Affecting Factors for the Adoption of Cloud-Based ERP System in Iraqi SMEs: An Empirical Study

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Abstract—Cloud-based enterprise resource planning (ERP) and cloud computing are critical requirements for all SMEs since they can be used to facilitate the SMEs' growth by creating competitive and personalized innovations considering their required business scope. To date, the growth of cloud technologies has led to the development of new systems and applications in many fields and areas including businesses. Our previous study proposed an adoption model to investigate the main determinants and logistical factors that influence decision-makers of SMEs to adopt cloud-based ERP systems. The aim of this research is to enhance the previous work by evaluating and validating the new model in real life to determine whether it has achieved what it was developed for and determine the reliability of the research results. The methodology and results of the evaluation and validation process of the proposed model are presented in this research. Considering there is little documentation in the literature specifically relevant to how proposed models have been evaluated and validated, hence providing this insight will assist both the academic researchers and decision-makers. The evaluation and validation methodology and the model itself contribute toward a better understanding of adoption processes. Furthermore, the evaluation and validation procedure in future work can be used to measure, enhance and determine whether the proposed models can be used in real life.

Keywords—evaluation, validation, cloud ERP, decision makers, SME, Iraq

1 Introduction

In this paper, we describe how we use a panel of experts to evaluate and validate our cloud-based ERP system adoption model within Iraqi SMEs. This study represents the

final stage of the model development. In previous work, we explain our theories and hypothesis for building the model and how we have identified and quantitively tested a number of factors that will assist decision-makers to adopt a cloud-based ERP system. A primary objective of this model is to guide decision-makers to adopt a cloud-based ERP system by identifying the logistical factors and preventing decision-makers from adoption failure through the adoption stage. SMEs' decision makers face failure after cloud ERP implementation despite the system's benefits due to a lack of knowledge and experience [9]. Moreover, the adoption process of the cloud ERP system is considered a very sensitive step and costly to most SMEs since the transition and adoption of innovation will require upgrading and moving forward from the previous system [26]. We have reached the final stage in development where we need to evaluate and validate whether the motivation for developing the cloud-based ERP adoption model is justified and whether the proposed model reflects the needs of the decision-makers. In this paper, we present our evaluation and validation methodology and report the findings of a detailed validation semi-structured interviews and evaluation questionnaire that involved a group of experts in the fields of SMEs and cloud computing. Studies make it very hard to clearly assess and communicate the credibility of models, which in turn makes it difficult, if not impossible, for decision-makers, who are usually not trained in assessing whether a model is good enough, to let models influence their decisions [10]. The evaluation and validation process are essential in model development, making it more effective and valuable [18].

1.1 Research's terms

Enterprise Resource Planning (ERP) is "Software applications that organize, define and standardize the business processes necessary to effectively plan and control an organization" [3].

Cloud ERP is "software applications that integrate business processes and transaction-oriented data across an organization via a model that enables ubiquitous, convenient, on-demand network access with minimal management effort or service provider response".

Validation is defined as "the process of ensuring that the framework actually meets the purpose for which it was intended" [6] or "an essential part in the process of framework development, making it more effective and valuable" [18]. Where Evaluation is defined as "the assessment of the framework regarding its acceptance by the end users and its performance in the field" [6]. At this stage of model development, we are looking to verify whether the model directly meets the needs of specific users, additionally, we test whether this model meets the initial criteria for building the model in the first place. We directly evaluate the model's relevance, effectiveness, usefulness, clarity, supportiveness, and comprehensiveness [6, 19]. Moreover, we validate the model in order to substantiate that the factors possess a satisfactory range of accuracy consistent with the intended application of the model [12].

1.2 Overview of cloud-based ERP adoption model development

The three main stages of our model development comprise: identifying the affecting factors; creating a model and quantitively testing it with defined processes and evaluating and validating the model. Results from this evaluation and validation phase will enhance the adoption rate and assist decision-makers in the adoption of cloud-based ERP systems within Iraqi SMEs. This paper is organised as follows. A brief overview of the cloud-based ERP and the problem area and validation and evaluation's prior studies within cloud computing technologies are presented in Section 2. In Section 3 we present our evaluation and validation methodology and our aims and objectives. The results of our evaluation and validation phase as well as the results' summary and how well our model meets our objectives in Section 4. We conclude the paper in Section 5 with a conclusion, limitations and future work.

