Managing projects in higher education institutions: a study on critical success factors

by Ivan Gunawan

Managing projects in higher education institutions: a study on critical success factors

Dian Trihastuti*, Ivan Gunawan,
Martinus Edy Sianto and Phatarina Natalia

Department of Industrial Engineering,
Universitas Katolik Widya Mandala Surabaya,
Surabaya, Indonesia
Email: d.trihastuti@ukwms.ac.id
Email: ivangunawan@ukwms.ac.id
Email: martinus.sianto@ukwms.ac.id
Email: nataliasmr19@gmail.com
*Corresponding author

Abstract: This article investigates the critical success factors (CSFs) of project management in Indonesian higher education institutions (HEIs). Based on the data from in-depth interviews with nine project managers in four Indonesian universities and survey results, this article identifies 12 critical success factors and their interconnectedness. The role of each factor and its relationship with other factors are described using a combination of decision-making trial and evaluation laboratory (DEMATEL), interpretive structural modelling (ISM) and *Matrice d'Impacts Croisés Multiplication Appliqué un Classement* (MICMAC). There are seven causal success factors and five effect success factors. These factors are interrelated to form a four-level hierarchical structure. The findings can inform project stakeholders in Indonesian HEIs on increasing the success potential and minimising the risk of failure.

Keywords: DEMATEL; higher education institutions; HEIs; interpretive structural modelling; ISM; critical success factor; CSF.

Reference to this paper should be made as follows: Trihastuti, D., Gunawan, I., Sianto, M.E. and Natalia, P. (2024) 'Managing projects in higher education institutions: a study on critical success factors', *Int. J. Project Organisation and Management*, Vol. 16, No. 2, pp.209–232.

Biographical notes: Dian Trihastuti received her PhD in Industrial Manufacturing and Systems Engineering from the University of Missouri. She is working as a Lecturer in the Industrial Engineering Department at Widya Mandala Surabaya Catholic University (WMSCU). She actively involves in various funded institutional projects, research and community services. She is currently assigned as the Secretary at the undergraduate school of Industrial Engineering. Her research interests include project management, sustainable supply chain, facility location and planning, input-output modelling and logistics management.

Ivan Gunawan is currently a Lecturer at the Widya Mandala Surabaya Catholic University (WMSCU), Indonesia. He received his Bachelor's in Industrial Engineering from the WMSCU, Master's in Technology Management from Institut Teknologi Sepuluh Nopember (ITS), and Doctorate's in Industrial Engineering from ITS. His research interests are in food supply chain and quality management. During the past few years, he has provided lectures in project management, statistical quality control, operations research, and industrial system simulation to the undergraduate level at the WMSCU.

Martinus Edy Sianto is a Lecturer of Industrial Engineering at the Widya Mandala Surabaya Catholic University. He received his Bachelor's in Industrial Engineering from the Institut Teknologi Sepuluh Nopember (ITS), Surabaya, and Master's in Industrial Engineering from Institut Teknologi Bandung (ITB). He is the Head of the Ergonomics and Work Design Laboratory since 2001. He is interested in research especially work design, product design and ergonomics. He is also interested in statistical and quality engineering. He has some publication collaborations with industrial engineering and chemical engineering lecturers to work on the design part of an experiment.

Phatarina Natalia is currently working at the Pulp and Paper Company in April as a planner in Paper Warehouse Department. She received her Bachelor's in Industrial Engineering from the Widya Mandala Surabaya Catholic University. She is interested in all types of industries ranging from oil and gas, mining industry, transportation industry, service industry and systems engineering.

1 Introduction

Every project has a unique configuration and distinct activities, so the undertaking always provides new lessons (Heldman, 2011). Even if the two designs are similar, the deliveries will not be the same. Each is unique and distinguished from one another, offering new lessons for teams and organisations whether the delivery fails or succeeds. Such lessons from past projects can improve future project management (Sepehri, 2015). Therefore, organisations need to document and manage project information systematically (Duffield and Whitty, 2015). However, knowledge from past projects is often tacit and hard to enumerate. Tacit knowledge accumulated from experiences and actions is understood and applied unconsciously – therefore challenging to articulate – but can be transferred through interactive conversations, storytelling and shared experiences (Ungan, 2006).

When experienced professionals join a project team, they transfer their tacit knowledge to the other team members through collaboration. Another transfer method is one-to-one coaching or sharing (Aljuwaiber, 2019). A junior team member can also learn from those with more experience by paying attention and observing. Such shared knowledge among team members increases the potential for success (Bhatti et al., 2021). However, two similar projects in an organisation may be separated by a long gap, which renders the relevancy of knowledge from the previous project. In this case, the new project team must start from scratch. Wasteful practices like this warrant research on preserving and updating tacit knowledge as an organisational asset for future use, even if it is in a distant future.

The core principle of project management lies in the critical success factors (CSFs) (Müller and Jugdev, 2012). A project can be successful if it achieves the objectives and meets or exceeds the stakeholders' expectations, necessitating the capability to overcome obstacles. Project success has been a focus of research in project management (Ali et al., 2021). Organisations study and adopt project management to achieve project success (Bond-Barnard et al., 2018). While the definitions vary, common indicators of success are the end products that meet customer demands (Bannerman, 2008) and the process that balances cost, time and scope (Bannerman, 2008). Aside from objective achievement, project success can also be indicated by the satisfaction of project stakeholders (Ayat et al., 2021), as both are essential for business and strategic perspectives. From a broader sense, a project is considered successful if it advances the organisation's mission (Castro et al., 2021).

Quantifying project success requires performance indicators (PIs) or success criteria (Chovichien and Nguyen, 2013). Time, cost, and specifications are three common indicators (Castro et al., 2021), but businesses and organisations now demand indicators aligned with their strategic objectives. New indicators include team morale, client satisfaction, quality, health and safety, business performance, productivity and sustainability (Jigeesh and Rao, 2018; Ofori-Kuragu et al., 2016; Stanitsas et al., 2021).

Past research has examined CSFs in project management. Pinto and Prescott (1988) piloted research on project CSFs at each stage in a project life cycle. Belassi and Tukel (1996) proposed a framework to determine the success and failure factors. Fortune and White (2006) proposed a CSF framework for systemic modelling projects. Gunduz and Almuajebh (2020) conducted further analysis by assessing and prioritising CSFs in the construction industry to inform decision-making. By reviewing the literature, Ayat et al. (2021) explored CSFs in the information and communication technology project. From these past studies, it is important to note that researching CSFs requires paying attention to the criticism put forward by Belassi and Tukel (1996) on the narrow perspective in the identification. They argued that analysing CSFs should not be too general or too specific to produce practical and theoretical contributions. Zwikael and Globerson (2006) mentioned that too general CSFs cannot support a project manager's decision-making. In other words, rigorously determining scopes and testing proposed CSFs is necessary.

Other researchers like Badewi (2016) believed that project investment success is more critical than project success, e.g., the identification of CSFs. Meanwhile, Bannerman (2008) clustered research on project success into three:

1 the factors that influence project success and failure

2 the variables that affect project outcomes and the ways to mitigate the adverse effects

3 the measurement of project success or failure.

The project investment concept aligns with the first and second research clusters proposed by Bannerman (2008).

This study examines project success factors at the organisational level to determine the CSFs, with higher education institutions (HEIs) as the subject of the study. In general, HEI projects aim to achieve organisational goals similar to any other project, but certain characteristics distinguish HEI projects from other organisations. For example, unlike commercial projects, HEI projects prioritise noble values, so financial profit is not the main goal.

Educational institutions such as HEIs seek to translate the organisation's vision, mission, and strategies into concrete actions. Identifying CSFs in HEI projects is essential because the projects' success and failure influence the institution's performance. With appropriate CSFs, HEIs can avoid the risk of failure, exploit the opportunities that could lead to project success, and foster organisational sustainability.

HEI projects are characterised by combinations of aspects. In some projects, such as curriculum preparation, the team consists of only internal members of the organisation. In other projects, such as national-level competitions or research, the team consists of internal employees and customers (students). Some projects are funded by external grants, while others are funded internally. The various conditions pose challenges that increase the risk of failure. Project management courses are accessible, but good practices may not always be well-adopted. When they are, the transfer of knowledge from one successful project to another may be hindered by departmental, time and functional barriers. This transfer could be eased by exploring in more depth the success drivers, i.e., project success factors (Chovichien and Nguyen, 2013).

To the best of our knowledge, only a few studies addressed project management in educational institutions, especially HEIs. Among the few is the identification of CSFs of business process reengineering in a Malaysian HEI (Ahmad et al., 2007), the identification of CSFs in enterprise resource planning (ERP) in universities (Al Dayel et al., 2011; Alhadi and Al-Shaibany, 2017; Rabaa'i, 2009), the identification of CSFs in international partner-funded education development projects in Egypt (Mohareb, 2017), and the measurement of CSFs in information systems development projects in HEIs (Subiyakto et al., 2016). These studies are limited to a specific context in an industry, which according to Belassi and Tukel (1996), only offers limited practical and theoretical contributions.

