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Model of the Influence of Contract Changes on Project Performance in Government Building Projects

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Abstract

Badung Regency as one of the regencies in Bali Province that has a construction service package in Badung Regency experienced a significant increase in 2023 as many as 128 project data. Project development always continues to increase due to demand by project owners, which occurs during the project period causing construction changes. These changes result in inconsistencies with the initial plan. Changes occur very often, so they will have an impact on increasing costs, late project completion, and also building quality that does not comply with the quality plan. The impact of contract changes occurs on costs because additional costs have implications for increasing work volume. The description of the work of implementing a building construction project is very complex, so it is rare in a building construction project that there is no change in the contract until the project is completed. In this study, a deductive approach will be carried out with a quantitative method. The sampling technique used is non-probability sampling with the convenience sampling method. There are 5 (five) factors that form contract changes, 5 (five) factors form cost performance, 6 (six) factors form time performance, 5 (five) factors form quality performance. The relationship model describes the direct relationship between contract changes and project performance using the second order on

Smart PLS. Contract changes have a significant relationship to project performance, where when a contract change occurs it will directly affect project performance.

Keywords
Project Performance, Effect of Contract Changes, Smart PLS

Introduction
Badung Regency, as one of the regencies in Bali Province with construction service packages, saw a substantial increase in 2023 with 128 project data. Project development is continuously rising due to demands from project owners during the project period, which causes construction changes. All construction projects can experience changes starting from the initial implementation, mid-project, or even at the project's end (Aziz 2013). These changes lead to inconsistencies with the initial plan. Contract changes need to be thoroughly examined to understand the variables influencing them so the model can accurately reflect the real phenomena. The work description in implementing a building construction project is very complex, and it is rare for a building construction project not to experience contract changes until it is completed. The impacts or consequences may affect the project, resulting in cost increases, delays in project completion, and lower quality outcomes than initially planned (Gumolili et al. 2012). Unplanned changes in construction projects can lead to additional work beyond what was expected, impacting costs, quality, and project time (Martanti 2018).

Given the complexity of the impact of contract changes, they significantly influence the performance of a construction project. In Badung Regency, contract changes are common in building construction projects, and several factors contribute to these changes. Hence, research is necessary to identify the factors affecting contract changes and their impact on cost, quality, and time in government building projects in Badung Regency.This research explores several key issues, including what factors contribute to contract changes and project performance in government building projects in Badung Regency, the relationship between contract changes and project performance, and which dominant factors influence project performance related to cost, time, and quality in these government projects.

2. Methods
This research adopts a deductive approach with a quantitative method. A survey approach will be used to identify the factors influencing contract changes and their consequences. The survey will target ongoing or recently completed projects, and the results will be analyzed based on responses from key stakeholders involved in the projects. The primary data will include structured interviews with experts and distributing questionnaires, while the secondary data will include a list of projects conducted in Badung Regency during 2022-2023. The sampling technique used is non-probability sampling with the convenience sampling method. The sample size is determined using the Slovin formula, with a total population of 90 projects, resulting in a sample of 74 respondents.

3. Results and Discussion
3.1 Factors Shaping Contract Changes and Project Performance

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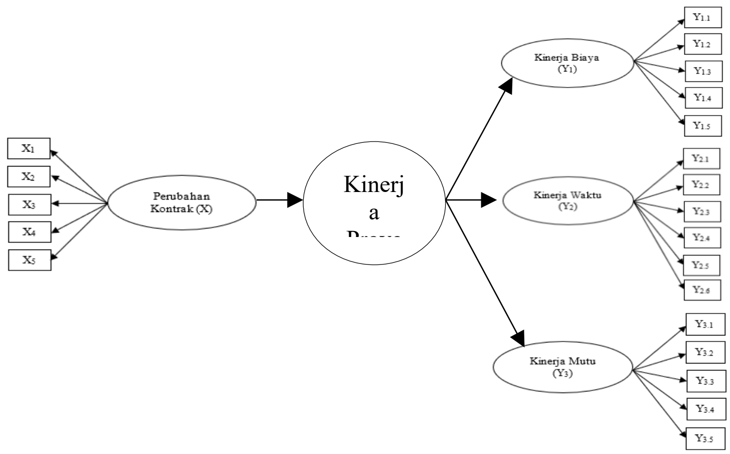

