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# Empirical Insights into Cloud Adoption: A new Model Exploring Influencing Factors for Saudi Arabian Small and Medium Enterprises

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***Abstract*—Cloud computing technology has emerged as a crucial driver of success for Small and Medium Enterprises (SMEs) globally, accelerating work processes and optimizing operations. Notably, SMEs in developed nations, including the United States and the United Kingdom, have proactively harnessed Cloud computing services, reaping substantial benefits in operational efficiency and time utilization. However, in many developing countries, including Saudi Arabia, most SMEs continue to rely on traditional technology, such as On-Premises Servers, instead of Cloud computing services. To investigate the factors influencing Cloud adoption, a new empirical model, the Adoption of Cloud Computing Model for Saudi Arabian SMEs (ACCM-SME), was developed. This study collected quantitative data from 412 participants representing Saudi SMEs in Riyadh city. The empirical data analysis revealed that 12 out of the 17 tested hypotheses exhibited significant positive influence, while five hypotheses failed to meet the specified research criteria and were consequently rejected. This research underscores the critical need to accelerate Cloud technology adoption among SMEs in developing countries, particularly Saudi Arabia. Bridging this technology gap has the potential to significantly enhance SMEs' competitiveness and operational efficiency, contributing to overall economic development. The ACCM-SME model provides nuanced insights into the factors influencing Cloud adoption, guiding further research. The study's rejected hypotheses highlight areas requiring attention for successful adoption. Policymakers and business leaders can leverage these findings to formulate strategies that facilitate Cloud adoption among SMEs.**

***Index Terms*—Cloud computing adoption, Saudi SMEs, Cloud services.**

## I. Introduction

CLOUD computing has the potential significantly enhance small to medium enterprises' (SME) competitiveness and operational efficiency, contributing to overall economic development. Critical to adoption of Cloud technology by SMEs is better understanding of the influencing factors leading to SME adoption.

Cloud computing, in recent years, has been an effective technology that accelerates business and contributes to its success after the technological exploitation made in Internet services. Cloud Computing has been found to play a significant role in the success of Small and Medium Enterprises (SMEs) from different perspective. Growth in the use of Cloud computing services among SMEs seeking new revenue opportunities has been fast over the previous five years, with a compound annual growth rate (CAGR) of 18% [1] In addition, Cloud Computing Technology (CCT) has become a game-changer for improving inter-organisational collaboration [2]. What makes the Cloud these days so popular and targeted by many organisations worldwide is that users can clearly use Cloud computing services on demand immediately and at affordable prices without making any further investments in hardware or software updates [3]. In the last ten years, in many developed countries, including the United States and the United Kingdom, SMEs have Utilized and adopted Cloud computing technology services effectively and widely, which contributes to reducing their cost and processing their tasks continuously without any disruption [4], [5].

In contrast, in many developing countries, SMEs still face challenges and obstacles that slow their conversion to Cloud services due to some hindering factors. For instance, in Saudi Arabia, where this study was conducted, despite significant growth in internet services, mainly Cloud computing services, in recent years, dealing with sophisticated security challenges still needs more research and knowledge [6], [7]. According to a study released by the International Trade Administration, the Kingdom of Saudi Arabia is among the top nations in the Middle East regarding investing in and promoting information and communications technology (ICT)[8]. However, the adoption of Cloud computing services seems to have not received abundant attention until 2020, when the Ministry of Communications and Information Technology (MCIT) officially announced the strategy of Saudi Arabia to adopt Cloud computing.

This study aims to comprehensively examine the adoption of Cloud computing services by Saudi SMEs. The objectives encompass a thorough review of existing literature [9], to unveil the barriers and challenges influencing adoption, identification of the most impactful factors from the perspectives of top managers, IT managers, and employees, investigation into the effects of Cloud computing adoption on the mentioned stakeholders, and validation of a suitable

conceptual framework for a nuanced understanding of this adoption within the context of Saudi SMEs.

The study results show the benefits of shifting to Cloud services for SMEs. In addition, two limitations have been recognised and should be investigated further: potential job opportunities decreasing after adopting the Cloud and the perspective of Cloud providers. These limitations offer an opportunity for future research to study them and explore their effect on Cloud adoption.

In this study, the factors that hinder the adoption of Cloud computing services by Saudi SMEs have been investigated in the four primary contexts: Technological, Organisational, Environmental, and Social. This study aims to determine what factors affect Cloud adoption and which do not. Thus, a novel Framework was designed for this study to identify the factors impacting Saudi SMEs' adoption of Cloud computing services based on the TOE Model blended with DOI theory. This study subsequently evaluates the real effects of factors by analysing the collected data. Then, it will provide a valuable contribution towards enhancing the perception of Cloud computing, hence increasing the intention of SMEs in Saudi Arabia to adopt Cloud computing services.

This study aims to enhance the intention of Saudi SMEs to adopt Cloud computing services. Through an examination of Cloud adoption across four primary contexts, this research develops 17 hypotheses aimed at understanding and increasing Cloud adoption among Saudi SMEs. Thus, any accepting or rejection hypothesis will contribute to clearly showing the factors that will help Saudi SMEs increase their intention and direction toward adopting Cloud computing services.

The subsequent sections of this paper will sequentially unfold the hypotheses of the study, introduce the framework, and elucidate the methodology employed. The discussion on methodology will be complemented by an exploration of measurements and assessment tools, providing a comprehensive understanding of the research approach. Following this, the results will be presented and discussed in detail, offering insights into the acceptance or rejection of the hypotheses, thus contributing to a nuanced interpretation of the study's findings.

## II. Hypotheses and Study Framework

A study conducted by [9] a thorough literature review to discern influential factors affecting SMEs' adoption of Cloud computing. From this examination, they devised a comprehensive framework, identifying 17 critical hypotheses encapsulating the most pressing challenges. Consequently, they proposed the 'Adoption of Cloud Computing Model by Saudi Arabian SMEs' (ACCM-SME), illustrated in Figure 1. Moreover, the framework was designed to represent the challenges in four primary contexts to investigate the fundamental difficulties in Cloud computing adoption. These contexts are: Technological, Organisational, Environmental and Social where each has a set of associated hypothesis linking factors to intention to adopt Cloud computing. These contexts and hypothesis are discussed in [9] but repeated here for convenience.