This research fills the gap by avoiding too narrow educational contexts. With a more holistic perspective of project success in educational institutions, the findings of this study offer novelty and more practical implications for the HEI stakeholders. The analysis starts with identifying the tacit knowledge of the project success factors from the perspective of HEI project experts. Then, these CSFs are systematically recorded and analysed as intangible assets that support organisational sustainability. The first approach is qualitative, using a sequential exploratory mixed method. The data were collected from interviews with HEI project experts, which were examined using content analysis to identify the CSFs. The next process was conducting further analysis of the identified CSFs using a quantitative approach, which includes the integration of the decision-making trial and evaluation laboratory (DEMATEL) and interpretive structural modelling (ISM) (Zhou et al., 2006). The DEMATEL-ISM approach has proven successful in exploring CSFs in various areas, providing rigorous analysis, and offering relevant managerial implications (Cui et al., 2020; Yin et al., 2012). The research samples are private universities in two big cities in East Java, Indonesia, i.e., Surabaya and Sidoarjo, selected using judgement sampling.

The remainder of the article is organised as follows. Section 2 describes the detailed research methods, with the narrative following the sequence of the research process. Section 3 describes the results of the study, which consists of three subsections: project success factors in HEIs, DEMATEL results and ISM results. Section 4 discusses the impact of the study, with two subsections based on the findings of DEMATEL: the causal factors and the effect factors. Finally, Section 5 concludes the study and provides directions for future research.

2 Research method

This research uses sequential exploratory mixed methods to achieve the research objectives. The first part of the research process was carried out using a qualitative approach, and the second part using a quantitative approach. The details of the research stages are as follows.

2.1 Conducting interviews to explore the project success factors

The interviews were held from March to May 2021. The respondents were selected using judgement sampling. The criteria were project managers with a minimum five-year experience leading projects in the higher education sector. The data were examined using content analysis to find keywords from the interviews' transcripts and identify the features of project management in HEIs. This study conducted interviews online using Zoom video conference. Table 1 shows the interview protocol in this research.

Table 1 Interview protocol

Q code	*List of question*
A1	What is the scope of the project?
A2	How is the project organised?
A3	What is the role of each party in the project?
A4	What is the time frame of the project?
A5	What are the stages of the project and its KPIs?
A6	What are the project costs?
A7	What are the problems and challenges of the project? How to solve them?
A8	How do you describe the success of the project?
A9	What are the success factors of the project?
A10	What strategy to ensure the success of the project?
A11	What are things that are important for the project?
A12	What are the criteria of a good team member?
A13	How do you see the progress of the project in comparison with a similar project in previous years?
A14	How do you evaluate the project? In your opinion, is the project successful?

2.2 Developing a pairwise comparison questionnaire and collecting data

The project success factors identified in the first stage were used to develop a pairwise comparison questionnaire. Ten experts from four Indonesian HEIs filled out the questionnaire to assess the interrelationships among the identified CSFs. This research uses this survey results as the primary data for further analysis.

2.3 Data analysis using the integrated DEMATEL and ISM methodology

The data from the questionnaire were analysed using DEMATEL-ISM as follows:

Step 1 Generating the direct relation matrix.

Using an averaging process, the survey results were aggregated to measure the relationships between variables. For comparison, this research uses a scale of 0 to 4, where 0 means no influence and 4 means strong influence. The direct-relation matrix $A = [a_{ij}]$ is calculated using equation (1) as follows:

$$a_{ij} = \frac{1}{H}\sum_{h=1}^{H} x_{ij}^{H} \tag{1}$$

where the H is the number of experts and the x_{ij}^{H} is the score given by the h^{th} expert, indicating the influential level that factor i has on factor j.

Step 2 Establishing the normalised direct relation matrix.

The normalised matrix (M) aims to scale the data so that the value of each matrix element is between 0 to 1. This step is necessary to avoid bias that may arise from the use of different scales, and ensure that the results will be consistent.

$$M = \lambda.A \tag{2}$$

$$\lambda = \text{Min}\left(\frac{1}{\max_{1\le i\le n}\sum_{j=1}^{n} a_{ij}}, \frac{1}{\max_{1\le j\le n}\sum_{i=1}^{n} a_{ij}}\right) \tag{3}$$

Step 3 Obtaining the total relationship matrix.

The total relationship matrix (T) emphasises the difference between elements to identify the sub-factors accurately. Equation (4) is used to obtain the total relationship matrix, where i indicates the identity matrix.

$$T = M + M^2 + M^3 + \cdots = \sum_{i=1}^{\infty} M^i = M(I-M)^{-1} \tag{4}$$

where $T = [t_{ij}]_{n\times n}$, $i, j = 1, 2, \ldots, n$.

Step 4 Calculating the prominence degree and the net effect.

The matrix T is used to calculate the prominence degree (D + R) and the net effect ($D - R$) and determine the roles and the order of priority of the sub-factors used in the study. The vector D represents the sum of rows [equation (5)], while the vector R represents the sum of columns of matrix T [equation (6)].

$$D = \sum_{j=1}^{n} t_{ij} \tag{5}$$

$$R = \sum_{i=1}^{n} t_{ij} \tag{6}$$

The degree of prominence of each sub-factor was ranked from the highest to the lowest, resulting in the sub-factors' order of importance. Meanwhile, the net effect classifies the sub-factors in the system based on their roles. A positive net effect indicates that a sub-factor is in the cause group, and a negative net effect indicates that a sub-factor is in the effect group. The higher the net effect, the stronger a sub-factor affects other sub-factors.

Step 5 Setting a threshold value to produce the initial reachability matrix.

Firstly, setting a threshold value of θ is necessary to exclude negligible relationships (Zhou et al., 2006). Then, the total relationship matrix is converted into a binary matrix to indicate a relationship between sub-factors using equation (7). This new matrix is called the initial reachability matrix $(\hat{T})$. If an element in the total relationship matrix is greater than or equal to the threshold, a value of 1 is assigned, which indicates a relationship between two sub-factors. If an element is smaller than the threshold, a value of 0 is assigned, indicating no relationship between two sub-factors.

$$\widehat{t_{ij}} = \begin{cases} 1, & \text{if } t_{ij} \geq \theta \\ 0, & \text{if } t_{ij} < \theta \end{cases} \tag{7}$$

Step 6 Producing the final reachability matrix.

The next step is to convert the initial reachability matrix $(\hat{T})$ into the final reachability matrix. This is accomplished through the application of the transitivity rules, which develops the sub-factor relationship logic: if element *A* affects element *B*, and element *B* affects element *C*; then, element *A* also affects element *C*.

Step 7 Constructing the hierarchical structure model.

The last step is constructing the hierarchical structure model using the ISM method through an iterative process. In the final reachability matrix, the reachability, antecedent, and intersection sets for each element are identified. The reachability set consists of row elements with a value of 1. The antecedent set consists of column elements with a value of 1. The intersection set consists of elements that belong to both reachability and antecedent sets. Secondly, sub-factors with reachability set as an intersection set are identified and positioned at level 1 in the hierarchical structure (top-level). Then, the top-level sub-factors were discarded from the matrix. Then, the process is repeated to identify the set of elements in the next levels. This iteration continues until all sub-factors are allocated a position in a hierarchical structure.

2.4 Developing MICMAC Cartesian diagram

Matrice d'Impacts Croisé Multiplication Appliqué un Classement (MICMAC) classifies elements into four: autonomous, dependent, linkage, and independent (Arcade et al., 1999). In doing so, MICMAC identifies significant elements and their roles in a system formation, validating the structural model obtained from the ISM. To obtain the dependence power and driving power of factors, MICMAC sums up the numbers in the columns of each element (*X*-axis) and the numbers in the rows of each element (*Y*-axis), respectively.

3 Results

3.1 Project success factors in HEIs

The interviews involved nine project experts from four private universities in Surabaya and Sidoarjo, Indonesia as shown in Table 2.

Table 2 Demographics of respondents

Respondent	*Position*	*Years of working at university*	*Projects led in the past five years*
R1	Lecturer	> 25	• The technological and professional skills development
R2	Vice dean	21–25	• Research project in waste management • Community service
R3	Lecturer	> 25	• Community service • Research project in the use of wind power as a renewable energy source • Procurement of oil and gas workshop equipment
R4	Lecturer	21–25	• Student creativity programme • Comparative study of academic senates
R5	Lecturer	21–25	• The student admission
R6	Lecturer	6–10	• Virtual exhibition • Community service
R7	Lecturer	21–25	• National accreditation • Community service
R8	Lecturer	21–25	• A research project funded by the Indonesian ministry of higher education
R9	Laboratory coordinator	6–10	• National conference

The interviews were conducted online on Zoom. The stopping rule was when a saturation point was reached (no more new information). The next step was extracting data and applying content analysis to identify the project's success factors. At this stage, the transcript was examined to identify keywords that appear most frequently. After that, the identified project success factors are corroborated by experts' opinions. This process resulted in 12 project success factors, as shown in Table 3.