Figure 1. Model of the Relationship Between Contract Changes and Project Performance (a)

Table 1. Factors Shaping Contract Changes and Project Performance(b)

Variable	Shaping Factors
Contract Changes (X)	Lack of communication or instructions (X1)
	Changes in work volume or added scope (X2)
	Design changes (X3)
	Discrepancies between planning drawings and field conditions (X4)
	Incomplete contract (X5)
Cost Performance (Y_1)	Compliance with work drawings (Y1.1)
	Control over changes in work (Y1.2)
	Cost variance or additional costs (Y1.3)
	Monitoring process and work stages (Y1.4)
	Control over the tender process (Y1.5)
Time Performance (Y_2)	Worker productivity (Y2.1)
	Compliance with terms of reference (Y2.2)
	Control over changes in work (Y2.3)
	Efforts to meet timely targets (Y2.4)
	Work scheduling (Y2.5)
	Control over the tender process (Y2.6)
Quality Performance (Y_3)	Compliance with work drawings (Y3.1)
	Monitoring process and work stages (Y3.2)
	Quality and standardization of materials used (Y3.3)
	Work productivity (Y3.4)
	Compliance with terms of reference (Y3.5)

a) Model of the Relationship Between Contract Changes and Project Performance

b) Relationship Between Contract Changes and Project Performance

The analysis is divided into two stages: the evaluation of the Measurement Model (outer model) and the Structural Model (inner model). The results of the Measurement Model are presented in Figure 2

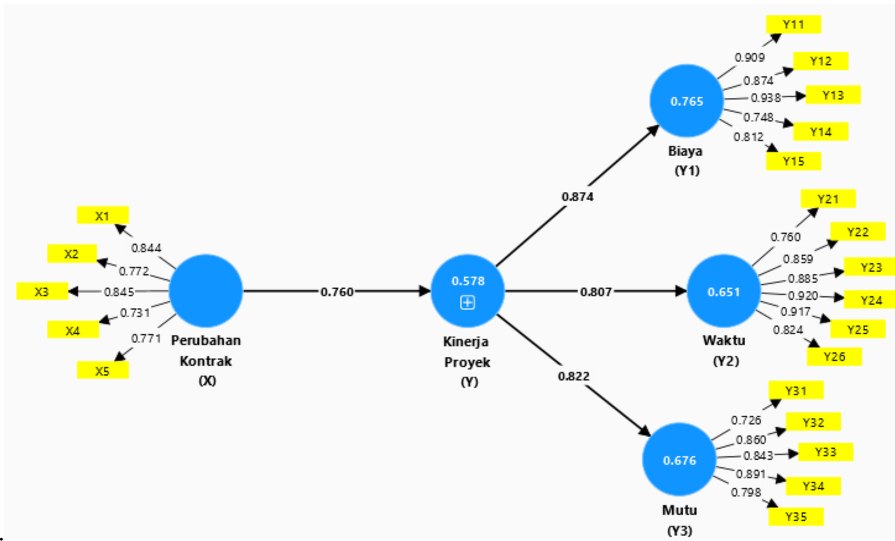

Figure 2. Outer Model PLS

Based on the outer model results, the following can be explained:
Validity Test The validity test is applied to assess the ability of the research instruments to measure what they are supposed to measure. The basis for measuring convergent validity is determined by the values of outer loading and Average Variance Extracted (AVE). If the outer loading value is > 0.5 and AVE > 0.5, the indicators of the constructs/latent variables used are considered valid and consistent. The results of the validity test for the constructs/latent variables in this study can be seen in **Table 2.(Please see APPENDIX -A**)

From **Table 2(APPENDIX -A**) , it is evident that the results of the convergent validity test show that the outer loading for each indicator used in this study is greater than 0.5, indicating that the data meet the convergent validity criteria.