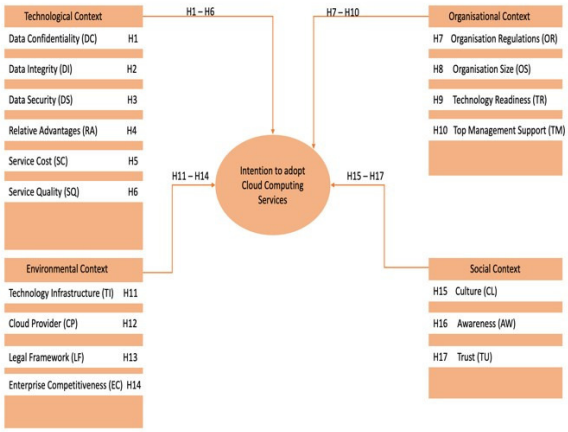


Fig. 1. The study framework (ACCM-SME)[9].

### A. Technological context

The technology context is concerned with investigating the **technical factors** that influence an SME's decision to adopt Cloud computing services. Therefore, the following six factors *(Data Confidentiality (DC), Data Integrity (DI), Data Security (DS), Relative Advantages (RA), Service Cost (SC), and Service Quality (SQ))* investigate the most actual elements that impact the adoption process of Cloud computing services in Saudi SMEs. Then, based on the that six hypotheses have been developed as shown in the Table 1.

Table 1. Technological context hypotheses [9].

| H | Hypothesis Statement |
|---|---|
| H1→ DC | "Increasing the **data confidentiality** of Cloud computing increases the Saudi SMEs' intention to adopt **Cloud computing services"** |
| H2 → DI | "Increasing the **data integrity** of Cloud computing increases the Saudi SMEs' intention to adopt **Cloud computing services"** |
| H3→ DS | "Increasing the **data security** of Cloud computing increases the Saudi SMEs' intention to adopt **Cloud computing services"** |
| H4→ RA | "The perceived **relative advantages** of Cloud computing have a positive effect that increases the Saudi SMEs' intention to adopt **Cloud computing services**" |
| H5→ SC | "Decreasing the **cost** of Cloud computing increases the Saudi SMEs' intention to adopt **Cloud computing services**" |
| H6→ SQ | "Increasing the **services quality** of Cloud computing increases the Saudi SMEs' intention to adopt **Cloud computing services**" |

### B. Organisational context

The organisational context is concerned with investigating the **organisational factors** that influence an SME's decision to adopt Cloud computing services. Therefore, the following four factors (*Organisation Regulations (OR), Organisation Size (OS), Technology Readiness (TR), and Top Management support (TM))* relate to corporate practices that are built on the foundations and concepts of SMEs in Saudi Arabia to adopt Cloud services. Then, based on the that four hypotheses have been developed as shown in the Table 2.

TABLE 2. ORGANISATIONAL CONTEXT HYPOTHESES [9].

| H | Hypothesis Statement |
|---|---|
| H7→ OR | "Increasing and updating the **organisational regulations** increases the Saudi SMEs' intention to adopt **Cloud computing services**" |
| H8→ OS | "A smaller **organisation size** is more likely to increase the Saudi SMEs' intention to adopt **Cloud computing services**" |
| H9→ TR | "Increasing **technology readiness** increases the Saudi SMEs' intention to adopt **Cloud computing services**" |
| H10→ TM | "Increasing the **top management support** of Cloud computing increases the Saudi SMEs' intention to adopt **Cloud computing services**" |

### C. Environmental context

The environmental context is concerned with investigating the **environmental factors** that influence an SME's decision to adopt Cloud computing. Therefore, the following four factors *(Technology Infrastructure (TI), Cloud Provider (CP), Legal Framework (LF), and Enterprise Competitiveness (EC))* discuss the most influential elements that may contribute to disrupting Saudi SMEs adopting Cloud computing services. Then, based on the that four hypotheses have been developed as shown in the Table 3.

TABLE 3. ENVIRONMENTAL CONTEXT HYPOTHESES [9].

| H | Hypothesis Statement |
|---|---|
| H11→ TI | "Obtaining a high level of the **technology infrastructure** increases the Saudi SMEs' intention to adopt **Cloud computing services**" |
| H12→ CP | "Increasing the number of **Cloud providers** within Saudi Arabia increases the Saudi SMEs' intention to adopt **Cloud computing services**" |
| H13→ LF | "Obtaining an organised **legal framework** of Cloud computing increases Saudi SMEs' intention to adopt **Cloud computing services**" |
| H14→ EC | "Increasing the **enterprise competitiveness** increases the Saudi SMEs' intention to adopt **Cloud computing services**" |

### D. Social context

The Social context concerned with investigating the actual users' **attitude and behaviour factors** that influence an SME's decision to adopt Cloud computing services. Therefore, the following three factors *(Culture (CL), Awareness (AW), and Trust (TU))* discuss deeply all elements that influence the intention of Saudi SMEs toward adopting Cloud services from the perspective of the social context. Then, based on the that three hypotheses have been developed as shown in the Table 4.

TABLE 4. SOCIAL CONTEXT HYPOTHESES [9].

| H | Hypothesis Statement |
|---|---|
| H15→ CL | "Increasing the technology **culture** for customers, IT managers, top managers, and employees increases the Saudi SMEs' intention to adopt **Cloud computing services**" |
| H16→ AW | "Increasing the **awareness** of the customers, IT managers, top managers and employees increases the Saudi SMEs' intention to adopt **Cloud computing services**" |
| H17→ TU | "Increasing the **trust** of the customers, IT managers, top managers and employees increases the Saudi SMEs' intention to adopt **Cloud computing services**" |

## III. STUDY METHODOLOGY

### A. Approach and Sample

This research employs a quantitative approach by conducting a comprehensive survey as the primary means of gathering initial data. The aim is to examine and assess the degree to which the adoption of Cloud computing services is effective among SMEs in Saudi Arabia. This study will discuss quantitative data analysis and provide a general overview of the fieldwork that was conducted to collect data from IT managers, top managers, and employees of SMEs in Riyadh, Saudi Arabia. An extensive examination of existing literature designed the survey questions. Then, three closed-ended questions were used as a minimum to measure each factor. This study used a 5-point Likert scale to measure participants' replies, with a rating of one indicating "strongly disagree" and five indicating "strongly agree".

