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Critical Success Factors Analysis on ERP Project Implementation of Manufacturing Company in Oceania

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Abstract: Implementing an ERP (Enterprise Resource System) system is very important nowadays to support business processes in a company. In this research, the Manufacturing company made a new ERP change as a presentation to the parent company of the leading plantation that has acquired it and as an answer to the problems faced by business operations. The research aims to identify CSF (Critical Success Factors) in ERP implementation for the parent organization of the plantation that uses SAP (System Application and Product in Data Processing). CSF analysis in SAP implementation is expected to provide reference factors that influence the success of improvisation for SAP implementation projects, especially for parent organizations. This study uses AHP (Analytical Hierarchy Process) to calculate and determine the priority scale of each CSF factor that affects the success of the implementation project. The variables used are distributed to ERP system users to obtain data using a questionnaire. The results of this study indicate that System Reliability and Flexibility are very influential factors, followed by ERP Fit and Top Management Support

Keyword: Critical Succes Factor (CSF); Enterprise Resource System (ERP); System, Application and Product in Data Processing (SAP); Manufacturing.

INTRODUCTION

Enterprise Resource Planning (ERP) systems have become the primary solution for many large companies worldwide to improve efficiency and integration of business processes. ERP integrates various business functions in one centralized platform, such as inventory management, production, finance, and human resources, which supports better decision-making and more efficient processes. SAP (Systems, Applications, and Products in Data Processing) is one of the most widely used ERP systems and provides various modules to help companies achieve their operational goals Klaus et al. (2000). Implementing an ERP system offers significant benefits, such as cost reduction, increased data accuracy, and operational efficiency. ERP systems have become an integral part of business operations in developed countries. In contrast, in developed countries, ERP adoption still faces various challenges, although some companies have successfully felt the benefits.

However, ERP project implementation is not free from obstacles. The implementation process often involves high costs, long time, and complex technical challenges, which causes the failure rate of ERP implementation projects to be quite high, especially in developing countries. Factors influencing this failure include errors in business processes, technical problems, and challenges in accepting organizational culture towards new technologies. (Seres et al., 2019) Therefore, companies need to understand the critical factors that can affect the success of ERP implementation so that the risk of failure can be minimized. Critical Success Factors (CSF) such as organizational readiness, top management commitment, employee competence, and the selection of the exemplary system significantly impact the smooth implementation. This study aims to analyze the factors that influence the success of ERP implementation and explore the relationship between these variables.

Based on the results of interviews with the assistant project manager of ERP implementation in this project initiated by a leading plantation company, ABC Group, which had just acquired XYZ Company experienced declining business performance. In order to obtain accurate and real-time business performance reports, the ERP implementation project was run using SAP as the ERP standard used by all companies in the plantation parent company. This study is also helpful in identifying factors that influence SAP implementation and can be used as a reference for implementation projects in other subsidiaries worldwide.

As an illustration, a plantation holding company, through one of its subsidiaries, WCS Company, faced a significant challenge in implementing the SAP ERP system after acquiring XYZ Company. One of the main problems faced was the deviation between the stock recorded in the system and the physical stock in the field, with a difference of up to 14 billion Rupiah. This data inaccuracy could affect the company's business and financial operations. In addition to the problem of stock differences, the use of different ERP systems across the plantation company's business units makes monitoring and controlling overall performance challenging.

To overcome this problem, the Plantation Company decided to implement SAP as the standard ERP system used across all business units. This will improve data accuracy and obtain more accurate and real-time business performance information. Before the go-live implementation of SAP, adjustments were made to the opening balance to ensure the conformity between physical stock and that recorded in the ERP system. This adjustment is important to create reliable inventory and operational management data consistency.

One indicator that shows the success of SAP implementation is the decrease in the number of reversal goods issues, which illustrates the improvement in the accuracy of stock recording. Data collected from July to October showed a significant decrease in the number of reversal goods issues, namely from 37 cases in July, increasing to 41 in August, then decreasing to 38 in September, and reaching 33 cases in October. This decrease reflects improvements in stock management and indicates that SAP implementation has positively impacted more accurate stock recording. Therefore, the researcher identified factors that influenced the SAP implementation project at XYZ Company, which can later be used as a reference for the factors prioritized in the SAP implementation project at the plantation parent company in other business units or subsidiaries.

