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Examining the Correlation between Contractual Elements and Construction Project Performance; A Comprehensive Study of Case Studies in Educational Building Projects

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Abstract

Buildings constitute the primary infrastructure supporting the effective execution of learning activities within higher education environments. The quality of these buildings is a paramount concern for all stakeholders involved. However, ensuring high-quality construction remains a challenge in building projects. Improving project performance requires construction contract documentation that comprehensively outlines the rights and responsibilities of the parties involved in the project. This research aims to identify the characteristics and relationships among contractual aspects, contract management, and project performance, focusing on improving the quality of construction projects, particularly within higher education institutions. This research applies an exploratory qualitative approach to achieve that goal. The data used results from structured interviews with stakeholders from five universities as study objects. The data processing stages consist of open coding, axial coding, and selective coding, as well as exploring the relationship between research variables using regression analysis. The study revealed three primary project characteristics in higher education institutions: contractual aspects, contract management, and project performance. Key elements within these groups include contract standards, organizational factors, and contract control. Notably, a significant negative correlation between contracts and project performance indicates that issues within contract-related aspects and management adversely impact project outcomes. The findings underscore the importance of effectively managing the involvement of multiple stakeholders in construction projects. Collaborative management between stakeholders and project management is essential for ensuring project success, particularly in quality monitoring, adherence to timelines, and profitability.

Keywords: educational building, higher education, construction contracts, project performance, stakeholders

1. Introduction

One of the objectives of sustainable development is to ensure quality education. Higher education institutions aim to produce graduates with strong character and the ability to apply and advance scientific and technological knowledge. To achieve this goal, these institutions must offer appropriate curricula and infrastructure that enable the production of high-calibre graduates [1]. The primary infrastructure supporting the quality of education in tertiary institutions consists of lecture buildings and supporting laboratories, the construction of which requires significant budget allocations.

According to data from the 2020 State Revenue and Expenditure Budget (APBN), the budget allocation for campus development and rehabilitation amounts to 4.4 trillion Rupiah, distributed across 44 campuses in Indonesia[2]. Given the substantial investment in development, ensuring high-quality construction results to support the learning process is imperative.

However, construction projects are inherently unique, complex, and temporary. Their uniqueness leads to various project risks that can impact project performance. These risks may arise from inadequate project financing mechanisms, poor contractor management capabilities, payment difficulties, low insurance coverage, and insufficient attention to safety and environmental concerns [3]. Additionally, the temporary nature of construction projects involves multiple stakeholders, equipment, supplies, and materials that require effective management to prevent interactions from causing organizational inefficiencies [4]. The involvement of various stakeholders, the occurrence of contract changes, the implementation of communication channels, cultural and language differences, project environmental conditions, and the application of financing mechanisms can describe the level of complexity of a construction project [5], [6], [7]. Failure to understand project complexity can adversely affect project performance [7], [8].

Hence, controlling project complexity and risks throughout the project cycle requires proficient contract management capabilities [9]. Contracts have an essential role in ensuring project performance, so implementing effective contract management strategies can improve the quality of construction project results.

Previous studies have identified administrative and technical challenges in educational infrastructure development projects. Design changes often lead to delays, scope alterations, and cost adjustments [10]. The contract's legal and technical provisions significantly influence the project's quality, while the financial provisions impact the project financing factors [11]. When designing contracts, stakeholders' behaviour, communication patterns, and organizational strategy objectives must be carefully considered to support high-quality project execution [12], [13], [14]. Furthermore, maintaining interpersonal, relational, and collaborative relationships among stakeholders involved in construction projects positively impacts project performance [[15], [16].

Contracts serve as a communication tool among stakeholders in construction projects, influencing communication patterns crucial for project success [17]. One of the main reasons for poor project performance is errors in contract document [18]. Contract components encompass administrative, technical, and managerial aspects, with contracts playing a vital role in clarifying stakeholders' responsibilities regarding organizational management, scheduling, resource management, work control, payment, and risk mitigation [19], [20]. Time and cost elements in contracts are critical performance indicators determining project success [21], [22], [23]. Stakeholder involvement, including project owners, contractors, and consultants, and integrating all project factors also impacts project performance indicators [24], [25], [26].

Improving project quality is expected to be influenced by the relationship between contractual aspects, contract management and project performance. Project performance indicators include time, cost, quality, occupational health and safety, participant satisfaction (project owner, consultant, contractor), user satisfaction, environmental performance, and project usability [27], [28]. Implementing contract management and selecting appropriate implementation methods can overcome problems related to time, costs and environmental impacts [29].

This research explores the relationship between contract elements, contract management, and project performance, expecting that effectively managing this relationship will enhance project quality.

2. Method

This research employed an exploratory qualitative approach to understanding the issues within a specific group or environment [30]. Methods are necessary to understand and study the phenomenon [31]. Figure 1 depicts the methodological framework of the research conducted.

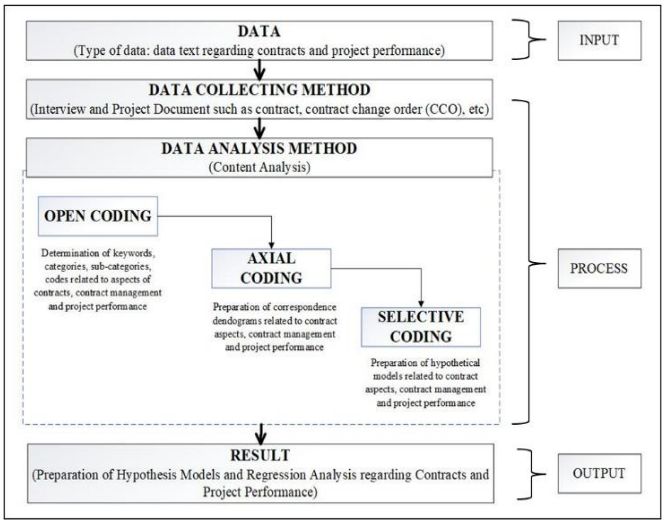


Figure 1. Methodology Framework Diagram

2.1 Method of Collecting Data

The data utilized in this study comprises primary data obtained from individual respondents. The data used is the result of conducting structured interviews with open questions. The interviews were held from February 19, 2021, to July 27, 2021, employing face-to-face and online meeting mechanisms. These interviews involved stakeholders from five universities under study.

Interviews were conducted using an open-ended questionnaire. The questions asked were related to contracts and project performance. Questions related to the contractual aspect consisted of administrative completeness and contract standards. Questions related to performance consisted of work

quality supervision (changes in the scope of work, application of methods and technologies, material management, and maintenance), time supervision (changes in work time), cost supervision (changes in contract value), HSE implementation, a satisfaction of the parties, environmental conditions, benefits, functionality, and work relationships. Project management consists of the implementation of project management. The main topics of the questions asked were 12 (twelve), which were developed into several additional questions. The list of questions can be seen in Appendix A.

