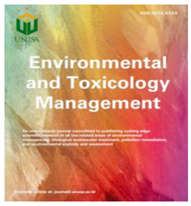
Environmental and Toxicology Management 3 (2023) 8-12

Contents lists available at journal2.unusa.ac.id

Environmental and Toxicology Management

journal homepage: www.journal2.unusa.ac.id/etm




# Environmental factors influencing construction implementation from contractors' perspective

Nelda Maelissa[1,2,*], Eko Prihartanto[2,3,], Anisa Ratnasari[4]

[1]*Civil engineering, Politeknik Negeri Ambon, Ambon, Maluku, Indonesia*
[2]*Civil engineering, Institut Teknologi Sepuluh Nopember, Surabaya, Indonesia*
[3]*Civil engineering, Borneo Tarakan University, Tarakan, North Kalimantan, Indonesia*
[4]*Enviromental engineering, Institut Teknologi Sepuluh Nopember, Surabaya, Indonesia*

## Abstract

To achieve the project's goal, both internal and external organization influencing factors (construction industry) should be aware, particularly at the construction implementation level. The objective of this research is to identify the environmental factors that influence construction implementation from the contractor's perspective as the main actors in the implementation of construction. The methodology used in this research was library research and surveys using questionnaires as data instruments. The analytical method used is principal component analysis, supported by the SPSS program. Based on the analysis results of the environmental factors that influence the construction implementation level using principle component analysis, the total class produced 15 main components and was capable of explaining the various data with a cumulative percentage of 85.672%. From the study results, it can be concluded that the company resource factor was the most influential factor compared with other factors.

Keywords :
Environmental factors, contractors, projects goal, principal component analysis

## 1 Introduction

The construction industry plays a very important role in the development of the national economy (Ma et al., 2019), but in reality, the implementation of the construction service industry also faces obstacles, challenges, and problems at all stages of construction and is no exception at the stages of construction implementation. This complexity causes the construction services industry to be able to turn these obstacles into driving factors for organizations to survive in the industrial world (Munirathinam, 2020). At the stage of construction carried out by the contractor, achieving its goals and objectives cannot be separated from challenges and obstacles, both internal and external. Construction projects are generally managed by a group of people who have different duties and responsibilities and are fully coordinated by the project manager (Hidalgo, 2019). The project manager is required to manage a project to achieve the main objective of the construction implementation, namely the timeliness of completion by maximizing profit while maintaining the quality of construction. So to achieve this goal, it is necessary to know what factors influence both internal and external organizations (the construction industry), especially at the construction stage.

**Corresponding Author.*
Email Address : maelissanelda@gmail.com
https://doi.org/10.33086/etm.v3i1.4145
Received from 15 April 2023;
Received in revised 26 April 2023;
Accepted 27 April 2023;
Available online 30 April 2023;

The complexity of a project organization is a specific matter, in which project management is faced with efforts to make the existing resources more effective and efficient (Vrchota et al., 2021). Environmental aspects (internal and external) of the organization are also one of the aspects that must be considered by project management because they are useful inputs for the preparation of the corporate strategy. In its development, the project organization is always faced with three constraints (triple constraints), namely: according to the specifications set, according to the time schedule, and according to the planned costs, all of which take place simultaneously. To overcome these obstacles, it is necessary to know which factors have the most influence on the process of construction implementation in relation to efforts to achieve company goals and objectives (AboAbdo et al., 2019).