The target population selected in Riyadh exceeds 100,000 IT managers, top managers, and SMEs employees, according to a report from the Small and Medium Enterprise General Authority in the Kingdom of Saudi Arabia. The sample size can be calculated using various techniques following the determination of the confidence level beside the margin of error. Therefore, based on the [10] technique, the sample size for this study has been calculated; it is 384, with a level of confidence that attains 95% degree and a margin of error that attains 5% degree. The sample was chosen randomly in 2022 from among Saudi SMEs in Riyadh. The link to a web-based survey was made and sent to each SMEs sample member separately. Following completion, each response was saved immediately into the database.

### B. Survey Implementation

The main goal of this part of the study is to examine the relationship of the developed hypotheses with the Saudi SMEs intention to adopt Cloud computing services. There was a total of 66 questionnaires used in this study; 11 were used to collect demographic data on the participants, and their respective companies, and the remaining 55 were used to assess the influence of various factors on the adoption of Cloud computing services among Saudi SMEs.

The questions and instructions that were asked in the primary survey were tested in a pilot study first, carried out in Saudi Arabia with the participation of IT managers, top managers, and staff members of Saudi SMEs. The pilot study was sent to the participants with the intention of gathering 20 responses. However, 27 responses were actually filled out and returned, which helped to evaluate the questionnaire draught. The primary objective of the pilot study was to determine whether the questionnaires and instructions could be easily understood and filled out without any problems and whether the allotted time was sufficient to complete the questionnaires. Therefore, the pilot study's findings were beneficial because they revealed great comments from the participants but did not result in any change in the questions.

Therefore, the main study was conducted and distributed from the 5th of September 2022 to the 3rd of December 2022 to the IT managers, top managers, and SMEs employees in Riyadh City, Saudi Arabia. Over 500 questionnaires were randomly distributed over three months; 440 (88%) out of

500 were filled out and returned. However, of these responses returned, 28 (6,36%) were considered invalid data as they had missing data for variables and would affect the analysis process, and 412 (93.64%) were complete and accurate, so it is used.

## IV. Study Results

### A. Confirmatory Factor Analysis (CFA)

Confirmatory Factor Analysis is considered an effective pattern that verifies the factors through variable load testing. It is carried out and emphasized to determine the relationship between observed variables and the theoretical definition of the factors.

Before receiving any results, the researcher must identify the correct factor to decide whether or not to accept the theory being investigated by picking the proper theory being researched. Therefore, following the CFA, the results influence the decision on the theory, and the procedure logically has two options: supported theory (accept) or unsupported theory (reject) [11].

Furthermore, when the researcher decides to employ the CFA, it should evaluate each construct measurement model's unidimensionality, reliability, and validity. To determine if each variable measures a single underlying feature, a latent measurement model for each construct, including external and internal factors, should be established. This is a critical stage in carrying out a technique to determine unidimensionality. It is essential to establish unidimensionality before proceeding with structural equation modelling, which entails removing any signs with factor loadings less than 0.60 [12].

### B. Construct Validity and Reliability

The assessments used to evaluate SMEs' adoption of Cloud computing services were developed after thorough literature research and then adjusted to this study. The main purpose of any assessment tools employed is to ensure that the study model is very accurate and has reliable data that can fit with it.

Three types of validity—convergent, discriminant, and reliability—were utilised to check the study model. Moreover, the measurement model's Composite Reliability (CR) and Cronbach's alpha were used to test this study's construct validity and reliability. CR and Cronbach's alpha should exceed the threshold value, which is 0.70 [13]. Table 5 shows that the construct validity and reliability results met the required level as Composite Reliability (CR) and Cronbach's alpha were over.70.

Convergent validity evaluation means the model has to have a good fit, and the AVE value needs to be more than 0.5. [14]. A high AVE indicates a robust relationship between latent and single variables. According to [15], [16], they proposed values for most indices as thresholds for them, which are as follows: CMIN/DF value should be between 1 and 5, CFI value should be $\succ$ 90, RMSEA should be $\leq$ 0.06, and SRMR should be $\leq$ 0.08, and when the thresholds are met, the model fit is considered acceptable.

In addition, according to [17], in order to determine whether or not a model is a good fit for the data that was obtained from more than 250 participants, the chi-square statistic must be less than 3. In this particular investigation, information was gathered from a total of 412 participants, resulting in a chi-square value of 1764.4. All of the model fit measurements have reached the excellent values, including CFI = 0.956, SRMR = 0.053, RMSEA = 0.031. This means that the needed degree of model fit at this stage has been obtained, as shown in Table 5.

Table 5: Construct Validity and Reliability.

| Factors | Cronbach (≥ 0.7) | CR | AVE | MSV |
|---|---|---|---|---|
| Data Confidentiality (DC) | 0.808 | 0.811 | 0.591 | 0.157 |
| Data Integrity (DI) | 0.748 | 0.749 | 0.500 | 0.146 |
| Data Security (DS) | 0.770 | 0.778 | 0.539 | 1.263 |
| Relative advantages (RA) | 0.747 | 0.749 | 0.500 | 0.456 |
| Service Cost (SC) | 0.783 | 0.784 | 0.547 | 0.804 |
| Service Quality (SQ) | 0.787 | 0.787 | 0.552 | 0.410 |
| Organisation Regulation (OR) | 0.821 | 0.820 | 0.603 | 0.223 |
| Organisation Size (OS) | 0.807 | 0.807 | 0.583 | 1.058 |
| Technology Readiness (TR) | 0.779 | 0.777 | 0.539 | 0.580 |
| Top Management Support (TM) | 0.778 | 0.778 | 0.540 | 0.014 |
| Technology Infrastructure (TI) | 0.781 | 0.784 | 0.548 | 0.372 |
| Cloud provider (CP) | 0.818 | 0.814 | 0.595 | 0.470 |
| Legal Framework (LF) | 0.787 | 0.808 | 0.587 | 0.275 |
| Enterprise Competitiveness (EC) | 0.788 | 0.787 | 0.554 | 0.145 |
| Culture (CL) | 0.771 | 0.770 | 0.529 | 0.281 |
| Awareness (AW) | 0.751 | 0.751 | 0.504 | 0.219 |
| Trust (TU) | 0.810 | 0.815 | 0.597 | 0.149 |
| Intention to Adopt Cloud computing services (ITAC) | 0.859 | 0.843 | 0.571 | 0.736 |

When describing the ability to differentiate one construct from others of the same kind, the term "discriminant validity" is used. This study assesses the discriminant validity using the [14] recommendation to link the value of squared roots estimates with Average Variance Extracted (AVE) values. According to [17] guidelines, the evaluation of discriminant validity comprises three distinct benchmarks, namely the Maximum Shared Squared Variance (MSV), the Fornell-Larcker test, and the Average Shared Squared Variance (ASV). Table 6 illustrates that the obtained square root of the constructs' Average Variance Extracted (AVE) value was greater than the values below the diagonal estimates.

