Journal of Theoretical and Applied Information Technology
15th April 2024. Vol.102. No 7

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

CRITICAL SUCCESS FACTOR ANALYSIS FOR CLOUD-BASED ERP PROJECTS IN INDONESIA

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ABSTRACT

Currently, ERP systems are experiencing rapid expansion through the utilization of cloud technology. This technology holds great promise as it is expected to significantly enhance productivity, facilitate seamless collaboration among teams, and ensure robust data security and transparency. Indonesia is one of the potential cloud markets as it is supported by the government's digitalization drive. This creates opportunities for the widespread implementation of cloud-based IT projects in Indonesia, including those involving cloud-based ERP systems. One aspect requiring careful consideration is the possibility of project failure. Certain pivotal factors warrant consideration due to their potential influence on the project's success. This article aims to identify the critical success factors (CSFs) for projects utilizing cloud-based ERP systems, with a particular focus on SAP deployed in the cloud within Indonesian projects. The research was a quantitative study that involved 138 implementors who have engaged SAP on cloud projects in the last 5 years in Indonesia. Data was analyzed by using the PLS-SEM method. 2 of the 8 hypotheses from 3 CSF dimensions were supported by the PLS-SEM results. This study provided evidence that several critical success factors related to the Organizational dimension and Technology dimension significantly and positively impacted the success of cloud-based projects, especially those related to SAP on the cloud in Indonesia. On the contrary, none of the Critical Resource Factors (CRFs) addressed the People dimension, which has been shown to significantly contribute to project success. These findings can serve as a foundation for crafting a project strategy aimed at enhancing the success potential of cloud-based ERP projects, whether they are in the planning phase or already in execution.

Keywords: *Critical Success Factors, Cloud-based ERP, SAP, PLS-SEM, IT Project Management*

1. INTRODUCTION

ERP is an acronym for Enterprise Resource Planning which is an integrated system capable of managing all of a company's core business processes such as Finance, HR, Manufacturing, Supply Chain, Services, Procurement, and others [1]. ERP is currently evolving rapidly by utilizing cloud technology and other modern technologies such as Artificial intelligence (AI), Internet of Things (IoT), and Machine Learning (ML), which make ERP systems able to run intelligently and automatically, provide greater efficiency, and generate new insights instantly from all aspects of the business [1]. Current ERP software facilitates the connection of companies' internal operations with their global business partners and networks. This capability enables companies to collaborate swiftly and agilely, ensuring they remain competitive in the ongoing era of digital transformation. [1].

The global ERP software market experienced an 8% growth, reaching a total software revenue market value of $44 billion. The top five positions in global market share are held by SAP, Workday, Oracle, UKG, and Sage. [2]. In early 2023, SAP is aggressively introducing cloud ERP technology in Southeast Asia including Indonesia [3]. As of now, SAP has surpassed 230 million cloud users, offers over 100 solutions that span across all business functions, and maintains the largest cloud portfolio

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

among all providers. [4]. Cloud technology is currently very promising because it is believed to increase productivity effectively and efficiently, foster collaboration between teams, and provide data security and transparency [5]. An interesting research result from International Data Corporation, a global market research company, estimates the market value of the cloud virtual storage business in Indonesia to reach US$ 933.63 million in 2023, growing 25% from the 2022 achievement of around US$ 747.15 million. The growth is supported by increasing adoption, especially in corporations, and the drive for digitalization by the government [6]. With the continued development of cloud technology in Indonesia as well as encouragement from the government and developers such as SAP, cloud-based information technology projects such as cloud ERP have the potential to be implemented in Indonesia. But, the thing to be cautious about is project failure. Project failure is an unpleasant fact for companies that implement information technology, including Enterprise Resource Planning (ERP) projects both on-premise and on the cloud. Project failure in question is not meeting project success criteria such as the project being completed within the given budget, the project being completed within the specified timeframe, and the realization of substantial business benefits [7].

Based on data collected by Netsuite in 2022 about the implementation of ERP systems in the world, it was found that: 50% of projects fail the first time [8]. Most implementations cost three to four times what was budgeted [8]. ERP implementation projects can take 30% longer than anticipated [8]. 51% of companies experience operational disruptions when they go live [8]. In Indonesia itself, several ERP project failures have also been recorded. Based on data from one of the ERP implementors in Indonesia, shows that the failure rate of ERP implementations carried out from 2015-2018 reached 23% [9]. In addition, ERP project failure was also recorded in one of the companies engaged in mining in Indonesia [10]. The company implemented ERP starting in 2017 and started operating in 2018 [10]. The financial statements issued by the ERP system turned out to be incorrect and unacceptable to the auditor [10]. The consultant overseeing the implementation conducted a thorough review of the executed business processes but could not identify the root cause of the implementation failure [10]. This setback disrupts company operations since they are required to manually record and calculate financial reports based on existing transactions [10]. These failure records can be an illustration of the risks that must be watched out for by companies that want to carry out ERP-related projects, including projects related to cloud ERP technology which are currently being intensively offered by software principals and supported by the government's digitalization drive in Indonesia.

In ERP-related projects including cloud ERP, there are critical factors that need to be considered because they can affect the success of the implementation project. These factors can be a reference for companies to keep the project successful. Based on previous research, these critical factors are at least categorized into 3 main factor dimensions, which are Organizational, People, and Technology [11]-[12]. Organizational factors include communication, project budget, project management, and others. Then, for People Factors such as user involvement in the project, project team, support from top management, and others. As for Technology Factors such as infrastructure, the ability of the system to adapt to business processes, data integrity, and others.

From the description of the background above, the authors are interested in researching the analysis of critical success factors (CRFs) of projects related to cloud ERP systems in Indonesia, especially projects related to SAP on cloud which is one of the cloud ERP solutions from ERP principal who have a good reputation in Indonesia. Since 1997 SAP Indonesia has served more than 1600 companies from 26 different industrial sectors [13]. The author applies the Partial Least Square-Structural Equation Modeling (PLS-SEM) analysis method to analyze the data obtained. Based on Hair et al, the SEM analysis method is a multivariate that can analyze complex variable relationships between constructs and indicators [14]. PLS-SEM can be used to analyze data where the model uses few indicators or medium or large sample sizes (>100). PLS signifies a causal-predictive approach to Structural Equation Modeling (SEM), giving priority to prediction when estimating models. The structure of these models is intentionally designed to offer causal explanations. [15]. The findings of this research are expected to be utilized in constructing a project strategy aimed at enhancing the probability of success for planned or ongoing cloud-based ERP projects.

