

Determinants of Software Development Success: Individual Factors as Moderator

Hafshah Nuridz Dzakiyyah^{1*}, Wiyarni Wiyarni², Enggar Nursasi³

¹student of Postgraduate STIE Malangkecewara, Indonesia.

²lecturer of Postgraduate STIE Malangkecewara, Indonesia

³lecturer of Undergraduate STIE Malangkecewara, Indonesia.

***Corresponding Author:** Hafshah Nuridz Dzakiyyah, student of Postgraduate STIE Malangkecewara, Indonesia.

Abstract: This study aims to examine the influence of organizational factors and process factors on the success of software development, by considering the moderating role of individual factors. The quantitative approach was conducted on 75 employees of XYZ Company as the research population. By using purposive sampling technique, data was collected through questionnaires and interviews on 50 employees who have experience working on software development more than 3 times. Data processing and analysis in this study using Partial Least Square which is divided into outer model and inner model with the help of SmartPLS software. The results show that organizational factors have a significant influence on software development success, while process factors have no direct effect. Individual factors, however, proved to strengthen the influence of organizational factors on system development success. The research conclusion highlights the importance of effective organizational support, including work structure, work culture, and management that supports innovation. Individual factors such as skills, motivation, and decision-making ability were also found to play a key role as moderators, enhancing the positive impact of organizational factors. Based on these results, suggestions are provided to improve organizational factors through the development of effective work structures, enhancement of innovative work culture, and strong management support. Improvement of individual skills, continuous assessment and improvement of processes, and emphasis on effective team collaboration are also proposed as measures to enhance the success of system development. It is hoped that the results of this study can contribute to further understanding of the factors that influence software development success and provide a foundation for strategic improvements in software development organizations.

Keywords: Software Development Success, Organizational Factors, Process Factors, Individual Factors

1. BACKGROUND

Software development is a complex activity, involving interactions between various elements that contribute to the success of a project. In this ever-evolving world, it is not only technical aspects that are the main determinants of the success of software development, but also organizational, process and individual factors that are closely interrelated. This statement reflects the recognition that achieving goals in software development is not only technical in nature, but also depends on organizational capabilities, process effectiveness, and the contributions of the individuals involved (de O. Melo et al., 2013; Livari & Huisman, 2007; Zulkefli Mansor et al., 2011).

The results of previous research state that organizational aspects which include the maturity and flexibility of the organizational structure in managing projects, managing resources, and the ability to adapt to changing needs and market demands are important aspects in the success of software development (Al-Saqqa et al., 2020). Besides the organizational aspects, a good software development process plays a central role in achieving project success. Well-defined processes can ensure optimal risk management, proper scheduling, and consistent quality control (Budi et al., 2016; Ullah et al., 2022). From an individual perspective, their role in software development cannot be ignored. Technical expertise, effective communication, and individual motivation can have a significant impact on the final outcome of a project. Previous research results found a positive correlation between

project managers' work experience and software development success (Jatiningsih et al., 2022). By understanding customer needs, the project development team can provide insight and solutions on how problems can be overcome technically, as well as communicate limitations if there are problems that cannot be resolved (Mansor et al., 2015).

An organization that is able to manage resources efficiently, including human resources, equipment, and budget, can ensure that software development projects have sufficient support. This helps in minimizing delays and imbalances that can affect the quality and completion time of the project. Thus, the close relationship between organizational, process and individual factors becomes an integral basis for achieving successful software development. Through a holistic understanding of the dynamics of dynamic business markets, organizations can maximize their potential to deliver software solutions that are innovative, reliable, and meet the expectations of users and other stakeholders. Based on background based on previous research, the implementation of this research was carried out to test and analyze organizational factors, process factors on the success of software development with moderation of individual factors at a company which engaged in software development in Surabaya. To maintain company confidentiality, this study uses the name XYZ Company instead of the actual name of the company. This research is expected to provide benefits for organizations and software developers.

2. LITERATURE REVIEWS

2.1. Organizational Factors

One of the biggest challenges in software development is how to manage projects effectively to meet user needs and produce high-quality products within the specified time and budget (Fleckenstein, 1983). To create a software solution that can meet user needs, systematic steps are needed in software development, starting from planning, needs analysis, design, implementation, testing to delivering the product to the client to maintaining the software product. Software development requires a deep understanding of risks related to project management, requirements management and personnel management (Ropponen & Lyytinen, 2000).

