub> ,I <sub>10</sub>	I <sub>1</sub> ,I <sub>8</sub> ,I <sub>10</sub>	

#### 5<sup>th</sup> Iteration

Element P(i)	Reachability Set R(Pi)	Antecedent Set: A(Pi)	Intersection R(Pi) & A(Pi)	Level
I <sub>1</sub>	I <sub>1</sub> ,I <sub>4</sub> ,I <sub>5</sub> ,I <sub>8</sub> ,I <sub>10</sub>	I <sub>1</sub> ,I <sub>8</sub> ,I <sub>9</sub> ,I <sub>10</sub>	I <sub>1</sub> ,I <sub>8</sub> ,I <sub>10</sub>	V
I <sub>4</sub>	I <sub>4</sub> ,I <sub>5</sub>	I <sub>1</sub> ,I <sub>4</sub> ,I <sub>5</sub> ,I <sub>8</sub> ,I <sub>9</sub> ,I <sub>10</sub>	I <sub>4</sub> ,I <sub>5</sub>	
I <sub>5</sub>	I <sub>4</sub> ,I <sub>5</sub>	I <sub>1</sub> ,I <sub>4</sub> ,I <sub>5</sub> ,I <sub>8</sub> ,I <sub>9</sub> ,I <sub>10</sub>	I <sub>4</sub> ,I <sub>5</sub>	
I <sub>8</sub>	I <sub>1</sub> ,I <sub>4</sub> ,I <sub>5</sub> ,I <sub>8</sub> ,I <sub>10</sub>	I <sub>1</sub> ,I <sub>8</sub> ,I <sub>9</sub> ,I <sub>10</sub>	I <sub>1</sub> ,I <sub>8</sub> ,I <sub>10</sub>	
I <sub>9</sub>	I <sub>1</sub> ,I <sub>4</sub> ,I <sub>5</sub> ,I <sub>8</sub> ,I <sub>9</sub> ,I <sub>10</sub>	I <sub>9</sub>	I <sub>9</sub>	
I <sub>10</sub>	I <sub>1</sub> ,I <sub>4</sub> ,I <sub>5</sub> ,I <sub>8</sub> ,I <sub>9</sub> ,I <sub>10</sub>	I <sub>1</sub> ,I <sub>8</sub> ,I <sub>9</sub> ,I <sub>10</sub>	I <sub>1</sub> ,I <sub>8</sub> ,I <sub>10</sub>	

#### 6<sup>th</sup> Iteration

Element P(i)	Reachability Set R(Pi)	Antecedent Set: A(Pi)	Intersection R(Pi) & A(Pi)	Level
I <sub>1</sub>	I <sub>1</sub> ,I <sub>8</sub> ,I <sub>10</sub>	I <sub>1</sub> ,I <sub>8</sub> ,I <sub>9</sub> ,I <sub>10</sub>	I <sub>1</sub> ,I <sub>8</sub> ,I <sub>10</sub>	VI
I <sub>8</sub>	I <sub>1</sub> ,I <sub>8</sub> ,I <sub>10</sub>	I <sub>1</sub> ,I <sub>8</sub> ,I <sub>9</sub> ,I <sub>10</sub>	I <sub>1</sub> ,I <sub>8</sub> ,I <sub>10</sub>	VI
I <sub>9</sub>	I <sub>1</sub> ,I <sub>8</sub> ,I <sub>9</sub> ,I <sub>10</sub>	I <sub>9</sub>	I <sub>9</sub>	
I <sub>10</sub>	I <sub>1</sub> ,I <sub>8</sub> ,I <sub>10</sub>	I <sub>1</sub> ,I <sub>8</sub> ,I <sub>9</sub> ,I <sub>10</sub>	I <sub>1</sub> ,I <sub>8</sub> ,I <sub>10</sub>	VI

#### 7<sup>th</sup> Iteration

Element P(i)	Reachability Set R(Pi)	Antecedent Set: A(Pi)	Intersection R(Pi) & A(Pi)	Level
I <sub>9</sub>	I <sub>9</sub>	I <sub>9</sub>	I <sub>9</sub>	VII