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

2. THEORETICAL BACKGROUND

2.1 Cloud-Based ERP

The ERP system is an enterprise information system crafted to facilitate enterprises in leveraging various resources by eliminating information barriers across departments. This is particularly crucial as modern enterprise organizational structures have become significantly more complex than in previous times [16]. The process of implementing an ERP system is both expensive and time-consuming. Digital transformation must be widely adopted by companies that have decided to run an ERP implementation. Organizations must securely store their transactions, data, and documents in a data center. However, establishing a private data center poses a high-risk investment for companies not specialized in information technology. This is due to the substantial capital investment required for expensive hardware and software. Furthermore, maintenance costs must also be carried out continuously as long as the ERP system is used, whereas there is no 100% guarantee that the transactions on this ERP system will be successful. One solution to reduce the investment costs associated with implementing an ERP system is to lease information technology infrastructure from a third party. This approach allows companies to concentrate on their core business activities without bearing the capital risk of high initial investment and ongoing maintenance costs [16]. Cloud technology can serve as an alternative infrastructure for ERP systems. An ERP system is categorized as cloud-based when it demonstrates characteristics that align with cloud computing principles.

Cloud computing services are provided in three models [17], which are: Software as a Service (SaaS) is software as a service that targets end users. This service provides software applications that can be accessed by many users via the Internet. Platform as a Service (PaaS) is the platform as a service that targets software developers. This service provides a platform that software developers can use, to enable them to build SaaS applications and manage the management of those applications. Infrastructure as a Service (IaaS) is infrastructure as a service that targets companies that want to have virtual servers. This service provides IT infrastructure such as servers, networks, storage, and others, which is paid for by the company according to its business needs and growth. Based on research, the SaaS and IaaS models are extensively adopted in cloud ERP implementations.

Some of the advantages of cloud ERP include [17]: *Lower upfront costs*: Because computing resources are detached from the company's physical location, organizations are not required to invest in constructing a computing environment. Instead, they only incur costs for accessing the environment through the internet. *Lower operational costs*: The cloud service provider oversees and delivers the cloud service, thereby streamlining the operational processes of the enterprise and leading to reduced operational costs. *Fast implementation time*: A diverse array of ERP solutions is provided by cloud service providers, catering to the majority of a company's requirements. The choice among various solutions and products is made based on the specific business needs of the company, resulting in a shorter implementation timeframe. *Scalability*: Cloud services exhibit elasticity, allowing companies to scale up or down their resource usage based on the current requirements of the organization. *Focus on core competencies*: Cloud-based ERP systems assist companies in enhancing business efficiency and enable them to concentrate on other aspects related to their core activities. *Better accessibility, mobility, and usability*: Cloud-based applications function in an open environment, which improves accessibility options. This increased accessibility, in turn, elevates the usability and mobility of cloud ERP, both within the enterprise and beyond. *Improved system availability and recovery after disasters*: Cloud service providers furnish clearly outlined policies and plans governing backup, restoration, recovery, and all other functions associated with availability and disaster recovery. *Security standards*: Certain cloud service providers enforce encryption and decryption standards, resulting in the shift of security concerns and responsibilities from the client to the cloud service provider.

2.2 Critical Success Factor (CSF)

The concept of 'success factors' was originally introduced by Daniel in 1961 in an article entitled 'Management Information Crisis'. Daniel introduced a new organizational approach to achieving performance and competitiveness targets. Daniel stated that organizations have several important areas where things are required to perform correctly. These areas are defined as the main keys that must be conducted excellently for the company to be successful [18]-[19]. In 1979, Rockart further developed this concept and introduced the notion of

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

the Critical Success Factor (CSF), characterizing it as essential areas where success is crucial for the business to flourish. If the outcomes in these critical areas are deemed insufficient, the company's performance will fall short of the planned objectives. He emphasized that CSF areas should receive serious and consistent attention from the company's leadership and management. Although originally proposed for design management, the CSF approach has subsequently been used broadly in various areas of business and information systems, such as the construction, manufacturing, and ICT sectors, including ERP system research [18] [20].

Based on prior research, Critical Success Factors (CSFs) are at least categorized into three main dimensions: Organizational, People, and Technology [12]. Huang et al. in 2021 identified 35 CSFs through a systematic literature review of 10 journals published after 2010 [12]. This finding is supported by Correia & Martens in 2023, who discovered 18 CSFs related to cloud computing projects through a qualitative study involving 23 experts in cloud computing projects via semi-structured interviews [21].

This research incorporates several widely used CSFs in cloud ERP implementations based on the findings of Huang and Correia & Martens. These include Organizational Culture, Communication, and Project Management to represent the Organizational dimension. Furthermore, Consultant Capability, End-User Participation, and Top Management Support are drawn from the People dimension. Additionally, Infrastructure and System Customization are considered from the Technology dimension.

2.3 Organizational Culture

Organizational culture comprises components such as vision, mission, values, beliefs, cultural norms, leadership style, hierarchy and authority structures, organizational style, ethics, and code of conduct [17]. Organizational culture is a vital element that significantly impacts a company's performance effectiveness. It ensures that the values, beliefs, and work systems within an organization create a conducive work environment that sustains the company's operations. Organizational culture enables employees to comprehend the company's vision and mission, fostering a shared understanding of its processes and objectives. This shared understanding empowers employees to actively participate in achieving the company's goals [22].

Organizational culture is pivotal in determining the success of implementing a cloud ERP system. Ahn & Ahn's research identifies organizational culture as an essential element in the process of cloud ERP implementation. In the context of adopting cloud-based ERP, revitalizing organizational culture is deemed necessary. The organization must be responsive and flexible. The organizational culture is expected to be open, easily accepting changes in the company's operational direction [23]. The findings of the study by Alsharari suggest that organizational culture may influence the success of ERP implementation in the UAE public sector study concludes that in a highly institutionalized environment, organizational responses to institutional pressures will indeed occur. However, these responses are contingent upon and influenced by aspects of organizational culture. The adoption of cloud ERP systems and their institutionalization have served as catalysts for significant transformations in organizational culture, resulting in a radical change in government processes. The public sector in the UAE has effectively aligned institutional work processes with the intrinsic logic of cloud ERP, ultimately leading to the seamless integration of the cloud version. This assimilation of ERP represents the extent to which an organization has evolved from understanding the functionality of an ERP system to proficiently implementing it within its operational processes [24].

2.4 Communication

According to PMBOK, communication is the process of maintaining a continuous flow of information between the organization and the project team, as well as within the team itself. It fosters collaboration among stakeholders through various means, including verbal and written communication, interactive meetings, face-to-face discussions, formal and informal dialogues, and activities aimed at sharing knowledge [25]. Ensuring effective and efficient communication entails deciding the methods, timing, frequency, and specific circumstances in which stakeholders both desire and should be involved. Communication is an important part of building and maintaining solid relationships (engagement). Engagement is described as a connection or attachment between stakeholders, characterized by an awareness of others' ideas, the assimilation of different perspectives, and the collaborative formation of shared solutions [25].

