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Identification of Critical Success Factors of Geographic Information System Development Project with AHP Approach

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***Abstract*—An Indonesian government agency in the field of research is developing a Geographic Information System (GIS) to distribute remote sensing data to customers. To prevent project failure, it is crucial to understand the success criteria related to project objectives and the critical success factors (CSFs), which drive project success. This research identifies these CSFs, enabling organizations to prioritize project success factors. The Analytic Hierarchy Process (AHP) ranks project success criteria and CSFs. The mixed research methodology incorporates qualitative elements through discussions with the project manager to validate the AHP hierarchy structure and quantitative aspects through questionnaires used to calculate weighted priorities using AHP. Results show stakeholder satisfaction and objective achievement as the top-ranked success criteria. The top 5 CSFs identified are team commitment and participation, clear roles and responsibilities, leadership, knowledge management, appropriate tools, infrastructure, and resources. Based on the success criteria ranking, development should enhance system functionality to maintain user satisfaction and achieve project objectives. Meanwhile, prioritizing human resources and providing adequate resources are crucial based on the identified top 5 CSFs, contributing to increased development success. This outcome aims to assist firms in improving project management and identifying the most critical success elements for GIS development. Furthermore, this research will likely be a learning experience for other government organizations seeking to enhance their information system development efforts.**

***Keywords*—Geographic information system; project success criteria; critical success factors; analytic hierarchy process.**

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I. INTRODUCTION

One of the main challenges in information technology (IT) project management is the risk of project failure, which may arise from diverse factors, sources, and methodologies applied during the project. Information systems development within governmental contexts is particularly susceptible to failure due to various driving and inhibiting factors throughout the development process. Analyzing success factors in developing information systems within government projects is imperative to ensure the success of IT projects in such environments.

Various literature has been explored to analyze the factors contributing to the success of IT development projects. Key success factors encompass digital literacy and internet penetration. The utilization of both internal and external knowledge through collaboration can facilitate the development of a more agile project [1] and enhance e-government implementation [2]. The project's complexity, the team's absorptive capacity, and e-leadership are also pivotal in determining whether an e-government project will encounter delays or overspending [3], [4].

E-Government is an electronic or computer-based governmental platform that enhances capabilities and capacities in delivering public services and advancing human resources development [5]. An Indonesian government agency in the field of research has developed a Geographic Information System (GIS) dedicated to supporting e-government by facilitating the retrieval of remote sensing satellite imagery data. The system functions as a geoportal, allowing users to access remote sensing data online, which undergoes processing to generate a province mosaic. The system is designed to elevate product utilization and foster innovation through a stakeholder-oriented perspective tailored for organizational enhancement.