2 Literature review

2.1 Cloud-based ERP

The quick growth in the infrastructure of Information and Communication Technology (ICT) has enhanced the area of usage and quality in information technology (IT) applications [17]. Cloud computing, for instance, has grown in popularity in recent years [14]. Furthermore, the notion of ERP adoption has been well explored. Nonetheless, cloud ERP has grown in popularity over the previous six years [22]. Cloud ERP is described as software applications that integrate business processes and transaction-oriented data throughout a business using an architecture that allows for ubiquitous, accessible, on-demand network access with little management effort or service provider reaction [13]. Cloud ERP systems allow companies to rent their whole ERP system landscape from a variety of service providers, including software and infrastructure providers [24]. The deployment of cloud technologies was highly connected to future SME growth whereas investment in them enables SMEs to grow faster than previously planned [20]. To get a competitive advantage, SMEs must leverage innovative products and e-commerce solutions [1]. Cloud ERP systems in the past few years are gaining more attention in the market, especially among SMEs, however, it has been recognized that SMEs have low motivation toward the adoption of this technology [23] due to the failure of implementation after the adoption of the cloud ERP system. Alsharari [9] stated that SMEs' decision makers face failure after cloud ERP implementation due to a lack of knowledge and experience. Therefore, it is critical to identify the factors and recognize the issues that lead to implementation failure through the adoption stage. Decision-making has become the essence of the administrative role and the primary task of achieving the goals of the organization [4]. To have a successful adoption, decision-makers are required to understand and evaluate the factors affecting the adoption of cloud ERP. The primary motivation for building a cloud ERP adoption model emanates from our previous empirical research with fourteen affecting factors that will lead to successful adoption without failure implementation concerns. Our research highlighted problem areas in adoption factors

that led to developing an adoption model that can be used particularly by SMEs' decision makers to evaluate their strengths and weakness during the adoption stage and reduction the non-success implementation.

Although there is little published evidence relating to how the cloud ERP adoption model can be evaluated and validated, many studies have reported limitations with their adoption model [1, 2, 23, 25]. The primary goal in developing the model is to address the need for enhanced efficiency. Performance, reliability, availability, and maintainability are examples of quality criteria that are directly tied to model complexity. Decision makers typically require that a model be verified to minimise the possibility of a poor decision related to an ambiguous, limited presentation. They usually request verification of model output with actual empirical data to see if any differences make the model too unrealistic to employ [10]. Decision makers would value some type of measurable certification that boosts confidence in the suitability of a model for implementation. In the literature, the phrase validation has not been used consistently. Depending on their point of view, many authors employed different definitions; others had similar concepts in mind but used different terms.

We did not find any existing scale for the SME sector from the cloud-based ERP literature which can evaluate and validate developed models in developing countries like Iraq. Hence, the present study is the first attempt in real life for developing countries to evaluate and validate a proposed model for cloud-based ERP system adoption in the context of Iraqi SMEs.

2.2 Validation and evaluation's prior research

To meet quality objectives in model evaluation and validation, there is a continual effort to generate new metrics [11, 21]. A model measure must include characteristics such as reliability, clarity, and usefulness [8, 18]. Evaluation and validation criteria can be used to explore these qualities. In general, model measure validation and evaluation criteria must be highly strong in order to examine all elements of the model measure. Existing research includes limited approaches and recommendations for evaluating various elements of model applicability and acceptability [5, 16]. Several unique ideas [7, 8] also exist for evaluating or validating model measurements. Unfortunately, not enough work has been put into developing a comprehensive procedure for analysing and validating model acceptability.

Kitchenham [15] stated that for a complete evaluation and validation, one should evaluate the key components from all important validation criteria. Furthermore, techniques and processes have evolved fast during the previous two decades, necessitating the development of new metrics. All these considerations have resulted in a greater need for more effort and study to establish new comprehensive and practical evaluation and validation criteria that also expand and integrate elements of prior methodologies.

Alhammadi [5] developed the Knowledge Management Based Cloud Computing Adoption Decision Making Framework. The aim of his validation and evaluation was to examine the clarity, usability, and practicality of using the proposed framework and the supporting models. He first validated his proposed framework and supported

models in real life environment through four workshops that brought together participants, also referred to as stakeholders, from cloud service providers (CSPs) and cloud consumers. The limitation of the workshop validation process as it might be too heavily influenced by the CSPs and the use of closed questions about the strengths and weaknesses of the framework, which restricted the options available to respondents. He used two types of questions to validate the proposed framework. A five-point Likert scale was employed for the closed questions and open questions. As part of the evaluation process, he used two of the same workshops to include case studies that reflected the experience of the participants in which to examine the practicality of using the proposed framework in a real-life environment. He employs a pairwise comparison matrix to weigh and prioritise the factors using an eigenvector in a pairwise comparison matrix to prioritise and calculate the factors' weights. His findings from the workshop supported the concept and structure of his proposed framework and enabled it to be evaluated in a real-life context with stakeholders.

