

Contract Change Management and Team Integration Optimization in Dr. Moewardi Hospital Project

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ABSTRACT

The increase in the number of patients and the complexity of medical cases at Dr. Moewardi Regional General Hospital has prompted the construction of a Critical Center and Support Services Building as modern facilities for handling critical conditions. However, this type A government hospital project requires effective management of contract changes and coordination between teams across stakeholders. Contract changes in government projects are strictly limited, which has implications for cost efficiency and timeliness. This study was conducted to evaluate the effect of contract change management on time and cost performance, assess the effectiveness of team integration, and formulate concepts for optimizing both. This study was conducted through a quantitative survey of 39 respondents, including project owners, planning consultants, supervisory consultants, and contractors. The survey focused on contract change management indicators and team integration indicators, and was supplemented by project document analysis and in-depth interviews with relevant parties. The results showed a strong influence on overall contract change management ($R^2 = 0.962$). K-Means clustering identified three patterns of team integration: positive in cooperation ($T5 = 3.21$) and responsibility ($T8 = 3.31$), neutral in mutual trust ($T6/T7 = 3.13$), and negative in formal communication ($T1 = 2.51$) and regular meetings ($T3 = 2.74$). The novelty of this study lies in its integrative approach, which combines regression and clustering simultaneously to analyze and optimize contract management and team integration, with recommendations for strengthening formal communication, BIM, cloud-based platforms, and periodic team evaluations that can be replicated in large-scale health infrastructure projects.

Keywords: team integration, construction project performance, K-Means Clustering, contract change management, multiple linear regression

INTRODUCTION

dr. Moewardi Regional General Hospital (RSUD) is a hospital owned by the Central Java Provincial Government that provides health services to the community in Surakarta City and its surrounding areas. RSUD dr. Moewardi is classified as a Type A hospital, making it the primary referral hospital for various regions in Central Java and parts of East Java. As the number of patients and the complexity of medical cases increase, facilities capable of handling critical conditions quickly and efficiently are needed. To address this need, the construction of a Critical Center and Support Services Building is planned as part of the hospital's infrastructure development. Similar to construction projects in general, the construction of these health facilities is not without contract changes and the need for coordination between stakeholders.

Government Procurement of Goods/Services, which limits total contract price changes by requiring a reduction in other work if there is additional work [7]. The Tamansari Iswara Bekasi project shows that contract changes are often caused by a lack of material control, weak contractor teamwork, and errors in estimating the volume of work [19]. As a result, there was a 20% increase in project costs and a 30% delay in completion time. Contract changes resulted in a 9% decrease in productivity in construction projects in Indonesia, mainly triggered by risks such as design errors and unclear scope of work [17].

Team integration is the process of bringing together various members and stakeholders in a project to work effectively and harmoniously, to achieve common goals through good communication, cooperation, and mutual trust. The importance of building trust and creating a collaborative culture

as the main foundation for achieving successful team integration [2]. The contract changes often arise due to weak communication and collaboration between stakeholders [4]. This shows that team integration involving project owners, contractors, consultants, and subcontractors is a key element in maintaining consistency in project implementation.

In healthcare facility construction projects, particularly type A hospitals, effective management of contract changes and integration of the implementation team is required. Although a number of studies have discussed these two aspects separately, there is still little research that examines their overall relationship in the context of hospital projects in Indonesia. In fact, large-scale projects such as the construction of the Critical Center Building and Support Services at Dr. Moewardi Regional General Hospital are highly susceptible to changes during implementation, and the success of the project is largely determined by the strength of cross-party cooperation, including owners, consultants, contractors, and subcontractors.

In this context, this study focuses on evaluating contract change management and team integration effectiveness in the Critical Center Building and Support Services construction project at Dr. Moewardi Regional General Hospital. The main objectives are to assess the impact of contract changes on project time and cost efficiency, examine the effectiveness of project implementation team cooperation, and develop optimization concepts that can be used as a reference in similar projects, especially in the public health facility sector.