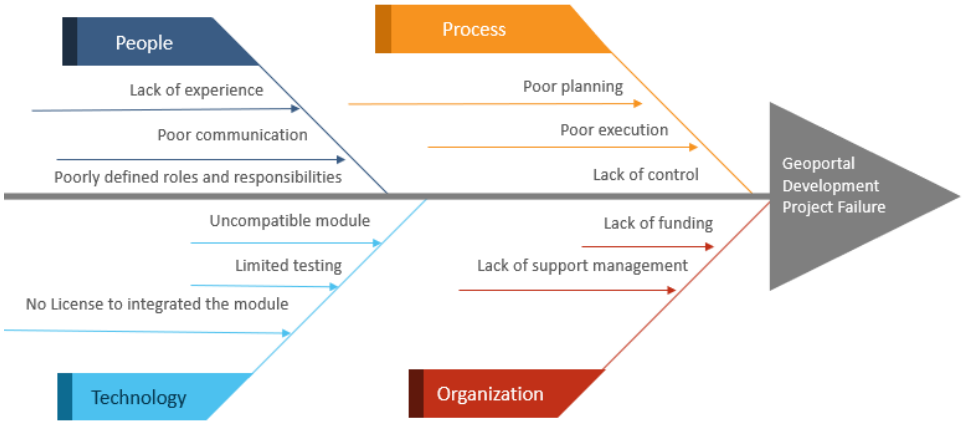

Fig. 1 Root Cause Problem Analysis Using Fishbone Diagram

The geoportal was launched in 2019, and its development was outsourced to external vendors or third-party entities. This system relies on web services and web portals, serving 34 provinces in Indonesia. Although it has been launched and is ready for user adoption, ongoing efforts to improve the system have been in progress since 2021, including integrating a land cover classification module. In 2022, a machine learning module was developed to facilitate tree counting and identification of burned areas. The project has transformed into a hybrid model, combining development or engineering projects with in-house research activities.

In the ongoing development process, in-house team members encounter several issues that, if left unaddressed, could impede the project's success. These challenges encompass insufficient capacity and capability of human resources, the inherent complexity of the projects, and the lack of literacy related to the system. The problems stem from the fact that the vendor undertook the initial development while subsequent refinement projects are being handled by internal staff. Although knowledge transfer from the vendor team to the internal team has been conducted previously, its effectiveness in facilitating subsequent projects remains suboptimal.

Another issue arises from the changes in work mechanisms, organizational culture, and the rotation of human resources, resulting in a reduction in the number of team members from the initial count due to the government agency's reorganization. These alterations may impact the project's success. Ideally, several modules should have been seamlessly integrated into the system by the end of 2021. However, due to the project's development, the intended scope was not achieved within the current year.

Projects can encounter failure due to various reasons. The Ishikawa Diagram, also known as fishbone analysis, served as a straightforward graphic tool for comprehending the causes of quality defects. It is employed to analyze the relationship between problems and all potential causes [6]. Following an interview with the project coordinator, Figure 1 illustrates the root cause analysis of the geoportal project failure. The underlying issues are categorized into four domains, namely People, Process, Technology, and Organization, utilizing the project failure framework [7].

To mitigate the risk of project failure, it is imperative to delineate the key factors driving the success of an IT project [8]. These factors are commonly known as Critical Success Factors (CSF). Various scholars have conducted previous research on CSFs in information system development or IT projects. Edwita *et al.*[9], for instance, explored the CSF of information system development project through Systematic Literature Review, Guntur *et al.* [10] identified CSFs in the E-Government development of the Finance Education and Training Agency, utilizing the Analytical Hierarchy Process (AHP) method, Gumay *et al.* [11]identified CSFs in IT projects within an Indonesian telco company AHP approach, Raharjo *et al.* [12] employed AHP for identifying CSFs in the project management office, Radujković and Sjekavica [13] utilized a literature review to identify CSFs in project management.

While numerous studies delve into identifying CSFs in information systems development, there has been little specific discussion of GIS development projects, particularly within the last five years. Recognizing this gap, the present research addresses the question, "What are the project CSFs in the geoportal development project?" To answer this research question, a thorough analysis is imperative, necessitating the application of an appropriate methodology.

The application of multicriteria decision-making is a common approach for establishing priorities or making decisions, with AHP emerging as the most frequently employed and successful method [14]. Building on prior research that highlights AHP's effectiveness in identifying CSFs by comparing the importance of one factor with another [10], [11], [12]This study utilized AHP Hierarchy for root cause analysis, guiding the examination of project success criteria and CSFs in developing geoportals. The primary aim of this research is to analyze the CSFs in geoportal development. The anticipated outcome of this study is an enhancement in the success of IT projects, particularly in developing geoportals as integral systems supporting e-government initiatives within organizations, thereby improving data services to the community.

II. Materials and Method

The following are the literature materials for this research. The literature materials encompass a comprehensive review, summarizing key aspects such as IT project management, project success criteria, CSFs associated with e-government, and AHP.