The questions were addressed to stakeholders involved in the construction project. At each study location, 2 (two) projects were taken, and stakeholders were appointed for each project representing the project owner, consultant, and contractor. This research focused on internal stakeholders directly involved in the project, including project owners, contractors, planning consultants, supervisory consultants, management consultants, internal supervisors, project managers, and procurement entities. Table 1 shows data on research respondents.

TABLE I. RESEARCH RESPONDENT

Main Stakeholder	• Employer/PPK (Commitment-Making Officials) • Contractor • Supervision Consultan • Construction Management Consultant • Project Management Consultant • Design/ Engineering Consultant • Internal Supervisor
Supporting Stakeholder	• Project Implementation Unit • Procurement Entity

The research locations were five universities with PTN BH (Legal Entity State University) status as study objects. PTN BH institutions possess autonomous authority to manage academic and non-academic affairs [32]. A key aspect of their non-academic autonomy is financial management, which includes policies on procuring goods and services. The construction project contracts examined in this study fall under this procurement category. Table 2 shows data from the research location and source of funds.

TABLE II. RESEARCH LOCATION AND SOURCE OF FUND

Universities	A, B, C, D, E
Source of Fund	Sources of Foreign Debt Loan Funds (F), Non Sources of Foreign Debt Loan Funds (NF)

A total of 37 respondents agreed to participate in the interviews. The respondents with the highest frequency were stakeholders in the roles of contractors, comprising 29.81%, followed by Commitment-Making Officials (PPK) at 18.84% and PIUs/Project Managers at 10.97%. Figure 2 shows data on the distribution of respondents.

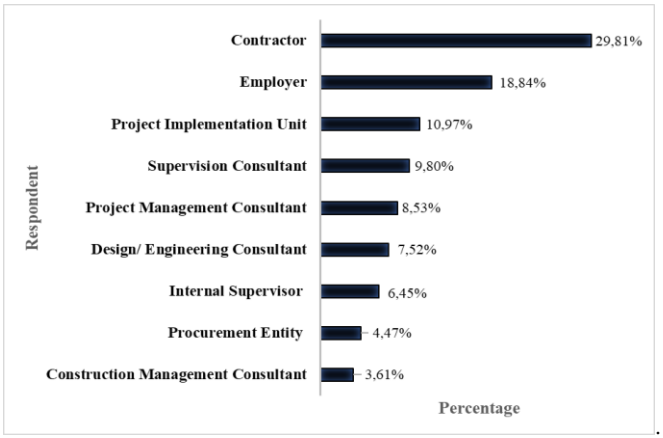


Figure 2. The distribution of respondents across various stakeholder groups

The data on construction projects within higher education environments used in this research includes projects funded by PHLN (Foreign Loans/Grants), which constitute 54.39% of the total, while the remaining 45.61% are funded from non-PHLN sources. Non-PHLN (Non-Foreign) funding sources encompass projects financed by internal university funds or aid from local private companies. In contrast, PHLN (Foreign) funding sources derive from loans or grants provided by external international institutions. Figure 3 depicts the distribution of funding sources for construction projects at universities.

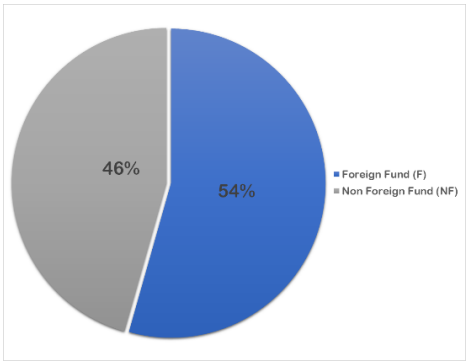


Figure 3. Project's Source of Fund

2.2 Method of Data Analysis

This research employs an exploratory qualitative approach to develop hypotheses based on the obtained data. Hypothesis formulation for theory construction was conducted by analyzing interview data utilizing content analysis, which systematically examines written, spoken, or visual documents. Categories and sub-categories of the research variables are

detailed in Table 3, while a comprehensive list of interview questions is available in Appendix A.

TABLE III. DATA CODIFICATION SYSTEM

Category	Sub- Category	Coding of Contract Condition and Project Performance
Contractual Aspects	Administration	• Contract control • Contract variations • Quality policy • Resource management • Environmental performance • Contract clauses/articles • Work relationship • Health, Safety, Security and Environment (HSE) • Cost • Contract risk • Value and Profit • Time • Quality • Organization • Participants' satisfaction • Technology implementation • Functionality • Contract standards • Characteristics of construction projects • Contract documents • Contract type • Contract disputes
	Contract Standards	
Project Performance	Quality	
	Time	
	Cost	
	Health, Safety, Security and Environment (HSE)	
	Participants' Satisfaction	
	Environmental Performance	
	Value and Profit	
	Functionality	
Contract Management	Work relationship	
	Project management	

Data analysis involves several stages: open, axial, and selective coding [33]. Initially, all information gathered from interviews and collected project documents was transcribed into text data for analysis. The first stage, open coding, involves identifying and grouping the transcript information and interpreting it into meaning segments, codes, categories, and sub-categories. This process entails arranging meaning segments, determining keywords, and building categories guided by the researchers' reasoning and word choices based on the meaning segments. This stage is crucial for the factor-building process.

The second stage, axial coding, establishes relationships between categories identified during open coding. This process is facilitated by JMP 18 software, which calculates the significance of the correspondence between factors. Correspondence is considered significant if the P-value is less than 0.05, indicating a confidence level of over 95%.

The last stage, selective coding, involves labelling new categories and forming a hypothesis model. This stage also includes visualizing the hypothesis model to enhance readability and comprehension, typically in a table or diagram. After constructing the hypothesis model, the subsequent stage analyses the relationships between the codes formed for contracts and project performance.

3. Result and Discussion

Data from the conducted interviews were analyzed using distribution analysis and content analysis. Distribution analysis aims to provide an overview of respondents' characteristics and information related to contracts and project performance within the tertiary institution environment. In contrast, content analysis seeks to identify and group the factors supporting contracts and project performance and examine the relationship between contracts and project performance.

3.1 Result

Contract research variables are divided into contractual aspects and contract management. The distribution analysis results regarding the importance of contractual aspect variables, contract management, and project performance (categorized) according to respondents in Figure 4. From the transcribed and analyzed respondents' answers, the category preferences in contractual aspects and contract management were determined based on the stages of content analysis. It was found that the project performance category had the highest frequency value at 65%, followed by the contract management category at 18% and the contractual aspects category at 17%.