Correia and Martens' research highlights that sufficient communication among suppliers,

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

teams, stakeholders, and service providers is a crucial factor contributing to the success of cloud-based project implementations [21]. More specific to cloud ERP implementation projects, the communication factor is the top three CSFs that are widely cited during cloud ERP implementation [12]. Effective communication has the potential to enhance team knowledge and facilitate learning among team members. Transparent and precise communication is essential to minimize ambiguity within the team's understanding throughout the implementation process [11] [12].

2.5 Project Management

Project Management is defined as the application of knowledge, skills, tools, and techniques in project activities to fulfill project requirements. It involves the guidance of project work to achieve the desired results [25]. Project management involves the creation of a plan document that outlines how the project will be executed, monitored, controlled, and closed. The Project Manager, acting as the project leader, will be in charge of overseeing the implementation of this plan and ensuring the achievement of the project objectives [25].

According to the results of a multi-dimensional study on the CSF of ERP implementation conducted by Vargas and Comuzzi, project management is an important factor in the ERP implementation process in developed countries, and becomes the most important factor if the ERP implementation is carried out for large-scale companies. Project management is also a CSF for ERP implementation in public sector companies [26]. According to the research conducted by Huang et al on cloud-based ERP implementation, project management ranks as the second most cited Critical Success Factor (CSF) and is deemed highly important for the successful implementation of cloud ERP systems [12]. Project management encompasses various processes, including initiation, planning, execution, and control [12].

2.6 Consultant Capability

External support provided by consultants from software vendors as well as from independent consultants, is very important in ERP system implementation projects. Even before the implementation, assistance from external onsultants is needed to review the existing business processes in the company. Because consultants understand the business processes of industry and ERP systems, they can inform what is needed during the ERP implementation project. External consultants can also provide reference examples and best practices from other customers [27].

According to the work results of Correia and Marten, one of the CSFs that strongly influences the success of cloud projects is the technical ability of the implementor team including consultants. This technical capability is related to documentation activities, programming, implementation, testing, and design creation, and is also related to quality and previous experience [21]. In the research conducted by Eampoonga and Leelasantitham on the success factors of hybrid cloud ERP systems in the automotive sector in Thailand, the findings suggest that the proficiency of business skills and technical skills in the field of information technology among project teams, including consultants, is positively associated with overall project outcomes. These outcomes encompass the success of ERP project implementation, ERP system quality, and organizational performance following the implementation of the ERP system [28].

2.7 End-User Participation

End-users are individuals or groups who will directly experience the results of the project. Certainly, projects necessitate precise guidance from customers and end-users concerning their needs, deliverables, and expectations. In some project environments, customers or end users engage with the project team to conduct reviews and provide feedback regularly [25].

Based on a comprehensive literature review conducted by Vargas and Comuzzi in terms of ERP implementation CSFs, it was found that ERP system end-user participation is an important CSF for ERP implementation in the service sector [26]. This aligns with the findings of Gupta and Misra's research, indicating that end-user participation in cloud ERP systems exhibits a positive correlation with the success of cloud ERP implementation [11]. In essence, the active involvement of system end-users can significantly contribute to fostering a positive environment and enhancing the success rate of cloud ERP implementation. [11].

2.8 Top Management Support

Top management includes pivotal decision-makers within the organization, such as the Chief Executive Officer, Chief Operating Officer, Chief

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

Financial Officer, Heads of Business Units, and Vice Presidents. [29]. The top management of an organization plays a vital role as a stakeholder in a project by actively contributing to project design and offering support to project managers, ensuring the successful implementation of the project. [29].

From the study by Mahmood et al, top-level management support was found to be the most important factor in ERP implementation. Top-level management decisions in the form of strategy/style/commitment emerged as the most important factor among other factors. In the era of digitalization, organizations intending to implement ERP must actively seek full support and commitment from top-level management. This proactive approach is essential to prevent problems or challenges that may emerge as barriers to the success of the ERP implementation project. [30]. Additionally, according to a study by Ploder et al, support from top-level management emerges as one of the most pivotal Critical Success Factors (CSFs) in cloud ERP implementation. Top-level management holds responsibility for allocating financial resources, facilitating discussions, taking decisive actions, and guiding the resolution of problems, assuming the role of decision-makers [27].

2.9 Infrastructure

Based on PMBOK, infrastructure in the project consists of facilities used, equipment, organizational and telecommunication networks, hardware from information technology, availability, and capacity [25]. Meanwhile, in cloud ERP implementation, according to Xie et al, infrastructure has attributes such as hardware, software, IT architecture, databases with quality that meets the needs, and data migration capabilities [31].

Following the finding research of Huang et al, one of CSFs influencing cloud ERP implementation from a technological perspective is IT infrastructure. For instance, the migration from on-premises ERP to cloud ERP can present challenges and expenses, particularly for large organizations managing extensive and complex infrastructures [12]. Backed by the findings of research conducted by Eampoonga and Leelasantitham, technological contexts such as infrastructure are items that need to be considered in determining project strategies because they can affect project success [28].

2.10 System Customization

Successful implementation of an ERP system necessitates adjusting the company's business processes to align with the selected ERP software. This is expected to minimize adjustments to the ERP system. However, companies usually refuse and prefer ERP systems that are tailored to their company's business processes. This causes problems, such as the high cost required to update the ERP system to match the company's business processes, and this system adjustment is tiring because every time the ERP system is upgraded it needs to recode adjustments [30]. System customization is related to WRICEF - Workflow, Report, Interface, Conversion, Enhancement, and Form.

According to the research results of Kiran and Reddy, the selection of an inappropriate ERP package and the selection of an ERP package that requires a very high level of customization can lead to ERP implementation failure in SME enterprises. Therefore, ensuring the optimal alignment between the organization's business processes and the chosen ERP package becomes imperative [7]. Excessive system customization will add cost and time and will continue to cause problems in future versions [7]. In another study conducted by Vargas and Comuzzi, it was concluded that minimal system customization is one of the important CSFs of a successful ERP implementation project, especially for companies engaged in services [26].

2.11 Project Success

PMBOK states that the success of a project can be seen from the value achieved after the project is implemented. This value focuses on the results of the work, including results from the perspective of the customer or end-user and based on the needs of the company. For example: a project is declared successful if it can contribute to the company's finances, or it can also have other benefits such as fulfilling business needs, improving company performance, adding social benefits, and many others [25].

According to a study conducted by Gupta and Misra, the success criteria for cloud ERP project implementation include [11]: Lower implementation costs; Ease of use and reporting; Lower customer waiting time; Increased customer retention; Improved ability to fulfill current user needs; and Increased flexibility to fulfill any changes in user needs. On the other hand, based on research by Kiran

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

and Reddy, things that can be the key parameters for a successful ERP system implementation project in small and medium-sized companies include [7]: The completion of the project within the allocated budget, adherence to the specified timeframe, and the achievement of significant business benefits are the key objectives. According to research by Eampoonga and Leelasantitham, indicators that can be used to measure the success of implementation projects of hybrid cloud ERP systems in the Thai automotive sector include [28]: The completion of the implementation within the designated timeframe, within budget, meeting expectations, and ensuring user satisfaction with the implemented system are crucial criteria.