Based on the above studies, it appears that contract changes and weak team integration are the dominant factors that directly impact the performance of construction projects. However, most studies still discuss these two aspects separately and have not comprehensively examined their interrelationship, especially in the context of health infrastructure projects, which are highly complex. This indicates a need to examine these two aspects simultaneously within a single integrated analytical framework.

The novelty of this research lies in its integrative approach, which examines two elements of project management simultaneously, namely contract changes and team integration, within a single evaluative framework. This study not only assesses the problems that arise but also offers information technology-based solutions and structured communication strategies that can improve the efficiency of highly complex construction projects.

RESEARCH METHODS

Materials

The research was conducted at the Dr. Moewardi Regional General Hospital of the Central Java Provincial Government, located at Jalan Kolonel Sutarto No. 132, Jebres Village, Jebres District, Surakarta City, Central Java Province.

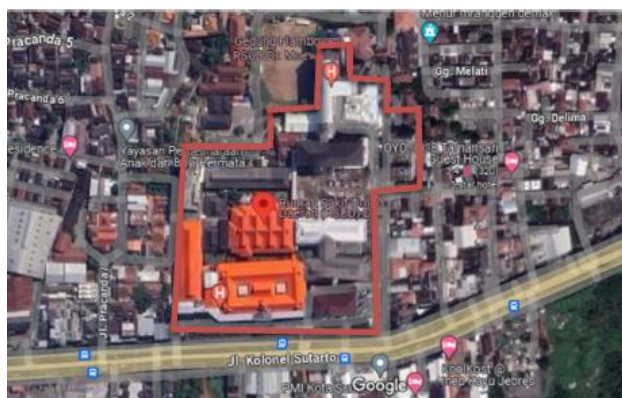


Figure 1. Research Location

Methods

This study uses a descriptive qualitative method that aims to describe in detail the conditions of contract change management and team integration in the construction project of the Critical Center Building and Support Services at Dr. Moewardi Regional General Hospital. The research stages began with the formulation of problems and research objectives based on the literature review results and the actual conditions of the project.

Primary data collection was conducted through a survey using a questionnaire to measure the effectiveness of contract change management and the level of team integration, as well as semi-structured interviews with project owners, consultants, and contractors to explore their perceptions and experiences in depth. Secondary data was obtained from project documents such as work contracts, budget plans (RAB), and implementation schedules (time schedules).

After all data was collected, it was verified for completeness. If the data were deemed adequate, the research would continue with an analysis of two main focuses, namely the evaluation of contract change management and the evaluation of team integration. The questionnaire analysis was conducted using descriptive and inferential calculations, while the interview results were analyzed qualitatively. The results of this analysis were used as the basis for drawing conclusions and recommendations in line with the research objectives.

Data Analysis

Primary data was processed using descriptive and inferential analysis. Descriptive analysis aimed to describe the characteristics of respondents and general patterns of questionnaire data by calculating the percentage of respondents in each answer category, calculating the mean or average score for each indicator, compiling frequency distributions, and presenting the results in bar charts, pie charts, or line graphs.

Inferential analysis was conducted using two methods. First, multiple linear regression was used to test the relationship between independent variables (contract change management indicators) and dependent variables (project performance). This regression model was used to identify the significant influence of each indicator on time performance and cost efficiency. Second, K-means cluster analysis was used to group respondents based on similarities in their perceptions of team integration indicators such as communication, trust, coordination, collaboration, and role alignment.

Qualitative data was analyzed using thematic analysis, which began with interview transcription, coding to identify themes, and then grouping themes based on the theoretical framework used. This analysis served to deepen quantitative findings and understand the context and dynamics of project management in the field.

To strengthen the validity of the findings, data triangulation techniques were used to cross-verify information from interviews, questionnaires, and document analysis. This approach ensures that the data obtained is consistent, reliable, and provides a complete picture of the relationship between contract changes, team integration, and project performance.