The objectivity and limitations of this study are in determining CSF in ERP implementation with the AHP method, especially in manufacturing companies. In previous studies (Wicaksono et al., 2022)(Kusumawardhana et al., 2024)(Aini et al., 2020), CSF analysis was found in consumer goods, insurance, and manufacturing companies that focused on the relationship between each factor that influences ERP implementation. The results of this study are to determine the priority of factors that significantly influence ERP implementation in the parent company so that they can be used as references for future projects. This study will raise the main research question: What factors influence the SAP ERP system implementation success at XYZ Company? By answering this question, it is

expected to find key factors that need to be considered by the company in implementing ERP so that the implementation process can run successfully and provide maximum positive impact for the business.

METHOD

Enterprise resource planning

Enterprise Resource Planning (ERP) systems are software solutions that integrate data across an organization's core functions, such as accounting, finance, marketing, and production. ERP facilitates real-time data flow and connects internal departments with partners and vendors, improving operational efficiency (Liu & Fan, 2020). In addition, ERP ensures that information flows dynamically and enables better communication between departments (Motiwalla & Thompson, 2012). While it aims to provide a unified infrastructure, the diversity of needs between departments can make integration challenging. Therefore, companies often adopt ERP to improve business processes, reduce costs, respond quickly to market changes, and generate accurate information to support strategic decision-making.

ERP is vital in improving collaboration and efficiency by unifying systems and data from different departments. However, integrating custom applications from other vendors can be challenging, so managers must be competent in balancing standard solutions with the necessary innovation (Chaffey, 2022). A consumer goods company implemented an ERP system to improve operational efficiency and overcome integration issues in its financial business functions. This system improved collaboration between divisions and coordination in business processes (Wicaksono et al., 2022).

Critical success factor

Critical Success Factors (CSF) are important factors in a company that include areas or activities that can determine its success. CSF is a key variable in project implementation because, without these factors, the project or implementation will not be successful. Success factors are elements an organization or project needs to achieve its goals. This method effectively identifies the company's information needs and facilitates information system planning (Utama & Purwandari, 2020).

Based on literature studies from several previous studies, there are three main criteria that are considered the most important in implementing ERP: Organization, Technology, and Process. However, the three main criteria are still too broad, so they need to be broken down into smaller and more detailed parts in the form of sub-criteria or factors that can influence decision-making in implementing ERP. The factors used in this study can be seen in Table 1.

Table 1. CSF from previous studies

Criteria	Code	Factor	Literature
Organization	FO1	Top Management Support	(Wicaksono et al., 2022), (Kusumawardhana et al., 2024), (Salih et al., 2022), (Wu, 2008)
	FO2	Change Management and Culture	(Wicaksono et al., 2022), (Kusumawardhana et al., 2024), (Johansson & Byström, 2024), (Salih et al., 2022)
	FO3	Clear Goals	(Wicaksono et al.,

Criteria	Code	Factor	Literature
			2022), (Kusumawardhana et al., 2024), (Johansson & Byström, 2024), (Salih et al., 2022)
Technology	FT1	Technological Infrastructure and Implementation	(Wicaksono et al., 2022), (Wu, 2008)
	FT2	Data Accuracy	(Wicaksono et al., 2022), (Wu, 2008)
	FT3	System Reliability and Flexibility	(Wicaksono et al., 2022), (Wu, 2008)
	FT4	IT Skills Organizations	(Wicaksono et al., 2022), (Wu, 2008)
	FT5	Vendor Competency	(Wicaksono et al., 2022), (Wu, 2008)
Process	FP1	User Involvement	(Wicaksono et al., 2022), (Kusumawardhana et al., 2024), (Wu, 2008)
	FP2	Training and Education	(Wicaksono et al., 2022), (Kusumawardhana et al., 2024), (Johansson & Byström, 2024)
	FP3	Cooperation Between Team Members	(Wicaksono et al., 2022), (Kusumawardhana et al., 2024), (Wu, 2008)
	FP4	ERP Fit	(Wicaksono et al., 2022), (Kusumawardhana et al., 2024), (Wu, 2008)
	FO1	Top Management Support	(Wicaksono et al., 2022), (Kusumawardhana et al., 2024), (Salih et al., 2022), (Wu, 2008)