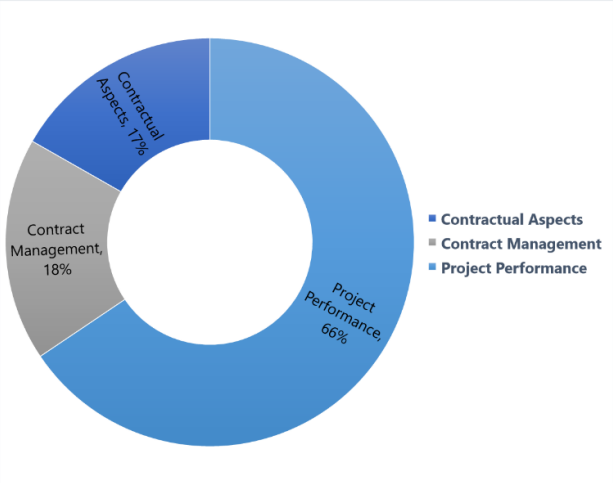


Figure 4. The distribution of Contractual Aspects, Contract Management, and Project Performance (Based on Category)

The distribution analysis results in each category group are further detailed into sub-categories. The respondents' answers are divided into two sub-categories for the contractual aspects

category: contract standards and administration. The contract management category is divided into work relations and project management. The project performance category, which has the most sub-categories, is divided into nine sub-categories: project usefulness, profits, costs, environmental performance, occupational health, environmental and safety (HSE), time, satisfaction of the parties, and quality. Figure 5 shows the distribution analysis results for the sub-categories of contractual aspects, contract management, and project performance.

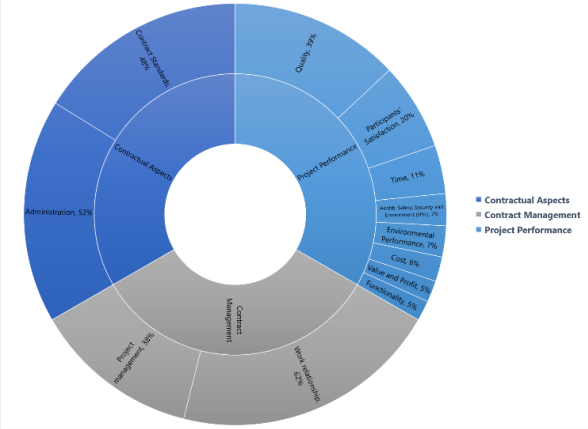


Figure 5. The distribution sub-category of Contractual Aspects, Contract Management, and Project Performance

The data in this research, namely contractual aspects, contract management, and project performance at the category level, were then analyzed again through meaning segmentation and code labelling. The comprehensive results from the content analysis, including both open and axial coding stages, were subsequently analyzed using JMP 18 software to identify relationships between categories and the codes formed. The correspondence analysis results between the categories (contractual aspects, contract management, and project performance) and the newly formed codes indicated a significant relationship ($p < 0.0001$). These findings can be utilized to develop a hypothetical model illustrating the relationship between contractual aspects, contract management, and project performance. Figure 6 shows the correspondence results.

The dendrogram illustrating the relationships between categories and codes and their frequency amounts forms three main groups: contractual aspects, contract management, and project performance. This code grouping serves as the basis for developing a hypothetical model. Figure 7 depicts the hypothetical models related to contractual aspects, contract management, and project performance.

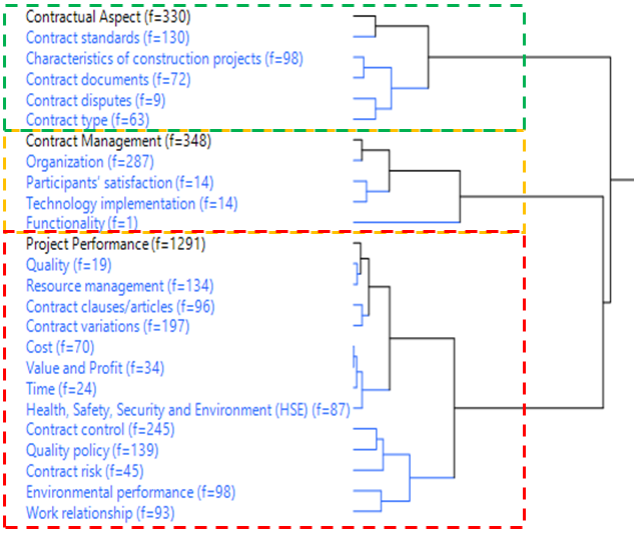


Figure 6. Dendrogram from correspondence analysis between categories and codes ($p<0.0001$)

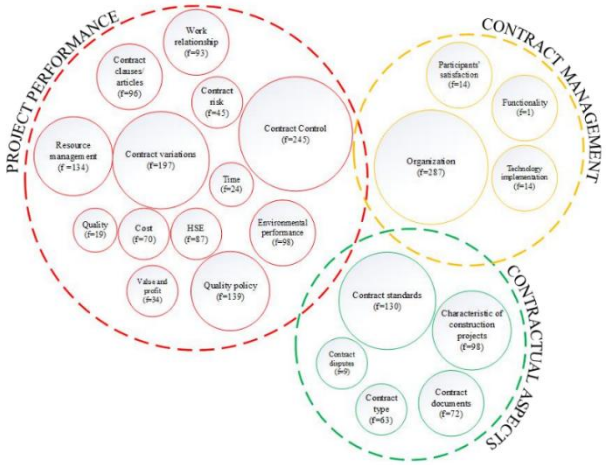
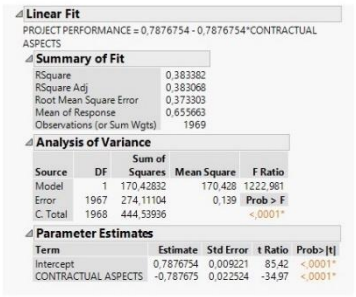


Figure 7. Hypothesis Model

The contractual aspects group includes contract standards, characteristics of construction projects, contract documents, contract disputes, and contract type. The contract management group includes organization, participants' satisfaction, technology implementation, and functionality. Meanwhile, the project performance group encompasses quality, resource management, contract clauses/articles, contract variations, cost, value and profit, time, health, safety, and environment (HSE), contract control, quality policy, contract risk, environmental performance, and work relationships.