RESULT AND DISCUSSION

Descriptive Analysis

The selection of the number of respondents was based on technical considerations and resource efficiency. In quantitative research, a minimum of 30 to 40 respondents is used as an adequate standard, especially if the analysis method used involves regression, t-test, or correlation with the assumption of a normal data distribution [16],[18]. If the number of respondents is too small, for example, only 10 to 20 people, there is a risk that the data collected will not be sufficient to explain the relationship between variables [10]. Conversely, if the number of respondents is too large, such as 50 to 100, it will require more time, money, and energy. Therefore, this study involved 39 respondents consisting of 18 people (46%) who were users, 6 people (15%) who were planning consultants, 7 people (18%) who were supervisory consultants, and 8 people (21%) who were contractors. These 39 respondents participated in filling out a questionnaire via Google Forms, which was conducted from September 9 to 12, 2024.

The questionnaire distributed consisted of 42 questions. A total of 39 questions were quantitative in nature and were used as a basis for descriptive and inferential analysis. The questions consisted of 13 points regarding project performance (Q1-Q13), 13 points regarding contract change management (M1-M13), and 13 points regarding team integration (T1-T13). The remaining 3 questions are qualitative in nature and are used to explore more in-depth information related to contract change management and team integration. The questionnaire questions regarding project performance are presented in **Table 1**, the questionnaire questions regarding contract change management are presented in **Table 2**, and those regarding team integration are presented in **Table 3**.

Table 1. Project Performance Questions

Code	Questions
Q1	Phase 1 of the project was well constructed
Q2	Phase 1 of the project was completed according to schedule
Q3	The phase 1 project budget was managed effectively and efficiently
Q4	Risk management in phase 1 of the project was carried out effectively
Q5	Project work was completed according to the milestone targets
Q6	The project schedule is realistic and easy to follow
Q7	There was no significant deviation between the planned and actual time
Q8	Budget utilization in accordance with the initial project plan
Q9	Cost efficiency is a key consideration in project implementation
Q10	Costs did not exceed the budget despite changes in the scope of work
Q11	The project was carried out by optimizing available resources
Q12	Project implementation documentation is carried out in a neat and systematic manner
Q13	Project implementation is evaluated regularly to avoid delays or waste

Table 2. Contract Change Management Questions

Code	Questions
M1	Contract changes are approved by all parties before implementation
M2	Contract changes often occur during project implementation
M3	Contract changes affect timely project completion
M4	Contract changes caused delays in the project schedule
M5	Contract changes impact project cost efficiency
M6	Contract changes led to project cost overruns
M7	Additional costs from contract changes are estimated and approved before implementation
M8	The formal contract change procedure was followed properly throughout this project
M9	Effective and clear communication regarding contract changes among all parties
M10	Contract changes are made based on the results of project needs assessments
M11	Documentation of contract changes is carried out in an orderly and complete manner
M12	The impact of contract changes is analyzed before decisions are made
M13	The project team is involved in the contract change decision-making process

Table 3. Team Integration Questions

Code	Questions
T1	This project uses communication tools or project monitoring tools
T2	Communication between project team members is effective
T3	There are formal mechanisms, such as regular meetings, to support teamwork
T4	Problems or conflicts within the team are resolved quickly.
T5	Team members work well together to achieve project goals
T6	There is mutual trust between users, contractors, and consultants
T7	Users, contractors, and consultants assist each other in resolving issues in the field
T8	Each party is responsible for its respective roles and duties

- T9 The project team is highly committed to the schedule and budget
T10 Users, contractors, and consultants are transparent in their decision-making
T11 Leadership in projects maintains team integrity and efficiency
T12 The project leader provides the necessary support and guidance
T13 The project leader listens to and follows up on input from team members