According to Sondang P. Siagian, organizations can be seen from three different points of view. First, organizations can be viewed as a forum, a place where individuals gather to achieve common goals. Second, an organization can be viewed as a process, where activities and interactions occur between individuals to achieve the desired results. Third, an organization can be considered as a group of people, where these individuals work together within a structured framework (Siagian, 1997). Organizational factors include various contextual factors including the maturity of the organizational environment which has an impact on developer working conditions and thus has the potential for employee productivity and the quality of the software produced (Curtis, 2019; Sowunmi et al., 2016).

According to Chow & Cao (2008) and Köse & Aydemir (2023), there are several indicators of organization that can influence software development. Those indicators are: 1) Management Commitment, encouraging organizational success, managers who are committed to managing and intensively monitoring the software development team can improve employee performance and effectiveness. 2) Organizational Culture, in agile software development the company focuses on collaboration rather than hierarchy. Organizational culture influences the successful implementation of information systems in a company, so a culture that supports innovation and employee loyalty is needed for project success. 3) Resource management and operational efficiency in software development companies must be calculated and measured. Too many or too few resources involved in the project scope will affect the team's productivity. Previewing plans for teams, roles or individuals can make resource management easier. 4) Collaboration, moving away from management control and hierarchy, agile emphasizes a more collaborative approach where decision making is more decentralized, involving the perspectives and input of team members from various divisions. Based on the indicators above, the proposed hypothesis is:

H1: Organizational factors have a significant influence on the success of software development

2.2. Process Factors

Besides organization factor, the process also can influence the software development. According to Chow & Cao (2008), there are several indicators that influence the process. These factors are: 1) Scope of the project, when making the initial agreement, the description of the scope of the project

must be spelled out clearly, to ensure that all stakeholders agree on what will be produced and what will not be. By clarifying the size of the project scope, this allows the company to calculate the size of the risks that may occur, the number of members and the team load that needs to be prepared. 2) Project planning, managers create a framework based on an agreed scope outline with reasonable estimates of resources, costs and schedules. As the project progresses, the framework is updated regularly. 3) Mechanism for monitoring software progress. This is usually done by holding daily stand-ups to monitor progress, discuss and resolve problems, and determine work priorities. This mechanism is the key to successful software development in companies that apply agile methods. However, every business can implement a monitoring mechanism system that suits the character of the team and the prevailing company culture.

Client involvement, alignment between client needs and requests and the software development company requires involvement in the form of communicative feedback during the software development process. This can be done by discussing client needs regarding software during meetings, when the quality testing process and review of software results is carried out, or at other times and places that require client participation. Based on the indicators above, the proposed hypothesis is:

H2: Process Factors have a significant influence on the success of software development.

2.3. Individual Factors

Individual factor also has influence on software development. Individuals play an important role in determining their commitment to the organizations they work for. This includes aspects related to individual beliefs, attitudes and values. Employees who have performance standards higher than those set by the company tend to show a higher level of organizational commitment. So this commitment benefits both individual employees and the organization as a whole because it can foster a positive and productive work culture (Pratama & Paulus, 2022). There are several factors that influence employee commitment in order to implement agile management. The factors are: 1) Required skills. Software development projects require individuals with diverse skill sets to collaborate effectively. 2) Project manager competency. Challenges and conflicts that may arise during the project development process require management and leadership that can handle problems effectively and provide solutions. Competent project managers can adapt to changes in project scope that occur in the agile management process while still meeting predetermined deadlines and budgets (Nguyen & Ph, 2016). 3) Quality of team work. Generally, in implementing projects that use simple methods, all final decisions depend on the level of the management hierarchy, but in agile management methods, the development team and clients play an important role in making decisions to respond to changes and challenges (Nerur et al., 2005). 4) Relationship with clients. Software features require an order of priority in their development, to be able to adapt to changes in client requests, the developer team and clients must communicate actively to evaluate and align the definition and review of each product feature so that it meets needs and expectations, but remains within the limits of the project scope (Trienekens et al., 2018). Based on the indicators above, the proposed hypothesis are:

H3: Individual factors moderate the influence of organizational factors on the success of software development.

H4: Individual factors moderate the influence of process factors on the success of software development.