Support provided by company leaders is considered important for making quick and effective decisions, solving problems, and building cooperation between teams within a company (Aini et al., 2020). Changes often occur within a company that can involve structural shifts through position transfers, changes in company culture, modifying business processes, and other changes (Kusumawardhana et al., 2024). Determining clear goals and objectives from the start of implementation is also very important for determining the success of a project (Kusumawardhana et al., 2024).

In ERP implementation, a complex migration process is carried out to an integrated information technology infrastructure. Data must be cleaned and moved correctly because data inaccuracies can affect the performance of other modules. The competence of ERP vendors and qualified service consultants is also vital because they can provide ongoing support throughout the system life cycle to ensure the success of implementation and maintenance. In addition, system reliability and flexibility are vital to ensure that the system can function stably and quickly adapt to changing organizational needs. Good organizational IT skills are also needed to prepare for significant changes and ensure users can optimize the ERP system effectively (Wicaksono et al., 2022), (Saaty, 2008).

User involvement increases user engagement with the system, while training and education ensure a proper understanding of ERP. Collaboration between team members facilitates smooth system integration. ERP compatibility ensures that the selected system fits the organization's needs and is compatible with existing systems, supporting long-term integration and sustainability (Johansson & Byström, 2024).

Analytical Hierarchy Process

Analytical Hierarchy Process (AHP) is a systematic and structured decision-making method designed to handle complex problems involving multiple criteria. In AHP, decision-makers can compare elements in a clear hierarchy, starting from the main objective (level 1), criteria (level 2), and sub-criteria (level 3) to alternative solutions (Saaty, 2008).

The main advantage of AHP is its ability to structure complex decision-making processes into something more structured and objective. This method reduces subjectivity through pairwise comparisons and can combine qualitative and quantitative criteria. The results produced by AHP are easy to understand, thus facilitating communication among stakeholders (Saaty, 2008).

The AHP stages define the problem and objectives, followed by a criteria and alternatives hierarchy. Users then perform pairwise comparisons to assess preferences, calculate priority weights, and test the consistency of judgments. This process helps to reach informed decisions in complex contexts (Saaty, 2008).

Previous research uses the DeLone & McLean model to determine the most important factors in the success of ERP implementation. This model identifies six main dimensions: system quality, information quality, usage, user satisfaction, individual impact, and organizational impact. With its systematic approach, this model helps organizations formulate more effective development strategies and improve user experience (DeLone & McLean, 2003).

The DeLone & McLean model does not directly identify CSFs but focuses on system success results and measurement (Aini et al., 2020). In contrast, AHP is more structured in identifying and giving weight to CSFs, specifically through direct comparison between relevant factors. AHP allows for more detailed results regarding CSF priorities (Wicaksono et al., 2022). Therefore, the author uses AHP as the method in this study.

Previous Study

Research (Wicaksono et al., 2022) used the AHP method to identify CSFs in ERP implementation in a consumer goods company. The results revealed that ERP selection, training and education, and technological infrastructure and implementation were the most important factors. Research (Utama & Purwandari, 2020) also used AHP to determine CSFs in software development and implementation projects, with the main factors found being Skilled Staff and Project Management. Further research using the DeLone & McLean model (Aini et al., 2020), which focused on ERP implementation at Toyota Astra Motor Company, identified that individual contribution, good project management, and information quality were the main factors for successful implementation. Research (Syafiraliany et al., 2020), which focused on a pharmaceutical company, found that factors such as net benefits, user

satisfaction, and system quality greatly influenced the success of ERP implementation. However, several other factors were not optimal. Finally, research (Kautsar & Budi, 2020), which examined ERP implementation at XYZ Company, found that information quality, system quality, and service quality positively affect user perception and project success. However, there were complaints from users that needed to be fixed.