In addition to achieving project success, knowing the environmental factors that influence construction implementation has many other benefits, such as research conducted by (Malara et al., 2019) who examines environmental factors in the implementation of construction to build a mathematical model of the productivity of construction workers. (Liu et al., 2020) was exploring environmental factors to minimize construction waste. Project environmental factors that influence the implementation of construction greatly affect the success of the project (Ahmadabadi and Heravi, 2019; Alaloul et al., 2020). Even if it is not identified and dealt with in advance, it can result in project delays, as mentioned by (Umar, 2018; Bajjou and Chafi, 2020; Yap et al., 2021; Tetelepta et al., 2019; Sohilait et al., 2022). Many studies address only one or two environmental factors associated with project success. There is also a connection with the triple constraints of the project (Kerzner, 2022; Gonze et al., 2020), but those that identify all environmental factors in the construction implementation process are quite limited, so this study aims to fill this gap. This study aims to identify environmental factors both from internal and external project organizations using the contractor's perspective. Taken from the contractor's perspective because they are the main actors in project implementation.

# 2 Materials and method

## 2.1 Data collection

The data collection methods used in this study were a literature review to obtain factors that influence the implementation of construction and a survey using a questionnaire as a research instrument. A set of questions aimed at respondents, namely the contractors who were chosen as samples, will later be included in the questionnaire. The sampling technique used in this study, known as non-probability sampling with quota sampling, involves choosing samples that meet particular criteria in a predetermined amount and quota (Iliyasu and Etikan, 2021). The researcher's concerns led to the selection of this sampling technique, which divides qualification classes according to the company's level of competence because the population is not homogeneous.

The obtained data from the surveys will be collated and put through validity and reliability tests. A validity test is carried out to test whether the data obtained by using instruments (tools) can answer the research objectives (Bull et al., 2019). A reliability test is conducted to test the consistency of the data (Sürücü and Maslakci, 2020). After obtaining data that has passed the test, it can be extracted from these variables.

## 2.2 Data analysis

Principal Component Analysis (Principal Component Analysis) was used in this study with the help of SPSS software. The selection of the principal component analysis method is based on the type of data collected and its relevance to the research objectives (Mahmoudi et al., 2021). This is because in this study there are no dependent variables and because the aim of this study is to find the dominant variables, namely to obtain a set of linear combinations of environmental variables (factors). The number of variables formed can be seen from the eigenvalues in the total variance explained table.

# 3 Results and discussion

## 3.1 Data collection

Project organizations have broad and quite complex characteristics and are basically a combination of human resources and other sources working together in a temporary organization to work on a specific goal. Project organization is divided into internal and external factors. The organization's external environment, which comprises factors that have a broad scope and are basically outside and apart from the company's operations. These factors include economic, social, cultural, political, legal, technological, and demographic factors. The internal environment is the organizational environment that is within the organization and has direct and specific implications for the company. These internal environmental factors include company resources, capabilities, and competencies. Based on the results of a literature study, it was found that there were two internal factors consisting of 47 variables and five external factors consisting of 27 variables, it can be seen in Table 1.

**Table 1** Enviromental factors in construction

| **Internal Factors** | **External Factors** |
|---|---|
| a. Aspects of Human Resources | a. Industry Aspect |
| 1. The Role of Field Engineers | 1. Rival between Contractors |
| 2. The Role of Skilled Labor | 2. Contractor Qualification |
| 3. The Role of Manpower/Labor | b. Economic Aspect |
| 4. The Role of Project Administration Personnel | 1. The Company's existing capital |
| 5. The Role of Logistics Personnel | 2. Allocation of Funds for Projects |
| 6. Education Level of Field Engineers | 3. Realization of Installment Payments |
| 7. Skilled Labor Education Level | 4. Loans from Banks/Other Authorized Financial Sources |
| 8. Education Level of Workers Labours | 5. Loans from Unofficial Sources |
| 9. Educational Level of Project Administration Personnel | 6. Special Funds for Project Success |
| 10. ducation Level of Logistics Personnel | 7. Inflation Rate |
| 11. Field Engineering Experience | 8. Increase in the price of materials |
| 12. Skilled Workforce Experience | 9. Smooth payment of wages, materials and tools |
| 13. Workforce/Labor Experience | c. Socio-Cultural Aspects |
| 14. Experience of Project Administration Personnel | 1. Local Community Culture |
| 15. Experience of Logistics Personnel | 2. The Role of Technical Agencies |
| 16. Honor requested by Field Engineering Personnel | 3. The Role of Financial Institutions |
| 17. Honor requested by Skilled Workforce | 4. The Role of the Planning Consultant |
| 18. Honor requested by Manpower/Labor | 5. The Role of the Project Owner |
| 19. Honor requested by the Project Administration Staff | 6. The Role of Community Figures |
| 20. Honor requested by the Logistics Personnel | 7. Relations with Technical Agencies |
| 21. Capability of field technicians in technical matters | 8. Relations with Financial Institutions |
| 22. Ability of Skilled Workforce in Technical terms | 9. Relations with Planning Consultants |
| 23. Ability of Manpower/Labor in technical matters | 10. Relations with Project Owners |