3. METHOD

3.1 Research Model

The authors identify CSFs affecting the success of cloud-based ERP projects in Indonesia and conduct literature reviews to explore them. These reviews involve analyzing numerous books and journals focusing on critical factors within the Organizational, People, and Technology dimensions that contribute to the success of ERP projects, cloud projects, and cloud-based ERP projects in various countries and contexts. After conducting the literature studies, variables from the Organizational dimension were determined, which are Organizational Culture, Communication, and Project Management. Then, the variables from the People dimension are Consultant Capability, End-User Participation, and Top Management Support. To identify the variables within the Technology dimension, Infrastructure, and System Customization were chosen. Eight variables from these three dimensions will be used as independent variables, and cloud ERP system project success (Project Success) will be used as the dependent variable.

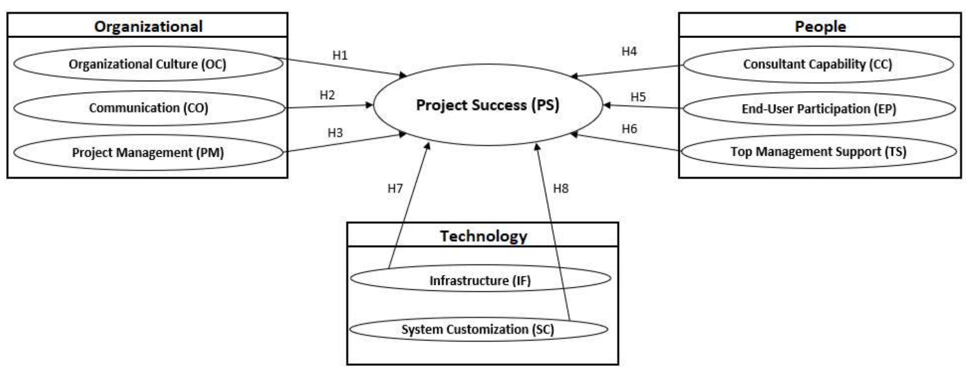

Figure 1. Architecture of the Research Model

This model is based on the findings of previous research, indicating that variables from the Organizational, People, and Technology dimensions, such as Organizational Culture (OC), Communication (CO), Project Management (PM), Consultant Capability (CC), End-User Participation (EP), Top Management Support (TS), Infrastructure (IF), and System Customization (SC), positively correlates with the success of cloud ERP projects (Project Success (PS)).

3.2 Hypothesis

The hypothesis is formulated in alignment with the research objectives, which aim to identify the factors impacting the success (Critical Success Factors) of cloud ERP system projects, particularly those related to SAP on Cloud in Indonesia. Based on the outcomes of the previous concept linkage study and the research model architecture outlined in section 3.1, several hypotheses will be tested:

H1: Organizational Culture (OC) positively contributes to Project Success (PS)
H2: Communication (CO) positively contributes to Project Success (PS)
H3: Project Management (PM) positively contributes to Project Success (PS)
H4: Consultant Capability (CC) positively contributes to Project Success (PS)
H5: End-user participation (EP) positively contributes to Project Success (PS)
H6: Top Management Support (TS) positively contributes to Project Success (PS)

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

H7: Infrastructure (IF) positively contributes to Project Success (PS)
H8: System Customization (SC) positively contributes to Project Success (PS)

3.3 Variables Measurement

The variables to be used in this study are Organizational Culture (OC), Communication (CO), Project Management (PM), Consultant Capability (CC), End-User Participation (EP), Top Management Support (TS), Infrastructure (IF), System Customization (SC) and Project Success (PS). Indicators for these variables are adapted from instruments used by previous studies. Variable measurement details are represented in Table 1.

Table 1. Variables Measurement

No	Dimension	Variable	Indicator	Statement	Sources
1	Organizational	Organizational Culture (OC)	OC-1: Responsiveness	Company responsiveness to the project affects the cloud-based ERP project success in Indonesia	[22] [23] [24] [25]
			OC-2: Open for changes	The open attitude of the company towards changes in the operational direction related to the project affects the cloud-based ERP project success in Indonesia	
		Communication (CO)	CO-1: Ways of Communicating	The ways of communicating between project stakeholders affect cloud-based ERP project success in Indonesia	[11] [12] [25] [21]
			CO-2: Communication Intensity	Organized and scheduled communication intensity influences the cloud-based ERP project success in Indonesia	
			CO-3: Communication tools	The use of the appropriate communication tools affects the cloud-based ERP project success in Indonesia	
		Project Management (PM)	PM-1: Project Planning	Effective project planning can significantly impact the cloud-based ERP project success in Indonesia	[12] [25] [26]
			PM-2: Project Execution	Executing the project according to the plan can impact the cloud-based ERP project success in Indonesia	
			PM-3: Project Controlling	Engaging in monitoring and problem-solving activities within the project can influence the cloud-based ERP project success in Indonesia	
2	People	Consultant Capability (CC)	CC-1: Business process knowledge	Having a thorough understanding of the client's business processes can impact the cloud-based ERP project success in Indonesia	[21] [27] [28]
			CC-2: Technical skills	The expertise of consultants in technical aspects can impact the cloud-based ERP project success in Indonesia	
			CC-3: Project Experiences	The number of experiences with ERP-related projects that consultants have can affect the cloud-based ERP project success in Indonesia	
		End-User Participation (EP)	EP-1: Participation in requirement gathering session	The involvement of end-users in requirement-gathering sessions influences the cloud-based ERP project success in Indonesia	[11] [25] [26]
			EP-2: Participation in UAT sessions	The participation of end-users in User Acceptance Testing (UAT) sessions influences the cloud-based ERP project success in Indonesia	
			EP-3: Participation in training sessions	The engagement of end-users in training sessions influences the cloud-based ERP project success in Indonesia	
		Top Management Support (TS)	TS-1: Financial Support	Financial support from top management affects the cloud-based ERP project success in Indonesia	[27] [29] [30]
			TS-2: Project Strategy	The determination of project strategy initiated by top management can impact the cloud-based ERP project success in Indonesia	
			TS-2: Direction	Directions from top management, if some problems occur in the project, can affect the cloud-based ERP project success in Indonesia	
3	Technology	Infrastructure (IF)	IF-1: Platform	The selection of the cloud platform can influence the cloud-based ERP project success in Indonesia	[12] [24]

Journal of Theoretical and Applied Information Technology
15th April 2024. Vol.102. No 7