Table 3. Average Variance Extracted (AVE) Results

	Cornbach's alpha	Composite reliability (rho_a)	Composite reliability (rho_c)	Average extracted (AVE)
X	0,852	0,856	0,895	0,630
Y	0,933	0,935	0,941	0,500
Y1	0,909	0,911	0,933	0,738
Y2	0,930	0,936	0,946	0,744
Y3	0,882	0,884	0,914	0,682

According to Table 3, the Average Variance Extracted (AVE) values for each construct used in this study exceed the expected value of 0.5, indicating that the constructs used in the study have good convergent validity.

a. Reliability Test The basis for determining the reliability of research variables in PLS is assessed using two methods: Cronbach's Alpha and Composite Reliability. If the values of Cronbach's Alpha and Composite Reliability are greater than 0.7 (or 0.6 is still acceptable), all latent variables are considered reliable. The reliability test results are shown in Table 4.

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Table 4. Cronbach's Alpha and Composite Reliability Results

	Cornbach's alpha	Composite reliability (rho_a)	Composite reliability (rho_c)
X	0,852	0,856	0,895
Y	0,933	0,935	0,941
Y1	0,909	0,911	0,933
Y2	0,930	0,936	0,946
Y3	0,882	0,884	0,914

Based on the analysis of Cronbach's Alpha and Composite Reliability in Table 4, it can be concluded that the values of Cronbach's Alpha and Composite Reliability for each construct in the study are greater than 0.7, indicating that all the latent constructs/variables are reliable.After evaluating the Measurement Model (Outer Model), the next step is to evaluate the Structural Model (Inner Model) using bootstrapping. The Structural Model in this study is presented in Figure 3.

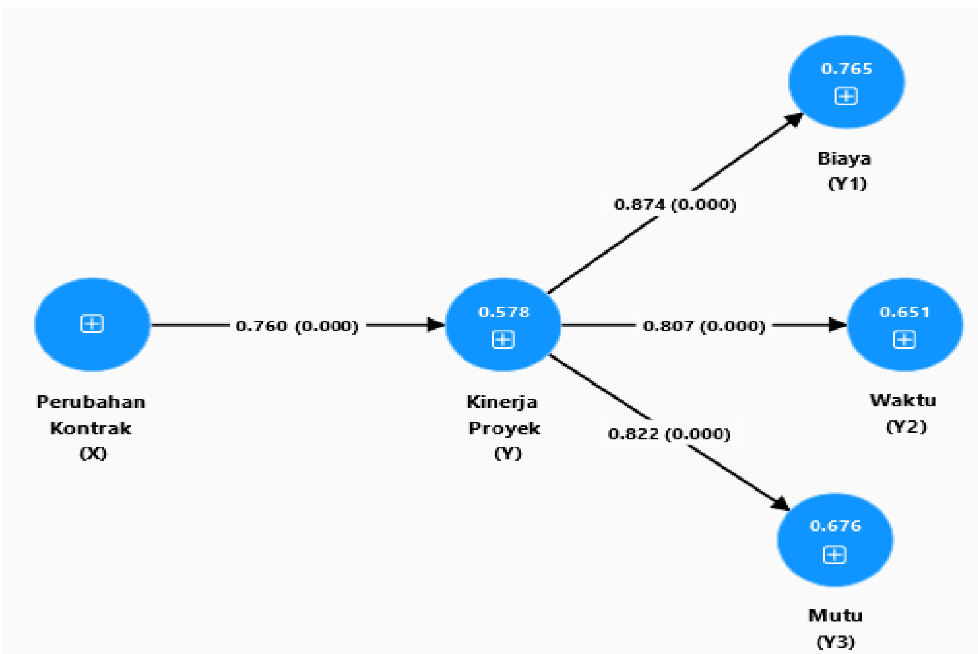

Figure 3. Inner Model PLS

Based on the bootstrapping results for the inner model, the following can be explained:

a. R-**Square (Coefficient of Determination)** The measurement criteria using R-square are assessed from the values of R-square, where values of 0.75, 0.50, and 0.25 indicate strong, moderate, and weak models, respectively. A higher R-square value indicates a better predictive model. The results of R-square are shown in Table 5.