| Internal Factors | External Factors |
|---|---|
| 24. Capability of Project Administrative Personnel in Technical terms | 11. Relations with Community Leaders |
| 25. Capability of Logistics Personnel in Technical matters | d. Legal and Political Aspects |
| 26. Capability of field technicians in non-technical terms | 1. Relations with Community Leaders |
| 27. Ability of Skilled Workforce in Non-Technical terms | 2. Government Regulations |
| 28. Ability of Manpower/Labor in Non-Technical terms | 3. Political Conditions |
| 29. Capability of Project Administrative Personnel in Non-Technical matters | 4. Safety Factor at the Project Site |
| 30. Capability of Logistics Personnel in Non-Technical terms | e. Aspects of Climate and Weather |
| 31. Relations between field engineers and related agencies | 1. Climate and Weather Around the Project Site |
| 32. Skilled Labor Relations with Related Agencies | 2. The occurrence of natural disasters (earthquakes, floods, etc.) or force majeure |
| 33. Labor/Labor Relations with Related Agencies | |
| 34. Relations between Project Administrative Personnel and Related Agencies | |
| 35. Relations between Logistics Personnel and Related Agencies | |
| 36. Ability of the Project Manager to Create a Project Implementation Plan | |
| 37. Ability of Project Manager Organizing existing units | |
| 38. Ability of Project Manager to Provide Task Direction | |
| 39. Ability of Project Manager to Supervise and Evaluate Work | |
| 40. Use of Proper Working Methods | |
| 41. Labor Suppliers | |

The classification of contractors in Indonesia is divided into small (K), medium (M), and large (B). Questionnaires were distributed to all contractor classification classes. The total number of questionnaire respondents who were collected was 65, which can be seen in Figure 1.

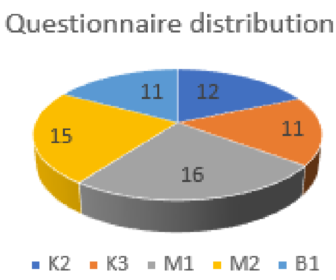



**Figure 1** Questionnaire distribution

Based on Figure 1, questionnaire distribution dan result consist of: Twelve contractors in the K2 category, eleven in the K3 category, sixteen in the M1 category, fifteen in the M2 category, and eleven in the B1 category were among the contractors who turned out to be respondents. The results of the questionnaire are then tabulated. Before being processed further, validity and reliability tests were first carried out on the questionnaire results.

## 3.2 Validity and reliability

A validity test is carried out to test whether the data obtained by using instruments (tools) can answer the research objectives (Budhathoki et al., 2022). The reliability test was carried out to test the consistency of the data. Invalid and/or unreliable variables must be excluded until valid and reliable data are obtained. A variable is said to be valid if r count is positive and > r table. The prices of r tables can be seen in the appendix; for N = 65 and a significant level of 5%, then = 0.244. In the SPSS output, the calculated r value for each variable can be seen in the corrected item-total correlation column. While a variable can be said to be reliable if the Alpha Cronbach value is positive and > r table.