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

No	Dimension	Variable	Indicator	Statement	Sources
			IF-2: ERP package	The ERP package chosen can affect the cloud-based ERP project success in Indonesia	[25] [31]
			IF-3: System Architecture	The design of the cloud system architecture used in the project can influence the cloud-based ERP project success in Indonesia	
		System Customization (SC)	SC-1: the number of customizations	The number of system customizations (WRICEF) requested by users affects the cloud-based ERP project success in Indonesia	[7] [26] [30]
			SC-2: Customization Scale	The scale of system customization (WRICEF) requested by users affects the cloud-based ERP project success in Indonesia	
		Project Success (PS)	PS-1: System is Accepted	The cloud ERP project is successful if users are satisfied with the resulting system	[11] [24] [25]
			PS-2: Within Budget	The cloud ERP project is considered successful if it is implemented within the specified budget.	
			PS-3: On-time	The cloud ERP project is successful if the project is completed on time as planned	

3.4 Data Collection Method

This research employs quantitative research methods, utilizing a questionnaire for data collection. The measurement scale applied in the questionnaire is a 5-point Likert Scale. The population represents a group of people, events, or interesting phenomena that researchers aim to conclude about, based on sample statistics [32]. In this study, the selected population is implementers who have been involved in SAP on cloud projects throughout Indonesia by performing sampling techniques. The target respondents are members of the implementation team who have been involved in SAP on cloud projects in Indonesia. This team can consist of a Solution Architect, Project Manager, Project Officer, Subject Matter Expert, and SAP Technical and Functional Consultant. According to Hair et al, the target sample size can be calculated by using the sample-to-variable ratio [33]. The suggested ratio implies a minimum observation-to-variable ratio of 5:1, with a preferred ratio of 15:1 or 20:1. This implies that although a minimum of five respondents may be sufficient for each independent variable in the model, it is highly advisable to aim for 15 to 20 observations per independent variable. [33]. There are 8 independent variables used in this study, making the minimum number of samples strongly recommended based on the sample-to-variable ratio calculation between 120 samples and 160 samples.

4. RESULTS

4.1 Demographic Data

Demographic data relies on the survey responses provided by 138 participants and then grouped by Gender, Age, Experience involved in SAP on Cloud-related projects in Indonesia in years, and the Role that respondents play when involved in SAP on Cloud-related projects. In this study, there was a higher number of men respondents compared to women respondents. Men respondents are 63.77% (88 people) and women respondents are 36.23% (50 people). In the age group, respondents in this study are dominated by the age range 31-40 years as many as 49.28% (64 people), followed by the age range 20-30 years as many as 35.51% (49 people), then the age range 41-50 years as many as 12.32% (17 people) and respondents aged > 50 years as many as 2.90% (4 people). In addition to age and gender, the demographics of respondents can also be seen from how long the respondents have been involved in projects related to SAP on the cloud. The number of respondents with 1-3 years of experience is 60.87% (84 people), and the respondents with 4-6 years of experience are 25.36% (35 people). Furthermore, respondents with 7-10 years of experience are 7.97% (11 people) and respondents with experience > 10 years are 5.80% (8 people). Respondents are also grouped based on the role they perform when they are involved in projects related to SAP on Cloud. A total of 61.59% (85 people) of respondents acted as SAP Functional Consultants, then 30.39% (28 people) of respondents acted as SAP Technical Consultants, 6.52% (9 people) acted as Solution Architects, and other respondents acted as Subject Matter Expert as a total of 5.07% (7 people), Project Manager at 5.07% (7 people) and Project Officer as follows 1.45% (2 people).

4.2 Measurement Model Analysis

The analysis of the Measurement Model (Outer Model), including validity and reliability tests, was conducted in this study using the Partial Least Squares-Structural Equation Modeling (PLS-

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SEM) analysis method. The data processing was performed using SmartPLS software version 4.0.9.6.

4.2.1 Validity test

Validity measurements are based on Reflective Indicator Loadings, Convergent Validity, and Discriminant Validity [31]. Figure 2 displays the results of the measurement model analysis conducted using Smart PLS.

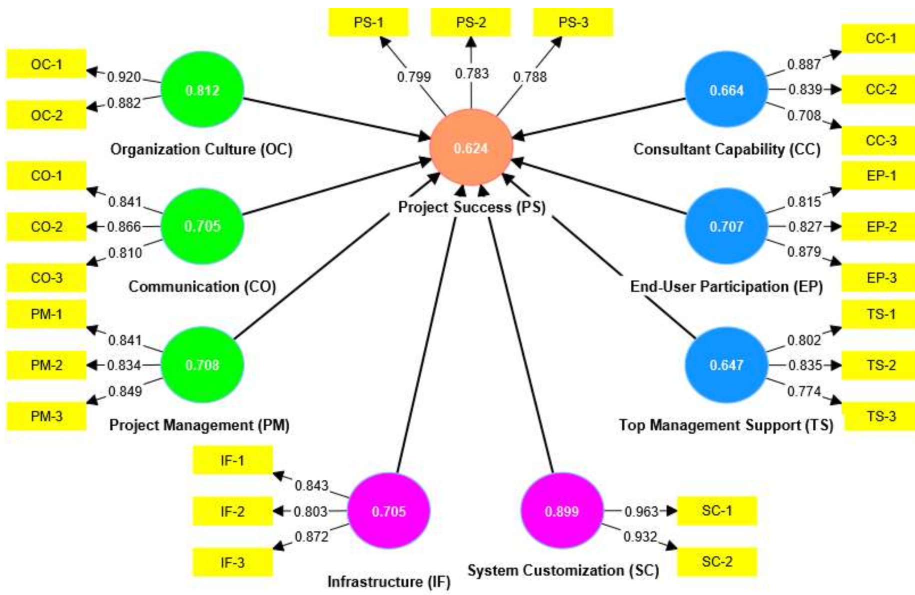

Figure 2. Outer Model Test Results

The validity test is conducted through the following steps:

a. Testing the recommended Reflective Indicator Loadings (Outer Loading) value is > = 0.708 [31].

Table 2. Validity Test Result - Reflective Indicator Loadings (Outer Loading)

Indicator and Construct Relationship	Outer Loading Value	Result	Indicator and Construct Relationship	Outer Loading Value	Result
OC-1 <- Organizational Culture (OC)	0.920	Valid	EP-3 <- End-User Participation (EP)	0.879	Valid
OC-2 <- Organizational Culture (OC)	0.882	Valid	TS-1 <- Top Management Support (TS)	0.802	Valid
CO-1 <- Communication (CO)	0.841	Valid	TS-2 <- Top Management Support (TS)	0.835	Valid
CO-2 <- Communication (CO)	0.866	Valid	TS-3 <- Top Management Support (TS)	0.774	Valid
CO-3 <- Communication (CO)	0.810	Valid	IF-1 <- Infrastructure (IF)	0.843	Valid
PM-1 <- Project Management (PM)	0.841	Valid	IF-2 <- Infrastructure (IF)	0.803	Valid
PM-2 <- Project Management (PM)	0.834	Valid	IF-3 <- Infrastructure (IF)	0.872	Valid
PM-3 <- Project Management (PM)	0.849	Valid	SC-1 <- System Customization (SC)	0.963	Valid
CC-1 <- Consultant Capability (CC)	0.887	Valid	SC-2 <- System Customization (SC)	0.932	Valid
CC-2 <- Consultant Capability (CC)	0.839	Valid	PS-1 <- Project Success (PS)	0.799	Valid
CC-3 <- Consultant Capability (CC)	0.708	Valid	PS-2 <- Project Success (PS)	0.783	Valid
EP-1 <- End-User Participation (EP)	0.815	Valid	PS-3 <- Project Success (PS)	0.788	Valid
EP-2 <- End-User Participation (EP)	0.827	Valid			

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b. Testing the recommended Convergent Validity value using AVE (Average Variance Extracted): If AVE >= 0.50 then the indicator is valid; If AVE <0.50 then the indicator is invalid [34]. Testing results in Table 3.