Although previous studies have made important contributions, some limitations must be noted. Some studies have too long questionnaires, which can reduce respondents' interest and limit the scope of relevant factors. In addition, although important factors have been identified, not all factors significantly affect the success of ERP implementation. Some models have also proven less than optimal in determining CSFs to address practical issues companies face, such as user complaints and lack of understanding of the system. This indicates the need for further research that includes various factors with a more comprehensive approach and following the actual conditions companies face in ERP implementation, especially in manufacturing companies.

The methodology in this research is divided into 3, namely the research instruments used, data collection methods, and data analysis techniques that have been collected.

Definition of the hierarchy of criteria and factors

This study began by conducting a literature review of several previous studies to define the hierarchy of criteria and factors used to determine CSF. As explained in Section 2, 3 criteria comprised 12 factors. The Organizational criteria consist of Top Management Support, Change Management and Culture, and Clear Goals. The Technological criteria consist of Technological Infrastructure and Implementation, Data accuracy, System Reliability and Flexibility, IT Skills Organization, and Vendor Competency. In contrast, the Process criteria consist of User Involvement, Training and Education, Cooperation Between Team Members, and ERP Fit. These criteria and factors are depicted in a hierarchy shown in Figure 1.

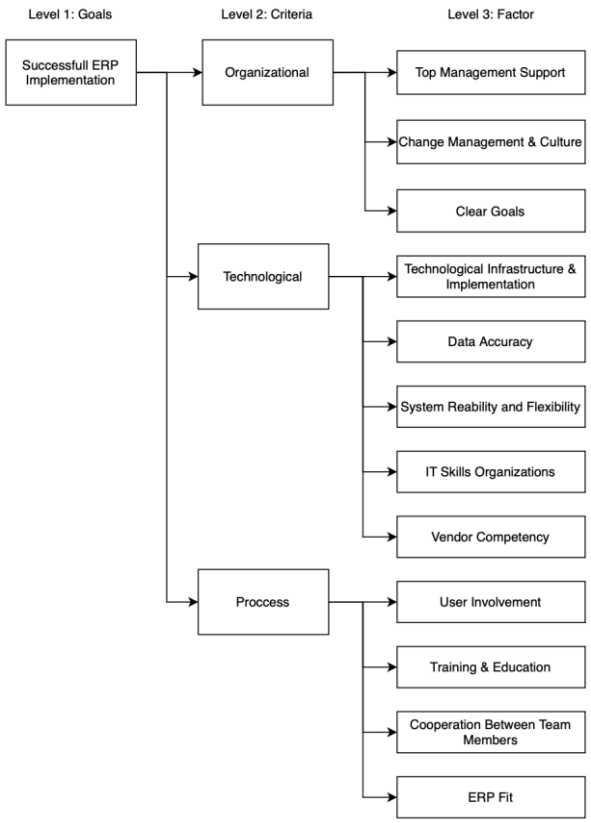

Figure 1. Hierarchy of criteria and CSF factors

Data collection

In this study, two data collection methods were used, namely interviews and questionnaires.

Interviews

The author conducted an interview with the assistant project manager, who is also part of the Financial Controller team from XYZ Company, to obtain information on the actual conditions experiencing stock issues that experienced a deviation of around 12 billion rupiah. This caused operational conditions to be disrupted in the distribution of products to customers. When the new ERP was used during go-live, the business and implementation teams agreed to adjust to the stock in the system after conducting stock opname so that there were no more deviations and bookkeeping was restarted. The new ERP system has positively impacted XYZ Company, where the reversal goods report has decreased over the past 4 months. This represents the new ERP system's ability to overcome issues in business operations. Therefore, the researcher identified critical success factors through this project, which can be used as a reference for the plantation's parent company in standardizing other business units that have not used SAP as an ERP to support business processes.