According to the SPSS results, all variables were judged to be trustworthy, with r Alpha = 0.918 > 0.244. However, 14 of the variables are invalid. It is necessary to exclude these 14 incorrect variables and they cannot be used in additional analysis.

## 3.3 Principal component analysis

Based on the results obtained by the principal component analysis with the help of the SPSS program, 15 main components were identified. The number of components formed is known through the initial eigenvalues. Initial Eigenvalues numbers indicate the importance of each factor—each variable—in calculating the overall variance of the variables analyzed. A component shows the number of factors or variables. The number of factors formed is seen in the initial eigenvalues, which are equal to or greater than one (>1).It is concluded that the first 15 main components have been able to explain the diversity of the data with a cumulative percentage of 85.672%. Then we obtained the variables that grouped together to form a factor In the matrix, the numbers listed in each column are called factor loadings, which show the correlation between a variable and each of the factors formed. Each variable is grouped into factors according to the largest factor loading number.

Component 1 is the most influential component among the other components. This is indicated by the eigen value of this component, which is the highest, namely 13.033. Based on the 14 variables grouped in component 1, this factor can be called the aspect of project resources (this aspect includes labour and project funding sources). This resource aspect is the most dominant environmental aspect for the entire contractor class, with an influence of 25.35%. Component 2 is the second-most influential component with an eigenvalue of 7.583 and consists of 11 variables. Based on the variables grouped in component 2, this factor can be called the social aspect of the project (this aspect includes the relationship between the project party and the agencies or parties related to project implementation, and in this aspect, there is also the quality of a skilled workforce). The social aspect is the second dominant environmental aspect for the entire contractor class, with an influence of 14.75%. Component 3, this component has an Eigen value of 5.549 and consists of 8 variables. Based on the variables grouped in component 3, this factor can be called the financial aspect and government regulations (this aspect includes wages given to workers who are closely related to company capital and government regulations governing this matter; it also includes factors related to transport to the project site). This aspect has an influence of 10.80% on construction implementation for the entire class of contractors. Component 4, this component has an Eigen value of 3.857 and consists of 4 variables. Based on the variables grouped in component 4, this factor can be called the non-technical aspect (this aspect includes the ability of the workforce in non-technical terms in its application in accordance with bestek/RKS). This aspect has an influence of 7.50% on construction implementation for the entire class of contractors. Component 5, this component has an Eigen value of 3.586 and consists of 4 variables. Based on the variables grouped in component 5, this factor can be called the Materials and Equipment Aspect (this aspect is the role of raw material producers, equipment availability, installment payment factors, as well as loans that contractors really need for the project to take place). This aspect has an influence of 6.98% on construction implementation for the entire class of contractors. Component 6 has an eigenvalue of 3.087 and consists of two variables. Based on the variables grouped in component 6, this factor can be called the workforce experience aspect. This aspect has an influence of 6.01% on construction implementation for the entire class of contractors. Component 7, this component has an Eigen value of 2.563 and consists of 2 variables. Based on the variables grouped in component 7, this factor can be called the Environment Project Surrounding Aspect (this aspect includes relations with community leaders and security at the location of the ongoing project). This aspect has an influence of 4.99% on construction implementation for the entire class of contractors.

Component 8 is made up of 3 variables and has an eigenvalue of 2.242. This factor can be referred to as the management aspect based on the variables grouped into component 8 (this aspect covers the job of the project manager and includes office management in overcoming contractor rivalry). For the total class of contractors, this factor has an impact of 4.36% on the execution of work. Component 9, which consists of 3 variables and has an eigenvalue of 1.848. This element can be referred to as the Field Engineering Personnel Qualification Aspect based on the variables gathered in component 9 (this aspect comprises the field engineer's level of education, experience, and competence). This factor has a 3.59% impact on how construction is carried out across the board for contractors. Component 10 is composed of two variables and has an eigenvalue of 1.738. This element, which covers the function and experience of the expert labor, can be referred to as an aspect of the role of the skilled employees based on the clustered variables in component 10. This factor has a 3.38% impact on how construction is carried out across the board for contractors.

