Research on the Management and Control Mode of Engineering Cost from the Perspective of Big Data Analysis -- An Empirical Analysis Based On 20 Groups of Data in Four Regions

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Abstract: With the increasingly fierce competition, the engineering industry has entered the era of low profit. In order to save costs and improve the engineering technology content, it is in an advantageous position in the fierce market competition. It is necessary to break through the traditional thinking, carry out data integration and seek benefits from management. In this paper, 20 sets of complete project cost control process data in North China, South China, East China and central China (2017-2019) obtained by cost cloud are analyzed by t-test of correlation, single factor variance and paired samples, and the correlation and regularity between the data are found, and the general situation of project cost control in North China, South China, East China and central China is summarized. The results of empirical analysis show that: due to the difference of cost setting value of condition difference, the total cost in North China, South China, East China and central China tends to be average; the difference between target value and dynamic value is significant, and the dynamic control is weak, so the inherent cost control mode needs to be changed; the cost control mode in the engineering industry is significantly different, and there is no unified, coordinated and benchmarked standard control mode. Based on this, it will become a new measure of management and control to explore the deep adaptation mode of big data analysis and engineering cost management and control, establish standardized engineering cost management and control to solve the problems of disunity, incoordination and benchmarking, and optimize and improve the implementation path of cost saving.

1. Introduction

Since the reform and opening up, large and super large-scale projects have been under construction, which is not only the need of national development but also the embodiment of national strength. However, due to the increasingly fierce competition, the engineering industry has entered the era of low profit. In order to save costs and improve the engineering technology content, it is in an advantageous position in the fierce market competition. It is necessary to break through the traditional thinking, integrate data and seek benefits from management. Zhou Xuhong et al. Studied the whole life cycle of steel structure, and found that steel structure has the characteristics of circular economy, which can save the engineering cost to the greatest extent [1]; some foreign experts and scholars suggested using prefabricated buildings, reducing expenditure through standard design and large-scale mass production, and applying lean concept to production process to reduce production cycle and cost [2-3] The above research realizes the goal of engineering cost saving from the perspective of material technology and technological innovation. Zhang Jianping, et al. Proposed a cost solution for dynamic resource control and real-time cost monitoring based on 4d-bim technology from the perspective of engineering management [4]; Ding lieyun, et al. Proposed a digital construction concept with intelligent construction and 3D printing as the key content, and gave a digital solution for cost control [5]. Wang Mengjun et al. established the cost control model of metro project by tracking the whole process of cost control of metro project, studying the key influencing factors and formation mechanism [6], and providing reference for the construction of standard model of project cost control. The standardization law of the People's Republic of China revised and implemented in 2018 also clearly points out that all industries should unify management standards. Although the relevant theoretical research has been very mature, but it is relatively scattered, mostly focusing on material technology, technological innovation, intelligence, digitization and other directions; this paper collects the dynamic cost control data of each region from the perspective of big data analysis for calculation and analysis, observes the differences between the data display, summarizes the external and internal laws between the data, and carries out the North China, South China, East China and central China regions Research on the mode of project cost control.

2. Theoretical Basis for Cost Control of Big Data Engineering

The subversive revolution of big data is not only the innovation of thinking mode, but also the change of behaviour mode, and the birth of new business form of engineering management. Big data, as a basic resource with hidden thoughts and connotations, deeply excavates its potential efficiency and relevance [7-8]. It will be the postnatal power for the future development to fit in with the concrete practice. From the perspective of big data analysis, the goal setting is applied to project cost control to meet the "smart" principle, with all employees participating and performance incentive [9-11]. Comprehensively improving management and control efficiency is one of the optimization paths of management and control. Analysis of economic big data, tracking the whole process of data, cost management as the control line of enterprise management, is the fundamental of the enterprise. The cost management mode of full cycle, all-round and all staff management, combination of economy and technology, and implementation of cost responsibility [12-13]. Make engineering cost control more efficient. The data mining, deep learning and optimization simulation technology of big data analysis [14] provides methods and means for cost management and target setting theory. This paper will use cross theoretical research to innovate the solution of engineering cost and explore the optimization path of engineering cost control.