Linear Fit

PROJECT PERFORMANCE = 0,7876754 - 0,7876754*CONTRACTUAL ASPECTS

Summary of Fit

RSquare	0,383382
RSquare Adj	0,383068
Root Mean Square Error	0,373303
Mean of Response	0,655663
Observations (or Sum Wgts)	1969

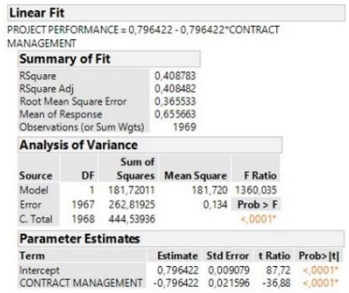
Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	170,42832	170,428	1222,981
Error	1967	274,11104	0,139	Prob > F
C. Total	1968	444,53936		<,0001*

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	0,7876754	0,009221	85,42	<,0001*
CONTRACTUAL ASPECTS	-0,787675	0,022524	-34,97	<,0001*

a. Regression between Contractual Aspects and Project Performance (R-Square = 0.38, P-value <0.0001)



Linear Fit

PROJECT PERFORMANCE = 0,796422 - 0,796422*CONTRACT MANAGEMENT

Summary of Fit

RSquare	0,408783
RSquare Adj	0,408482
Root Mean Square Error	0,365533
Mean of Response	0,655663
Observations (or Sum Wgts)	1969

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio
Model	1	181,72011	181,720	1360,035
Error	1967	262,81925	0,134	Prob > F
C. Total	1968	444,53936		<,0001*

Parameter Estimates

Term	Estimate	Std Error	t Ratio	Prob>|t|
Intercept	0,796422	0,009079	87,72	<,0001*
CONTRACT MANAGEMENT	-0,796422	0,021596	-36,88	<,0001*

b. Regression between Contract Management and Project Performance (R-Square = 0.41, P-value <0.0001)

Figure 8. Regression relationship between contractual aspect and contract management to project performance

After identifying the characteristics of contracts and construction project performance in a higher education environment, the subsequent stage involves analyzing the relationship between contracts and project performance. This relationship was examined using regression analysis to determine the strength of the causal connection between contracts and project performance. The regression analysis results for both contractual aspects and performance, as well as contract management and performance, are presented in Equations 1 and 2.

The regression analysis indicates a significant relationship between contractual aspects and project performance and between contract management and project performance, with P-values of less than 0.0001 for both regressions. The following equations describe the relationships, illustrating the significant impact of contractual aspects and contract management on project performance.

$$Y = 0{,}7876754 - 0{,}7876754*X1 \qquad \text{Equation (1)}$$

Equation 1. The regression equation between contractual aspects and project performance

$$Y = 0{,}796422 - 0{,}796422*X2 \qquad \text{Equation (2)}$$

Equation 2. The regression equation between contract management and project performance.

Information:

Y = Project Performance
X1 = Contractual Aspect
X2 = Contract Management

The two linear regression equations in Figure 8 demonstrate a significant relationship between contractual aspects, contract management, and project performance. Both regression relationships exhibit a negative sign, indicating that contractual and contract management issues adversely affect project performance. Each contractual issue corresponds to a decrease in project performance by 0.78 units. Similarly, issues in contract management lead to a reduction in project performance by 0.79 units.

3.2 Discussion of contract characteristics and project performance

The characteristics of construction projects in higher education environments based on the model hypothesis are grouped into 3 (three) groups: contractual aspects, contract management and project performance. These three aspects will be discussed in detail in the following discussion.

3.2.1 Characteristics of Contractual Aspects of Projects in Case Studies

Contracts are a communication tool between stakeholders involved in a construction project. Figure 9 shows the distribution analysis results related to contractual aspect elements. According to the study results, contractual aspects consist of contract standards, characteristics of construction projects, contract documents, contract types, and contract disputes. Contract standards are an element of the highest contract standards (f=102). The use of this contract standard depends on the kind of funding source used for project funding. The ability to read and interpret the contents of a contract is significant in project implementation [34], so understanding contract documents is necessary. Respondents' answers related to the use of standard contracts are as follows:

"There are obstacles in the contract language that cause disputes" (Contractor).

The type of funding source influences the characteristics of a construction project. Construction project characteristics include scope, licensing issues, work priority scale, project work dynamics, deficiencies in planning results, land problems, and project information systems. Project scope is the element with the highest frequency (f=79). The building design concept influences the scope of this project according to the funder's request, the function of the building, the method of carrying out the work based on the funding period, and the

characteristics of the project owner. Project characteristics influence project quality at the planning stage [35]. This is in line with the results of data analysis, which show that the project scope, especially the design concept, is a significant concern. One of the causes of poor quality of construction projects is that there are errors in contract documents, especially in technical documents consisting of drawings, bills of quantities, and specifications [18]. The results of data analysis show that the hierarchy of contract documents has the highest frequency value of contract documents (f=39). This hierarchy of contract documents is also related to the contract type. Respondents considered the application of the unit price contract type in construction projects better than the lump sum and combined contract types (f=30).

Equal understanding regarding the type of unit price contract can reduce the risks. The advantage of using this type of unit price contract is controlling risk in the event of quantity fluctuations and reducing disputes that may arise due to the interpretation of quantity clauses changing [36]. Architects and engineers, as construction contract administrators, are often asked to make interpretations and instructions. In this case, mitigation is needed regarding contract defects that can give rise to disputes [37].

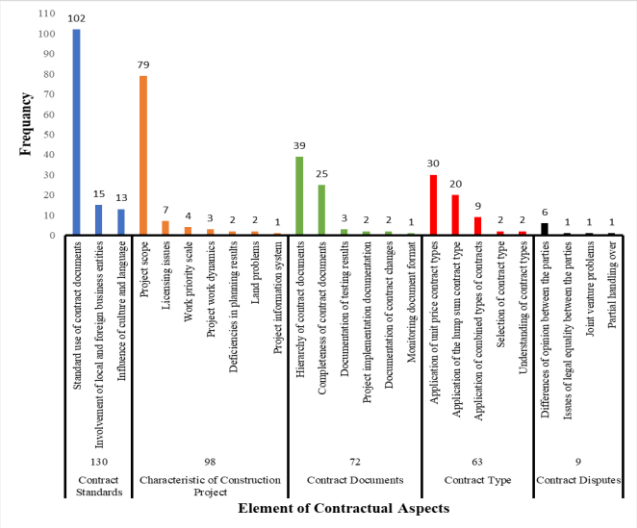


Figure 9. Elements of Contractual Aspects

"For construction implementation contracts, it is better to use a unit price contract because it can better guarantee the quality per item and fairness in the audit process" (PPK/ Commitment-Making Officials) and,

"Unit price contracts are more relevant to conscience, obligations and commitment" (Contractor).

Contract disputes are the smallest element of the contractual aspect, with differences of opinion between the parties being the most frequent element (f=6). Excellent and appropriate contract design is not a sufficient requirement to reduce disputes, so it is also necessary to manage project stakeholders and their relationship behaviour [15].

3.2.2 Characteristics of Contract Management on Projects in Case Studies

Construction projects involve various stakeholders in carrying out the stages of work so that they comply with those stated in the contract. Management of stakeholders according to responsibility, exploration of needs and obstacles, and communication between stakeholders are critical factors for project success [38]. In addition to stakeholder management, project success also depends on contract management. Figure 10 shows the distribution analysis results related to contract management elements.