The first CSF identified from the content analysis is the relevance of project plans to the organisation's vision and mission (SP). These projects will likely obtain full support, making the delivery more straightforward and efficient. Indeed, support from organisation members can guarantee a project's success.

The second CSF is the tactical planning of a project that considers long-term cooperation (TP). For sustainability purposes, HEI projects need cooperation and support from internal parties in the form of, among others, intra-departmental collaboration, as well as from external partners, such as partnerships with vendors or other HEIs. Such internal and external cooperation instils trust among the stakeholders. In future project initiations, the collaboration will be more effective because the stakeholders do not have to undertake the engagement and orientation process, which is sometimes time-consuming.

Table 3 Project success factors in HEIs

No.	*Project success factor*	*Code*
1	Relevancy of a project plan to the organisation's vision and mission (Shenhar and Holzmann, 2017)	SP
2	Project tactical planning that considers long-term cooperation (Müller and Jugdev, 2012)	TP
3	Detailed project operational plans (Slavin et al., 2018; Zid et al., 2020)	OP
4	Budget planning accuracy (Zid et al., 2020)	BP
5	Alignment between budget planning and realisation (Zid et al., 2020)	BR
6	Strategic placement of project team members (Tohidi, 2011)	MP
7	Interpersonal skills (Lima and Quevedo-Silva, 2020)	CS
8	Servant leadership (Harwardt, 2020; van Dierendonck, 2011)	SL
9	Regular internal coordination meetings (Turkulainen et al., 2015)	IC
10	Intensive external coordination (Turkulainen et al., 2015)	EC
11	Alignment between project performance indicators and organisational performance indicators (Sanchez and Robert, 2010)	PI
12	Intrinsic motivation (Zighan, 2020)	IM

Educational institutions are hierarchical in terms of organisational structure, with groups clustered based on functions and services. This organisational structure does not support project management because the roles and work hours of project managers and team members are limited. They will have exhausted their time and energy to sustain daily operations at the HEI, leaving little room for other duties. Overcoming this weakness requires a project manager to prepare the operational project plan thoroughly. Therefore, a detailed operational plan (OP) is another CSF of HEI projects. A big task should be broken down into smaller activities, guided by a dedicated person in charge (PIC) who understands their jobs, responsibilities and authorities. The project's operational directions must also be disseminated and consolidated multiple times to ensure that all members understand their roles and responsibilities.

Next, financing in HEIs must adhere to the existing regulations, so project budget planning (BP) must follow suit, especially if the projects involve external funding. The regulations include the value and proportion of budget components to the overall budget. Unsound BP may delay project approval, lead to failure in achieving project specifications, and dissatisfaction among stakeholders. In addition, the budget time frame and processing procedure need to be robust as they can impede or advance the initial project plan. For example, the proposed time frame must comply with the financial year's reporting. Therefore, accurate BP is another CSF in HEI project management.

An accurate budget plan should then be followed by the sound budget realisation (BR). Budget overrun reduces the opportunity to secure additional funding, which poses a challenge to project completion. Likewise, projects that are delivered under the proposed budget cause a negative impact on future funding and may result in budget cuts. Thus, the realisation of a budget plan must be monitored. Immediate corrective actions must be taken when non-conformities are found. Therefore, alignment between budget plan and realisation is identified as another SCF.

Another CSF is the strategic placement of project team members (MP). Project members' roles in institutional operations often differ from their roles in the project. Thus, selecting project members by considering their passion is essential to avoid frustration or losing motivation that will jeopardise project success.

The next CSF is interpersonal skills (CS), or the ability to establish verbal and non-verbal communication between two or more people and find common ground. This skill emphasises one's relationship with another individual or a group. Good interpersonal skills can decrease departmental tension and support the creation of a solid team.

The project leadership concept understood by the participants is servant leadership (SL), another CSF in HEI project management. Leading HEI projects require a strong spirit of service. Leaders with this principle can facilitate people's growth and help create an environment where organisational relationships thrive (van Dierendonck, 2011).

The CSFs related to internal coordination (IC) and external coordination (EC) emphasise the importance of communication. The respondents believed their institutions' organisational structure was incompatible with project undertaking. As project members, they only have little time left as they dedicate most of their time to working at the institution. Establishing regularities such as regular meeting schedules can help structure their work. With members' self-discipline in attending the meetings, IC and EC will be manageable and help achieve project success. Collaboration with experienced external vendors also requires intensive coordination (Bohnstedt and Wandahl, 2019). Therefore, team members should be accustomed to regular meetings. Advances in technology can support intensive communication, which includes reporting, seeking support, seeking approval and collaboration (Ershadi et al., 2021). Effective communication with departments and units within the organisation, as well as relevant external vendors, will create synergy, integrate governance, and result in collaborative decision-making to meet the project management objectives.

Success or failure is determined by the achievement of PIs. The formulation of this PI itself is a CSF. A set of correct PIs will recognise the project's overall success. Without proper indicators, the project may only be successful quantitatively but not holistically. Acknowledging a project's success and reaching a consensus on what constitutes success is essential. In doing so, it is imperative to consider the alignment with organisational PIs. Therefore, such an alignment with corporate PIs becomes a CSF.

Educational institutions are not profit-driven but are inclined toward the creation of noble values. Therefore, HEI projects are hardly ever commercialised. For project members, the ultimate achievement is self-development. Respondents in this study agreed that self-development is the main intrinsic motivation (IM). Therefore, it becomes a CSF in HEI projects. Project members motivated by financial benefits are often unsuitable for HEI projects.

3.2 DEMATEL results

After identifying the project CSFs, the next step is to create a pairwise comparison questionnaire. The expert panel filled out the pairwise comparison questionnaire. The initial direct relation matrix for 12 project success factors was prepared, as shown in Table 4.

Table 4 Direct relation matrix

PSF	*SP*	*TP*	*OP*	*BP*	*BR*	*MP*	*CS*	*SL*	*IC*	*EC*	*PI*	*IM*
SP	0.00	1.80	2.20	2.36	2.60	1.90	1.70	2.00	1.40	4.10	2.20	2.10
TP	1.70	0.00	1.70	2.18	2.90	3.10	2.30	2.60	1.70	3.10	2.20	2.30
OP	2.00	1.20	0.00	2.36	3.30	2.70	2.90	2.40	2.50	2.30	2.60	2.20
BP	2.60	2.10	2.80	0.00	2.30	1.30	3.20	2.90	2.50	1.70	3.00	2.40
BR	2.30	2.50	2.90	2.55	0.00	2.60	2.70	2.70	3.40	2.30	2.80	2.90
MP	2.60	2.30	1.80	2.09	3.00	0.00	3.50	2.60	2.60	1.80	3.10	1.70
CS	1.70	3.20	2.40	2.55	1.50	3.50	0.00	1.30	3.50	3.20	3.90	2.50
SL	2.50	3.20	3.00	2.45	2.20	3.80	1.20	0.00	1.90	3.70	2.50	3.30
IC	2.00	0.90	2.60	2.27	2.00	2.90	1.90	2.40	0.00	3.20	2.50	2.70
EC	3.60	1.90	2.60	2.18	2.30	2.30	2.20	3.10	2.60	0.00	1.90	2.00
PI	2.30	2.00	1.70	2.27	2.70	3.20	1.60	2.40	3.00	1.10	0.00	1.40
IM	2.90	3.10	1.50	1.91	1.90	3.30	3.00	2.20	1.30	3.10	3.50	0.00

Then, Table 4 is converted into the normalised relation matrix according to equation (2) and equation (3), as illustrated in Table 5.