A. IT Project Management

A project comprises temporarily executed activities or tasks to create an organization's distinctive product, service, or outcome. A project manager, chosen from the organization, assumes the leadership role and is accountable for accomplishing project objectives [7]. Projects vary in size, duration, and cost, contingent upon their specific attributes. They can be small, large, short, long, or low-cost.

IT projects are IT investment activities based on products, services, or organizational investments, wherein organizations anticipate returns from the allocated resources, finances, and time invested in project implementation [7]. IT projects support diverse organizational activities, including maintaining current or legacy systems and innovative development, leveraging technological advancements and current trends. Information system development, a subset of IT projects, involves collaborating pooling resources from various experts to develop a software product. The team typically comprises system analysts, developers, testers, database analysts, trainers, and other specialized experts [15].

Project management involves applying techniques, skills, tools, and knowledge derived from project activities to fulfill project requirements. Within project management, a set of processes is organized into process groups: initiating, planning, executing, monitoring and control, and closing. The project team is required to concentrate on maintaining a balance among various project constraints, including quality, budget, resources, risk, schedule, and scope [16]. By addressing this constraint, project management facilitates the equilibrium necessary for achieving project success.

B. Project Success Criteria and Critical Success Factors from Related Research

Unique success criteria, distinct from other IT projects, characterize every IT project. The assessment of project success hinges on factors such as timely completion, adherence to budget constraints, and fulfillment of user requirements [10]. Defining project success criteria holds significance as they serve as the cornerstone for all project activities [17]. Various literature sources have outlined success criteria for IT projects, and a summary is presented in Table I below.

TABLE I
PROJECT SUCCESS CRITERIA DEFINE BY LITERATURE

Project Success Criteria	References						
	[18]	[11]	[10]	[17]	[19]	[7]	[16]
Time	✓	✓	✓	✓	✓	✓	✓
Cost	✓	✓	✓	✓	✓	✓	✓
Scope	✓	✓	✓	✓		✓	✓
Quality	✓	✓	✓	✓			✓
Risk	✓	✓	✓	✓			✓
Stakeholder's satisfaction	✓	✓	✓	✓	✓		
Technical Requirement					✓		
Objective Achievement					✓		
Communication	✓						
Process	✓						

CSF is often used as a key to developing information systems and IT projects. It is important to define CSF so that organizations can prioritize CSF in their strategic plans to achieve a competitive advantage. CSF is an applicable and powerful method to carry out challenges in IT implementation [20]. CSF can identify issues that need attention in emerging IT projects. If the CSF is not done well, the project will potentially not achieve its mission, goals, or business [21] [22] . Recognizing the significance of identifying CSF in information system development, a literature review was conducted on previous research pertaining to CSFs in IT/IS development projects. The review revealed the classification of 48 CSFs into categories such as people, process, technology, organization, and external environment, as illustrated in Table II.

TABLE II
IT PROJECTS CSF MAPPING BY PREVIOUS RESEARCH

CSF	References							
	[18]	[23]	[14]	[10]	[12]	[9]	[13]	[24]
People								
Efficient communication	✓	✓		✓		✓		✓
Team skills and competencies		✓	✓	✓			✓	✓
Team composition, team size		✓	✓	✓			✓	✓
Leadership	✓			✓	✓		✓	
Trust						✓		
Customer Involvement		✓						✓
Project manager experience	✓							
Project manager formal power	✓	✓						
Project manager skill	✓	✓						
Clear roles and responsibilities					✓			
Team commitment and participation	✓							
Process								
Proper planning	✓			✓		✓		✓
Realistic schedule				✓	✓			✓
Business process reengineering								
Knowledge management, sharing knowledge		✓		✓				
Project evaluation				✓	✓	✓	✓	
Efficient project management	✓	✓		✓		✓		✓
Project size, project complexity		✓	✓			✓		