Based on Figure 10, stakeholder management consists of the organization, the participants' satisfaction, technology implementation, and functionality. Organization is the most significant element of contract management. The roles and responsibilities of the parties with the most significant frequency value (f=139). In the project management framework, stakeholder management requires an understanding of organizational structure, stakeholder activities, and stakeholder relationships [39]. The involvement of many stakeholders in construction projects also requires a stakeholder management implementation strategy.

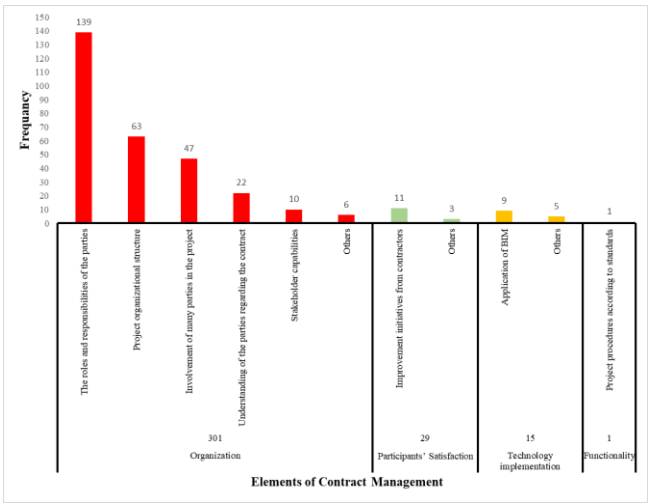


Figure 10. Elements of Contract Management

The implementation of stakeholder management is centred on identifying project stakeholders and analyzing various types of relationships between stakeholders [40]. Respondents' answers regarding stakeholder involvement in construction projects within higher education are as follows:

"Too many decision makers are involved in university projects" (PPK/ Commitment-Making Officials), and

"The many levels of parties involved result in the time and flow being long, and if there is an error, it takes time to detect it" (PIU/Project Manager), and

"In a loan project, many parties are involved" (Project Management Consultant).

Proper stakeholder management can contribute to all parties' satisfaction with project quality. Participants' satisfaction with the most significant frequency (f=29) consisted of contractor improvement initiatives, contractor cash flow problems, problems related to mobilization, and obstacles to contract implementation.

Implementation of technology is necessary for construction projects. Based on the results of data analysis, the use of BIM (Building Information Modeling) has the highest frequency value (f=9), followed by unique, renewable and standard technology. The application of BIM can support project performance, especially regarding project cost utilization [41]. Implementing procedures that comply with standards is a form of project functionality based on the results of data analysis.

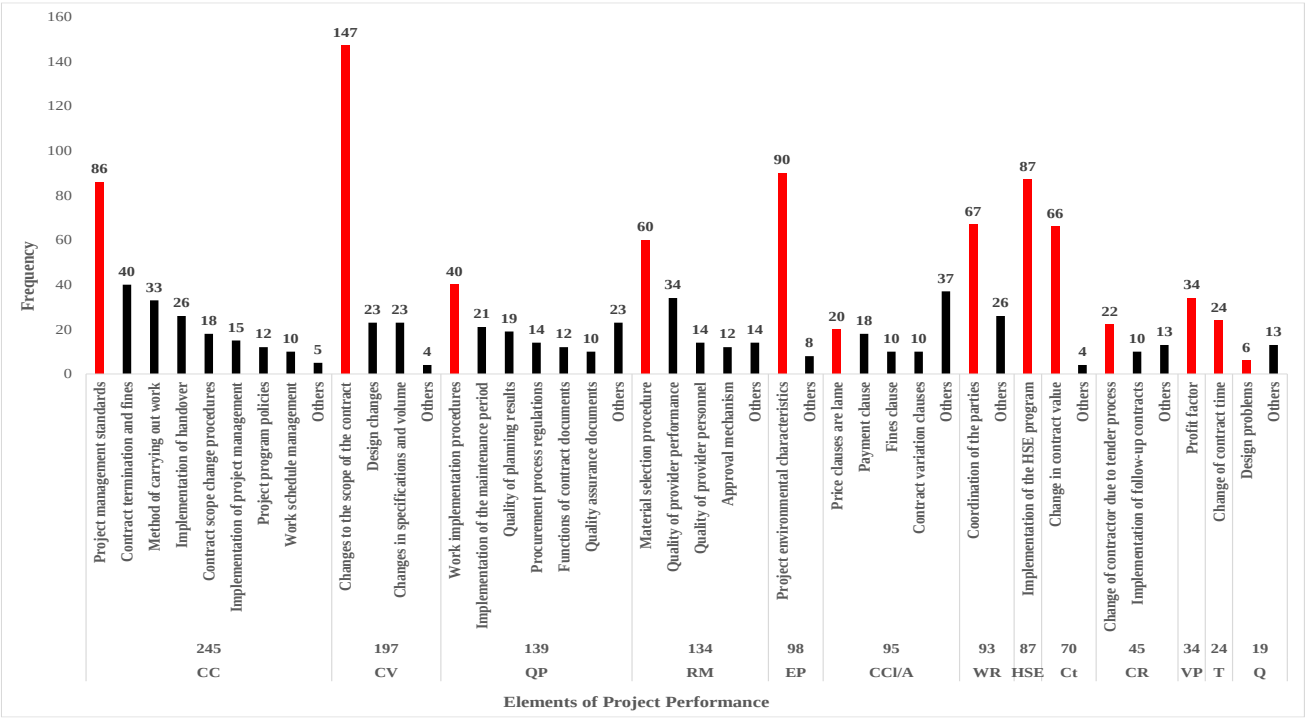


Figure 11. Elements of Project Performance

Legend:
CC = Contract Control; CV = Contract Variations; QP = Quality Policy; RM = Resource Management; EP = Environmental Performance; CCl/A = Contract Clauses/Articles; WR = Work Relationship; HSE = Health, Safety, Security, and Environment; Ct = Cost; CR = Contract Risk; VP = Value and Profit; T = Time; Q = Quality

3.2.3 Project Performance Characteristics in Case Studies

Contractual aspects and contract management aim to support the successful implementation of construction projects. Indicators of the success of a construction project are not only costs, time and quality but also include safety, functionality and participants' satisfaction involved in the construction project [27]; apart from that, there are also indicators of profit and work productivity [28]. Communication between stakeholders [18], alignment between stakeholder responsibilities, and finance also play an essential role in the success of each project [42]. Figure 11 shows the distribution analysis results related to project performance elements.