Table 3. Convergent Validity Test Result – AVE

Variable	AVE	Result
Organizational Culture (OC)	0.812	Valid
Communication (CO)	0.705	Valid
Project Management (PM)	0.708	Valid
Consultant Capability (CC)	0.664	Valid
End-User Participation (EP)	0.707	Valid
Top Management Support (TS)	0.647	Valid
Infrastructure (IF)	0.705	Valid
System Customization (SC)	0.899	Valid
Project Success (PS)	0.624	Valid

c. Testing the value of Discriminant Validity is recommended using The Heterotrait-Monotrait ratio (HTMT): If HTMT <0.90 then the construct is valid; If HTMT>=0.90 then the construct is invalid [34]. The testing results are presented in Table 4.

Table 4. Discriminant Validity Test Result - HTMT

Relationship between Constructs	HTMT	Result	Relationship between Constructs	HTMT	Result
(OC) <-> (CO)	0.557	Valid	**(TS) <-> (PS)**	0.415	Valid
(OC) <-> (CC)	0.474	Valid	**(TS) <-> (SC)**	0.289	Valid
(OC) <-> (EP)	0.312	Valid	**(SC) <-> (CO)**	0.247	Valid
(OC) <-> (IF)	0.333	Valid	**(SC) <-> (CC)**	0.326	Valid
(PM) <-> (CO)	0.714	Valid	**(SC) <-> (EP)**	0.317	Valid
(PM) <-> (CC)	0.648	Valid	**(SC) <-> (IF)**	0.273	Valid
(PM) <-> (EP)	0.566	Valid	**(SC) <-> (OC)**	0.096	Valid
(PM) <-> (IF)	0.389	Valid	**(SC) <-> (PM)**	0.178	Valid
(PM) <-> (OC)	0.667	Valid	**(SC) <-> (PS)**	0.222	Valid
(CC) <-> (CO)	0.67	Valid	**(IF) <-> (CO)**	0.531	Valid
(EP) <-> (CO)	0.544	Valid	**(IF) <-> (CC)**	0.597	Valid
(EP) <-> (CC)	0.657	Valid	**(IF) <-> (EP)**	0.427	Valid
(TS) <-> (CO)	0.742	Valid	**(PS) <-> (CO)**	0.456	Valid
(TS) <-> (CC)	0.814	Valid	**(PS) <-> (CC)**	0.389	Valid
(TS) <-> (EP)	0.618	Valid	**(PS) <-> (EP)**	0.201	Valid
(TS) <-> (IF)	0.491	Valid	**(PS) <-> (IF)**	0.441	Valid
(TS) <-> (OC)	0.472	Valid	**(PS) <-> (OC)**	0.55	Valid
(TS) <-> (PM)	0.748	Valid	**(PS) <-> (PM)**	0.448	Valid

4.2.2 Reliability test

A reliability test is carried out to demonstrate the precision, consistency, and accuracy of indicators in measuring constructs. A reliability test is recommended to use the ρA (Rho-A) value to assess Internal Consistency Reliability [34]. Cronbach's alpha is the lower limit in assessing Internal Consistency Reliability, and Composite Reliability is the upper limit. While, ρA (Rho-A) is between the two and can be a good representation of construct reliability. If the ρA (Rho-A) value is below 0.60, it is considered "unreliable"; If the ρA (Rho-A) Value is between 0.60 and 0.70 it is considered "acceptable in exploratory research"; If the ρA (Rho-A) Value is between 0.70 and 0.90 it is considered "satisfactory to good"; If the ρA (Rho-A) Value >= 0.95 is considered "invalid" to avoid data.

Table 5. Reliability Test Result

Variable	Cronbach's alpha	Composite reliability (rho_a)	Composite reliability (rho_c)	Result
Organization Culture (OC)	0.771	0.790	0.896	Reliable
Communication (CO)	0.790	0.790	0.877	Reliable
Project Management (PM)	0.794	0.795	0.879	Reliable
Consultant Capability (CC)	0.749	0.805	0.855	Reliable
End-User Participation (EP)	0.811	0.922	0.879	Reliable
Top Management Support (TS)	0.731	0.733	0.846	Reliable
Infrastructure (IF)	0.796	0.831	0.878	Reliable
System Customization (SC)	0.890	0.948	0.947	Reliable
Project Success (PS)	0.705	0.713	0.833	Reliable

4.3 Structural Model Analysis

Structural Model Analysis, or testing on the inner model, is utilized to predict causal relationships between latent variables or variables that cannot be measured directly. The results of the analysis of the structural model using Smart PLS are shown in Figure 3.

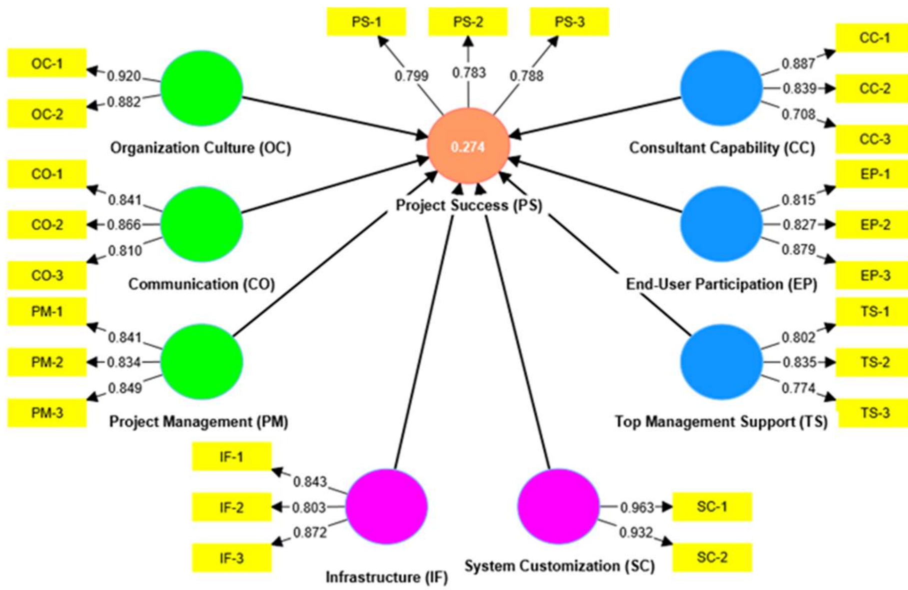

Figure 3. Inner Model Test Results

With the PLS-SEM analysis method, the inner model can be tested using:

a. Collinearity evaluation using Variance Inflation Factor (VIF), ideally VIF is less than 3 [34].