Conceptual Framework

Based on the literature reviews, the conceptual framework of this study can be seen in the figure 1 below.

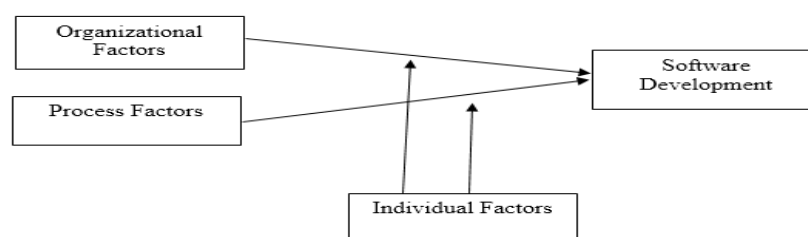


Figure 1. Conceptual Framework

3. RESEARCH METHOD

In this research, the population used is employees who have experience in the field of software development at information technology (IT) companies located in Surabaya. The population in this study was 76 company employees. Sampling in this research used a purposive sampling technique because sampling was taken with certain considerations or criteria. Where the criteria in this research are 50 employees who have experience working on software development projects more than 3 times.

This research determines 2 independent variables, 1 moderating variable and 1 dependent variable. The independent variables are organizational factors and process factors. The success of software development is the dependent variable, while the individual factors in this research act as moderators between the independent variable and the dependent variable. Organizational factors are measured by management commitment, organizational culture, resource management, and collaboration. Process factors are measured by project scope, project planning, software progress monitoring mechanism, and client involvement. Individual factors as moderating variable is measured by required skills, competence of the project manager, quality of team work, and relationship with clients. Dependent variable, software development in this study is measured by quality, scope, and time.

In this research, data analysis uses the Partial Least Square (PLS) approach using SmartPLS software. Analysis of the PLS-SEM research model involves two stages, the first stage is a measurement model to test the validity and reliability of the research instrument, including convergent validity and Cronbach Alpha. The second stage is a structural model to test the relationship between latent construct in the research model. There are several tests for the structural model, they are R-Square and Estimate for Path Coefficients.

4. RESULTS AND DISCUSSIONS

XYZ Company is a company engaged in software development, focused on providing system creation consulting services according to the needs of clients located in Surabaya. The following is demographic data on the characteristics of respondents in this study, with a total of 50 employees participating. Figure 2, 3, 4, and 4 below describe the respondents based on their education, gender, age, and years of work.

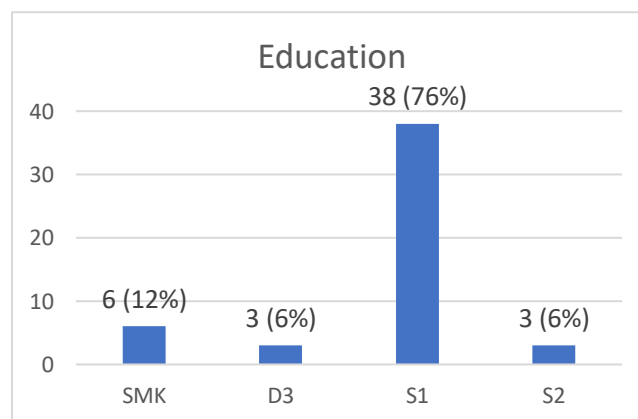


Figure2. Respondents based on education

Note:

SMK = High School

D3 = Diploma 3

S1 = Undergraduate

S2 = Master

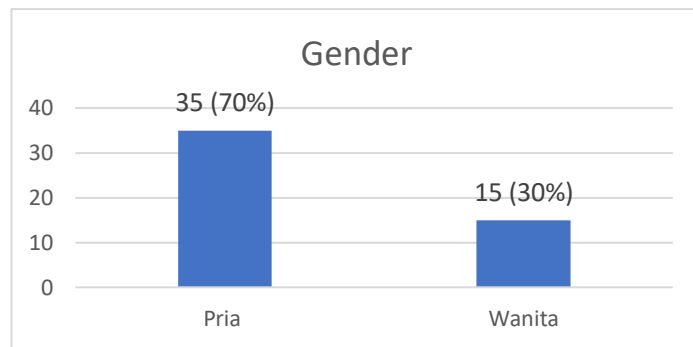


Figure3. Respondents based on gender

Note:

Pria = Male

Wanita = Female

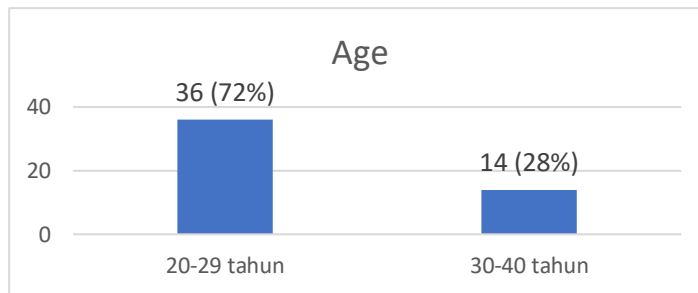


Figure4. Respondents based on age

Note: Tahun = Year

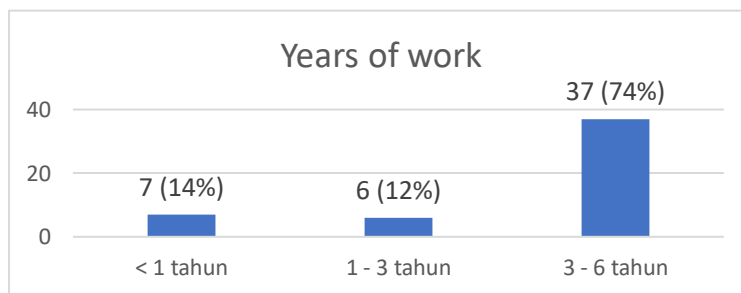


Figure5. Respondents based on years of work

The next test is outer model test. The outer model is a model that specifies the relationship between the latent variable and its indicators (Ghozali, 2006). Table 1 below show the results of outer model.

Table1. Results of outer model

	Individual Factors	Organizational Factors	Process Factors	Software Development
FI1	0.760			
FI2	0.695			
FI3	0.778			
FI4	0.798			
FO1		0.888		
FO2		0.817		
FO3		0.865		
FO4		0.787		
FP1			0.896	
FP2			0.950	

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FP3			0.951	
FP4			0.943	
KS1				0.904
KS2				0.792
KS3				0.842

Based on the outer model, all loading factor values are more than 0.6, so that it meets the validity criteria.

Another method to see the discriminant validity value is to assess the validity of the construct based on the AVE value, where a good model is required if the AVE of each construct is greater than 0.5. Table 2 below shows the result of Average Variance Extracted (AVE).

Table2. Average Variance Extracted (AVE)

Variable	AVE
Individual Factors	0,518
Organizational Factors	0,706
Process Factors	0,713
Software Development	0,742

Based on the output results, it shows that the AVE value for each construct is greater than 0.5, so it can be concluded that all constructs are good models, so that all constructs in the estimated model meet the discriminant validity criteria. Table 3 below show the results of reliability of each variable.

Table3. Construct Reliability

Variable	Cronbach's Alpha
Individual Factors	0,694
Organizational Factors	0,860
Process Factors	0,865
Software Development	0,825

Based on the reliability test results in the table above, it can be seen that all Cronbach's alpha values in the model are all greater than 0.60. So it can be concluded that all the indicators used in this research are reliable.

Model evaluation uses R-square (R^2) for the dependent construct. The R-square value reflects the predictive power of the entire model with the R-square value being greater than 0.10 or greater than 10 percent (or goodness-fit of the model) (Falk & Miller, 1992; Pirouz, 2006). Based on data processing with PLS, the coefficient of determination (R-square) value is produced as follows:

Table4. R-Square

	R Square
Software Development	0,877

Goodness of fit in PLS can be known from the Q^2 value. The Q^2 value has the same meaning as the coefficient of determination (R-square / R^2) in regression analysis. The higher R^2 , the better the model can be said to fit the data. An R Square value greater than 0 (zero) indicates that the model has predictive relevance (Ghozali, 2006). From the table it can be seen that the R^2 value is = 0.877. In this research model, the R-square value produced in the overall model equation is 87.7%, this means that the structural model has very high predictive relevance, the model is getting better and is suitable for use in predictions.

The results of hypotheses tests can be seen in the table 5 below.