Frequency and Percentage

Table 4. Percentage of Respondent Answers from the Performance Question Category

Questionnaire	Percentage								Total	
	4	3	2	1	Percentage	Percentage	Percentage	Percentage	Percentage	Respondents
Q1	79,49%	31	20,51%	8	0,00%	0	0,00%	0	100%	39
Q2	20,51%	8	71,79%	28	7,69%	3	0,00%	0	100%	39
Q3	12,82%	5	51,28%	20	35,90%	14	0,00%	0	100%	39
Q4	15,38%	6	74,36%	29	10,26%	4	0,00%	0	100%	39
Q5	20,51%	8	48,72%	19	28,21%	11	2,56%	1	100%	39
Q6	10,26%	4	79,49%	31	10,26%	4	0,00%	0	100%	39
Q7	41,03%	16	58,97%	23	0,00%	0	0,00%	0	100%	39
Q8	25,64%	10	71,79%	28	2,56%	1	0,00%	0	100%	39
Q9	25,64%	10	69,23%	27	5,13%	2	0,00%	0	100%	39
Q10	38,46%	15	46,15%	18	15,38%	6	0,00%	0	100%	39
Q11	46,15%	18	46,15%	18	7,69%	3	0,00%	0	100%	39
Q12	71,79%	28	28,21%	11	0,00%	0	0,00%	0	100%	39
Q13	64,10%	25	35,90%	14	0,00%	0	0,00%	0	100%	39



Figure 2. Percentage of Respondent Answers from the Performance Question Category

Based on the results of **Table 4** and **Figure 2**, 79.49% of respondents strongly agreed that the quality of construction was good. In addition, the project documentation aspect obtained a result of 71.79% and the existence of routine evaluations obtained a result of 64.10%.

Table 5. Percentage of Respondents' Answers from the Contract Change Management Question Category

Questionnaire	Percentage								Total	
	4	3	2	1	Percentage	Percentage	Percentage	Percentage	Percentage	Respondents
M1	79,36%	29	23,08%	9	2,56%	1	0,00%	0	100%	39
M2	12,82%	5	76,92%	30	10,26%	4	0,00%	0	100%	39
M3	12,82%	5	51,28%	20	35,90%	14	0,00%	0	100%	39
M4	10,26%	4	76,92%	30	12,82%	5	0,00%	0	100%	39
M5	23,08%	9	46,15%	18	28,21%	11	2,56%	1	100%	39
M6	5,13%	2	84,62%	33	10,26%	4	0,00%	0	100%	39
M7	33,33%	13	64,10%	25	2,56%	1	0,00%	0	100%	39

Questionnaire	Percentage								Total	
	4	3	2	1	Percentage	Percentage	Percentage	Percentage	Percentage	Respondents
M8	28,21%	11	69,23%	27	2,56%	1	0,00%	0	100%	39
M9	33,33%	13	61,54%	24	5,13%	2	0,00%	0	100%	39
M10	38,46%	15	46,15%	18	15,38%	6	0,00%	0	100%	39
M11	46,15%	18	46,15%	18	7,69%	3	0,00%	0	100%	39
M12	71,79%	28	28,21%	11	0,00%	0	0,00%	0	100%	39
M13	64,10%	25	35,90%	14	0,00%	0	0,00%	0	100%	39

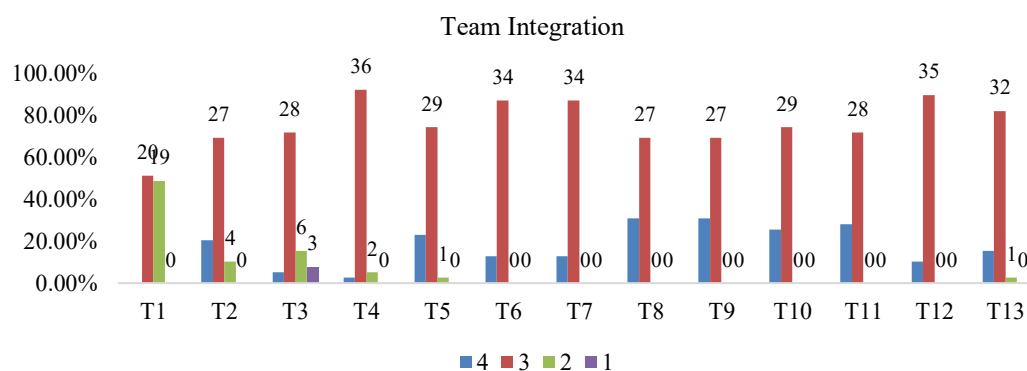


Figure 3. Percentage of Respondent Answers by Question Category: Contract Change Management

Based on these results, the M1 indicator received a very high score of 74.36%, indicating that the majority of respondents agreed that contract changes should be made with the consent of all parties before implementation.