Table 5. R-square Coefficient of Determination Results

	R-square	R-square adjusted
Y	0,578	0,572
Y1	0,765	0,761
Y2	0,651	0,646
Y3	0,66	0,671

b. Goodness of Fit

The goodness of fit is measured by the value of Q^2 to calculate the predictive accuracy of the research model.

$Q^2 = 1 – (1 - R_1^2) … (1 – R_n^2)$
$Q^2 = 1 – (1 – 0{,}578) (1 – 0{,}765) (1 – 0{,}651) (1 – 0{,}676)$
$Q^2 = 1 – (0{,}422 \times 0{,}235 \times 0{,}449 \times 0{,}324)$
$Q^2 = 0{,}986$

From the calculation above, the value of Q^2 is 0.986, which is greater than 0, indicating that the model used in this study has predictive relevance.

c. Hypothesis Testing and T-Values

Table 6. Bootstrapping Results of Direct Effects

	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statics (|O/STDEV|)	P values
X → Y	0,760	0,764	0,049	15,629	0,000
Y → Y1	0,874	0,876	0,033	26,211	0,000
Y → Y2	0,807	0,807	0,053	15,136	0,000
Y → Y3	0,822	0,825	0,038	21,072	0,000

Based on the bootstrapping results presented in Table 6, the relationship between the independent and dependent variables used in this study shows that contract changes have a significant direct effect on cost, time, and quality performance in government building projects in Badung Regency.

Table 7. Bootstrapping Results of Indirect Effects

	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statics (|O/STDEV|)	P values
X → Y1	0,665	0,669	0,056	11,940	0,000
Y → Y2	0,614	0,617	0,066	9,266	0,000
Y → Y3	0,625	0,630	0,053	11,827	0,000

From the bootstrapping results presented in Table 7, it is evident that contract changes also have a significant indirect effect on cost, time, and quality performance in government building projects in Badung Regency.

3.2 Dominant Factors Affecting Project Performance

5. Conclusion

In this research, five factors were identified that shape contract changes: lack of instructions, addition of work scope, design changes, discrepancies between planning drawings and field conditions, and incomplete contracts. Five factors also shape cost performance, six shape time performance, and five shape quality performance. The model illustrates a direct relationship between contract changes and project performance using second-order Smart PLS. Contract changes significantly influence project performance, and the dominant factors affecting project performance in

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government building projects in Badung Regency include 1) design changes causing scheduling shifts, 2) control over changes in work, 3) worker productivity, and 4) Compliance with terms of reference.
Recommendations for the government include considering the dominant factors that positively influence project performance when making decisions for future projects.

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APPENDIX -A

Table 2. Convergent Validity Test Results

	X	Y	Y1	Y2	Y3
X1	0,844				
X2	0,772				
X3	0,845				
X4	0,731				
X5	0,771				
Y11		0,752			
Y11			0,909		
Y12		0,713			
Y12			0,874		
Y13			0,938		
Y13		0,794			
Y14		0,735			
Y14			0,748		
Y15		0,750			
Y15			0,812		
Y21		0,609			
Y21				0,760	
Y22				0,859	
Y22		0,690			
Y23		0,711			
Y23				0,885	
Y24		0,770			
Y24				0,920	
Y25				0,917	
Y25		0,747			
Y26		0,634			
Y26				0,824	
Y31		0,642			
Y31					0,726
Y32		0,624			
Y32					0,860
Y33		0,656			
Y33					0,843
Y34		0,724			
Y34					0,891
Y35					0,798
Y35		0,730			

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