Table 5 Normalised direct relation matrix

PSF	*SP*	*TP*	*OP*	*BP*	*BR*	*MP*	*CS*	*SL*	*IC*	*EC*	*PI*	*IM*
SP	0.000	0.059	0.072	0.077	0.085	0.062	0.056	0.065	0.046	0.134	0.072	0.069
TP	0.056	0.000	0.056	0.071	0.095	0.101	0.075	0.085	0.056	0.101	0.072	0.075
OP	0.065	0.039	0.000	0.077	0.108	0.088	0.095	0.078	0.082	0.075	0.085	0.072
BP	0.085	0.069	0.092	0.000	0.075	0.042	0.105	0.095	0.082	0.056	0.098	0.078
BR	0.075	0.082	0.095	0.083	0.000	0.085	0.088	0.088	0.111	0.075	0.092	0.095
MP	0.085	0.075	0.059	0.068	0.098	0.000	0.114	0.085	0.085	0.059	0.101	0.056
CS	0.056	0.105	0.078	0.083	0.049	0.114	0.000	0.042	0.114	0.105	0.127	0.082
SL	0.082	0.105	0.098	0.080	0.072	0.124	0.039	0.000	0.062	0.121	0.082	0.108
IC	0.065	0.029	0.085	0.074	0.065	0.095	0.062	0.078	0.000	0.105	0.082	0.088
EC	0.118	0.062	0.085	0.071	0.075	0.075	0.072	0.101	0.085	0.000	0.062	0.065
PI	0.075	0.065	0.056	0.074	0.088	0.105	0.052	0.078	0.098	0.036	0.000	0.046
IM	0.095	0.101	0.049	0.062	0.062	0.108	0.098	0.072	0.042	0.101	0.114	0.000

The next step is creating the total relation matrix using equation (4) and calculating the value of D and R based on equations (5) and (6). Table 6 shows the total relationship matrix in this study.

The questionnaire results are then processed in stages as described in the method section to obtain the cause-effect value of each factor. Table 7 shows the degree of influence of each factor.

Table 6 Total relation matrix with *D* and *R* calculations

PSF	*SP*	*TP*	*OP*	*BP*	*BR*	*MP*	*CS*	*SL*	*IC*	*EC*	*PI*	*IM*	*D*
SP	0.479	0.495	0.524	0.528	0.562	0.604	0.526	0.545	0.525	0.646	0.605	0.523	6.564
TP	0.559	0.468	0.537	0.550	0.599	0.673	0.572	0.590	0.563	0.649	0.639	0.556	6.955
OP	0.579	0.516	0.496	0.567	0.622	0.675	0.601	0.595	0.599	0.639	0.665	0.565	7.120
BP	0.598	0.545	0.583	0.499	0.597	0.641	0.611	0.612	0.601	0.628	0.680	0.575	7.169
BR	0.641	0.602	0.634	0.624	0.579	0.735	0.648	0.658	0.677	0.700	0.731	0.637	7.867
MP	0.603	0.556	0.560	0.569	0.623	0.606	0.625	0.609	0.611	0.637	0.689	0.560	7.249
CS	0.612	0.608	0.606	0.611	0.615	0.745	0.556	0.607	0.668	0.708	0.747	0.611	7.693
SL	0.650	0.623	0.636	0.621	0.649	0.768	0.609	0.580	0.633	0.739	0.722	0.647	7.878
IC	0.559	0.486	0.553	0.543	0.563	0.655	0.551	0.574	0.499	0.640	0.636	0.557	6.814
EC	0.625	0.536	0.576	0.563	0.595	0.664	0.580	0.616	0.599	0.574	0.645	0.561	7.136
PI	0.533	0.488	0.497	0.513	0.552	0.627	0.511	0.542	0.558	0.547	0.525	0.491	6.383
IM	0.622	0.588	0.557	0.571	0.601	0.712	0.620	0.607	0.581	0.681	0.709	0.513	7.362
R	7.059	6.512	6.759	6.761	7.156	8.106	7.010	7.135	7.115	7.787	7.994	6.797	

Table 7 Degree of influence

PSF	*D*	*R*	*D* + *R*	*D* – *R*
SP	6.564	7.059	13.6230	–0.4950
TP	6.955	6.512	13.4670	0.4430
OP	7.120	6.759	13.8790	0.3610
BP	7.169	6.761	13.9300	0.4080
BR	7.867	7.156	15.0230	0.7110
MP	7.249	8.106	15.3550	–0.8570
CS	7.693	7.01	14.7030	0.6830
SL	7.878	7.135	15.0130	0.7430
IC	6.814	7.115	13.9290	–0.3010
EC	7.136	7.787	14.9230	–0.6510
PI	6.383	7.994	14.3770	–1.6110
IM	7.362	6.797	14.1590	0.5650

Table 6 is visualised in the prominence degree and the net effect diagrams, as shown in Figure 1 and Figure 2, respectively.

Figure 1 shows CSFs' strength of influences from the highest to the lowest according to the $D + R$ values. The factor with the highest value of $D + R$ is MP, indicating that the role of MP as a CSF is the most significant even though it receives more influence from other CSFs. The result is supported by MP's negative $D - R$ value. Following MP, the order of $D + R$ values from the heist to the lowest is BR, SL, EC, CS, PI, IM, BP, IC, OP, SP and TP.

Figure 2 shows the net effect group into two according to the positivity or negativity of $D - R$ values: the left and the right sides. The right-side group with positive $D - R$ values is called the causal group, consisting of seven CSFs with $D - R$ values from the highest to the lowest: SL, BR, CS, IM, TP, BP and OP. The remaining CSFs belong to the effect group, with the highest to lowest negative $D - R$ values: PI, MP, EC, SP and IC.

Figure 1 The prominence degree

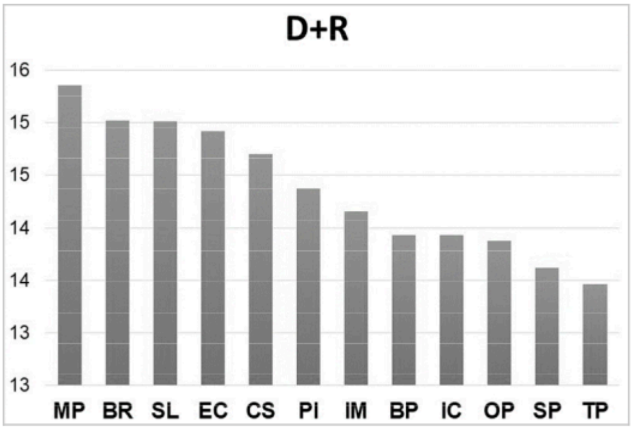
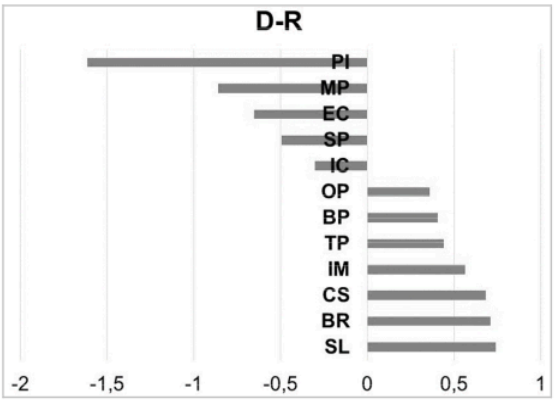


Figure 2 The net effect



3.3 *ISM results*

The total relation matrix obtained through the DEMATEL procedure is translated into an initial reachability matrix by changing t_{ij} into a binary number. If t_{ij} is smaller than the threshold (0.599), t_{ij} is 0. Otherwise, t_{ij} is 1 [equation (7)]. Then, the final reachability matrix is obtained by incorporating the transitivity enumerated in the ISM methodology. Table 8 shows the final reachability matrix with driving and dependence power calculation, where transitivity results are denoted by value 1 with an asterisk (1*).

Table 8 Final reachability matrix

PSF	*SP*	*TP*	*OP*	*BP*	*BR*	*MP*	*CS*	*SL*	*IC*	*EC*	*PI*	*IM*	*Driving power*
SP	1	0	0	0	1*	1	1*	1*	1*	1	1	0	8
TP	1*	1	1*	1*	1	1	1*	1*	1*	1	1	1*	12
OP	1*	0	1	0	1	1	1	1*	1	1	1	1*	10
BP	0	0	0	1	0	1	1	1	1	1	1	0	7
BR	1	1	1	1	1	1	1	1	1	1	1	1	12
MP	1	1*	1*	1*	1	1	1	1	1	1	1	1*	12
CS	1	1	1	1	1	1	1	1	1	1	1	1	12
SL	1	1	1	1	1	1	1	1	1	1	1	1	12
IC	1*	0	0	0	0	1	0	1*	1	1	1	0	6
EC	1	0	0	0	0	1	0	1	1	1	1	0	6
PI	1*	1*	1*	1*	1*	1	1*	1*	1*	1*	1	1*	12
IM	1	0	0	0	1	1	1	1	1*	1	1	1	9
Dependence power	11	6	7	7	9	12	10	12	12	12	12	8	

The final reachability matrix goes through a level partitioning process (see Table 9), and the results become the basis for building a digraph.