Odeh [18] employed evaluation and validation to determine his proposed framework's weaknesses and limitations, to evaluate the practical issues experienced during the process of implementing cloud computing and to improve the framework as much as possible based on the evaluators' feedback. Evaluation and validation of the proposed framework were achieved in three phases. The first involved designing the validation and evaluation questions. In the second phase, he updated the proposed framework based on the evaluators' written feedback and comments. In the final stage, he invited the evaluators to individual online interviews to discuss their feedback and comments and to make any further comments and suggestions. Odeh [18] acknowledged there were limitations to his validation and evaluation process where more evaluators are required. In addition, the time allowed for the evaluation process was limited. Alharbi [6] developed a Holistic Approach Framework for cloud computing Strategic Decision-Making in the Healthcare Sector. He validated and evaluated the framework in order to test whether the framework is appropriate for its purpose and to assess whether it could be used in practice and to assess the framework based on established criteria. The validation was achieved by conducting two workshops with experienced decision-makers from Saudi healthcare organisations while expert feedback and judgement have been used in the evaluation. He used his framework as a tool to measure the progress of cloud computing and to support decision-makers in understanding the organisation's position regarding cloud and identifying any gaps that may hinder the adoption. His measurement technique of the proposed framework is based on the Likert scale approach. In the evaluation process, seven experts who are involved in cloud computing adoption and have relevant experience in healthcare organisations took part. In the evaluation phase, a questionnaire was designed to gain feedback from the experts to ensure that the framework will be appropriate for its purpose and will work as expected.

3 Methodology

This part presents the design of the validation and evaluation of the model using a panel of experts. In this research, we follow [12] main processes that are involved in evaluating and validating the model:

1. Highlight the objectives for building the model.
2. List the criteria and technique using for the evaluation and validation purpose.
3. Design evaluation and validation instrument to test the success criteria.
4. Select an expert panel.
5. Present results.
6. Discuss how these strengths and weaknesses might affect our objectives.

3.1 Aim and objectives

We aim to develop a model that has the potential to enhance the adoption rate and can be applied to assist decision makers on the adoption of clous-based ERP system within Iraqi SMEs. Additionally, to examine the concepts that underpinned the developed model, primarily in terms of usefulness, clarity and relevance. Furthermore, to verify the applicability and acceptability of the proposed model.

3.2 Validation's technique and evaluation's criteria

A semi-structured interview has been chosen to validate the finalized research model. The interviewees were designed to examine the context and sub-factors of the finalized model. The interviewee consists of closed questions asking the interviewers their level of agreement. After gathering the interviewees' responses, we will account for the agreement percentage for these experts adapted from [7], as shown in formula 1.

$$Agreement\ Rate = \frac{Number\ of\ Observation\ agreed \times 100}{Total\ number\ of\ Observations} \quad (1)$$

The evaluation questionnaire was built on OECD evaluation criteria [19] and Alharbi [5] as shown in Table 1. The questionnaire contains closed questions using a five-point Likert scale to enable users to evaluate the model using criteria.

Table 1. Evaluation assessment criteria

Assessment Criterion	Definition
Relevance	The degree to which model is relevant to the scope [19].
Effectiveness	The degree to which an expert agrees that using the model would be effective [19].
Usefulness	The degree to which the model is useful to the scope [6]
Clarity	The degree to which the model being clear and easy to understand [19].
Supportiveness	The measurement of how much the model will provide support for the adoption of cloud ERP [6].
Comprehensiveness	The measurement of how comprehensive the model is [6].

3.3 Selection of the experts

We adopt previous studies that evaluate and validated models and frameworks by inviting a panel of experts [5, 6, 12, 18]. Beecham [12] recommended to target experts from different audience groups and backgrounds. Therefore, it is vital to invite experts who had the necessary knowledge of SMEs, cloud ERP as well as the socio-economic environment in Iraq. The selection procedure was challenging since it involved identifying individuals who have those three skill sets. The number of experts was another critical decision. According to [12], small samples can be used to develop and test explanations. Previous studies have used small samples to gain expert feedback to evaluate and validate model development. According to [18], there is no specified number of specialists, but Odeh [18] stated that three to five would be an adequate number. Therefore, we invited seven experts to get at least five positive responses, consequently, six experts accepted the invitation. The experts were in the fields of ICT and IS, with four of them holding academic positions as professors at a well-known institution in Iraq and the remaining two working for cloud service solution providers. Table 2 classifies our experts.