Questionnaires

A questionnaire was distributed to SAP ERP users at XYZ Company to determine the CSF of the predetermined factors. The questionnaire was distributed to 49 users, including project manager assistants, inventory managers, asset management managers, financial accountant managers, sales managers, and staff from each operational team using SAP daily. Twenty-eight users filled out the questionnaire entirely, while 21 users did not fill out the questionnaire completely or did not complete the questionnaire given. This questionnaire is in the form of a paired comparison using a semantic comparison scale, where respondents will choose the value of one factor compared to another factor with a value range of 1 to 9, where each value represents a statement determined in Table 2.

Table 2. CSF Semantic Scale for AHP

Value	Description
1	Both items have the same priority
3	The first item is *slightly more important* than the second item
5	The first item is *more important* than the second item
7	The first item is *much more important* than the second item
9	The first item is *absolutely more important* than the second item
2,4,6,8	The intermediate value between the values already mentioned
Invers	Inverse value, if comparing the second item with the first item

The inverse values in Table 2 are not shown in the questionnaire but will be used as a reference in the data analysis section. Table 3 shows an example of a pairwise comparison between two factors in this questionnaire.

Table 3. Example of pairwise comparison

	9	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	
Factor A																		Factor B

Respondents will choose one value from the given range. When filling out this questionnaire, the thing to note is the respondent's understanding of the factors given. The answers from

each respondent will be assessed for consistency, which will determine whether this research is valid or not.

Data analysis

The results of the collected questionnaires will be processed by creating a pairwise comparison matrix between factors in each criterion. After that, a comparison is also made between the existing criteria. The comparison value between factors A and B will be stored in the pairwise comparison matrix. Likewise, the inverse of the value will be stored in the pairwise comparison matrix B against factor A. This pairwise comparison matrix will then be processed using the geometric mean method to calculate the relative weight of each factor. This process is carried out by calculating the geometric mean of each element in the pairwise comparison matrix to obtain a weight that reflects the value of each factor in the decision-making process. The relative weight obtained is then searched for the eigenvector of the pairwise comparison matrix to obtain the priority vector. The eigenvector obtained is then normalized so that the total number of elements is 1. The normalized eigenvector is the priority vector in this calculation. After obtaining the priority vector, a consistency ratio (CR) test is carried out to ensure that the pairwise comparison matrix is consistent. CR is calculated by comparing the consistency index (CI) with the random consistency index (RI). CI is calculated using formula (1).

A. $CI = \frac{\lambda_{max}-n}{n-1}$

λ_{max} is the largest eigenvalue of the pairwise comparison matrix, and n is the number of criteria or factors being compared. CR is calculated by comparing CI with RI using formula (2).

B. $CR = \frac{CI}{RI}$

If the CR value is less than 0.1, the pairwise comparison matrix is considered consistent and can be used for decision-making. If the CR is greater than 0.1, a revision of the pairwise comparison is needed to improve consistency.

RESULTS AND DISCUSSION

Identification of CSF priority levels of ERP implementation at XYZ Company begins with aggregating respondent data using geometric mean and forming a pairwise comparison matrix for each criterion and factor that can be seen in Tables 4, 6, 8, and 10. From the pairwise comparison matrix obtained, it was found that each pairwise comparison matrix has a consistency ratio value below 10%. Hence, the data is valid, and the CSF sorting using the AHP method can be done.

Table 4. The respondents' data aggregation results were formed using a pairwise comparison (Criterion)

	FO	FT	FP
FO	1	0.70065	0.826028
FT	1.427245	1	0.995228
FP	1.210613	1.004795	1

Table 5. The results of calculating the priority value of the criterion using the AHP method

Code	Criterion	CR	Priority	Rank
FO	Organization	0.00275	0.275495	3
FT	Technology		0.371612	1
FP	Process		0.352893	2

Based on the pairwise comparison matrix and the criterion priority level table, it is found that the Technology criterion gets the highest priority value, followed by the Process criterion, and the Organization criterion with the lowest priority value. The results of the priority value calculation in this section will be the weight to be multiplied by the priority value of the factors for the criterion to obtain the overall CSF ranking