CSF	References							
	[18]	[23]	[14]	[10]	[12]	[9]	[13]	[24]
Ability to provide added value			✓		✓			
Alignment with company business goals					✓			
User-oriented change management			✓					✓
Project control and monitoring	✓							
Project risk management	✓	✓						
Project duration	✓	✓						
Vendor support		✓	✓					
Technology								
System compatibility, system integration			✓	✓		✓		
Familiar with technology					✓	✓	✓	
Information system expertise					✓	✓		
Clear requirements and specification	✓						✓	
Appropriate tools, infrastructure, adequate resources, IT readiness		✓	✓		✓		✓	
Data quality, data availability		✓	✓					
Software customization		✓						
HW/SF selection		✓						
Organization								
Top management support, management commitment	✓	✓	✓	✓	✓			✓
Politics in organization				✓				
Organization culture		✓	✓		✓	✓	✓	
Business professional expertise					✓	✓		
Client expertise					✓	✓		
Independent PMO					✓			
Realistic budget and financial resource								✓
Relationship with third party	✓							
Organization strategic planning	✓	✓						
Rules and regulation	✓	✓						
Subject matter expert	✓							
Outsourcing index		✓						
External Environment								
Competitor pressure			✓					
Trend	✓	✓						

Like project success criteria, CSFs vary in each project and are contingent upon specific conditions. From the pool of the 48 identified CSFs, a subset related to the challenges encountered in the geoportal's development will be chosen. The project manager overseeing the geoportal development will validate this selection.

C. Analytic Hierarchy Process (AHP)

AHP is known as a sophisticated technique employed in group decision-making. Saaty has introduced it into a versatile tool for decision selection across diverse situations. AHP operates as a multicriteria decision-making approach, systematically arranging factors in a hierarchical structure. This hierarchical framework organizes factors from the overall goal down to criteria, sub-criteria, and alternatives at sequential levels in the decision-making process [25].

When establishing the hierarchy, several considerations should be taken into account, as outlined in [25]:

a. Hierarchies should comprehensively represent problems while remaining sensitive to changes in elements.
b. It is crucial to pay attention to the environment surrounding the problem.
c. Identify issues or attributes that contribute to the solution.
d. Recognize participants associated with the problem.

Goals, attributes, issues, and stakeholders are organized in a hierarchy to offer a comprehensive view of the complex relationships within a situation. This hierarchical structure aids decision-makers in assessing problems, enabling accurate comparisons of elements [25]. In the application of AHP to this study, a literature review was conducted and revealing a substantial body of previous research that utilized AHP in studies related to IT/IS Projects [10], [11], [12], [14], [23], [24], [26].

The methodology employed in this research is outlined in the following sections. The methodology is discussed in several sections: research flow, research instrument, and data collection and technique. This research utilizes a mixed method approach, combining qualitative and quantitative procedures sequentially or simultaneously. Qualitative research focuses on "words" to capture a phenomenon, employing ethnography and case studies to emphasize qualitative data. On the other hand, quantitative research involves procedures such as experiments or surveys, highlighting "numbers" or quantitative data [27]. This study utilized qualitative methods to analyze the root of the problem

and validate the list of project success criteria and CSFs obtained from a compilation found in the literature. Quantitative methods were applied to rank or prioritize CSFs and project success criteria using the AHP method.

D. Research Flow

This study consists of 11 stages, as illustrated in Figure 2. The explanation of each stage is as follows:

1) Problem Identification: This involves identifying problems and root causes through observations of ongoing projects within the organization. The findings are validated through discussion with project managers or coordinators.

2) Literature Study: Conduct a literature review of previous research related to identifying CSF in IT/IS projects that used AHP or other methods.

3) Project Success Criteria and CSF Identification: In this stage, project success criteria and CSF are collected and summarized based on the literature review. Further validation is performed through discussions with the project manager.

4) Define Hierarchy: Creating an AHP hierarchy that serves as the framework for this study.

5) Determine Participants: Identifying participants directly involved in the project. Participants were chosen based on their direct involvement in the ongoing GIS project. All active remaining team members were included to ensure firsthand knowledge and relevant experience. Participants are coded R1 to R5.