Table 6. Collinearity Evaluation Result - VIF

Path	VIF	Result
(OC) -> (PS)	1.455	Good
(CO) -> (PS)	1.883	Good
(PM) -> (PS)	2.041	Good
(CC) -> (PS)	2.058	Good
(EP) -> (PS)	1.508	Good
(TS) -> (PS)	2.109	Good
(IF) -> (PS)	1.350	Good
(SC) -> (PS)	1.124	Good

If VIF < 3 then there is no indication of collinearity, the predictive ability of the model is good; If VIF> = 3 then there is an indication of collinearity, the predictive ability of the model is not good [34].

b. Assessment using R-square, the coefficient of determination R-square provides insight into the proportion of variance in endogenous constructs that can be explained by exogenous constructs: If the R-square value is 0.75 then it is considered substantial (strong); If the R-square value is 0.50 then it is considered moderate (moderate); and If the R-square value is 0.25 then it is considered weak. From Figure 3, we get the R square coefficient of the model is 0.274, or the explanatory power is weak but acceptable.

4.4 Structural Model Analysis

Hypotheses testing was conducted using SmartPLS version 4.0.9.6 through bootstrapping calculations with a significance level (p-value) of 0.05. Some indicators used in analyzing the hypothesis are Path Coefficient, T Statistic or t-value, and p-value. The Path Coefficient, ranging from 0.000 to 1.000, is numerically indicated on the path connecting two constructs, specifying its direction and significance. Values greater than 0.1 are considered significant. In Structural Equation Modeling (SEM), the Path Coefficient represents the partial correlation coefficient between the independent variable and the dependent variable. In essence, it quantifies the extent to which a change in the value of the independent variable influences the dependent variable [35]. T Statistic or t-value describes the estimation of how much a specific indicator contributes to the construct in the model. t-

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value is expected to be >= 1.96 to support the relationship between the independent variable and the dependent variable is significant in the model [35]. The p-value serves to measure the probability of obtaining the observed result. A lower p-value indicates a higher statistical significance of the observed difference. Ideally, the p-value should be smaller than 0.05 to establish that the path relationship between the independent variable and the dependent variable is statistically significant [34]. The results of the hypothesis test using SmartPLS are shown in Figure 4.

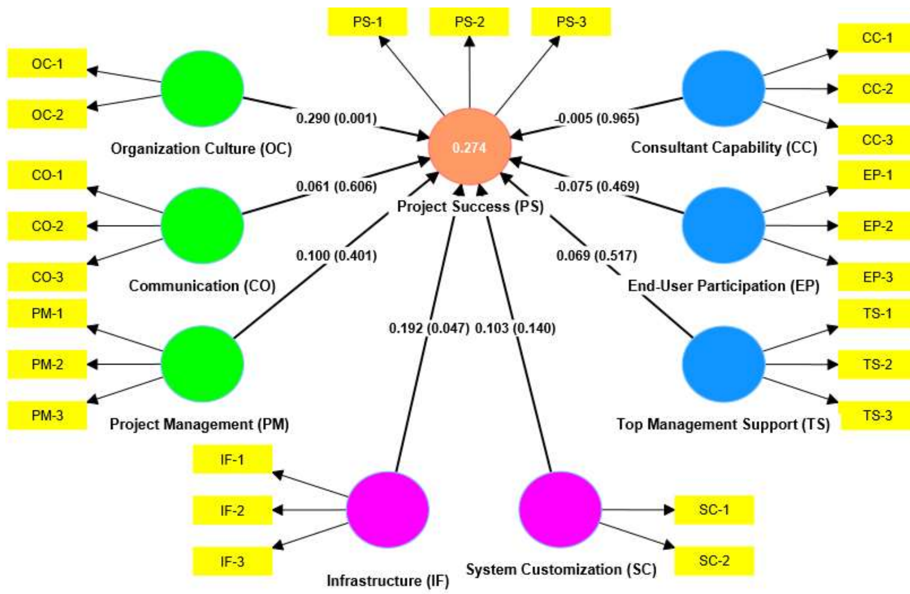

Figure 4. Hypothesis Test Result

H1: Organizational Culture (OC) positively contributes to Project Success (PS)

With a Path Coefficient value of 0.290, a t-value of 3.236, and a p-value of 0.001, the relationship between the independent variable Organizational Culture (OC) and the dependent variable Project Success (PS) is significant. This means that Organizational Culture (OC) positively contributes to Project Success (PS).

H2: Communication (CO) positively contributes to Project Success (PS)

The results of the relationship test of the independent variable Communication (CO) and the dependent variable Project Success (PS) show a Path Coefficient value of 0.061, a t-value of 0.516, and a p-value of 0.606. The Path Coefficient value, t-value, and p-value do not meet the expected value, so it can be concluded that the independent variable Communication (CO) has no significant effect on the dependent variable Project Success (PS). This means Communication (CO) does not positively contribute to Project Success (PS).

H3: Project Management (PM) positively contributes to Project Success (PS)

The Path Coefficient value for the relationship between the independent variable Project Management (PM) on Project Success (PS) is 0.100, this value does not meet the expected Path Coefficient value. Likewise, the t-value is 0.841 and the p-value is 0.401. The t-value and p-value also do not meet the expected value, so it can be concluded that the independent variable Project Management (PM) has no significant effect on the dependent variable Project Success (PS). This means that Project Management (PM) does not positively contribute to Project Success (PS).

H4: Consultant Capability (CC) positively contributes to Project Success (PS)

The p-value for the Consultant Capability (CC) -> Project Success (PS) path relationship in Table 7 is 0.965. This value is well above the maximum expected value. The Path Coefficient value of -0.005 and the t-value of 0.044 also do not match the expected value. Thus, it can be concluded that the independent variable Consultant Capability

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

(CC) has no significant effect on the dependent variable Project Success (PS). Therefore, the hypothesis test result for H4 is that Consultant Capability (CC) does not positively contribute to Project Success (PS).

H5: End-user participation (EP) has a positive influence on Project Success (PS)

The results of the relationship test of the independent variable End-User Participation (EP) on the dependent variable Project Success (PS) resulted in a Path Coefficient value of -0.075, a t-value of 0.724, and a p-value of 0.469. These three values illustrate that the independent variable End-User Participation (EP) has no significant effect on the dependent variable Project Success (PS). This means that the hypothesis test result for H5 is that End-User Participation (EP) does not positively contribute to Project Success (PS).