Table 2. Experts' profile

Respondent	Position	Qualification	Experience (Years)	Industry
E1	Lecturer	Ph.D.	10	Dijlah University
E2	Lecturer	Ph.D.	16	Dijlah University
E3	Lecturer	Ph.D.	15	Dijlah University
E4	Lecturer	Ph.D.	10	Dijlah University
E5	Senior ICT Manager	Masters	7	ICT and Cloud services
E6	Head of ICT Department	Masters	8	ICT and Cloud services

3.4 Data collection mechanism

We first sent an email to all experts, attaching a copy of the evaluation questionnaire and the developed model with supporting documentation. The experts were kindly requested to study the developed model and, if necessary, contact the researcher for additional clarification. Experts were asked to respond evaluation questions within three weeks. A week before the scheduled return date, an email reminder was sent. We then performed semi-structured video-call interviews with the six experts on an individual basis. Each Interview took about 20-30 minutes.

4 Evaluation and validation's results

This part presents the results of validation and evaluation on the finalized model using a panel of experts.

4.1 Validation results

The overall validation resulted in a high degree of conformity among the experts, where the agreement rate was 84%, which demonstrates a high amount of consistency among the six experts. 86.6% of the experts had agreed to the components and aspects of the technological context and its possible impact on the cloud-based ERP adoption model in the SMEs in Iraq. Considering every component, 83.3% of the experts consented to it, including the organization and its effect in adopting a cloud-based ERP system. Moreover, the environmental context was discovered to have an overall 74.9% of the consent of experts in affecting the decision on the adoption of cloud-based ERP system. Meanwhile, the experts agreed on the human context with an overall 91.5% in private SMEs in Iraq. Based on these outcomes, we can conclude that the resultant aspects were viewed in a positive light by the experts to be associated with the study model for the Iraqi SMEs domain. Table 3 demonstrates the experts' validation result.

Table 3. Experts' validation results

Main and Sub-Factors	Agreement	Percentage
Main Factor - Technological context	**-**	***86.6%***
Relative Advantage	6	100%
Compatibility	5	83.3%
Trialability	4	66.6%
Security & Privacy	5	83.3%
Cost Saving	6	100%
Main Factor – Organizational context	**-**	***83.3%***
Employees' Cloud knowledge	6	100%
Firm size	4	66.6%
Main Factor – Environmental context	**-**	***74.9%***
Industry	4	66.6%
Supplier Efforts and External Computing Support	5	83.3%
Main Factor – Human context	**-**	***91.5%***
Decision maker's Innovativeness	5	83.3%
Decision maker's Cloud Knowledge	6	100%
Overall agreement rate	**-**	***84%***

4.2 Evaluation results

The questionnaire's objective was to enable specialists to evaluate the final model using particular criteria. This section will discuss the analysis of the questionnaire responses. The model's overall evaluation is depicted in Figure 1, and each criterion is described in turn:

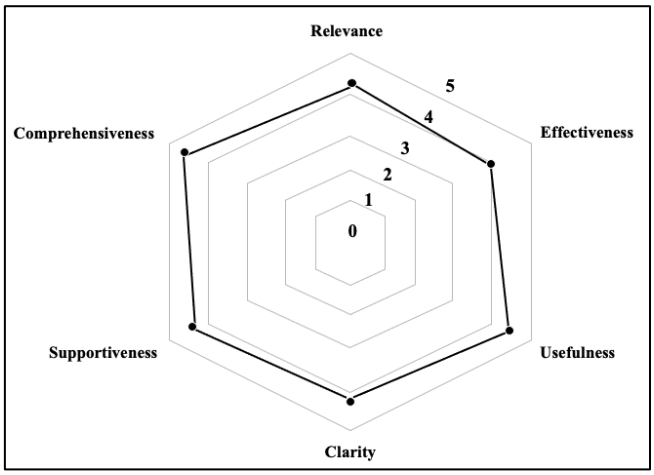

Fig. 1. The overall evaluation of the model

Relevance is used to measure the degree to which a participant believes that this model is relevant to adopting the cloud ERP system. Most of the participants considered the model somewhat relevant. Figure 2 shows the results for assessing the model's relevance based on the experts' opinions.