Project management standards are the most significant factor in contract control (f=86). Other elements contributing to contract control include contract termination and fines, method of carrying out work, implementation of handover, contract scope change procedures, project management, project program policies, work schedule management, and others.

Changes in construction projects are unavoidable, especially regarding design changes. Internal and external factors can influence design changes. The project owner is an

internal factor that plays a role in design changes, while external factors are political, economic and environmental [43]. Although changes always occur in construction projects, design changes are categorized as a form of contract error [44]. Based on the results of data analysis, changes to the scope of the contract (f=147) are the most significant element of contract variation. Other factors causing contract variations include design, specifications, and volume changes. Work implementation procedures need to be considered to manage contract variations.

Work implementation procedures are the most significant factor in quality policy (f=40). Work implementation procedures are related to productivity. One form of productivity is resource management. The resource management element consists of material selection procedures as the most significant element (f=60), followed by quality of provider performance, quality of provider personnel, approval mechanism, and others. Effective material management is one of the keys to the success of a construction project.

Problems related to material management that can hinder the implementation of construction projects include late delivery of materials, inaccurate material planning, insufficient information and communication between stakeholders, financial problems procuring materials, changes in specifications, and difficulties transporting material delivery [45].

Environmental performance influences the quality of project performance, which is the project's environmental characteristics (f=90). The project's environmental characteristics include social and environmental problems, campus environmental problems, and specification determination policies. Meanwhile, the contract clause that contributes to project performance with the highest frequency is price clauses are lame (f=20). Other contract clauses that can influence project performance are payment clauses, fines and contract variations, special contracts, standard contracts, technical drawings, critical contracts, price adjustments, insurance, implementation schedule, contract value, sanctions, warning letters, guarantees, HSE control, temporary suspension, retention, technical specifications, claims and handover.

These contract clauses have a role in employment relationships. Working relationships between stakeholders also contribute to project performance. Coordination of the parties is the element with the highest frequency (f=67). Implementation of the HSE program is also an element of project performance (f=87). Work factors are the leading cause of work accidents [46], and management commitment is the primary driver of familiarizing work safety culture and the need to control worker behaviour [47]. Changes in contract value (f=66) are part of the cost elements that contribute to project performance, the reasonableness of the price and the availability of contingency funds.

Construction projects are prone to risk. One of the risks is contract risk. Based on the results of data analysis, contract risk is influenced by the element of change of contractor due to the tender process with the highest frequency (f=22). Changes in the implementation of construction projects are a form of project risk that occurs, so proper planning is needed to realize change management and risk management [48]. Respondents' answers regarding profit factors and changes in contract time are as follows:

"The profits obtained by the contractor are not too large due to design changes and changes in work completion time" (PIU/Project Manager)

Elements of profit factor, change of contract time, and design quality also contribute to project performance. Design problems constitute the most significant quality factors, followed by planning problems, implementation and material issues, specification problems, and incomplete planning.

3.3 Discussion of Contractual Relations and Project Performance

Based on the results of the analysis, a relationship between contracts and project performance exists, as seen in Figure 8. Contractual aspects and contract management have a negative (-) regression relationship with project performance. Changes to aspects of contracts and contract management have the opposite effect on project performance. Table 4 presents contract aspects and management elements that influence project performance.

Elements of contractual aspects that have a significant relationship with a P-value <.0001 are contract standards, characteristics of construction projects, and contract documents. Contract standards and documents negatively correlate (-), namely β= -0.1999 and β= -0.2224. Unclear contract standards and incomplete contract documents have an impact on reducing quality by 0.1999 and 0.2224. Contract documents also positively correlate (+) with participants' satisfaction of β= 0.3680. The more complete the contract documents are, the more satisfied the parties involved will be. Construction project characteristics have a positive (+) correlation value of β= 0.1593. The complexity of a construction project affects the project's time. The more complex it is, the more it can affect the timeliness of project implementation. The characteristics of construction projects influence project performance at the planning stage; project owners especially need this because it can help facilitate decision-making during initial project planning [35]. The quality of a project consists of the quality of the project

process, the quality of the project organization, and the quality of the results [49].

The contract management element that has a significant relationship with the organization (P-value <.0001). This organization has a negative (-) correlation value of β= -0.1487. This means that a project organization that is well managed has active communication, and has the transfer of tasks between stakeholders carried out well can positively impact project quality. Managing relationships between stakeholders in a project organization can reduce the occurrence of conflicts between stakeholders in construction projects, especially regarding perceptions of fairness for all parties [50]. A good perception of justice can minimize conflict and create satisfaction for the parties. Poor relationships between stakeholders can harm project performance [51].

Project performance elements with a significant relationship with a P-value <.0001 are contract variations, resource management, work relationships, HSE, and contract risk. Contract variations, resource management, and contract risk positively correlate (+) with values β= 0.3642, β= 0.2779, and β= 0.2611. Meanwhile, work relationships and HSE negatively correlate (-) with values β= -0.1897 and β= -0.2678. This positive correlation (+) means that various issues related to this element can directly impact project quality, in contrast to a negative correlation (-). The participants' satisfaction element on project performance has a significant relationship with a P-value <.0001 on contract variations, environmental performance, contract clauses/articles, and work relationships. The parties' satisfaction can be realized through effective financial management so that the contractor can complete the work well and indirectly satisfy the client [52].

The driving force for a construction project's success is its correct completion, whether on time, at the right cost, and using the right workforce and technology. Project performance management is required to realize it. The factors used in performance management can include HSE, environment, costs, sustainability, quality, and party satisfaction [53].

TABLE IV. REGRESSION AND SIGNIFICANCE VALUE OF THE RELATIONSHIP BETWEEN PROJECT PERFORMANCE AND CONTRACT ASPECTS AND CONTRACT MANAGEMENT