Table 6. Percentage of Respondent Answers for the Team Integration Question Category

Questionnaire	Percentage								Total	
	4	3	2	1	Percentage	Percentage	Percentage	Percentage	Percentage	Respondents
T1	0,00%	0	51,28%	20	48,72%	19	0,00%	0	100%	39
T2	20,51%	8	69,23%	27	10,26%	4	0,00%	0	100%	39
T3	5,13%	2	71,79%	28	15,38%	6	7,69%	3	100%	39
T4	2,56%	1	92,31%	36	5,13%	2	0,00%	0	100%	39
T5	23,08%	9	74,36%	29	2,56%	1	0,00%	0	100%	39
T6	12,82%	5	87,18%	34	0,00%	0	0,00%	0	100%	39
T7	12,82%	5	87,18%	34	0,00%	0	0,00%	0	100%	39
T8	30,77%	12	69,23%	27	0,00%	0	0,00%	0	100%	39
T9	30,77%	12	69,23%	27	0,00%	0	0,00%	0	100%	39
T10	25,64%	10	74,36%	29	0,00%	0	0,00%	0	100%	39
T11	28,21%	11	71,79%	28	0,00%	0	0,00%	0	100%	39
T12	10,26%	4	89,74%	35	0,00%	0	0,00%	0	100%	39
T13	15,38%	6	82,05%	32	2,56%	1	0,00%	0	100%	39

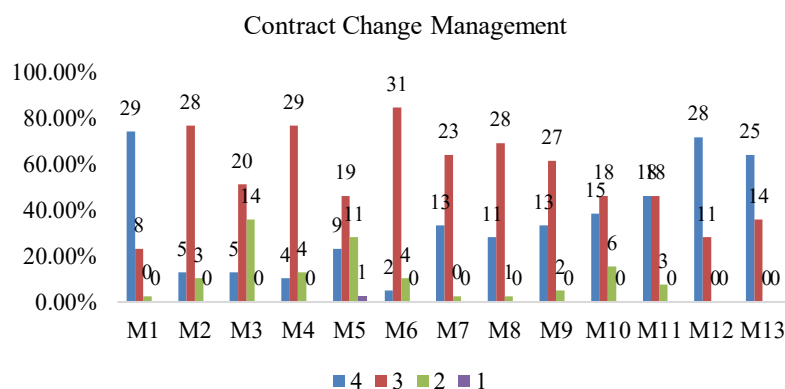


Figure 4. Percentage of Respondent Answers from the Team Integration Question Category

Based on the above results, 92.31% of respondents agreed that problems or conflicts within the team were resolved quickly (T4), resulting in high satisfaction [21].

Mean Average

The average of each questionnaire is then shown in Table 7 below:

Table 7. Average Questionnaire Results

Variable	Average	Variable	Average	Variable	Average
Project performance		Contract change management		Team integration	
Q1	3,79	M1	3,72	T1	2,51
Q2	3,13	M2	3,03	T2	3,10
Q3	2,77	M3	2,77	T3	2,74
Q4	3,05	M4	2,97	T4	2,97
Q5	2,87	M5	2,90	T5	3,21
Q6	3,00	M6	2,95	T6	3,13
Q7	3,41	M7	3,31	T7	3,13
Q8	3,23	M8	3,26	T8	3,31
Q9	3,21	M9	3,28	T9	3,31
Q10	3,23	M10	3,23	T10	3,26
Q11	3,38	M11	3,38	T11	3,28
Q12	3,72	M12	3,72	T12	3,10
Q13	3,64	M13	3,64	T13	3,13