6) Define questionnaire: Preparing an online questionnaire using the AHP Online System (AHP-OS) by Bpmsg.com [28]. For example, the questionnaire posed comparative questions such as comparing Factor A to Factor B, Factor B to C, and Factor A to Factor C, asking participants to determine which factor is more crucial. This process continued until all factors were compared with one another.

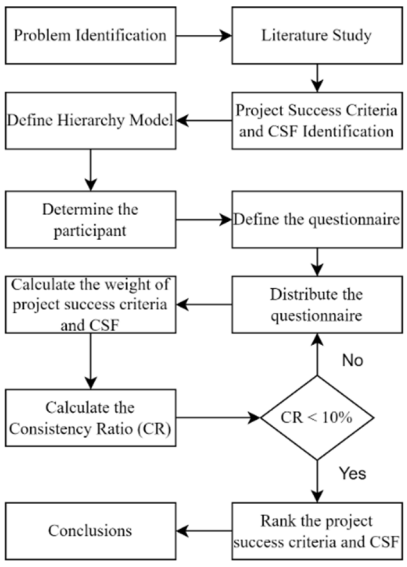

Fig. 2 Research Flow

7) Distribute Questionnaire: The questionnaire was distributed to predetermined participants through a link (bpmsg.com). Participants can access the link, fill in personal data, and answer questions. The data collected automatically will be analyzed for consistency using AHP-OS tools.

8) Calculate Weight of Project Success Criteria and CSF: Determining the weight of project success criteria and CSFs, forming the basis for priority rankings based on participant-assigned weights. The weight calculation employs the AHP eigenvector method, a widely accepted approach in the literature [28]. This method assigns weights to each criterion and factor based on the participant's responses to pairwise comparisons, ensuring a systematic and consistent calculation process. The AHP eigenvector method provides a rigorous and transparent way to quantify the relative importance of success criteria and CSFs, contributing to the robustness of the prioritization process.

9) Calculate the Consistency Ratio (CR): Ensure the CR is below 10%. If it exceeds 10%, participants are required to correct their questionnaire until it falls below 10%.

The CR formula used in AHP-OS is as follows [28]:

$$CR = \frac{\lambda - n}{2.7699\,n - 3.43513 - n} \quad (1)$$

Here, λ is the value of n x n decision matrix for n criteria.

10) Rank the Project Success Criteria and CSF: The project success criteria and CSFs are ranked using the processed weights. AHP-OS provided a group consensus result to ensure that the weight results do not lead to a deadlock due to conflicting judgments for two criteria. The interpretation of the AHP consensus indicator is presented in Table III.

TABLE III
AHP GROUP CONSENSUS INDICATOR [28]

Consensus Indicator	Explanation
≤ 50%	Very low
50% - 65%	Low
65% - 75%	Moderate
75% - 85%	High
≥ 85%	Very High

11) Conclusions: Based on the preceding stages, it can be deduced which factors must be considered to achieve project success.

E. Research Instrument

In Table I, 10 criteria for project success were identified. Following validation with the project manager, six project success criteria were selected: Time, Cost, Scope, Quality, Stakeholder Satisfaction, and Objective Achievement. Table II presents 48 CSFs gathered from the literature, with 23 factors selected, distributed as follows: seven factors in the People category, six factors in the Process category, six factors in the Technology category, and four factors in the Organizational category. A comparison of each success criterion and CSFs is conducted using an absolute scale, as illustrated in Table IV [28].

Additionally, based on the extensive number of CSFs utilized in this study, 57 questionnaire items were designed. It offers a participant-driven prioritization of factors according to their subjective significance. The Analytical Hierarchy Process (AHP) creates rankings based on participants' responses to these pairwise comparisons. According to the AHP hierarchy presented in Figure 3, the scale mentioned

earlier yields a priority ranking of the project success criteria and CSF for comparison.