Table 9 Level partition matrix

Iteration	*Factor*	*Reachability set*	*Antecedent set*	*Intersection set*	*Level*
1	SP	1, 5, 6, 7, 8, 9, 10, 11	1, 2, 3, 5, 6, 7, 8, 9, 10, 11	1, 5, 6, 7, 8, 9, 10, 11	1
	MP	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12	1
	SL	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12	1
	IC	1, 6, 8, 9, 10, 11	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12	1, 6, 8, 9, 10, 11	1
	EC	1, 6, 8, 9, 10	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12	1, 6, 8, 9, 10	1
2	BP	4, 7, 11	2, 4, 5, 7, 11	4, 7, 11	2
	CS	2, 3, 4, 5, 7, 11, 12	2, 3, 4, 5, 7, 11, 12	2, 3, 4, 5, 7, 11, 12	2
	IM	2, 3, 4, 5, 7, 11, 12	2, 3, 4, 5, 7, 11, 12	2, 3, 4, 5, 7, 11, 12	2
	PI	5, 7, 11, 12	2, 3, 5, 7, 11, 12	5, 7, 11, 12	2
3	OP	3, 5	2, 3, 5	3, 5	3
	BR	2, 3, 5	2, 3, 5	2, 3, 5	3
4	TP	1	1	1	4

The iteration process in level partitioning produced a four-level digraph (see Figure 3). There are five CSFs in level 1: SP, MP, SL, IC and EC, four in level 2: IM, BP, CS and PI, two in level 3: OP and BR, and one at level 4: TP. CSFs at level 1 are the most important because they directly affect the project's success. CSFs at level 2 affect CSFs at level 1, and CSFs at level 3 directly affect CSFs at level 2. Positioned in the middle, CSFs at levels 2 and 3 function as interplays in the digraph. Last, CSFs at level 4 directly affect CSFs at level 3 and indirectly affect all CSFs above level 3.

Figure 3 ISM digraph

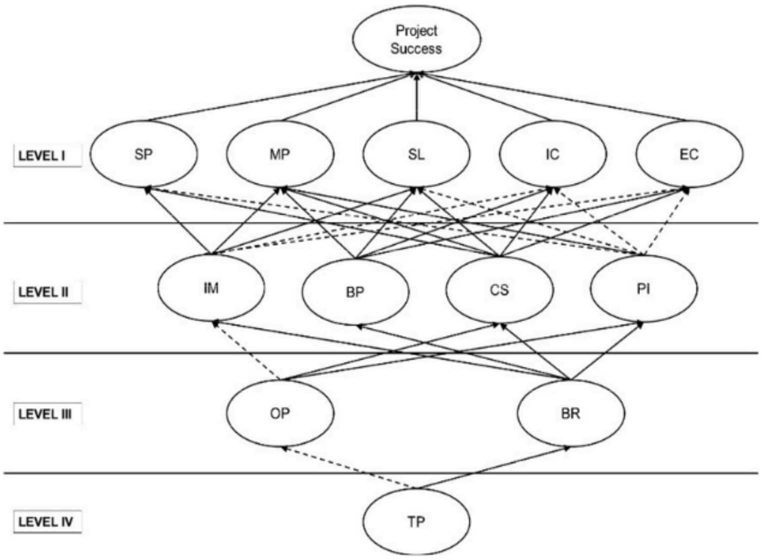
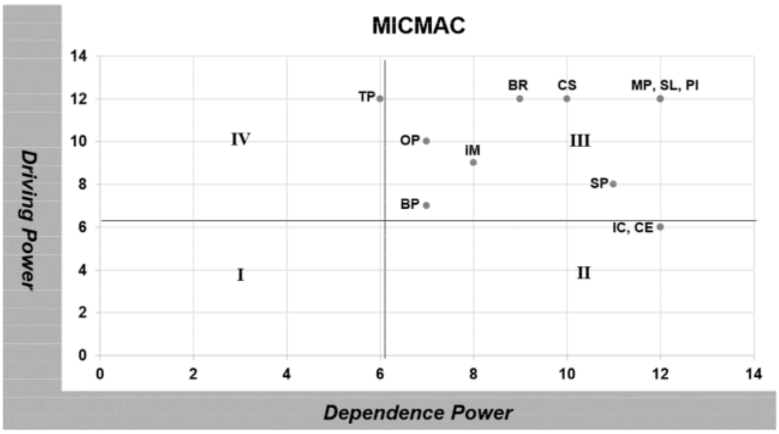


Figure 4 The MICMAC diagram



Finally, the MICMAC diagram is constructed by summing up all elements in rows and columns in the final reachability matrix (Figure 4). The summation of each column shows the dependence power position on the *X*-axis. Meanwhile, the summation of each row shows the driving power position on the *Y*-axis. As such, the Cartesian coordinates of each factor are established.

As shown in Figure 4, the Cartesian MICMAC diagram is divided into four quadrants: autonomous (I), dependent (II), linkage (III) and independent (IV). CSFs in the autonomous quadrant (Quadrant I) indicate that they have low driving power and dependence power. This study observes no CSFs in this quadrant, suggesting that all identified CSFs significantly affect the project's success. Hence, they are linked to each other. Meanwhile, IC and EC factors belong to the dependent quadrant (Quadrant II), which means weak driving power but strong dependence power. This indicates that other CSFs strongly influence EC and EC factors. Quadrant III consists of nine factors: OP, BP, IM, SP, BR, CS, MP, SL and PI. These factors have a significant mutual relationship, which means they actively influence not only the system but also themselves. Lastly, in the independent area (Quadrant IV), there is only TP factor, which actively influences other CSFs but is not affected by other CSFs.

4 Discussion

4.1 The causal factors

Seven of the 12 CSFs fall under the causal factor category. They have an extremely significant influence on the success of HEI projects. We also found that the most influential CSF is SL. According to the value of $D + R$ (Figure 1), SL is also in the top three positions. Leadership is one of the good practices learned by organisations through projects (Duffield and Whitty, 2015). This is in line with the findings of previous studies, stating that leadership is one of the project CSFs (Aga et al., 2016; Ali et al., 2021; Ayat et al., 2021; Badewi, 2016).

The remains what leadership style supports the HEI projects. Yang et al. (2011) found that transactional and transformational leadership styles can improve team communication, collaboration, and cohesiveness for project success. Aga et al. (2016) stated that transformational leadership empirically proved to support project success in Ethiopian non-governmental organisations (NGOs). Ali et al. (2020) noted that humble leadership, a friendly and supportive leadership style that eliminates power distance, has a mediating role in supporting the success of information technology projects. This study notes that SL is even more humble than humble leadership, including the stewardship element (Russell and Stone, 2002).

As illustrated in Figure 3, SL is at the top of the ISM hierarchy, directly affecting project success. Likewise, Figure 4 shows that SL is in the linkage quadrant, which indicates its direct influence on project success. However, it should be noted that leadership as a CSF is directly affected by the team members' IM, BP and interpersonal skills.

The second most influential CSF is the alignment between budget plan and BR. Budgeting is one of three key indicators of project success. From the value of $D + R$, alignment between budget plans and realisation in HEI projects ranks higher than SL. Past studies on project management have shown that cost overrun may have a detrimental impact on future projects, which indicates the criticality of budgeting in project management. However, it is important to note that most literature studies discussing cost overruns are in the construction industry (Aljohani et al., 2017; Munizaga and Olawale, 2022). Therefore, we see a potential research gap in examining the risk of project cost overrun in the context of HEI.

Mentis (2015) states that cost overrun is caused by uncertainty, which is a common threat in projects. Risk management is needed to minimise the risk of cost overruns in HEI projects, which may cause problems in the delivery and delay the project's completion. Avoiding cost overruns requires a project manager to monitor and control the spending. Project tools that can facilitate this include S-curve, optimisation model (Tseng et al., 2005), earned value (Czarnigowska, 2008) and earned value development (Acebes et al., 2014). In the ISM digraph, the budget plan and realisation alignment is at level 3. This alignment is directly influenced by project tactical planning oriented toward long-term cooperation, affecting all factors at level 2. The alignment is also in the linkage area, indicating that this CSF influences and is influenced by other CSFs.

This study also found that interpersonal skills have a causal effect on project success. In the digraph, interpersonal skills belong to level 2, suggesting that this CSF acts as an active interplay or connector between CSFs at the top and bottom of the hierarchy. This finding confirms the research by Lima and Quevedo-Silva (2020), stating that interpersonal skills are a mediating factor of project success. These skills include communication, teamwork, interpersonal relationships and conflict management. HEI projects require interpersonal skills not only to support project success but also to teach interpersonal skills, which can be conceptualised as project-based learning (Konrad et al., 2020). The position of interpersonal skills in the MICMAC Cartesian diagram is in the linkage quadrant, suggesting that it influences and is also influenced by other CSFs.