Table 6. The respondents' data aggregation results were formed using a pairwise comparison (Organization)

	FO1	FO2	FO3
FO1	1	3.607112	0.770901
FO2	0.277230	1	0.550163
FO3	1.297183	1.817643	1

Table 7. The results of calculating the priority value of the organization factor using the AHP method

Code	Factor	CR	Priority	Rank
FO1	Top Management Support	0.086352	0.429841	1
FO2	Change Management & Culture		0.163317	3
FO3	Clear Goals		0.406841	2

In the Organization criterion, Top Management Support (FO1) received the highest priority score, followed by Clear Goals (FO3) at rank 2, and lastly by Change Management & Culture (FO2).

Table 8. The respondents' data aggregation results were formed using a pairwise comparison (Technology)

	FT1	FT2	FT3	FT4	FT5
FT1	1	1.211639	0.433640	1.042119	1.605964
FT2	0.825328	1	0.658266	1.907648	3.569740
FT3	2.306060	1.519142	1	3.124546	3.047687
FT4	0.959583	0.524206	0.320046	1	1.149610
FT5	0.622679	0.280132	0.328118	0.869861	1

Table 9. The results of calculating the priority value of the technology factor using the AHP method

Code	Factor	CR	Priority	Rank
FT1	Technological Infrastructure & Implementation	0.025354	0.178520	4
FT2	Data Accuracy		0.237745	2
FT3	System Reliability and Flexibility		0.357712	1
FT4	IT Skills Organizations		0.127347	3
FT5	Vendor Competency		0.098675	5

For the Technology criterion, System Reliability and Flexibility (FT3) appears as the factor with the highest priority, followed by Data Accuracy (FT2), IT Skills Organization (FT4), Technological Infrastructure and Implementation (FT1), and finally Vendor Competency (FT5).

Table 10. The respondents' data aggregation results were formed using a pairwise comparison (Process)

	FP1	FP2	FP3	FP4
FP1	1	0.632112	1.487161	0.586018
FP2	1.581999	1	1.368131	0.662393
FP3	0.672422	0.730924	1	0.529159
FP4	1.706432	1.509677	1.889792	1

Table 11. The results of calculating the priority value of the process factor using the AHP method

Code	Factor	CR	Priority	Rank
FP1	User Involvement	0.011665	0.208192	3
FP2	Training & Education		0.264003	2
FP3	Cooperation Between Team Members		0.171949	4
FP4	ERP Fit		0.355855	1

Finally, for the Process criterion, ERP Fit (FP4) was obtained as the factor with the highest priority value, followed by Training and Education (FP2), User Involvement (FP1), and Cooperation Between Team Members (FP3).

After obtaining the priority value of each criterion, the overall CSF order was obtained by multiplying each factor's priority value by the criterion's priority value. Multiplying the weights obtained from the priority value of the criterion with each priority value of the relevant factor obtained the overall CSF ranking, which can be seen in Figure 2. Overall, the CSF obtained rank 1 in System Reliability and Flexibility, followed by ERP Fit for rank 2, and Top Management Support for rank 3.