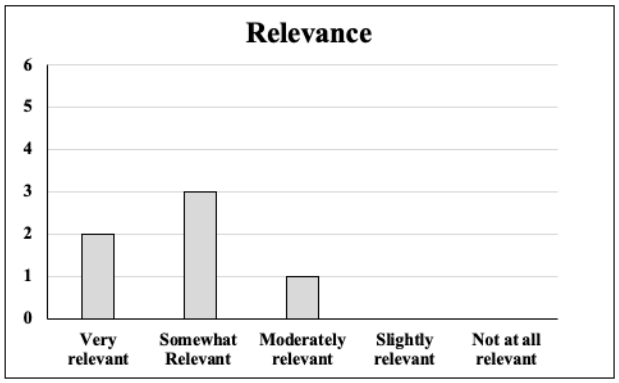

Fig. 2. Relevance criterion

Effectiveness was implemented to assess how an expert believes that the model would be effective. Most of the experts agreed that the model is effective in adopting the cloud ERP system and effective in identifying the affecting factors. Figure 3 presents the experts' views on the effectiveness of the model.

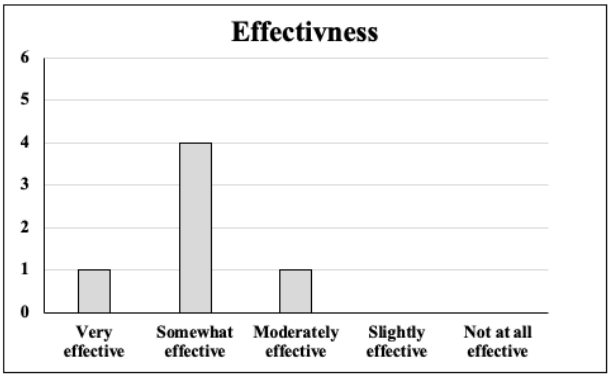

Fig. 3. Effectiveness criterion

Usefulness assesses an expert's belief in the model's usefulness. Almost all, experts agreed that the model would aid in the decision-making process for Cloud ERP. The experts' perspectives on the usefulness are depicted in Figure 4.

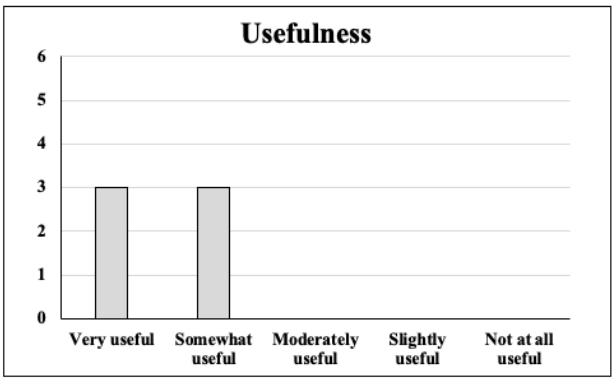

Fig. 4. Usefulness criterion

Clarity measures the clarity of the model when presented to the decision-makers regarding introducing the factors affecting the adoption of cloud ERP in SMEs and each context belongs to. While two experts believed the model was very clear and obvious, three experts answered it somewhat clear, and the last one responded moderately clear. Figure 5 shows the assessment of the framework's clarity.

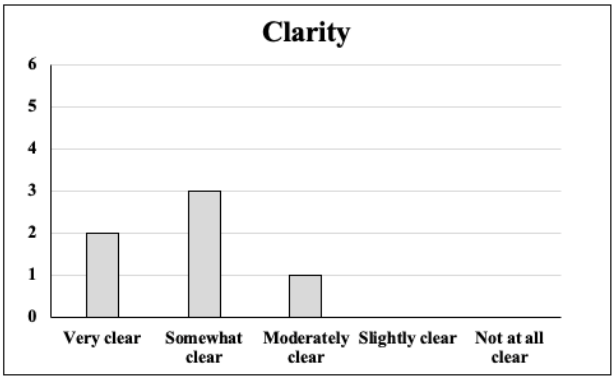

Fig. 5. Clarity criterion

Supportiveness quantifies the model's support for the Cloud ERP decision-making process. All experts agreed that the model would support the decision-making process for Cloud ERP. The assessment of the model's support for the cloud ERP process is depicted in Figure 6.