Participating in a project requires clarity of the purposes and benefits. For example, in an HEI project, the team members may be motivated by self-development. IM is a reason that comes from within an individual which motivates participation in an activity (Fishbach and Woolley, 2022). HEI projects are usually not for profit, similar to other non-commercial projects, such as developing open-source software, which requires strong IM (Bitzer et al., 2004). Therefore, it becomes a CSF in achieving project success in educational institutions. According to van Blankenstein et al. (2019), IM is usually high at the beginning and middle of the project.

In the digraph, IM is at level 2 and affects the alignment between project plans and the organisation's vision and mission, strategic placement of project team members, and SL. IM may be positively influenced by the alignment between budget plan and realisation. In the MICMAC diagram, IM is in the linkage area, indicating that IM is a significant CSF in influencing and being influenced by other CSFs.

Project tactical planning that considers long-term cooperation (TP) is an important causal factor in HEI project implementation. HEI projects often demand more cooperation from various parties compared to industrial projects. HEIs realise that good cooperation, which can be intra- or inter-organisational, will increase projects' ease, speed, and performance. Even in intra-organisational collaboration, the terms of reference need to be stated clearly: partnership, service provider, or vendor. This ensures clarity in roles so that every party knows what to expect and the project can be delivered efficiently (Morgan, 2007). The challenge in tactical planning is ensuring that cooperation in a project ends on good terms and a long-term relationship is established.

Interestingly, project tactical planning that fosters long-term cooperation (TP) is at level 4 in the digraph. This CSF affects all CSFs at the level above it. The position of TP on the MICMAC diagram is in the independent area, confirming that it is not influenced by other CSFs but actively influences all CSFs.

Dvir et al. (2003) found that project success was more determined by planning than implementation. Accurate BP is a causal factor of project success in HEIs. This requires a precise analysis of predictable and unpredictable risks (Kwon and Kang, 2019). The threats can be anticipated through a risk contingency budget (Khamooshi and Cioffi, 2009). In HEI projects, BP is a CSF that needs to be prioritised because it is on the level 2 digraph and the linkage area in the MICMAC diagram. It actively influences and is influenced by other CSFs.

In addition to BP, a detailed project OP is a causal factor in project success. The development of technology, such as software that supports project management, allows for the creation of detailed project operational plans. Slavin et al. (2018) found that awareness of the importance of thorough planning prompts the creation of a reliable workflow with good coordination. A reliable operational plan emphasises target accomplishment. Approaches such as Lean Six Sigma or lean and agile line management can be adapted to support project operational planning (Cruz et al., 2020; Sunder, 2016; Tenera and Pinto, 2014). Accurate BP is at level 2 in the diagram and the linkage area in the MICMAC diagram, which indicates that it has a strong influence on other SCFs and is also influenced by other SCFs, especially the alignment between the budget plan and realisation.

4.2 *The effect factors*

Since other factors influence effect factors, they are not considered project success factors. However, when analysed further using ISM and MICMAC digraph, the results support each factor to be considered a project success factor in HEIs.

Strategic placement of project team members (MP) ranks first in the $D + R$ value among the five effect factors. Our findings support the statement that passion and interest at work are individual factors that drive project performance (Tohidi, 2011). However, managing unique talents is challenging for HEIs (Takagi, 2018). Strategic placement, albeit an effect factor, needs to be a priority. Its influence is significant, and it can also be influenced by other CSFs. Moreover, in the ISM digraph, strategic placement is at level 1, which directly impacts project success. In the MICMAC diagram's linkage area, MP is also a significant factor.

Regularly scheduled IC and intensive EC meetings are at level 1 in the ISM digraph and directly affect project success. These two CSFs fall under the communication management category, which is integral to project management (Turkulainen et al., 2015). Internal communication refers to exchanging information and knowledge among project members, whereas external communication involves exchanging information with third parties: partners, service providers or vendors. Cervone (2014) stated that communication is successful when all project team members communicate effectively. A project manager must facilitate synchronous meetings to ensure direct communication as it is the most effective, undisrupted method. A regularly scheduled meeting should become a staple in the coordination. In a product development project, the involvement of suppliers as external parties from the earliest possible and as intensive as possible can be a good practical approach (Wagner and Hoegl, 2006). HEI projects can adopt this approach. Moreover, as illustrated in the MICMAC diagram (Figure 4), these two CSFs are in the dependent area, which supports the results of the DEMATEL analysis. It is important to note that these two CSFs are included in the effect factor group because they implement operational and tactical planning.

The relevance of the project plan to the organisation's vision and mission is also at the level 1 digraph and directly affects project success. In the MICMAC diagram, this factor is also included in the linkage area, which is significantly influenced by other CSFs and influences CSFs. However, the influence is lower than being influenced.

The alignment between project PIs and organisational PIs belongs to the effect factor group and is at the level 2 digraph. However, in the MICMAC diagram, PI is in the linkage, which is the same position as the strategic placement of project team members and SL, which significantly influences and is influenced by other CSFs. Therefore, we still have to consider it as a project success factor. Previous findings suggest that sustainable development principles facilitate the alignment of strategic and tactical plans for managing projects (Herazo et al., 2012). HEIs play an essential role in promoting sustainable development, so they strive to become sustainable organisations (Aleixo et al., 2018; Wu and Shen, 2016). These findings encourage HEIs to adopt sustainability principles, facilitating the alignment between project plans and PIs and organisational strategic plans.

5 Conclusions

Projects in educational institutions have unique characteristics different from commercial projects. This study identifies the CSFs of HEI projects in Indonesia, resulting in 12 CSFs. The 12 CSFs are analysed using the integrated DEMATEL-ISM method. The DEMATEL results show that seven factors, namely SL, BR, IM, TP, BP, CS, and OP, are grouped as the causal factors; and five factors, namely PI, MP, EC, SP, and IC, are grouped as the effect factors.

The ISM and MICMAC analyses reveal that the five factors in the effect factor group remain significant. Although the DEMATEL method shows reliable results, it has a narrow perspective because it only groups factors into two extreme groups. The ISM method complements the DEMATEL results by dividing the factors into a hierarchical structure so that their roles can be analysed further. MICMAC validates the position of each factor in project success by dividing the factors into four quadrants, allowing for further interpretation.

To conclude, all CSFs are significant project success factors because they are bound to each other. This research implies that the project CSFs and their roles can inform project stakeholders in the decision-making so that project success in Indonesian HEIs can be optimised. The practical implication is the importance of selecting suitable leaders and team members. Good leaders can improve team communication, collaboration, and cohesiveness, which are CSFs of project success. Strategic placement of project team members for suitable project tasks is crucial, as is coordination between team members. Project members can be more compatible when they have worked together on previous projects. Thus, it is necessary to consider the interpersonal skills of each member to enhance a friendly working environment. The limitation of this study is that it uses non-probability sampling, so the results cannot be generalised. The suggestion for further research is to use a larger sample.

References

Acebes, F., Pajares, J., Galán, J.M. and López-Paredes, A. (2014) 'A new approach for project control under uncertainty. Going back to the basics', *International Journal of Project Management*, Vol. 32, No. 3, pp.423–434 [online] https://doi.org/10.1016/j.ijproman.2013.08.003.

Aga, D.A., Noorderhaven, N. and Vallejo, B. (2016) 'Transformational leadership and project success: the mediating role of team-building', *International Journal of Project Management*, Vol. 34, No. 5, pp.806–818 [online] https://doi.org/10.1016/j.ijproman.2016.02.012.

Ahmad, H., Francis, A. and Zairi, M. (2007) 'Business process reengineering: critical success factors in higher education', *Business Process Management Journal*, Vol. 13, No. 3, pp.451–469 [online] https://doi.org/10.1108/14637150710752344.

Al Dayel, A., Aldayel, M. and Al-Mudimigh, A. (2011) 'The critical success factors of ERP implementation in higher education in Saudi Arabia: a case study', *International Journal of Information Technology and Management*, Vol. 2, No. 2, pp.1–16.

Aleixo, A.M., Leal, S. and Azeiteiro, U.M. (2018) 'Conceptualization of sustainable higher education institutions, roles, barriers, and challenges for sustainability: an exploratory study in Portugal', *Journal of Cleaner Production*, Vol. 172, pp.1664–1673 [online] https://doi.org/10.1016/j.jclepro.2016.11.010.

Alhadi, M. and Al-Shaibany, N. (2017) 'Critical success factors (CSFs) of ERP in higher education institutions', *International Journal of Computer Science and Software Engineering*, Vol. 7, pp.93–95 [online] https://doi.org/10.23956/ijarcsse/V7I4/01401.

Ali, M., Li, Z., Khan, S., Shah, S.J. and Ullah, R. (2021) 'Linking humble leadership and project success: the moderating role of top management support with mediation of team-building', *International Journal of Managing Projects in Business*, Vol. 14, No. 3, pp.545–562 [online] https://doi.org/10.1108/IJMPB-01-2020-0032.