The current stage endeavours to conduct a comparative evaluation of the value of absolute relationship among constructs and the square root of the average variance extracted

TABLE 6: DISCRIMINANT VALIDITY

| | DC | DI | DS | RA | SC | SQ | OR | OS | TR | TM | TI | CP | LF | EC | CL | AW | TU | ITAC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DC | **.768** | | | | | | | | | | | | | | | | | |
| DI | .241 | **.707** | | | | | | | | | | | | | | | | |
| DS | .021 | .016 | **.734** | | | | | | | | | | | | | | | |
| RA | .227 | .214 | .265 | **.707** | | | | | | | | | | | | | | |
| SC | .247 | .202 | .374 | .494 | **.740** | | | | | | | | | | | | | |
| SQ | .180 | .191 | .206 | .470 | .450 | **.743** | | | | | | | | | | | | |
| OR | .143 | .167 | .273 | .377 | .348 | .308 | **.777** | | | | | | | | | | | |
| OS | .225 | .212 | .171 | .473 | .432 | .383 | 381 | **.763** | | | | | | | | | | |
| TR | .249 | .211 | .370 | .573 | .725 | .462 | .375 | .455 | **.734** | | | | | | | | | |
| TM | -.101 | -.088 | -.111 | .000 | -.103 | -.109 | -.055 | -.026 | -.122 | **.734** | | | | | | | | |
| TI | .272 | .226 | .190 | .486 | .465 | .352 | .298 | .395 | .460 | -.113 | **.740** | | | | | | | |
| CP | .249 | .229 | .411 | .601 | .610 | .519 | .431 | .487 | .620 | -.110 | .440 | **.771** | | | | | | |
| LF | .275 | .217 | .287 | .513 | .589 | .502 | .350 | .470 | .603 | -.093 | .486 | .593 | **.766** | | | | | |
| EC | .017 | .034 | .828 | .216 | .300 | .198 | .217 | .162 | .302 | -.099 | .162 | .344 | .270 | **.744** | | | | |
| CL | .179 | .186 | .206 | .518 | .424 | .428 | .417 | 1.02 | .483 | .018 | .376 | .502 | .464 | .174 | **.727** | | | |
| AW | .227 | .191 | .154 | .402 | .506 | .326 | .263 | .350 | .462 | -.124 | .395 | .440 | .365 | .137 | .375 | **.709** | | |
| TU | .154 | .145 | .215 | .358 | .405 | .257 | .308 | .371 | .393 | -.034 | .284 | .469 | .429 | .188 | .363 | .278 | **.772** | |
| ITAC | .353 | .323 | .287 | .715 | .639 | .585 | .537 | .655 | .698 | -.037 | .590 | .734 | .687 | .242 | .679 | .520 | .515 | **.758** |

(AVE) for each construct. According to the criterion established by [18], if the relationship are less than the square root of the construct's average variance extracted, then it is improper to argue that a model has attained discriminant validity. However, the model demonstrates discriminant validity as evidenced by the "diagonal cells" of the Average Variance Extracted's square root exhibiting a greater value than the values below the diagonal estimates among constructs. Therefore, in the next section, this paper will discuss the data analysis intensely by showing the descriptive data first, then determining which hypothesis has been accepted and which was rejected through structural equation modelling testing.

## V. DATA ANALYSIS

It is essential to ensure the validity and reliability of the model through many measurement processes to identify its quality before going to further statistical analysis. Therefore, this section shows the details about the instruments that have been used in the test of the Confirmatory Factor Analysis (CFA). For the consistent validity test, the Statistical Software for the Social Sciences (SPSS) version 28 was employed. At the same time, the CFA assessed the model's fitness by employing the software of Analysis of Moment Structure (AMOS) version 28. However, before going to test hypotheses, the use of these instruments assists in giving proof of the validity and reliability of the model's unidimensional, discriminant, and convergent properties. The CFA findings indicated 18 latent constructs, which are the intention to Adopt Cloud computing services (ITAC), Data Confidentiality (DC), Data Integrity (DI), Data Security (DS), Relative advantages (RA), Service Cost (SC), Service Quality(SQ), Organisation Regulation (OR), Organisation Size(OS), Technology Readiness (TR), Top Management Support (TM), Technology Infrastructure (TI), Cloud provider (CP), Legal Framework (LF), Enterprise Competitiveness (EC), Culture (CL), Awareness (AW), Trust (TU). To investigate the perceived efficacy of using Cloud computing services by Saudi SMEs, 18 factors and 55 items were used. Furthermore, the loading factors for the majority of individual items were larger than 0.60. To ensure that a measurement model procedure is unidimensional, any items to be employed must have a loading factor of 0.50 or above, while any things with a loading factor of 0.50 or below must be disregarded and removed from consideration [14], [19]. As a result, after conducting an analysis of data and developing the model by AMOS software, no items were holding loading under 0.50, which meets the threshold of most references.

### A. Descriptive statistics

This study has collected 440 responses. However, of these responses collected, 28 (6.36%) were considered invalid data as they had missing data for variables and would affect the analysis process, and 412 (93.64%) were complete and accurate.

After analysing the data on participants' ages, the result indicated that 15.5% are between 18-25 years, 36.9% are between 26-35 years, 31.1% are between 36-45, and 16.5% are equal or greater than 46 years. The result of this study found that 23.1% of participants are female and 76.9% are male. The result of the data regarding the levels of Education of the participants revealed that the majority of them, which is 195

(47.3%) participants, have a bachelor's degree, 107 (26%) participants have a diploma degree, and 72 (26%) participants have a master's degree, and 30 (7.3%) participants have a high school or less, and 8 (1.9%) participants have a Ph.D. degree.