F. Data Collection Technique

The initial data collection involved qualitative data, including observation and discussion with the project manager to identify problems and root causes and validate the success criteria and CSFs for the GIS development project. The validation results were then used to create a questionnaire instrument, which was subsequently distributed to team members.

For the data collection phase using questionnaires, the distribution took place online among members of the geoportal development project team in May 2022. The questionnaire employed AHP-OS tools from bpmsg.com to facilitate calculations and analyze results [28]Efforts were made to keep the CR below 10% to mitigate the inconsistency and contradiction in AHP. Fortunately, AHP-OS checks the CR of each user inputting his questionnaire, highlighting any inconsistencies. Users can then revise their questionnaire responses to determine the rating until the CR meets the requirements of being below 10%.

III. Result and Discussion

A. Results

Based on the previous research stage, an AHP hierarchy model was developed. Following validation with the project manager, six project success criteria relevant to this project were selected, namely Time, Cost, Scope, Quality, Stakeholder Satisfaction, and Objective Achievement. The weighting of project success criteria will be conducted using AHP, with participants determining the priority of criteria in the geoportal development.

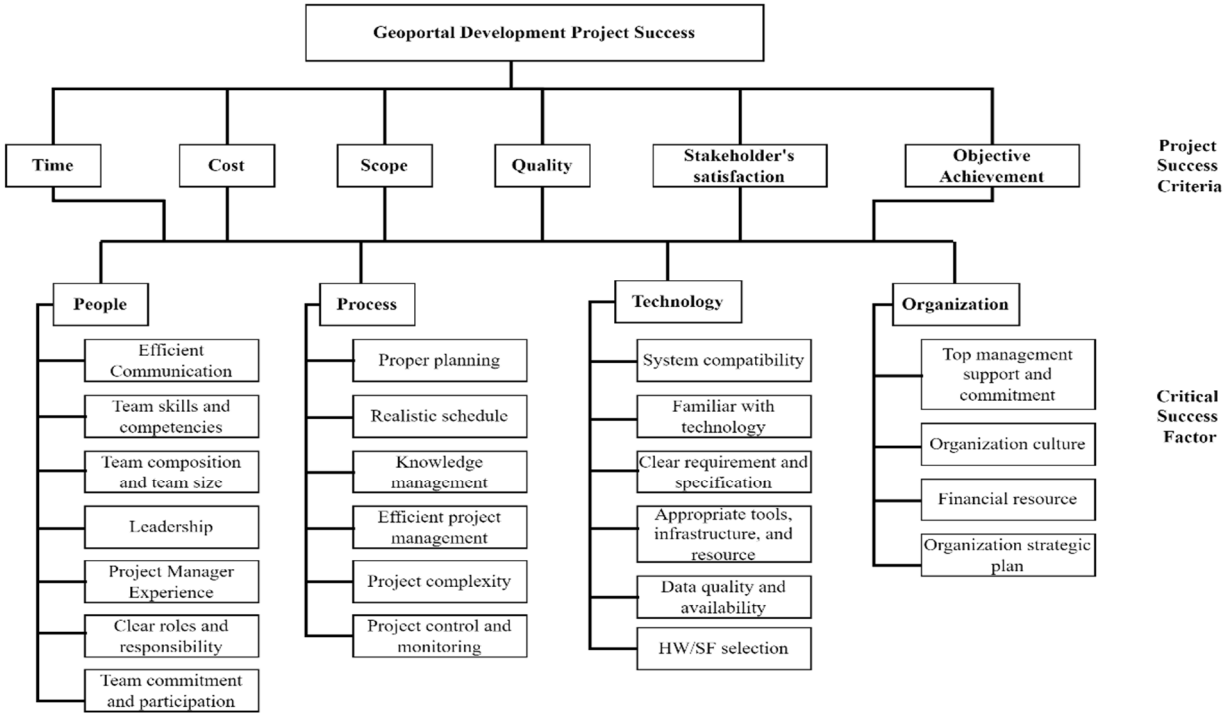

Fig. 3 AHP Hierarchy Model

Additionally, there are four categories of CSF: People, Process, Technology, and Organization, encompassing 23 CSFs related to the project, all of which have been validated by the project manager. This hierarchy serves as the foundation for creating AHP questionnaires with a structure comprising two hierarchy levels, 23 hierarchy leaves, and five hierarchy nodes. The research questionnaire utilizes AHP-OS [28]. The weighting results of project success criteria are presented in Table V, while the weights for the CSF Group Categories are displayed in Table VI. A Group Consensus of 84.8% indicates a high consensus on the success criteria, ensuring that the resulting solution is meaningful for the decision problem. All respondents provided CR calculations below 10%, confirming the consistency of the questionnaire results. In addition to individual weights per respondent, the final weights are calculated in groups, as in Table V and Table VI. The criterion or factor with the highest weight is considered the organization's most important and recommended priority.

TABLE V
Rank of Project Success Criteria

Success Factor Criteria	Weight (%)					
	R1	R2	R3	R4	R5	Group
Stakeholder's satisfaction	21.1	33.4	26.5	25.6	16.7	25.9
Objective achievement	21.1	33.4	26.5	25.6	16.7	25.9