Frequency Distribution

Interval classification calculations were performed using formula I to interpret the results in a more structured manner:

$$\text{Interval} = \frac{\text{Range}}{\text{Amount of Data}} \dots\dots\dots \text{formula I}$$

$$\text{Interval} = \frac{4-1}{4}$$

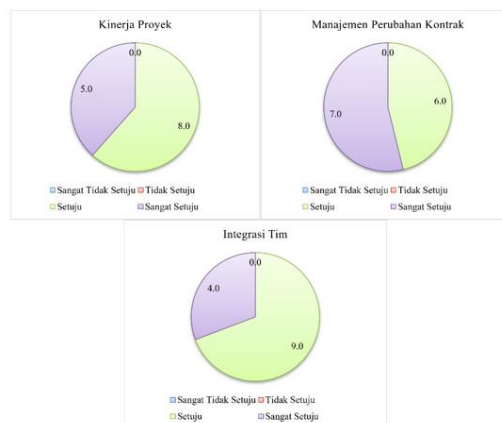
$$\text{Interval} = 0,75$$

Based on these calculations, the following four categories of intervals were obtained:

Table 8. Frequency Distribution Category

Range of Value	Category
1,00 – 1,75	Strongly disagree
1,76 – 2,50	Disagree
2,51 – 3,25	Agree
3,26 – 4,00	Strongly Agree

This classification is used to group the average scores of respondents for each indicator analyzed. From the average results of each category of the questionnaire, a frequency distribution can be made with results as shown in **Figure 5**.

**Figure 5.** Frequency Distribution for Each Category

Based on the results of the questionnaire, which consisted of three categories, namely project performance, contract change management, and team integration, it can be concluded that the implementation of the project was generally considered to be running well. The majority of statements on the project performance dimension were positive and received responses ranging from “Agree” to “Strongly Agree,” indicating that aspects such as budget management, scheduling, work quality, and implementation documentation had been carried out effectively and efficiently. A similar pattern was observed in the team integration dimension, where communication, cooperation, transparency, and team leadership received strong positive ratings from respondents. However, in the contract change management dimension, although it received a high quantitative score, it should be noted that some of the statements were negative. The high level of agreement with statements such as delays and cost overruns due to contract changes indicates that this aspect still needs to be more effective in order to minimize negative impacts. This shows that even though the change procedures have been followed properly, the impact of contract changes on schedules and cost efficiency is still an important concern in overall project management.

Inferential Analysis

Multiple Linear Regression

Multiple regression analysis was used to determine the effect of contract change management (independent variable) on project performance, which in this study was measured based on time performance and cost efficiency indicators (dependent variables). Data processing was performed using SPSS software. The approach used in this analysis was the variable selection method, which automatically included or excluded independent variables based on their statistical significance.

		Correlations												
	Y	M1	M2	M3	M4	M5	M6	M7	M8	M9	M10	M11	M12	M13
9	Pearson	1	.375*	.299	.416**	.364*	.554**	.508**	.384*	.476**	.598**	.548**	.469**	.457**
	Correlation													
	Sig. (2-tailed)													
	N	39	39	39	39	39	39	39	39	39	39	39	39	39

*. Correlation is significant at the 0.05 level (2-tailed).
**. Correlation is significant at the 0.01 level (2-tailed).

Figure 6. Correlation of Contract Change Management with Project Performance

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
9	.981	.962	.951	0.05811

Predictors: (Constant), M9, M5, M11, M2, M10, M8, M12, M7, M3

Figure 7. Model Summary

Based on the results of the stepwise regression analysis shown in the Model Summary, it can be concluded that contract change management (M) has a very significant effect on project performance (Y). In the first model, only indicator M9, namely effective and clear communication regarding contract changes among all parties, was included. Indicators were added gradually, until in the ninth model the R-Square value was consistently at 0.962. This indicates that the more aspects of contract change management are well managed, ranging from cost efficiency, documentation, frequency of changes, to formal procedures and impact analysis, the greater the contribution to improving overall project performance.