Regarding the participants' positions, the data revealed that 82 (19.9%) of the directors of organizations participated in this study, along with 22 (5.3%) IT directors, 48(11.7%) IT staff, 220 (53.4%) employees, and 40 (9.7%) selected the others. The number of years of experience for participants was 29 (7.1%) with one year of experience or less, 160 (38.8%) with one year of experience to three years, 90 (21.8%) with four years of experience to five years, and 133 (32.3%) with more than six years of experience.

Regarding the distribution of SMEs participants in this study on the different sizes of Saudi SMEs, the data revealed 228 (55.3%) participants from medium-sized enterprises, 136 (33%) participants from small-sized enterprises, and 48 (11.7%) participants from micro-sized enterprises (see Table 7).

The business sectors of participants who participated in this study, the data showed that the largest number of participants in the study worked in Information Technology and Communication Sector 48 (11.7%), followed by the Retail Sector 42 (10.2%), then Education and Training Sector 39 (9.5%) and Financial Sector 39 (9.5%). Then, the Construction and Contracting Sector 36 (8.7%), the Administrative Services Sector 28 (6.8%), the Energy Sector 27 (6.6%), the Health Sector 25 (6.1%), the Manufacturing Sector 23 (5.6%), Estate and Utilities Sector 23 (5.6%), Transportation and Storage Sector 22 (5.3%), Others 20 (4.9%) which is a type of business that is not categorized under a specific sector or its sector is not listed in this study, Food Sector 15 (3.6%), Home Services Sector 14 (3.4%), and Sports Sector 11 (2.7%) (see figure 2).

The participants were asked whether their organizations had adopted the Cloud services. 92 (22.3%) answered yes, and 320 (77.7%) responded no. However, those 92 participants who answered yes to their organizations adopting Cloud computing services were asked the additional question of what type of Cloud their organization used. Then out of 92, 20 (21.3%) used public Cloud, 27 (28.7%) used private Cloud, 1 (1.1 %) used community Cloud, 6 (6.4%) used hybrid Cloud, and 38 (41.30%) they do not know which the Cloud is their organization used.

Overall, the descriptive data of the participants in this study shows that data were collected from various participants and various types of Saudi SMEs, as Figure 2 shows.

TABLE7: DEMOGRAPHICS DATA.

| Item | Type | Frequency | Percent |
|---|---|---|---|
| Collected Data | Valid | 412 | 93.64 |
| | Missing | 28 | 6.36 |
| Age | 18-25 | 64 | 15.5 |
| | 26-35 | 152 | 36.9 |
| | 36-45 | 128 | 31.1 |
| | >=46 | 68 | 16.5 |
| Gender | Female | 95 | 23.1 |
| | Male | 317 | 76.9 |
| Education | High School or less | 30 | 7.3 |
| | Diploma | 107 | 26 |
| | Bachelor | 195 | 47.3 |
| | Master | 72 | 17.5 |
| | Ph.D. | 8 | 1.9 |
| Job positions | Director of organisation | 82 | 19.9 |
| | IT director | 22 | 5.3 |
| | IT staff | 48 | 11.7 |
| | employees | 220 | 53.4 |
| | others | 40 | 9.7 |
| Years of experience | 1 year or less | 29 | 7.1 |
| | 1-3 years | 160 | 38.8 |
| | 4-6 years | 90 | 21.8 |
| | More than 6 years | 133 | 32.3 |
| SMEs sizes | micro-sized | 48 | 11.7 |
| | small-sized | 136 | 33 |
| | medium-sized | 228 | 55.3 |

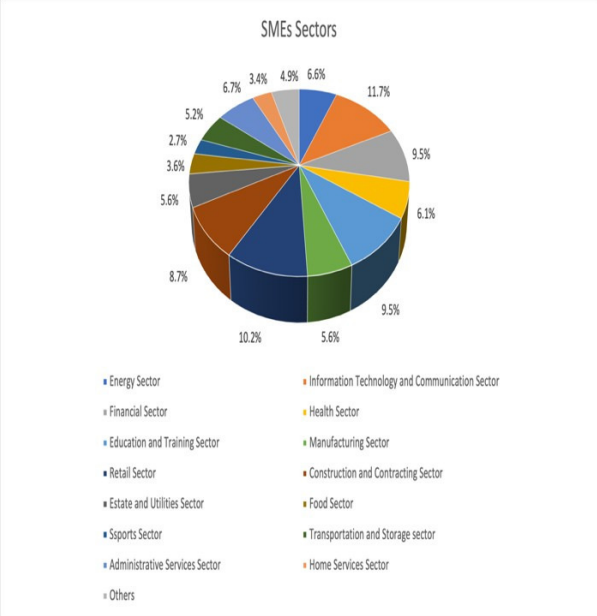


Figure 2: The participants' sectors.

TABLE 8: MODEL FIT MEASURES.

| Measure | Chi-square (CMIN) / Degrees of freedom (DF) | Comparative fit index (CFI) | Standardised root mean square residual (SRMR) | Root mean square error of approximation (RMSEA) | P of Close Fit (PClose) |
|---|---|---|---|---|---|
| Estimate | 1.384 | 0.956 | 0.053 | 0.031 | 1.000 |
| Threshold | Between 1 and 5 | > 0.95 | < 0.08 | < 0.06 | > 0.05 |
| Interpretation | Good fit | Good fit | Good fit | Good fit | Good fit |