Quality	19.6	11.6	10.9	25.6	16.7	17.3
Time	15.3	7.3	26.5	9.5	16.7	14.6
Cost	18.2	12	4.8	4.3	16.7	10
Scope	4.8	2.3	4.8	9.5	16.7	6.3
CR	8.8	9.1	0.9	0.9	0.0	0.4
Group Consensus Indicator	84.8% (high)					

Table V reveals that the most crucial success criteria for a project are stakeholder satisfaction and objective achievement.

This aligns with the geoportal's purpose, serving as a tool to enhance remote sensing data services through E-Government.

TABLE VI
RANK OF CSF GROUP CATEGORY

CSF Category	Weight (%)					
	R1	R2	R3	R4	R5	Group
People	56.5	56.5	5.5	56.5	56.5	43.8
Technology	5.5	26.2	26.2	26.2	26.2	23.5
Process	26.2	11.8	56.5	11.8	11.8	23.4
Organization	11.8	5.5	11.8	5.5	5.5	9.3
CR	4.3	4.3	4.3	4.3	4.3	1.9
Group Consensus Indicator	67.5% (moderate)					

Table VI indicates that People are the most important factor in achieving development success, highlighting the significant influence of human resources on the development process. Table VII details the consolidation of each CSF group category weighing from 5 respondents.

TABLE VII
SUMMARY OF CSF LOCAL WEIGHT

Group Category	CSF	Local Weight (%)	Ranking	Indicator (%)
People	Efficient Communication	12.12	5	CR=0.3684 Group Consensus = 84.3 (high)
	Team skills and competencies	14.48	4	
	Team composition and team size	3.44	7	
	Leadership	17.63	3	
	Project Manager Experience	7.18	6	
	Clear roles and responsibilities	21.30	2	
	Team commitment and participation	23.86	1	
Process	Proper planning	12.13	4	CR=0.8431 Group Consensus = 78.7 (high)
	Realistic schedule	12.80	3	
	Knowledge management	31.43	1	
	Efficient project management	11.67	5	
	Project complexity	8.48	6	
	Project control and monitoring	23.49	2	
Technology	System compatibility	15.89	3	CR=0.1881 Group Consensus = 73.6 (moderate)
	Familiar with technology	10.19	5	
	Clear requirements and specification	13.01	4	
	Appropriate tools, infrastructure, and resource	28.23	1	
	Data quality and availability	23.13	2	
	HW/SF selection	9.56	6	
Organization	Top management support and commitment	30.30	2	CR=1.0722 Group Consensus = 87.9 (very high)
	Organization culture	9.14	4	
	Financial resource	42.83	1	
	Organization strategic plan	17.74	3	

All four group categories have CR below 10%, indicating the consistency of the AHP questionnaire results. Furthermore, all group consensus values are above 65%, affirming that the rank of the CSF groups is a viable solution to the problem. In the People category, team commitment and participation are the most crucial factors

The most important factor in the process category is knowledge management. Within the Technology category, the most significant factor is the availability of appropriate tools, infrastructure, and resources. Finally, in the Organizations category, the most critical factor is the availability of financial resources.