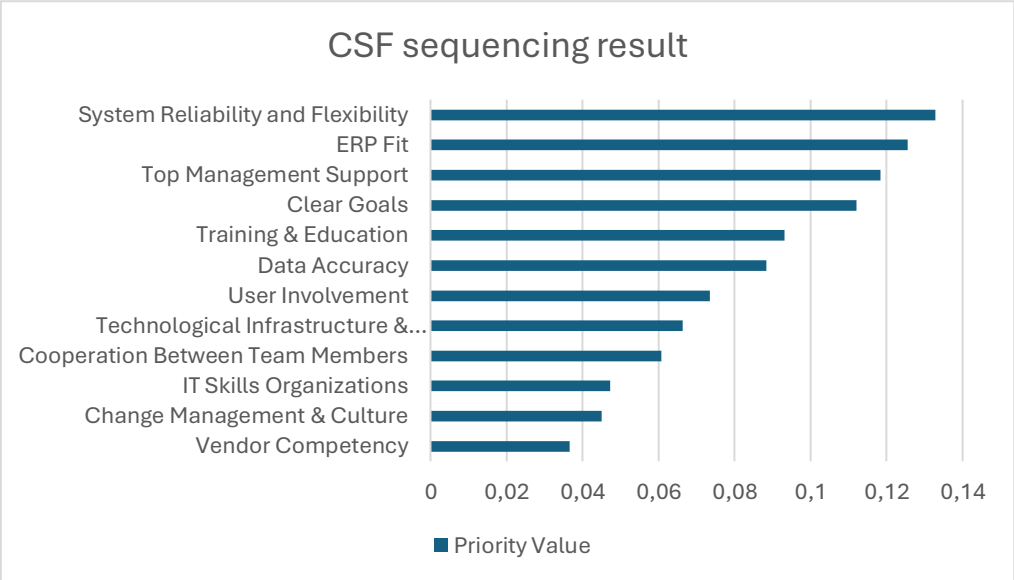

Figure 2. CSF sequencing result based on priority value

By calculating with the AHP method on the previously determined CSFs and calculating the overall CSF ranking, the overall CSF ranking can be seen based on its priority level in Figure 2. System Reliability and Flexibility is the most important factor in this study, marked by obtaining the highest overall priority value. This is because the Technology criterion has the highest priority value. A system that can optimize business processes is an

important thing to consider in the ERP system that the company will use. Moreover, a reliable and flexible system that meets business needs ensures smoother operations, increased efficiency, and easier use, so that it can improve the performance of ERP implementation in an organization as a whole (Kusumawardhana et al., 2024), (Hansen et al., 2023).

The high priority of the System Reliability and Flexibility factor is also related to the ERP Fit factor, which is ranked second. This shows that a reliable system must also align with its ability to accommodate the company's business processes appropriately. This is confirmed by research (Wicaksono et al., 2022), which found that selecting the right ERP (ERP Selection) is the highest priority factor because it is directly related to the system's ability to support the organization's business processes. A suitable ERP allows organizations to maintain their unique business processes while taking advantage of the best practices offered by an ERP system.

Support from top management is also important in ERP implementation, as evidenced by Top Management Support being the CSF with the third highest priority value. Support from top management includes commitment and active involvement from senior executives in the ERP implementation process (Kusumawardhana et al., 2024). Top management can allocate the necessary resources, set a clear vision and goals, and motivate and direct the entire team. Support from top management plays an important role in helping to overcome obstacles, ensure smooth communication, and increase the likelihood of overall project success.

Other factors, Clear Goals, Training and Education, Data Accuracy, User Involvement, Technological Infrastructure and Implementation, Cooperation Between Team Members, IT Skills Organizations, Change Management and Culture, and Vendor Competency, also have an important role in ERP implementation success. Although these factors are not the highest priority scale, they still significantly impact the implementation project, which will later become a reference by the parent company of XYZ company.

CONCLUSION

Based on the results of this study, 12 factors were obtained as the key to the success of ERP implementation in XYZ Company. The CSF priority scale was calculated and divided into three criteria: Organization, Technology, and Process. The three factors with the highest ranking, namely System Reliability and flexibility, ERP Fit, and Top Management, were considered by respondents to influence ERP implementation greatly. These chosen factors do not mean that the company ignores other factors, such as Clear Goals, Training and Education, Data Accuracy, User Involvement, Technological Infrastructure and Implementation, Cooperation between Team Members, IT Skill Organizations, and Change Management and Culture. By determining the priority scale, the parent company can consider all factors for planning and implementing future implementation projects. These factors can be a reference for the Plantation Parent Company in future ERP implementation projects, especially business units that have not used SAP as a mandatory ERP system. For further research, respondents must understand each factor in the questionnaire to obtain consistent data with a maximum inconsistency of less than 0.1 (10%). If the respondents do not understand the factors being compared, the research needs to be repeated until data with a standardization below 0.1 is obtained.

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