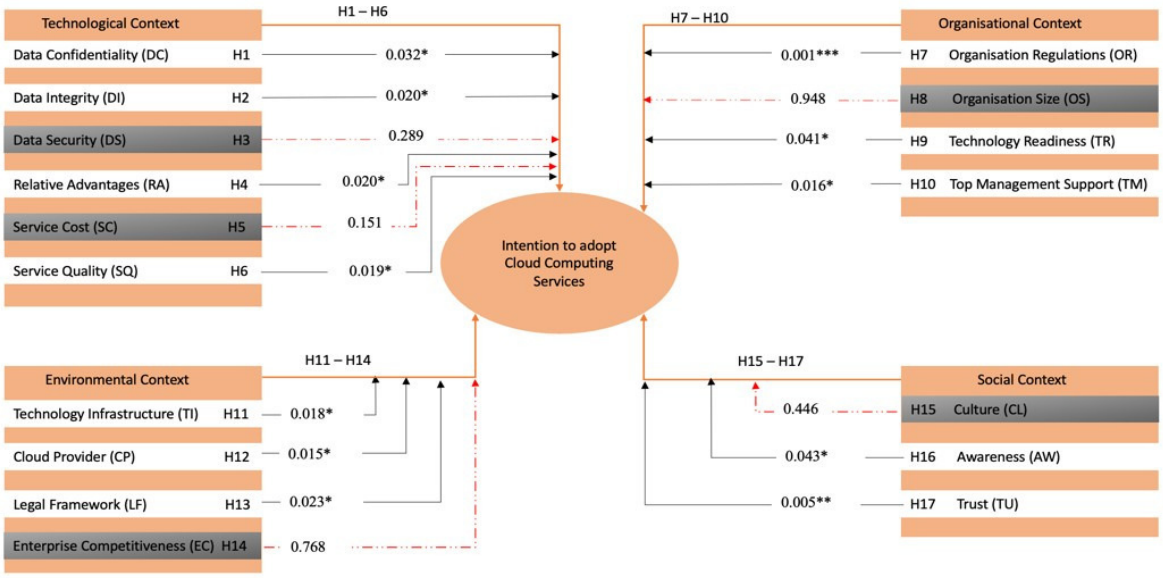


Fig. 3. The study framework (ACCM-SME) after analysis.

### B. *Structural Equation Model (SEM)*

The structural equation modelling testing shows the relationship between empirically tested constructs and whether it is significantly related or not to each other. The structural equation model and measurement models are not identical; instead, there is a distinction between the two. In the measurement model, the focus is placed on assessment, which demonstrates the links between constructs. Still, in the structural model, measured variables are used to illustrate how significant the relationships between constructs are. According to [20], the hypothesis testing object through SEM is to identify the extent to which predictors, also known as independent variables, contribute to explaining the dependent variables being studied. Overall, the model identified the following exogenous (independent) constructs: Data Confidentiality (DC), Data Integrity (DI), Data Security (DS), Relative advantages (RA), Service Cost (SC), Service Quality(SQ), Organisation Regulation (OR), Organisation Size(OS), Technology Readiness (TR), Top Management Support (TM), Technology Infrastructure (TI), Cloud provider (CP), Legal Framework (LF), Enterprise Competitiveness (EC), Culture (CL), Awareness (AW), and Trust (TU). The endogenous (dependent) construct is then identified as the Intention to Adopt Cloud computing services (ITAC). Therefore, the model indices in this stage assure that it is at a good level of fitting as follows: ($\chi 2$ = 1764.4, df = 1275, CFI = 0.956, SRMR = 0.053, and RMSEA = 0.031) as shown in the table 8.

The researchers used SEM with AMOS 28 to build the model and check whether it is good fitting. Therefore, the path analysis was assessed based on the structural model fit criteria. This research developed the framework (ACCM-SME), which consisted of 17 different relationships that were hypothesised based on the literature. The empirical data analyses revealed that 12 out of the 17 hypotheses tested had significant and positive influence, and five did not satisfy the criteria specified for this research, which have been rejected, as shown in table 9, and in updated framework see figure 3.

TABLE 9: PATH ANALYSIS FOR ALL CONSTRUCTS.
NOTE: ("***=SIGNIFICANCE AT THE 0.001 LEVEL, **=SIGNIFICANCE AT THE 0.01 LEVEL AND *=SIGNIFICANCE AT THE 0.05 LEVEL")

| Structural Relation | | | Regression Weight | Standard Error (S.E.) | Critical ratio (C.R.) | P value | Result |
|---|---|---|---|---|---|---|---|
| ITAC | ← | DC | .094 | .044 | 2.149 | .032* | Accepted |
| ITAC | ← | DI | .125 | .054 | 2.326 | .020* | Accepted |
| ITAC | ← | DS | -.061 | .057 | -1.061 | .289 | Rejected |
| ITAC | ← | RA | .136 | .058 | 2.323 | .020* | Accepted |
| ITAC | ← | SC | -.191 | .134 | -1.428 | .151 | Rejected |
| ITAC | ← | SQ | .116 | .050 | 2.344 | .019* | Accepted |
| ITAC | ← | OR | .135 | .035 | 3.855 | .001*** | Accepted |
| ITAC | ← | OS | -.013 | .202 | -.065 | .948 | Rejected |
| ITAC | ← | TR | .295 | .144 | 2.044 | .041* | Accepted |
| ITAC | ← | TM | .066 | .027 | 2.411 | .016* | Accepted |
| ITAC | ← | TI | .115 | .048 | 2.364 | .018* | Accepted |
| ITAC | ← | CP | .131 | .054 | 2.440 | .015* | Accepted |
| ITAC | ← | LF | .154 | .068 | 2.273 | .023* | Accepted |
| ITAC | ← | EC | .020 | .068 | .295 | .768 | Rejected |
| ITAC | ← | CL | .145 | .190 | .762 | .446 | Rejected |
| ITAC | ← | AW | .139 | .068 | 2.028 | .043* | Accepted |
| ITAC | ← | TU | .105 | .037 | 2.801 | .005** | Accepted |

Most factors of this empirical study affect the intention of Saudi SMEs to adopt Cloud computing services except five of them, which are Data Security (DS) (P=0.289), Service Cost (SC) (P=0.151), Organisation Size (OS) (P=0.948), Enterprise Competitiveness (EC) (P=0.768), and Culture (CL) (P=0.446) (see table 9). This will be discussed in more detail in the following section.

## VI. Discussion

This study has developed a framework in the context of adopting Cloud computing services by Saudi SMEs. Then, it was tested through empirical data to identify the relationship through factors hypothesis based on four contexts, which are: Technological context, Organisational context, Environmental context, and social context.

### A. Technological context

The technological context is an essential element of economic enhancement, and it plays an indispensable role in transforming the organisations' traditional work into more reliable and advanced technological pathways. This requires a contemporary and robust technology infrastructure.

The IT background and usage of Cloud computing in Saudi SMEs have been addressed by recent studies [21], [22], [23]. However, confidentiality, privacy, data control, the service cost, a lack of Cloud knowledge, and the integrity of the data have not been adequately considered in the recent studies that have been conducted in the area of data security [6], [24].