Kode	Kategori	Project Performance (Y)															
		Functionality		Value and Profit		Cost		Environmental Performance		HSE		Time		Participants' Satisfaction		Quality	
		β	P-value	β	P-value	β	P-value	β	P-value	β	P-value	β	P-value	β	P-value	β	P-value
Contractual Aspects (X1)	Contract Standards	-0,0326	0,0365*	-0,0348	0,0306*	-0,0315	0,0666	-0,0500	0,0090*	-0,0517	0,0079*	-0,0289	0,2217	-0,0667	0,0296*	-0,1999	<,0001**
	Characteristic of Construction Project	-0,0106	0,5523	-0,0235	0,2018	0,0147	0,4538	-0,0384	0,0789	-0,0508	0,0222*	0,1593	<,0001**	-0,1277	0,0003*	-0,0439	0,3323
	Contract Documents	-0,0316	0,1255	-0,0337	0,1132	-0,0385	0,0899	-0,0485	0,0557	-0,0212	0,4092	-0,0615	0,0492*	0,3680	<,0001**	-0,2224	<,0001**
	Contract Type	-0,0315	0,1528	-0,0172	0,4496	-0,0219	0,3656	-0,0483	0,0742	-0,0498	0,00694	-0,0428	0,1999	0,0449	0,3042	-0,0513	0,3593
	Contract Disputes	-0,0306	0,5942	-0,0327	0,5818	-0,0372	0,5554	-0,0469	0,5058	-0,0485	0,4986	-0,0735	0,3986	-0,1321	0,2421	0,1893	0,1943
Contract Management (X2)	Organisation	-0,0275	0,0122*	-0,0299	0,0083*	-0,0312	0,0098*	-0,0261	0,0525	-0,0442	0,0012*	-0,0530	0,0014*	0,0377	0,0806	-0,1487	<,0001**
	Participants' Satisfaction	-0,0307	0,5058	-0,0327	0,4915	-0,0373	0,4615	0,0249	0,6605	-0,0486	0,3981	-0,0017	0,9804	-0,1325	0,1441	0,0300	0,7981
	Technology implementation	-0,0307	0,5058	0,0392	0,4101	-0,0373	0,4615	0,0249	0,6605	-0,0486	0,3981	-0,0737	0,2918	-0,1325	0,1441	0,1019	0,3842
	Functionality	-0,0305	0,8593	-0,0325	0,8546	-0,0371	0,8445	-0,0467	0,8249	-0,0483	0,8219	-0,0732	0,7789	-0,1316	0,6972	-0,2561	0,5576
Project Performance (Y1)	Contract Control	-0,0068	0,5606	-0,0185	0,1271	-0,0097	0,4518	-0,0114	0,4287	-0,0551	0,0002*	0,0330	0,0633	0,0176	0,4462	0,0992	0,0009*
	Contract Variations	0,0169	0,1906	-0,0361	0,0067*	0,0021	0,1419	-0,0519	0,0010*	-0,0536	0,0009*	0,1444	<,0001**	-0,1123	<,0001**	0,3642	<,0001**
	Quality Policy	-0,0018	0,9041	-0,0195	0,2118	-0,0167	0,3162	-0,0271	0,1453	-0,0287	0,1282	-0,0090	0,6939	-0,0641	0,0311*	0,0729	0,0576
	Resource Management	0,2075	<,0001**	0,0052	0,7452	-0,0318	0,0603	-0,0341	0,0709	-0,0518	0,0069*	-0,0384	0,0991	-0,1091	0,0003*	0,2779	<,0001**
	Environmental Performance	0,0001	0,9934	0,0087	0,6343	-0,0390	0,0463*	0,5414	<,0001**	-0,0508	0,0022*	-0,0770	0,0043*	-0,1384	<,0001**	-0,1525	0,0008*
	Contract Clauses/Articles	-0,0320	0,075	0,0096	0,6039	0,0486	0,0139*	-0,0491	0,0261*	-0,0069	0,7578	-0,0769	0,0048*	0,5078	<,0001**	-0,1596	0,0005*
	Work relationship	-0,0320	0,0799	-0,0003	0,9891	-0,0389	0,0526	0,0074	0,7419	-0,0506	0,0261*	-0,0542	0,0501	0,2682	<,0001**	-0,1897	<,0001**
	HSE	-0,0319	0,0908	-0,0340	0,0804	-0,0388	0,0613	-0,0008	0,9731	0,9356	<,0001**	-0,0765	0,0073*	-0,1256	0,0007*	-0,2678	<,0001**
	Cost	-0,0168	0,4226	-0,0041	0,8503	0,5059	<,0001**	-0,0484	0,0593	-0,0500	0,0551	-0,0314	0,3221	-0,1216	0,0031*	0,1938	0,0003*
	Contract Risk	-0,0312	0,2292	0,0122	0,6479	0,0075	0,7914	0,0204	0,5216	-0,0266	0,4101	-0,0521	0,1847	-0,1119	0,0282*	0,2611	<,0001**
	Value and Profit	-0,0310	0,2973	0,9546	<,0001**	-0,0377	0,2487	-0,0475	0,193	-0,0491	0,1856	-0,0744	0,0986	-0,1339	0,0221*	-0,2605	0,0006*
	Time	-0,0308	0,3825	-0,0329	0,3665	-0,0375	0,3337	-0,0473	0,2754	-0,0488	0,2673	0,6852	<,0001**	-0,0488	0,4823	-0,1326	0,1392
	Quality	0,1287	0,0012*	-0,0328	0,4223	0,0157	0,7185	0,0060	0,9025	-0,0487	0,3243	-0,0207	0,7303	-0,1328	0,0883	0,2730	0,0066*