H6: Top Management Support (TS) has a positive influence on Project Success (PS)

The relationship between the independent variable Top Management Support (TS) and the dependent variable Project Success (PS) based on the data results in a Path Coefficient value of 0.069, a t-value of 0.649, and a p-value of 0.517. The three values do not meet the expected value so it can be concluded that the independent variable Top Management Support (TS) has no significant effect on the independent variable Project Success (PS). Thus, the hypothesis test result for H6 is that Top Management Support (TS) does not positively contribute to Project Success (PS).

H7: Infrastructure (IF) has a positive influence on Project Success (PS)

The p-value for the relationship between the Infrastructure (IF) variable and Project Success (PS) is 0.047 and it can be interpreted that the Infrastructure (IF) variable has a significant effect on the Project Success (PS) variable. This is supported by the Path Coefficient value of 0.192 and the t-value of 0.047, which also fulfills the requirements. In other words, the result of hypothesis H7 is that Infrastructure (IF) positively contributes to Project Success (PS).

H8: System Customization (SC) has a positive influence on Project Success (PS)

With a Path Coefficient value of 0.103, a t-value of 1.480, and a p-value of 0.140, the relationship between the independent variable System Customization (SC) and the dependent variable Project Success (PS) is considered insignificant. Therefore, the result of hypothesis test H8 is System Customization (SC) does not positively contribute to Project Success (PS).

Table 7. Hypothesis Test Result

Hypothesis	Path	Path Coefficient	t-value	p-value	Result
H1	Organizational Culture (OC) -> Project Success (PS)	0.290	3.236	0.001	Accepted
H2	Communication (CO) -> Project Success (PS)	0.061	0.516	0.606	Rejected
H3	Project Management (PM) -> Project Success (PS)	0.100	0.841	0.401	Rejected
H4	Consultant Capability (CC) -> Project Success (PS)	-0.005	0.044	0.965	Rejected
H5	End-User Participation (EP) -> Project Success (PS)	-0.075	0.724	0.469	Rejected
H6	Top Management Support (TS) -> Project Success (PS)	0.069	0.649	0.517	Rejected
H7	Infrastructure (IF) -> Project Success (PS)	0.192	1.989	0.047	Accepted
H8	System Customization (SC) -> Project Success (PS)	0.103	1.480	0.140	Rejected

5. THEORETICAL IMPLICATION

Based on the results of hypothesis testing, several Critical Success Factor (CSF) hypotheses exhibit contradictions with existing theories or previous research. For instance, the hypothesis testing results for CSF Communication (CO) indicate that it does not positively influence Project Success (PS), which contradicts the findings of previous research conducted by Correia and Martens in 2023, Huang et al. in 2021, and Gupta and Misra in 2016. Similarly, the hypothesis testing results for CSF Project Management (PM) suggest that it does not positively influence Project Success (PS), contradicting the results of previous research conducted by Vargas and Comuzzi in 2019 and Huang et al in 2021. Furthermore, the hypothesis testing results for CSF Consultant Capability (CC) imply that it does not have a positive influence on Project Success (PS), contrary to the research conducted by Correia and Martens in 2023 and Eampoonga and Leelasantitham in 2023. Similarly, the hypothesis testing results for CSF End-User Participation (EP) suggest that it does not positively influence Project Success (PS), contradicting the findings of previous research conducted by Vargas and Comuzzi in 2019 and Gupta and Misra in 2016. Additionally, the hypothesis testing results for CSF Top Management Support (TS) reveal that it does not positively influence Project Success (PS), which contradicts previous research conducted by Mahmood et al. in 2020 and Ploder et al. in 2021. And for the last, the hypothesis testing results for CSF System Customization (SC) suggest that it does not positively influence Project Success (PS), contradicting the findings of previous research conducted by Kiran and Reddy in 2019 and Vargas and Comuzzi in 2019.

Out of all CSF hypotheses tested to find CSF, only two were found to be consistent with previous research. Firstly, Organizational Culture (OC) was observed to have a positive influence on Project Success (PS), aligning with previous research conducted by Ahn and Ahn in 2020 and Alsharari in 2022. Secondly, CSF Infrastructure (IF) was found to positively influence Project Success (PS), which is consistent with the findings of previous research conducted by Huang in 2021 and Eampoonga and Leelasantitham in 2023.

6. CONCLUSIONS

Drawing from the research conducted to analyze the critical factors influencing the success of projects involving cloud ERP systems, particularly SAP on the cloud in Indonesia, the following conclusions are derived:

Based on the analysis of Critical Success Factors (CSFs) across three dimensions in this study, it has been established that only CSFs from the Organizational and Technology dimensions exert a significant contribution on the success of projects related to cloud ERP systems, particularly SAP on cloud in Indonesia. Conversely, CSFs from the People dimension have not demonstrated a significant impact on the success of such projects in this study.

Out of the 8 Critical Success Factors (CSFs) tested, 2 CSFs have been demonstrated to significantly impact the success of projects related to cloud-based ERP systems, particularly SAP on cloud in Indonesia. These are the Organizational Culture factor, representing the Organizational dimension, and the Infrastructure factor, representing the Technology dimension. Notably, Organizational Culture emerged as the most important CSF, supported by the highest t-value, suggesting its critical role in cloud-based ERP project success in Indonesia. This suggests that the success of cloud-based ERP projects is influenced by the company's ability to foster a responsive and accepting attitude among all stakeholders involved. Socializing stakeholders regarding the project's objectives, the benefits of the cloud ERP system, and potential changes post-project completion can help prepare them to accept the project outcomes and mitigate resistance to changes that may arise. On the other hand, infrastructure refers to the cloud platform chosen, the ERP package selected, and the architectural design of the cloud system used. Therefore, the implementor team is strongly advised to pay close attention to these three aspects related to infrastructure.

These findings serve as valuable insights for the implementor team to craft an optimal strategy concerning the company's responsiveness to the project, its adaptability to changes in operational direction, the selection of the cloud platform, the chosen ERP package, and the employed cloud ERP architecture design. By incorporating these considerations, the implementor team can effectively increase the likelihood of success for the execution of the cloud-based ERP project in Indonesia.

For future researchers who are interested in continuing research on CSFs of cloud-based ERP projects, adding variables and indicators associated with the Organizational, People, and Technology dimensions to the new research model is highly recommended. This will facilitate the identification of additional CSFs impacting cloud-based ERP projects in Indonesia. Enhancing the model through the inclusion of mediator variables, for instance, is strongly advised. To enhance the accuracy of hypothesis testing results in future research, It is advisable to enhance the number of respondents, especially considering the weak explanatory power of the model in this study. The greater the number of samples utilized, the stronger the explanatory power of the tested model.

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

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