To fill the knowledge gap mentioned by the previous authors in their recommendations for further investigation, this study investigated to identify all of the significant factors that influence Cloud computing adoption in Saudi SMEs in the context of technology. Then, the result of our study revealed that data confidentiality and data Integrity are considered important factors that are significantly related to the intention to adopt Cloud computing by Saudi SMEs, and that results were consistent with the results of [25].

Data security as a significant term was not a concern for Saudi SMEs, which may lay for some reasons, one of them being a recent requirement that the Saudi government forces all businesses to store their data locally in Saudi.

Service quality and relative advantage were found to play a role in our investigation. They positively affect the adoption of Cloud computing services, and [26] showed the significance of service quality and relative advantage along with their benefits toward Cloud adoption.

Service cost found to be not posed a concern or a challenge. It was expected that lower service costs would encourage Cloud computing use; this has not been the case, and it may be due to the concern of Saudi SMEs about quality, whatever the cost is.

### B. Organisational context

The organisational context investigates four factors revealed after a deep dive in the literature: Organisation regulation, Organisation size, Technology readiness, and Top management support. The organisational context is an essential and indispensable part that plays a significant role in adopting Cloud computing and impacts most developing countries, including Saudi Arabia [27].

Our results revealed that organisation regulation is a crucial factor and has a relationship with the intention of adopting the Cloud and positively affected Saudi SMEs, consistent with [28], who confirmed that keeping updated organisation regulations reinforces the adoption of the Cloud.

In addition, organisation size was found not to be a relationship with Saudi SMEs' intention to adopt Cloud computing services, and this result refuted what has been found in this study regarding the importance of organisation size in the adoption of Cloud [29].

From the perspective of technology readiness, it positively affects the adoption of the Cloud. The path coefficient is relative, suggesting that this element has a noteworthy impact on Saudi SMEs' decisions to move their operations to the Cloud, which is consistent with the result [30].

Top management support is considered an essential factor related to the decision that may be made regarding Cloud adoption. Other studies have investigated how top management affects the adoption of Cloud computing services and discovered that they relate to each other positively [31]. Therefore, this study's results found that the top management support factor significantly positively influences Saudi SMEs' adoption of Cloud computing.

### C. Environmental context

The environmental context is considered a key that leads organisations to adopt Cloud computing services as it represents significant factors that are part of the life cycle of organisations. Technology infrastructure is one of them that has been investigated in this study. A study has assessed how the private Cloud with solid technology infrastructure helps organisations migrate from traditional technology to the Cloud. It found that it is beneficial and helps the organisation carry many virtual services, houses more than 35 services without any disruption, and is capable of more [32]. Our results were consistent with that and confirmed the technology infrastructure substantially impacts the Saudi SMEs' intention to adopt Cloud computing services as the critical ratio demonstrated a significant connection between them.

A Cloud provider is the second factor in the environmental context that seems to impact SMEs' adoption of Cloud services due to Saudi government restrictions, which prohibit dealing with any Cloud provider whose data centres are outside of Saudi, which resulted in a limited number of Cloud providers within Saudi. An increasing number of Cloud providers within Saudi increasing SMEs' intention to adopt the Cloud is the hypothesis that was made regarding the Cloud provider factor. It was correct, and it was found that a positive relationship exists between the Cloud provider and the adoption of Cloud computing in Saudi SMEs. [33] confirmed that organisations in Saudi Arabia trust the Cloud provider based in Saudi Arabia, which increases their confidence and results in adopting the Cloud.

Regarding the third factor in the environmental context of the legal framework, [34] found that when the legal framework and strategies within organisations are revised continuously, it leads to getting good quality and pushing for adopting Cloud services. Therefore, this study found a positive link between the Legal framework and the adoption of Cloud computing in Saudi SMEs.

Then, competitive pressure, the fourth factor in the environmental context, was investigated to check its effects. According to [35], competitive pressure is an influencer factor in adopting Cloud. Moreover, our findings were against that and showed no concern for enterprise competitiveness, which resulted in no impact on the intention of Saudi SMEs to adopt Cloud services.

### D. Social context

The social context plays a significant role in the success of adopting new technologies, especially the adoption of Cloud computing services. Social context is one of the most essential parts of understanding any problem, and the most critical factors have been found, including societal behaviour (culture) and awareness [36]. However, this part of the study investigates three social context factors identified after a deep search in the literature about the factors that may affect the decision to adopt Cloud computing services: culture, awareness, and trust.

This study showed no relationship or influence between culture and intention to adopt Cloud computing services by Saudi SMEs as follows ($\beta = .145$, $p < 0.446$). This refuted the result of [37], who found a negative relationship and indirect impact of cultural factors on the decision of Saudi SMEs to adopt the Cloud, and [38], who found that culture significantly impacts the Cloud computing adoption decision in developing countries.

In addition, the result of this study regarding awareness revealed that the route from awareness to intention to adopt Cloud computing services had a positive effect ($\beta = .139$, $p < 0.043$), indicating that all derived values, including the crucial ratio for each item, were substantially within the range. This implies that Saudi SMEs feel embracing Cloud computing depends on their employees' awareness. Saudi SMEs should be aware of adopting Cloud services effectively to fulfil organisations' demands. Consequently, the data analysis results of the awareness component showed a positive relationship with Cloud computing adoption. Indeed, the study results are consistent with the outcome of [36], which confirmed that people's awareness should be considered as it is regarded as a key that helps accelerate organisations' transition toward Cloud adoption.

Regarding the trust factor, the study results found a significant positive relationship between trust and the adoption of Cloud computing in Saudi SMEs. Thus, the noteworthy, related relationship, as shown by the critical value obtained between trust and intention to adopt Cloud computing services ($\beta = .105$, $p < 0.005$). This indicates the trust factor significantly impacts the level to which Saudi SMEs adopt Cloud computing. Many authors agree that trust is essential to maintain transparency between organisations and their employees, pushing them to adopt Cloud computing services, for example [27], [39].

Therefore, Data Security (DS) (P=0.289), Service Cost (SC) (P=0.151), Organisation Size (OS) (P=0.948), Enterprise Competitiveness (EC) (P=0.768), and Culture (CL) (P=0.446) were the independent factors that did not significantly affect Saudi SMEs' adoption of Cloud computing, as shown in Table 9.