Cluster Analysis (K-Means)

This study used the K-Means Cluster Analysis method to group 39 respondents based on 13 research indicators. Data processing was carried out using SPSS software, so that clustering could be visualized and analyzed more accurately.

Iteration History ^a			
Change in Cluster Centers			
Iteration	1	2	3
1	1.296	1.358	1.411
2	.513	.082	.162
3	.306	.000	.135
4	.000	.646	.252
5	.257	.187	.106
6	.408	.000	.229
7	.000	.000	.000

a. Convergence achieved due to no or small change in cluster centers. The maximum absolute coordinate change for any center is .000. The current iteration is 7. The minimum distance between initial centers is 3.000.

Figure 8. Iteration History K-Means

The K-Means clustering process was carried out by setting the number of clusters to 3 (three), namely:

- Cluster 1 : Groups with high positive perceptions of team integration
- Cluster 2 : Groups with negative or low perceptions, especially on certain indicators
- Cluster 3 : Groups with neutral or moderate perceptions

Based on **Figure 8**, the clustering process reached convergence (cluster stability) at the 7th iteration. This is indicated by the cluster centers becoming smaller and smaller, until at the 7th iteration the maximum absolute change reached 0.000, which indicates that the cluster centers no longer changed significantly.

	Cluster		
	1	2	3
T1	2.64	2.25	2.55
T2	3.36	3.25	2.90
T3	2.91	1.63	3.10
T4	3.09	2.88	2.95
T5	3.64	3.13	3.00
T6	3.45	3.00	3.00
T7	3.45	3.00	3.00
T8	3.82	3.13	3.10
T9	3.82	3.00	3.15
T10	3.91	3.00	3.00
T11	3.82	3.13	3.05
T12	3.36	3.00	3.00
T13	3.55	2.88	3.00

Figure 9. Final Cluster Centers

Based on the cluster center results in the figure above, it can be concluded that Cluster 1 (group with high perception of team integration) shows high average values on almost all indicators. The highest score is found in indicator T10 (3.91), which is related to transparency in decision making. Other high scores are seen in the indicators of teamwork (T5), mutual trust (T6), and mutual responsibility (T8). This shows that this group has a very positive perception of the implementation of team integration in the project. Cluster 2 (low perception of team integration) had the lowest scores on most indicators, particularly T3 (1.63) and T1 (2.25). These scores indicate that this group experiences limitations in formal mechanisms and the use of communication tools in the project, which has the potential to hinder integration among team members. The scores in Cluster 3 (group with neutral perceptions of team integration) range from 2.90 to 3.15, with the highest score on the team commitment indicator (T9 = 3.15). In general, this group reflects a neutral or fairly satisfied perception of team integration. Although there are no indications of dissatisfaction, this group has the potential to be improved through appropriate management strategies.

CONCLUSION

This study was conducted with the aim of evaluating the effect of contract change management on time performance and cost efficiency, assessing the effectiveness of team integration in projects, and formulating concepts for optimizing both in the construction of the Critical Center Building and Support Services at Dr. Moewardi Regional General Hospital. In this project, contract change management was implemented procedurally through the approval of all parties, complete documentation, and adequate impact analysis. The results of the study show that contract change management has a very strong influence on overall project performance. However, contract changes still require effective management in order to maintain time and cost efficiency, so a more optimal management strategy is still needed. Team integration in this project showed relatively effective results, as reflected in the cooperation, mutual trust, and shared responsibility among stakeholders. This condition indicates a fairly good professional relationship. However, weaknesses were still found in formal communication and the implementation of regular meetings, so that project coordination was not yet optimal. The novelty of this research lies in its integrative approach, which combines regression and clustering simultaneously to analyze and optimize contract management and team integration, with recommendations for strengthening formal communication, BIM, cloud-based platforms, and periodic team performance evaluations. Overall, the results of this study can be an alternative for project owners in accelerating the contract change approval process, for consultants to strengthen the documentation system, and for contractors to anticipate the impact of costs and time.

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