*) p <0.0001**, p<0.05**

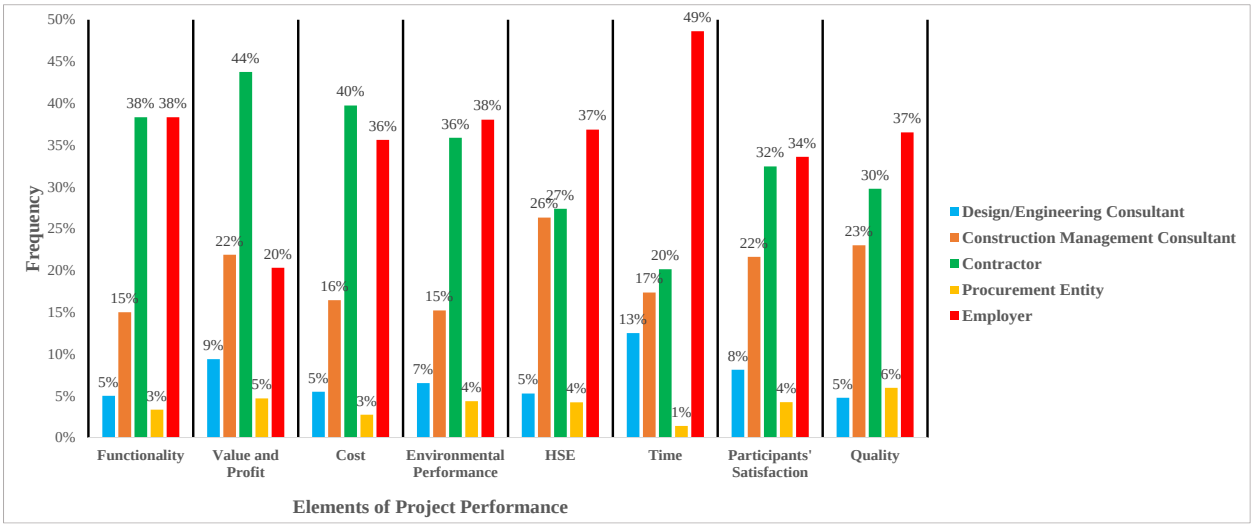


Figure 12. Elements of Project Construction and Stakeholder

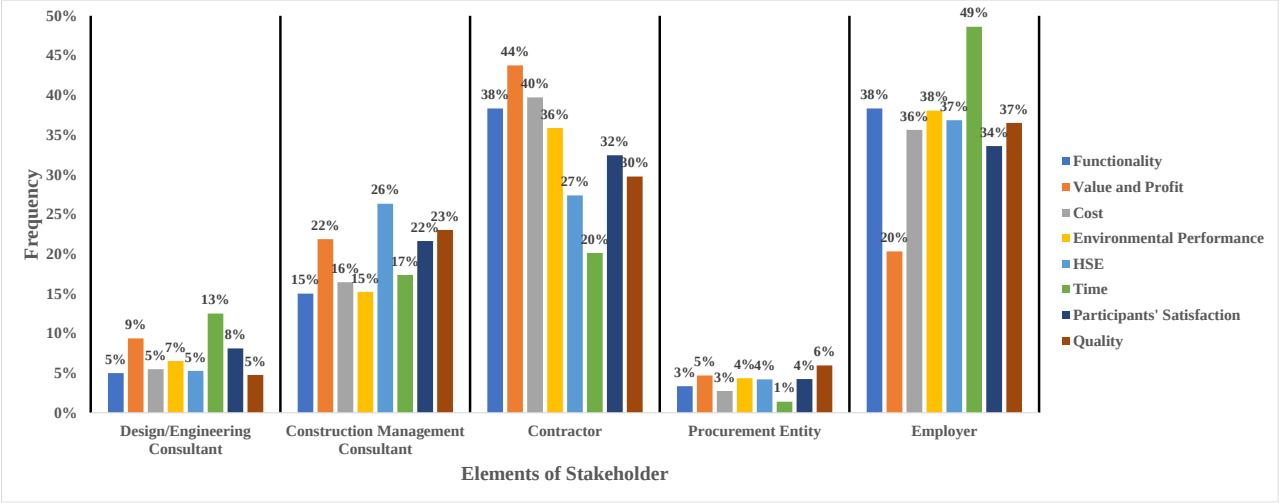


Figure 13. Elements of Project Construction and Stakeholder

3.4 Discussion of Stakeholder Relations and Project Performance

Relationships between stakeholders in construction projects are significant. Effectively established relationships can significantly improve project outcomes. It is because it leads to increased efficiency, reduced risk, and increased quality and safety standards, which can contribute to the successful implementation of construction projects. Based on the results of the data analysis, Figure 12 shows that there are different stakeholder perceptions of each project performance indicator. The highest project performance indicator, based on the results of previous data analysis, is quality. The highest stakeholder perception of quality is by the project owner (f=37%). Project owners have the highest expectations for the quality of construction projects compared to contractors as implementers, supervising consultants and other stakeholders. Apart from quality, project owners also have higher expectations regarding time (f=49%), HSE (f=37%), party satisfaction (f=34%) and environmental performance (f=38%) compared to contractors and stakeholders—other interests. Collaboration between project owners and contractors in understanding work systematics, organization, costs, design, construction, implementation and maintenance is one factor that influences the quality of construction projects [54], [55]. Project owners focus on expectations and satisfaction and assess quality as an investment so that it can meet technical standards and safety standards as well as impact the environment. Meanwhile, contractors focus on implementation, processes, cost and time management, and risk management. Therefore, proper and good cooperation management.

Overall project performance indicators, the project owner focuses on time (f=49%) while the contractor focuses on profits (f=44%), as seen in the results of data analysis in

Figure 13. Profits are identified as having a relationship with design change requests, and profits are also related to risk management in decision-making [56], [57]. Design changes that occur in construction projects have an impact on the completion time of the work. The complexity of construction projects reduces profits, but applying project management can overcome this reduction in profits [58].

3.5 Research Contribution and Implication

Current research developments related to contracts and project performance are related to implementing technology in contracts. Blockchain and project management are interrelated approaches to achieving project success [59]. The application of technology in projects contributes to improving project cost management, process automation systems, and communication between stakeholders. Factors of contract aspects and contract management and a description of the relationship between the two to project performance based on stakeholder opinions can contribute to the development of smart contracts. Using smart contracts to deal with the complexity of construction projects can reduce contract waiting times and financial losses, identify factors that cause conflict, and improve contract administration [60], [61]. The development of smart contracts, using blockchain in payment systems, and enhancing project management systems can be collaborated with BIM (Building Information Modeling) technology. The main category of BIM challenges related to contracts is the dependence on contract documents [62].

CONCLUSION

Based on the analysis and discussion above, it can be concluded that the characteristics of construction projects follow project conditions in higher education institutions, forming 3 (three) groups: contractual aspects, contract management, and project performance. The three contractual aspects that influence project performance are contract standards, characteristics of construction projects, and contract documents. These three elements are also significantly related to project performance with a negative correlation value (-). Organization is the main element of contract management, which influences project performance and has a significant relationship to project performance with a negative correlation value (-). The internal aspects of project performance that affect project performance results are contract variations, environmental performance, contract control, and HSE. Contract variations and HSE significantly relate to project performance with a positive correlation value (+). The involvement of many stakeholders in construction projects can impact contract management and organization, so there is a need for good cooperation and project management to realize the success of construction projects, especially in controlling quality, time and profits.

APPENDIX

Appendix A. List of Questions

Administration	1. Are there/are no contract documents? 2. Is there/isn't there an amendment to the contract documents?
Contract Standards	What contract standards are used to prepare contract Documents? (FIDIC/PUPR/Internal Agency)
Quality	1. Are there contract variations and Contract Change Orders (CCO)? 2. Are there any changes to the planning (design) documents during construction? 3. How is the use of supporting methods and technology during construction? 4. How does selecting materials in technical specifications support construction implementation? 5. What is the mechanism for implementing work handover? 6. How is post-construction maintenance carried out?
Time	Is the contract/work implementation schedule the same as the planned schedule?
Cost	Are there any changes to the initial contract value?
Health, Safety, Security and Environment (HSE)	How is HSE management implemented during construction contract implementation?
Participants' Satisfaction	1. What contract clauses have the greatest influence in monitoring contract control? 2. Does the contract terminate before the contract is declared to have ended? 3. Are coordination meetings held regularly?
Environmental Performance	1. Does the contract monitor environmental performance at the work control stage during construction? 2. Are there obstacles to environmental conditions during contract implementation?
Value and Profit	Does the contract value consider both material and non-material benefits for both parties?
Functionality	Is the selection of materials and preparation of technical specifications following the building's function?
Work relationship	1. What is the organizational

	structure for implementing contract control/supervision? 2. Is it done yourself, or does a construction supervisor/ management consultant do it?
Project management	How is project management implemented in the project being implemented?

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