Ali, M., Zhang, L., Shah, S.J., Khan, S. and Shah, A.M. (2020) 'Impact of humble leadership on project success: the mediating role of psychological empowerment and innovative work behavior', *Leadership & Organization Development Journal*, Vol. 41, No. 3, pp.349–367, https://doi.org/10.1108/LODJ-05-2019-0230.

Aljohani, A., Ahiaga-Dagbui, D. and Moore, D. (2017) 'Construction projects cost overrun: what does the literature tell us?', *International Journal of Innovation, Management and Technology*, pp.137–143 [online] https://doi.org/10.18178/ijimt.2017.8.2.717.

Aljuwaiber, A. (2019) 'Technology-based vs. face-to-face interaction for knowledge sharing in the project teams', *International Journal of Project Organisation and Management*, Vol. 11, No. 3, pp.227–242 [online] https://doi.org/10.1504/IJPOM.2019.102943.

Arcade, J., Godet, M., Meunier, F. and Roubelat, F. (1999) 'Structural analysis with the MICMAC method & actor's strategy with MACTOR method', *Futures Research Methodology*, pp.1–69, The Millennium Project, American Council for the United Nations University.

Ayat, M., Imran, M., Ullah, A. and Kang, C.W. (2021) 'Current trends analysis and prioritization of success factors: a systematic literature review of ICT projects', *International Journal of Managing Projects in Business*, Vol. 14, No. 3, pp.652–679 [online] https://doi.org/10.1108/IJMPB-02-2020-0075.

Badewi, A. (2016) 'The impact of project management (PM) and benefits management (BM) practices on project success: towards developing a project benefits governance framework', *International Journal of Project Management*, Vol. 34, No. 4, pp.761–778 [online] https://doi.org/10.1016/j.ijproman.2015.05.005.

Bannerman, P.L. (2008) 'Defining project success: a multi-level framework', *Proceedings of the Project Management Institute Research Conference*, PMI, pp.13–16.

Belassi, W. and Tukel, O.I. (1996) 'A new framework for determining critical success/failure factors in projects', *International Journal of Project Management*, Vol. 14, No. 3, pp.141–151 [online] https://doi.org/10.1016/0263-7863(95)00064-X.

Bhatti, S.H., Kiyani, S.K., Dust, S.B. and Zakariya, R. (2021) 'The impact of ethical leadership on project success: the mediating role of trust and knowledge sharing', *International Journal of Managing Projects in Business*, Vol. 14, No. 4, pp.982–998 [online] https://doi.org/10.1108/IJMPB-05-2020-0159.

Bitzer, J., Schrettl, W. and Schröder, P.J.H. (2004) 'Intrinsic motivation in open source software development', *Journal of Comparative Economics*, Vol. 35, No. 1, pp.160–169 [online] https://doi.org/10.1016/j.jce.2006.10.001.

Bohnstedt, K.D. and Wandahl, S. (2019) 'Selecting the right collaborative components in a construction project', *International Journal of Project Organisation and Management*, Vol. 11, No. 1, pp.65–92 [online] https://doi.org/10.1504/IJPOM.2019.098714.

Bond-Barnard, T.J., Fletcher, L. and Steyn, H. (2018) 'Linking trust and collaboration in project teams to project management success', *International Journal of Managing Projects in Business*, Vol. 11, No. 2, pp.432–457 [online] https://doi.org/10.1108/IJMPB-06-2017-0068.

Castro, M.S., Bahli, B., Barcaui, A. and Figueiredo, R. (2021) 'Does one project success measure fit all? An empirical investigation of Brazilian projects', *International Journal of Managing Projects in Business*, Vol. 14, No. 3, pp.788–805 [online] https://doi.org/10.1108/IJMPB-01-2020-0028.

Cervone, H.F. (2014) 'Effective communication for project success', *OCLC Systems and Services: International Digital Library Perspectives*, Vol. 30, No. 2, pp.74–77 [online] https://doi.org/10.1108/OCLC-02-2014-0014.

Chovichien, V. and Nguyen, T.A. (2013) 'List of indicators and criteria for evaluating construction project success and their weight assignment', *Proceedings of the 2013 (4th) International Conference on Engineering, Project, and Production Management*, pp.130–150 [online] https://doi.org/10.32738/CEPPM.201310.0011.

Cruz, A., Alves, A.C. and Tereso, A. (2020) 'Traditional, agile and lean project management – a systematic literature review', *The Journal of Modern Project Management*, Vol. 8, No. 2, Article 2 [online] https://doi.org/10.19255/JMPM02407.

Cui, H., Zhu, X. and Wang, H. (2020) 'Collaborative innovation of low-carbon technology from the triple helix perspective: exploring critical success factors based on DEMATEL-ISM', *Polish Journal of Environmental Studies*, Vol. 29, No. 2, pp.1579–1592 [online] https://doi.org/10.15244/pjoes/109723.

Czarnigowska, A. (2008) 'Earned value method as a tool for project control', *Budownictwo i Architektura*, Vol. 3, No. 2, pp.15–32 [online] https://doi.org/10.35784/bud-arch.2320.

Duffield, S. and Whitty, S.J. (2015) 'Developing a systemic lessons learned knowledge model for organisational learning through projects', *International Journal of Project Management*, Vol. 33, No. 2, pp.311–324 [online] https://doi.org/10.1016/j.ijproman.2014.07.004.

Dvir, D., Raz, T. and Shenhar, A.J. (2003) 'An empirical analysis of the relationship between project planning and project success', *International Journal of Project Management*, Vol. 21, No. 2, pp.89–95 [online] https://doi.org/10.1016/S0263-7863(02)00012-1.

Ershadi, M., Jefferies, M., Davis, P. and Mojtahedi, M. (2021) 'A framework for conceptualising the organisational communications of a project management office', *Int. J. Project Organisation and Management*, Vol. 13, No. 1, p.25.

Fishbach, A. and Woolley, K. (2022) 'The structure of intrinsic motivation', *Annual Review of Organizational Psychology and Organizational Behavior*, Vol. 9, No. 1, pp.339–363 [online] https://doi.org/10.1146/annurev-orgpsych-012420-091122.

Fortune, J. and White, D. (2006) 'Framing of project critical success factors by a systems model', *International Journal of Project Management*, Vol. 24, No. 1, pp.53–65 [online] https://doi.org/10.1016/j.ijproman.2005.07.004.

Gunduz, M. and Almuajebh, M. (2020) 'Critical success factors for sustainable construction project management', *Sustainability*, Vol. 12, No. 5, p.1990 [online] https://doi.org/10.3390/su12051990.

Harwardt, M. (2020) 'Servant leadership and its effects on IT project success', *Journal of Project Management*, pp.59–78 [online] https://doi.org/10.5267/j.jpm.2019.7.001.

Heldman, K. (2011) *PMP Project Management Professional Exam Study Guide*, 6th ed., Wiley. Indianapolis, Ind [online] https://www.wiley.com/en-us/PMP+Project+Management+Professional+Exam+Study+Guide%2C+6th+Edition-p-9781118083215.

Herazo, B., Lizarralde, G. and Paquin, R. (2012) 'Sustainable development in the building sector: a canadian case study on the alignment of strategic and tactical management', *Project Management Journal*, Vol. 43, No. 2, pp.84–100 [online] https://doi.org/10.1002/pmj.21258.

Jigeesh, N. and Rao, N.S.N. (2018) 'Significance of time and cost dimensions in pharmaceutical projects and prioritisation of project phases', *International Journal of Project Organisation and Management*, Vol. 10, No. 2, pp.175–189 [online] https://doi.org/10.1504/IJPOM.2018.092086.

Khamooshi, H. and Cioffi, D.F. (2009) 'Program risk contingency budget planning', *IEEE Transactions on Engineering Management*, Vol. 56, No. 1, pp.171–179 [online] https://doi.org/10.1109/TEM.2008.927818.

Konrad, T., Wiek, A. and Barth, M. (2020) 'Embracing conflicts for interpersonal competence development in project-based sustainability courses', *International Journal of Sustainability in Higher Education*, Vol. 21, No. 1, pp.76–96 [online] https://doi.org/10.1108/IJSHE-06-2019-0190.

Kwon, H. and Kang, C.W. (2019) 'Improving project budget estimation accuracy and precision by analyzing reserves for both identified and unidentified risks', *Project Management Journal*, Vol. 50, No. 1, pp.86–100 [online] https://doi.org/10.1177/8756972818810963.

Lima, L.F. and Quevedo-Silva, F. (2020) 'Emotional intelligence and success of project management: the mediating effect of interpersonal skills', *Int. J. Project Organisation and Management*, Vol. 12, No. 1, p.20.

Mentis, M. (2015) 'Managing project risks and uncertainties', *Forest Ecosystems*, Vol. 2, No. 1, p.2 [online] https://doi.org/10.1186/s40663-014-0026-z.