Table5. Hypotheses Tests

	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics ((O/STDEV))	P Values
Organizational Factors -> Software Development	0.354	0.355	0.072	4.953	0.000
Process Factors -> Software	0.131	0.146	0.109	1.197	0.232

Development					
OF*IF -> Software Development	0.156	0.150	0.048	3.231	0.001
PF*IF -> Software Development	0.267	0.269	0.075	3.587	0.000

Based on the statistics results in the table 5 above, the discussions can be explained as follows:

The influence of organizational factors on software development

The estimation results of the direct influence of organizational factors on system success show a path coefficient value of 0.354 with a P value of 0.000 which is smaller than $\alpha=5%$, this shows that the direct influence of organizational factors on system success is significantly positive, which means that the better the organizational factors, the success will also increase. Thus H1 is accepted.

Based on research conducted by Curtis, organizations play an important role in estimating the cost, schedule and quality of software development projects. When estimating these things, organizational readiness such as management and provision of resources and the technical capabilities of the team that will work on the project also need to be taken into account, so that the organization can make strategic decisions and prioritize initiatives that lead to successful software development(Curtis, 2019).

In direct proportion to the results of the first hypothesis in this research, the test results show that Organizational Factors have a significant positive influence on the success of software development. This proves that there is a positive influence of Organizational Factors on the success of the software, thus the hypothesis is accepted. The indicators used in this research to represent organizational factors such as commitment, culture, resource management and collaboration, have been proven to influence the success of software development.

Support between employees in an organization is also an effort to build a positive organizational culture. With good communication, team members can collaborate by exchanging ideas and discussing or exchanging opinions to obtain solutions to problem solving, thus indirectly increasing individual contributions to the success of the project. Apart from paying attention to employees as human resource assets, organizations must also pay attention to technical resources such as managing information technology infrastructure, systems and hardware. Proper utilization of technical resources is expected to help organizations ensure the integrity, security and reliability of data used in software development.

This is supported by analysis conducted from interviews with several key employees involved in the software development process. In project management that uses agile project management, the company makes efforts to support the project development team in order to achieve mutual success. These forms of support include establishing regular monitoring standards, providing several special rooms for daily project team meetings and scheduling online and offline meetings with clients according to the timebox deadlines for each software feature. This is useful for minimizing the accumulation of bugs and errors that escape detection. Holding training and sharing knowledge to develop existing skills, being open to suggestions and input from employees and regularly evaluating management patterns are also forms of the company's efforts to achieve software development success.

The influence of process factors on software development

The estimation results of the direct influence of process factors on system success show a path coefficient value of 0.131 with a P value of 0.232 which is greater than $\alpha=5%$, this shows that the direct influence of process factors on system success is not significant. Thus H2 is rejected.

According to Fajriah & Nazar (2020) a structured and controlled project system under management supervision in software development is something that must be considered. In his research, it was found that business process reengineering (BPR) analysis can help in developing a distributed system for eye lens products based on mobile applications. By conducting real-time business process evaluation reviews, organizations can identify areas that need improvement and implement changes requested by clients so that the success of software development increases.

This contradicts the results of this research, where it is proven that process factors do not have a significant effect on the success of software development. Where the level of complexity of the software development process can be a burden on the success of software development. This means that the higher the level of complexity in the development process - the more complex the software scope and planning, and the client involvement that is too intense - the lower the success rate of software development. Based on the researcher's analysis obtained from interviews conducted with

several development teams, this is because many individuals on the development team are still adapting to the agile management method which has only been implemented for about 2 years. Where agile allows changes to requirements to occur when the development process has been carried out - with the applicable provisions. These changes are possible if various conditions occur, one of which often occurs is miscommunication between users and the development team. Namely, there is a misunderstanding between the development team's understanding and the needs expressed by the customer. It can also happen if the customer's team restructures, where there is a change in the customer responsible for the project. This condition often occurs due to different understanding of needs between old and new customers who have undergone restructuring. Thus, process complexity can hinder the success of software development.

Process factors can have a negative influence on software development if not managed properly. Organizations and project teams are required to have the ability to manage dynamic changes in requirements which must adapt to demand or requirements volatility. In line with the results of Dasanayake's research which states that continuous changes in software development needs and demands can cause software architecture instability and a decrease in system quality (Dasanayake et al., 2019). Adding features or changing the project scope without appropriate adjustments to the schedule and budget is also a process factor that can have a negative impact on the success of the software, because it can cause delays in project completion times, additional costs outside the budget, which can lead to client dissatisfaction (Hasnain et al., 2023).