Component 11 can be referred to as the aspect of the role of field engineers because it only contains one variable, the role of field engineers, and has an eigenvalue of 1.485. This aspect also includes the function of engineers throughout the project. For the total class of contractors, this factor has an impact of 2.89% on how the building is carried out. Component 12, which consists of 2 variables and has an Eigen value of 1.333. The element of non-technical competence can be applied to this factor based on the variables grouped under component 12. For the total class of contractors, this factor has a 2.59% impact on the execution of work. Component 13 is made up of two variables and has an eigenvalue of 1.306.

This factor, which encompasses the labor force's function and regional culture, can be referred to as the cultural aspect based on the variables grouped under component 13. For the total class of contractors, this factor has a 2.54% impact on the execution of work. With an eigenvalue of 1.166, component 14 has only one variable, which is the timely payment of salaries, supplies, and equipment. the ease with which some components of payment (such as the payment of workers, supplies, and tools) are made. This factor has a 2.27% impact on how construction is carried out across the board for contractors. 15th component: The one variable in this component, relations with technical agencies, has an eigenvalue of 1.027. It might also be referred to as the relationship with technical agencies component. The final factor, which has a 2% impact on how construction is carried out across the board for contractors, is this one.

# 4 Conclusion

Based on the results of an analysis of environmental factors that influence the construction implementation stage using principal component analysis for the total class, it produces 15 main components. The 15 main components are: project resources, the social aspect of the project, the financial aspect and government regulations, non-technical aspect, materials and equipment, workforce experience, environments project surroundings, management, personnel qualifications, skilled employees, the role of field engineers, non-technical competence, payments, cultural and 15th component is relations with technical agencies. The project resource aspect is the most dominant aspect that has the most influence on construction implementation for the entire class of contractors, with an influence of 25.35%. While the aspect of relations with technical agencies is the one that has the least influence on construction implementation, with an influence of 2%. These results can provide insights and input for contractors so they can pay attention to and adjust their company's development strategy with dominant environmental factors so as to facilitate efforts to achieve company goals. These results can provide insights and input for contractors so they can pay attention to and adjust their company's development strategy with dominant environmental factors so as to facilitate efforts to achieve company goals. Furthermore, it can help in achieving the success of the project being handled and future projects.

# Declaration of competing interest

The authors declare no known competing interests that could have influenced the work reported in this paper.

# Acknowledgments

The authors thank Politeknik Negeri Ambon for facilitating the current work.

# Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

## References


AboAbdo, S., Aldhoiena, A., and Al-Amrib, H., 2019. Implementing enterprise resource planning ERP system in a large construction company in KSA', Procedia Comput. Sci. 164, 463-70

Ahmadabadi, A. A., and Heravi G., 2019. The effect of critical success factors on project success in public-private partnership projects: A case study of highway projects in Iran, Transp. Policy. 73, 152-161

Alaloul, W. S., Liew, M. S., Zawawi, N. A. W. A., and Kennedy, I.B., 2020. Industrial Revolution 4.0 in the construction industry: Challenges and opportunities for stakeholders, Ain Shams Eng. J. 11, 225-30

Bajjou, M. S., and Chafi, A., 2020. Empirical study of schedule delay in Moroccan construction projects, Int. J. Constr. Manag. 20, 783-800

Budhathoki, S. S., Hawkins, M., Elsworth, G., Fahey, M. T., Thapa, J., Karki, S., Basnet, L. B, Pokharel, P. K., and Osborne, R. H., 2022. Use of the english health literacy questionnaire (HLQ) with health science university students in Nepal: A validity testing study, Int. J. Env. Res. Pub. Health. 19, 3241

Bull, C., Byrnes, J., Hettiarachchi, R., Downes, M., 2019. A systematic review of the validity and reliability of patient-reported experience measures, Health Serv Res. 54, 1023-1035