Mohareb, M. (2017) *Critical Success Factors of International Development Projects in the Education Sector in Egypt: Community Schools as a Case Study* [online] http://dar.aucegypt.edu/handle/10526/5073 (accessed 30 July 2021).

Morgan, J.N. (2007) 'Establishing performance metrics for managing the outsourced MIS project', in Schniederjans, M.J., Schniederjans, A.M. and Schniederjans, D.G. (Eds.): *Outsourcing Management Information Systems*, pp.94–124, Idea Group Pub, Hershey, PA.

Müller, R. and Jugdev, K. (2012) 'Critical success factors in projects: Pinto, Slevin, and Prescott – the elucidation of project success', *International Journal of Managing Projects in Business*, Vol. 5, No. 4, pp.757–775 [online] https://doi.org/10.1108/17538371211269040.

Munizaga, N. and Olawale, Y.A. (2022) 'Leading factors and root causes of delay and cost overrun of IT and construction projects in the retail industry in Chile', *International Journal of Project Organisation and Management*, Vol. 14, No. 3, pp.283–327 [online] https://doi.org/10.1504/IJPOM.2022.125881.

Ofori-Kuragu, J.K., Baiden, B.K. and Badu, E. (2016) 'Key performance indicators for project success in Ghanaian contractors', *International Journal of Construction Engineering and Management*, Vol. 5, No. 1, pp.1–10 [online] https://doi.org/10.5923/j.ijcem.20160501.01.

Pinto, J. and Prescott, J. (1988) 'Variations in critical success factors over the stages in the project life cycle', *Journal of Management – J. Manage.*, Vol. 14, pp.5–18 [online] https://doi.org/10.1177/014920638801400102.

Rabaa'i, A.A. (2009) 'Identifying critical success factors of ERP systems at the higher education sector', *ISIICT 2009: Third International Symposium on Innovation in Information & Communication Technology*, Amman, Jordan, December [online] https://doi.org/10.14236/ewic/ISIICT2009.12.

Russell, R.F. and Stone, A.G. (2002) 'A review of servant leadership attributes: developing a practical model', *Leadership & Organization Development Journal*, Vol. 23, No. 3, pp.145–157 [online] https://doi.org/10.1108/01437730210424.

Sanchez, H. and Robert, B. (2010) 'A matrix for monitoring the strategic performance of project portfolios', *International Journal of Project Organisation and Management*, Vol. 2, No. 2, pp.135–153 [online] https://doi.org/10.1504/IJPOM.2010.033659.

Sepehri, M. (2015) 'Lesson learned knowledge in project management', *2015 Science and Information Conference (SAI)*, pp.949–953 [online] https://doi.org/10.1109/SAI.2015.7237257.

Shenhar, A. and Holzmann, V. (2017) 'The three secrets of megaproject success: clear strategic vision, total alignment, and adapting to complexity', *Project Management Journal*, Vol. 48, No. 6, pp.29–46 [online] https://doi.org/10.1177/875697281704800604.

Slavin, A., Sinenko, S. and Yoshin, N. (2018) 'The evolutionary development of the methodology of operational planning of construction production', *IOP Conference Series: Materials Science and Engineering*, Vol. 365, No. 6, p.062040 [online] https://doi.org/10.1088/1757-899X/365/6/062040.

Stanitsas, M., Kirytopoulos, K. and Leopoulos, V. (2021) 'Integrating sustainability indicators into project management: the case of construction industry', *Journal of Cleaner Production*, Vol. 279, p.123774 [online] https://doi.org/10.1016/j.jclepro.2020.123774.

Subiyakto, A., Ahlan, A.R., Kartiwi, M. and Putra, S.J. (2016) 'Measurement of the information system project success of the higher education institutions in Indonesia: a pilot study', *International Journal of Business Information Systems*, Vol. 23, No. 2, pp.229–247.

Sunder, M.V. (2016) 'Lean Six Sigma project management – a stakeholder management perspective', *The TQM Journal*, Vol. 28, No. 1, pp.132–150 [online] https://doi.org/10.1108/TQM-09-2014-0070.

Takagi, K. (2018) 'Accommodating project-based professionals in higher education institutions in Japan', *Journal of Higher Education Policy and Management*, Vol. 40, No. 3, pp.272–286 [online] https://doi.org/10.1080/1360080X.2018.1462434.

Tenera, A. and Pinto, L.C. (2014) 'A Lean Six Sigma (LSS) project management improvement model', *Procedia – Social and Behavioral Sciences*, Vol. 119, pp.912–920 [online] https://doi.org/10.1016/j.sbspro.2014.03.102.

Tohidi, H. (2011) 'Human resources management main role in information technology project management', *Procedia Computer Science*, Vol. 3, pp.925–929 [online] https://doi.org/10.1016/j.procs.2010.12.151.

Tseng, C-L., Lin, K.Y. and Sundararajan, S.K. (2005) 'Managing cost overrun risk in project funding allocation', *Annals of Operations Research*, Vol. 135, No. 1, pp.127–153 [online] https://doi.org/10.1007/s10479-005-6238-4.

Turkulainen, V., Aaltonen, K. and Lohikoski, P. (2015) 'Managing project stakeholder communication: the Qstock Festival case', *Project Management Journal*, Vol. 46, No. 6, pp.74–91 [online] https://doi.org/10.1002/pmj.21547.

Ungan, M.C. (2006) 'Standardization through process documentation', *Business Process Management Journal*, Vol. 12, No. 2, pp.135–148 [online] https://doi.org/10.1108/14637150610657495.

van Blankenstein, F.M., Saab, N., van der Rijst, R.M., Danel, M.S., Bakker-van den Berg, A.S. and van den Broek, P.W. (2019) 'How do self-efficacy beliefs for academic writing and collaboration and intrinsic motivation for academic writing and research develop during an undergraduate research project?', *Educational Studies*, Vol. 45, No. 2, pp.209–225 [online] https://doi.org/10.1080/03055698.2018.1446326.

van Dierendonck, D. (2011) 'Servant leadership: a review and synthesis', *Journal of Management*, Vol. 37, No. 4, pp.1228–1261 [online] https://doi.org/10.1177/0149206310380462.

Wagner, S.M. and Hoegl, M. (2006) 'Involving suppliers in product development: insights from R&D directors and project managers', *Industrial Marketing Management*, Vol. 35, No. 8, pp.936–943 [online] https://doi.org/10.1016/j.indmarman.2005.10.009.

Wu, Y-C.J. and Shen, J-P. (2016) 'Higher education for sustainable development: a systematic review', *International Journal of Sustainability in Higher Education*, Vol. 17, No. 5, pp.633–651 [online] https://doi.org/10.1108/IJSHE-01-2015-0004.

Yang, L-R., Huang, C-F. and Wu, K-S. (2011) 'The association among project manager's leadership style, teamwork and project success', *International Journal of Project Management*, Vol. 29, No. 3, pp.258–267 [online] https://doi.org/10.1016/j.ijproman.2010.03.006.

Yin, S-H., Wang, C., Teng, L. and Hsing, Y.M. (2012) 'Application of DEMATEL, ISM, and ANP for key success factor (KSF) complexity analysis in R&D alliance', *Scientific Research and Essays*, Vol. 7, No. 19 [online] https://doi.org/10.5897/SRE11.2252.

Zhou, D., Zhang, L. and Li, H. (2006) 'A study of the system's hierarchical structure through integration of DEMATEL and ISM', *2006 International Conference on Machine Learning and Cybernetics*, pp.1449–1453 [online] https://doi.org/10.1109/ICMLC.2006.258757.

Zid, C., Kasim, N. and Soomro, A.R. (2020) 'Effective project management approach to attain project success, based on cost-time-quality', *International Journal of Project Organisation and Management*, Vol. 12, No. 2, pp.149–163 [online] https://doi.org/10.1504/IJPOM.2020.106376.

Zighan, S. (2020) 'Motivational paradox: a Delphi study to reach a consensus knowledge regarding individual vs. team motivation in the context of project-based organisations', *International Journal of Project Organisation and Management*, Vol. 12, No. 3, pp.240–259 [online] https://doi.org/10.1504/IJPOM.2020.108936.

Zwikael, O. and Globerson, S. (2006) 'From critical success factors to critical success processes', *International Journal of Production Research*, Vol. 44, No. 17, pp.3433–3449 [online] https://doi.org/10.1080/00207540500536921.

Managing projects in higher education institutions: a study on critical success factors

ORIGINALITY REPORT

2%	2%	2%	0%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	repository.wima.ac.id Internet Source	1%
2	www.iieta.org Internet Source	1%
3	pen.ius.edu.ba Internet Source	1%

Exclude quotes On
Exclude bibliography On
Exclude matches < 1%