The role of individual factors as moderating the effect of organizational factors on software development

The results of estimating the moderating effect on the direct influence of individual factors on system success show a path coefficient value of 0.156 with a P value of 0.001 smaller than $\alpha=5\%$, this shows that there is a positive moderating effect on the influence of organizational factors on system success. This means that individual factors contribute to organizational factors in supporting the success of the system. Thus H3 is accepted.

From the results of interviews with 10 software development project managers in the US in Nguyen & Ph.(2016) that managing team collaboration globally is to build commitment with a common goal for all members, align expectations and performance, build trust, motivate team members to collaborating and sharing knowledge is a big challenge, because at the same time both project managers and team members have to face differences in each other's characters and personalities. Thus the researcher concludes that project managers play a key role in the success of software development, they must be able to manage project risks, build a supportive work environment, select and utilize appropriate technology, and ensure communication and coordination run effectively between team members. So the role of the project manager as a competent and experienced individual has a significant influence in moderating the organization on the success of software development.

This research proves that individual factors significantly moderate the success of software development, so it can be stated that the third hypothesis is accepted. The better the skills each individual has, the better the quality and coordination of the team, the more competent the manager on the team, and the better the relationship with clients/users, the higher the level of success in software development. From the results of the analysis based on interviews conducted by researchers with several employees on the software development team, the quality of the team's performance is supported by managers who are competent in solving problems, managing their teams, and continuing to communicate reciprocally with users/clients. According to the researcher's analysis, the good quality of the team is also supported by the team being dominated by relatively young employees where the employees still have the will to continuously develop their abilities, also supported by the training provided by the company. Based on several things, this has an impact on team coordination which continues to improve and increases success in software development.

The role of individual factor as moderation the effect of process factors on software development

The estimation results of the moderating effect of individual factors on the direct influence of process factors on system success show a path coefficient value of 0.267 with a P value of 0.000 which is smaller than $\alpha=5\%$, this shows that there is a positive moderating effect on the influence of individual factors on system success. This means that individual factors contribute to organizational factors in supporting the success of the system. Thus H4 is accepted.

The explanation that individual factors play an important role in increasing the success of software development can be based on several concepts and aspects that strengthen the influence of individuals in this context. Individuals who have high skills and competence in software development can make a significant contribution to project success. Technical skills, understanding of the latest technologies, and proficiency in software development can strengthen the development process. Individual factors such as the ability to work together, communicate effectively, and collaborate with a team can help improve coordination among development team members. This can increase efficiency and output quality during the development process. Individuals who are highly motivated and dedicated to project success tend to work harder and be more focused. High motivation can overcome obstacles and challenges during development, allowing the project to progress better. An individual's ability to adapt to change and learn continuously can be a valuable asset in a dynamic software development environment. In an ever-evolving industry, an individual's ability to keep up with the latest technology and practices can increase project success.

5. CONCLUSIONS AND SUGGESTIONS

The research examines the influence of organizational factors and process factors as well as the moderating role of individual factors on the success of system development. The results of this research indicate that organizational factors have an influence on the success of software development. Meanwhile, process factors have not been proven to directly have a significant effect on the success of system development. Individual factors are proven to significantly strengthen the influence of organizational factors and individual factors on the success of system development.

Based on the research results, it can be concluded that organizational factors have a significant role in determining the success of software development. Organizational factors include elements such as organizational structure, work culture, and management support that contribute to the achievement of project goals. In contrast, process factors do not directly have a significant effect on the success of system development, indicating that procedural aspects may not play a dominant role without strong organizational support.

Interestingly, individual factors were shown to play an important role as moderators, strengthening the influence of organizational factors on the success of system development. This indicates that individual skills, motivation, and decision-making quality can increase the positive impact of organizational factors. Therefore, the success of system development seems to depend on a good combination of good organizational support and individual contributions in the development team.

Even if process factors are not proven to have a direct influence, still assess the existing process. Process refinements and adjustments can help create an environment that is more conducive to achieving project goals. Changes in organizational conditions, individual factors, and project needs may occur over time. Therefore, it is important to carry out continuous monitoring and evaluation to ensure that the strategies implemented remain relevant and effective.

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