Gonze, X., Amadon, B., Antonius, G., Arnardi, F., Baguet, L., Beuken, J.-M., Bieder, J., Bottin, F., Bouchet, J., Bousquet, E., Brouwer, N., Bruneval, F., Brunin, G., Cavignac, T., Charraud, J.-B., Chen, W., Côté, M., Cottenier, S., Denier, J., Geneste, G., Ghosez, P., Giantomassi, M., Gillet, Y., Gingras, O., Hamann, D.R., Hautier, G., He, X., Helbig, N., Holzwarth, N., Jia, Y., Jollet, F., Lafargue-Dit-Hauret, W., Lejaeghere, K., Marques, M.A.L., Martin, A., Martins, C., Miranda, H.P.C., Naccarato, F., Persson, K., Petretto, G., Planes, V., Pouillon, Y., Prokhorenko, S., Ricci, F., Rignanese, G.-M., Romero, A.H., Schmitt, M.M., Torrent, M., van Setten, M.J., Van Troeye, B., Verstraete, M.J., Zérah, G., and Zwanziger, J.W., 2020. The Abinitproject: Impact, environment and recent developments, Comput. Phys. Commun. 248, 107042

Hidalgo, E. S., 2019. Adapting the scrum framework for agile project management in science: case study of a distributed research initiative, Heliyon. 5, e01447

Iliyasu, R., and Etikan, I., 2021. Comparison of quota sampling and stratified random sampling, Biom. Biostat. Int. J. 10, 24-27

Kerzner, Harold. 2022. Project management metrics, KPIs, and dashboards: a guide to measuring and monitoring project performance (John Wiley Sons).

Liu, J., Yi, Y., Wang, X., 2020. Exploring factors influencing construction waste reduction: A structural equation modeling approach, J. Clean. Prod. 276, 123185

Ma, M., Cai, W., Cai, W., Dong, L., 2019. Whether carbon intensity in the commercial building sector decouples from economic development in the service industry? Empirical evidence from the top five urban agglomerations in China, J. Clean. Prod. 222, 193-205

Mahmoudi, M.R., Heydari, M.H., Qasem, S.N., Mosavi, A., Band, S.S., 2021. Principal component analysis to study the relations between the spread rates of COVID-19 in high risks countries, Alex. Eng. J. 60, 457-464

Malara, J., Plebankiewicz, E., and Juszczyk, M., 2019. Formula for determining the construction workers productivity including environmental factors, Buildings. 9, 240

Munirathinam, Sathyan. 2020. 'Chapter Six - Industry 4.0: Industrial Internet of Things (IIOT).' in Pethuru Raj and Preetha Evangeline (eds.), Advances in Computers (Elsevier)

Sohilait, M., Maelissa, N., Rokhim, I., N., and Bhat, S. A., 2022. Ana lysis of the influence of environmental factors on the delay in the construction of Maluku traffic office service building, Environ. Toxic. Manag. 2, 10-13

Sürücü, L., and Maslakci, A., 2020. Validity and reliability in quantitative research, Bus. Manag. Stud. Int. J. 8, 2694-2726

Tetelepta, J., Maelissa, N., and Tuanakotta, A., 2019. An analysis of delay causing factors in implementation of working construction project (case study: Building of the agriculture office in Masohi City, Central Maluku Regency), Int. J. Adv. Eng. Res. Sci. 6, 379-385

Umar, T., 2018. Causes of delay in construction projects in Oman, Middle East J. Manag. 5, 121-36

Vrchota, J., Řehoř, P., Maříková, M., and Pech, M.,2021. Critical Success Factors of the Project Management in Relation to Industry 4.0 for Sustainability of Projects, Sustainability. 13, 281

Yap, J. B. H., Goay, P. L., Woon, Y. B., and Martin S., 2021. Revisiting critical delay factors for construction: Analysing projects in Malaysia, Alex. Eng. J. 60, 1717-29