For a comprehensive view of the ranking of all factors serving as CSFs in geoportal development, Figure 4 illustrates the overall combined CSF ranking across the four group categories. The overall CR showed a value of 1.9263%, indicating that after merging the four categories, the factors provided by the five respondents were consistently filled in, making the results feasible for use as a solution to address the problem.

Fig. 4 Summary of CSF Global Weight (CR = 1.9263%)

B. *Discussion*

Based on the findings, the top 5 critical success factors for GIS project development are in consecutive order.

1) Team Commitment and Participation: This factor, ranked first under the People category, significantly impacts GIS project development. Literature supports the notion that thorough commitment and active participation from each team member are crucial for successful geoportal development [18]. Organizations should ensure that human resource concentration is not overly divided among multiple projects to support geoportal's successful development.

2) Clear Roles and Responsibility: Ranked second under the People category, Clear Roles and Responsibilities are crucial. The literature emphasizes the importance of involving team members not only during execution but also in the planning phase [12]. Assigning tasks and responsibilities clearly ensures that every member knows and agrees on their roles, preventing unassigned tasks.

3) Leadership: Ranked third factor under the People category, Leadership is a vital factor supported by various literature sources as an IT/IS success factor [10], [11], [12], [13], [18]. Project managers must efficiently distribute tasks, persuade and motivate team members, and adhere to timelines for effective contributions to geoportal development.

4) Knowledge Management: Ranked fourth under the Process category, Knowledge Management is identified as an IT/IS success factor [10], [23]. Regularly sharing tools or media about experiences in GIS development is necessary, and effective documentation minimizes difficulties in further development.

5) Appropriate Tools, Infrastructure, and Resources: Ranked fifth under the Technology category, the availability of Appropriate Tools, Infrastructure, and Resources is emphasized by literature [11]–[14], [23]. The organization must be committed to providing IT facilities for geoportal development readiness.

The following three factors are Team Skills and Competencies (under the People category), Project Control and Monitoring (under the Process category), and Data Quality and Availability (under the Organization category). This indicated that human resources development through certified training, internal monitoring and evaluation, and data availability for trials in executing draft modules are crucial for success [29]-[30].

The last three factors ranked are Organizational Culture, Team Composition and Size, and Organizational Strategic Plan. These factors suggest that changes in organizational structure, reduced team size, and cultural changes minimally interfere with the development process. Financial resources are ranked 10th because they play a significant role in meeting facility needs for development.

IV. Conclusion

Based on the AHP-weighted results, project success criteria and CSFs were ranked for the GIS project development. Stakeholder satisfaction and objective achievement emerged as the top project success criteria. The top five CSFs identified are Team Commitment and Participation, Clear Roles and Responsibilities, Leadership, Knowledge Management, Appropriate Tools, Infrastructure, and Resources. These findings will guide organizations in enhancing project management and prioritizing success factors crucial for GIS development success. Moreover, the research is a valuable learning experience for other government agencies seeking to improve their information system development projects.

It is important to note that this research is limited to a single case study, limiting its generalizability to the organization under study. Nevertheless, the AHP variables and hierarchies can serve as a reference for similar research in case studies involving other projects and organizations. The study acknowledges the absence of consideration for emotional influence factors, especially regarding the potential impact of a lengthy AHP questionnaire on respondent enthusiasm. Future research could explore these emotional factors and integrate additional ranking methods such as Fuzzy AHP and TOPSIS to enhance solution accuracy performance evaluation.

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