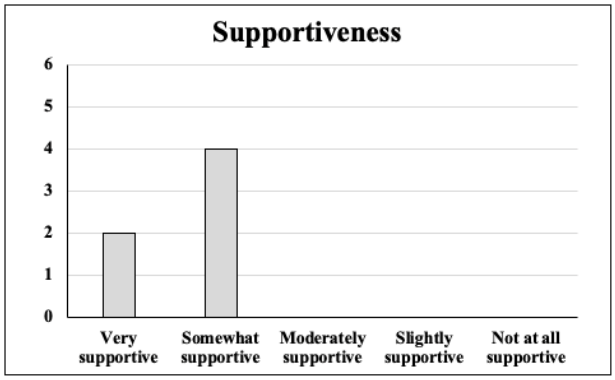

Fig. 6. Supportiveness criterion

Comprehensiveness determines if the model addressed all essential aspects of cloud ERP prior to the adoption process that decision-makers in SMEs must consider. The experts classified the model as comprehensive or moderately comprehensive. This result indicated that the model captured the most critical aspects to consider while making cloud ERP decision. Figure 7 summarises expert perspectives on the model's comprehensiveness.

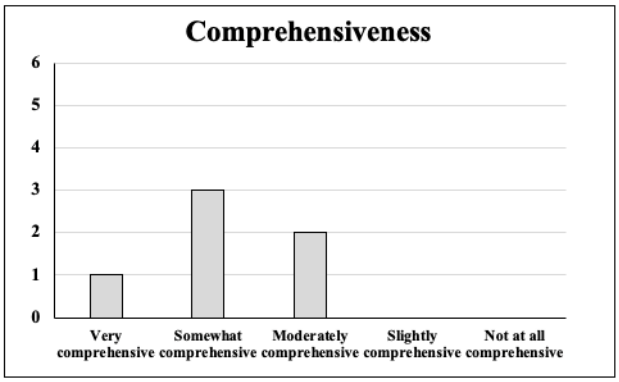

Fig. 7. Comprehensiveness criterion

4.3 Summary of results

The process of using an expert panel to validate the cloud ERP adoption model has proved very helpful in highlighting some of the model's potential strengths and weaknesses. We believe that the involvement of such a high calibre panel adds weight and rigour to our results. The high response rate and contributions made suggest that the experts took the task seriously. The range of responses elicited from this relatively small group formed a good basis for us to gauge how cloud ERP adoption might be viewed in practice. It is a particularly worthwhile exercise as it provides an objective view of work that, otherwise, could easily become unrelated to the needs of the SMEs. In the validation phase, the experts were asked about their agreement on the factors used in the adoption mode. There are four main contexts of factors, technological, organisational, environmental, and human. The agreement rate for each factor was calculated using formula 1. Factors (Relative Advantage, Cost Saving, Employees' Cloud knowledge, and Decision maker's Cloud Knowledge) obtained the highest agreement compared to other factors. Whereas Human context scored the highest score compared to other contexts. The validation showed that the proposed model is holistic and provides support for cloud ERP adoption decision-making. The evaluation phase was conducted using a questionnaire among six experts. The outcome of the evaluation showed positive results regarding the decision makers' intention to use the model in their cloud ERP adoption. The results show that the framework is useful and supportive. Experts also indicate that the model is relevant for cloud ERP adoption. Additionally, it was reported that the model will be effective during the adoption stage. Finally, the evaluation results indicate that the model supports cloud ERP adoption and can be applied in a real-world context by SMEs' decision makers.

5 Conclusion

We have shown how we used a group of experts to evaluate and validate the cloud ERP adoption model. Their diverse responses in both phases highlight some potential strengths and weaknesses. The results showed that the research proposed model has the potential to enhance the adoption rate and can be applied to assist decision-makers in the adoption of cloud-based ERP systems within Iraqi SMEs. Moreover, the results reflect that the present model is a better representation of most of the parameters that are required to evaluate and validate a new complexity measure. In addition, the experts showed encouraging feedback, general satisfaction, positive perceptions and good intentions towards the model and the evaluation and validation procedure after completing their interviews and responding to the survey. However, although the proposed model was evaluated and validated by six experts, further validation and evaluation by decision-makers from SMEs are still required. Through the evaluation and validation process, the proposed model and the identified factors in our previous study represents evidence for SMEs' decision maker to consider and use the model in the adoption of a cloud-based ERP system. This study, therefore, serves as a guide to SMEs' decision makers in cloud ERP adoption. Additionally, the research community can gain from this study as we combine best practices from several sources into one cohesive methodology that allows for replication. The results and attitudes of the experts towards the proposed model are likely to be of interest to a wide range of specialists in both the research community and the decision-makers.

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