The null hypothesis H3, "Increasing the data security of Cloud computing increases the Saudi SMEs' intention to adopt Cloud computing services", was rejected with a value of (P=0.289), indicating that the data security had no impact on the decision of the Saudi SMEs to adopt Cloud computing services. Similarly, the null hypothesis H5, "Decreasing the cost of Cloud computing increases the Saudi SMEs' intention to adopt Cloud computing services", was rejected with a value of (P=0.151), indicating that the cost associated with Cloud computing had no significant impact on the decisions of Saudi SMEs to adopt Cloud computing.

This outcome may be attributed to the Saudi government's assistance and expertise in information technology (IT), which has helped the private sector improve its data security practices. In addition, the fact that Saudi organisations do not care about saving money when it comes to transforming into new technologies is evidence that they value innovation and competitiveness above all else.

Moreover, the null hypothesis H8, "A smaller organisation size is more likely to increase the Saudi SMEs' intention to adopt Cloud computing services", was rejected with the value of (P=0.948), showing that the organisation size does not influence the intention of Saudi SMEs toward adoption of Cloud computing services. In addition, the value of (P=0.768) proving that the null hypothesis H14, "Increasing the enterprise competitiveness increases the Saudi SMEs' intention to adopt Cloud computing services", was rejected, indicating that the enterprise competitiveness does not have an impact on the intention to adopt Cloud computing services by Saudi SMEs. The culture factor seems does not affect the intention of Saudi SMEs to adopt Cloud computing services since the null hypothesis H15, "Increasing the technology culture for customers, IT managers, top managers, and employees increases the Saudi SMEs' intention to adopt Cloud computing services", was rejected with the value (P=0.446).

This empirical data adds to our knowledge of the essential elements from the viewpoint of SMEs, for whom Cloud computing adoption become a big concern. This research addresses a knowledge gap and expands SMEs' grasp of Cloud computing in Saudi Arabia. The difference that may be noticed between the result of this study and other studies is that variations between nations and the populations studied might account for discrepancies with previous research.

## VII. Conclusions

Nowadays, Cloud computing has become an essential technology service on a par with the service of electricity, gas, and water. It plays a significant role in making the process and storage of data very flexible and on everyone's hands as it offers pay-per-use service. The result of the study may contribute to helping SMEs in the future by making them conscious of the challenges that face Cloud adoption in the early stage.

Further, the findings of this study may contribute to assisting organisations and their leadership to understand the accurate perception of those organisations. In addition, it may help SME reformulate their thinking and strategies, around Cloud adoption, which is consistent with factors that this study has proved as challenges SMEs face.

Due to the technological advancements facilitated by Cloud computing, such as improved infrastructure flexibility and efficiency, enhanced data processing capabilities, and heightened automation, alongside the associated benefits of cost reduction and operational optimization, many organizations are keen to implement Cloud solutions. This study empirically explores the factors influencing organizations' adoption of Cloud services, shedding light on both the challenges and obstacles encountered across technological, organisational, environmental, and social contexts.

Specifically, this study investigates seventeen factors (Data Confidentiality, Data Integrity, Data Security, Relative Advantages, Service Cost, Service Quality, Organisation Regulations, Organisation Size, Technology Readiness, Top Management support, Technology Infrastructure, Cloud Provider, Legal Framework, Enterprise Competitiveness, Culture, Awareness, and Trust) affecting SMEs' Cloud computing adoption within these four contexts. First, a systematic literature review has been conducted [9], to find the knowledge gap around factors that might influence adoption of Cloud computing in the contexts mentioned. Critical factors that pose challenges and obstacles to Saudi SMEs have thus been identified and modelled in the ACCM-SME framework, Figure 1. Then, the research framework was developed based on the TOE model blended with DOI theory in different contexts (technological, organisational, environmental, and social). Based on that, 17 hypotheses (covering all factors) were constructed leading to a compressive survey development with 66 items; 11 querying demographic data, while 55 examined how the factors influence Cloud computing adoption empirically.

The study survey was distributed to over 500 participants in Saudi SMEs in Riyadh city, including Top management, IT directors, and employees. Four hundred and twelve participants have fully answered the survey. As a result, after analysing the data, we found that the factors: Data Security (DS), Service Cost (SC), Organisation Size (OS), Enterprise Competitiveness (EC), and Culture (CL) showed no impact on the Saudi SMEs to adopt Cloud computing services. In contrast, the rest of the identified factors impacted Cloud adoption.

This research shows that through the ACCM-SME framework (based on the merging of two established theories called the TOE model and DOI theory), we were able to examine SMEs' use of Cloud computing from a more comprehensive technological, organisational, environmental, and social vantage point, which may give helpful insights for businesses.

The research also clarified and highlighted the importance of leaders in fostering an environment conducive to developing systems that need the involvement of organisational leaders with the skills to overcome obstacles in adopting and implementing suitable information technology. Several factors that might encourage and reinforce businesses to switch to Cloud-based systems have been explored in this research.

Through the ACCM-SME framework we were able to establish both factors that had no influence and those that influenced adoption of Cloud computing from an SME perspective (Table 9, Figure 3). This gave us useful insights as to why SMEs are not yet moving to the Cloud. These are crucial findings for SMEs, particularly in Saudi Arabia, where a better understanding of relevant factors may lead to an increase in SME intention to adopt Cloud computing. As such, the ACCM-SME framework will serve as a useful resource for SMEs when they intend to start adopting Cloud services.

### A. Study limitations

This study's results indicate how SMEs in future can both benefit from and adopt Cloud computing. Nonetheless, various limitations have been highlighted, giving an opportunity to investigate them. Directors, IT directors, and workers of SMEs were among the survey respondents for this research. As a result, there are two limitations that were out of the study scope. First, the study has not considered the views of consumers or Cloud computing service providers. Secondly, it does not consider job opportunities that may arise from the adoption of Cloud computing by the SME, and which may influence their choice to adopt. These limitations may be overcome in the future as new variables of study.

### B. Future work

In the upcoming stage of our research, these results will also be validated by qualitative data. This study will be extended to the other factors that influence the process of Cloud adoption, such as the perception of Cloud providers and job opportunities that Cloud adoption may disparage. It is worth noting that the challenges that face SMEs to adopt Cloud computing services may differ from one country to another due to the different environments and the styles of organisations. Finally, to increase the efficiency of future studies, the researchers should think about acquiring samples with various viewpoints of all partners who are related to SMEs.

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