3. Research Objectives of Big Data Engineering Cost Control

With big data analysis technology as the main line, the project cost management and control mode research is carried out, focusing on the following two points:

(1) Mining the correlation and regularity of cost control process data of 20 complete engineering projects in North China, South China, East China and central China (2017-2019) obtained by cost cloud;

(2) Through the calculation and analysis of correlation, single factor variance and paired sample t-test, the general situation of engineering cost control in North China, South China, East China and central China is summarized.

4. Research Methods for Cost Control of Big Data Engineering

4.1 Data Statistics

Based on the data statistics technology, relying on the cost cloud management platform, this paper deconstructs the digital characteristics of correlation and regularity between the project cost control data. In order to study the control process of engineering cost, find out the relationship and law between independent variable and dependent variable, so as to facilitate the future engineering cost control, 20 groups of complete engineering project cost control process data from 2017 to 2019 are obtained through the cost cloud as the original data, and the income, cost, profit and profit rate of target cost and dynamic cost are selected as the research factors The project covers different regions in North China, South China, East China and central China (Table 1). The general performance of the research results can reflect the general situation of project cost control in different regions. Now, 20 groups of data are analysed and processed.

Table 1. Cost Control Data List of 20 Engineering Projects (2017-2019)

Unit: 100 million Yuan

Project	Target cost				Dynamic cost			
	Income	Cost	Profit	Profit margin (%)	Income	Cost	Profit	Profit margin (%)
North China region								
1	6.70	6.32	0.38	6.01 %	6.65	6.41	0.24	3.74 %
2	7.01	6.29	0.72	11.45 %	6.93	6.42	0.51	7.94 %
3	13.87	11.43	2.44	21.35%	14.55	12.06	2.49	20.65%
4	16.43	15.74	0.69	4.38 %	17.50	16.48	1.02	6.19 %
5	15.23	12.97	2.26	17.42 %	14.53	13.10	1.43	10.92 %
South China region								
6	7.30	6.01	1.29	21.46 %	7.45	6.67	0.78	11.69 %
7	6.64	5.85	0.79	13.50 %	7.13	6.58	0.55	8.36 %
8	12.51	10.41	2.10	20.17%	13.11	10.42	2.69	25.82%
9	15.12	12.68	2.44	19.24 %	15.80	13.31	2.49	18.71 %
10	12.12	10.88	1.24	11.40 %	15.93	13.83	2.10	15.18 %
East China region								
11	8.15	7.37	0.78	10.58 %	8.20	7.69	0.51	6.63 %
12	9.45	8.42	1.03	12.23 %	10.40	9.01	1.39	15.43 %
13	10.41	9.21	1.20	13.03 %	10.98	10.05	0.93	9.25 %
14	8.46	7.68	0.78	10.16 %	9.38	7.88	1.50	19.04 %
15	13.76	11.66	2.10	18.01 %	14.36	11.67	2.69	23.05 %
Central China								
16	6.45	6.07	0.38	6.26%	6.4	6.16	0.24	3.90%
17	16.18	15.49	0.69	4.45%	17.25	16.23	1.02	6.28%
18	10.16	8.96	1.20	13.39%	10.73	9.8	0.93	9.49%
19	12.26	10.16	2.10	20.67%	12.86	10.17	2.69	26.45%
20	8.21	7.43	0.78	10.50%	9.13	7.63	1.50	19.66%

4.2 Data Characteristics

4.2.1 Data Correlation

The correlation of the collected 20 groups of data was calculated to observe the closeness of data factors, reveal the correlation of data, seek the relationship between variables, and determine that the collected data has research value and statistical significance. Correlation calculation of random data combination (Table 2).

Table 2. Correlation Analysis

		Target revenue	Target cost	Target profit	Dynamic income	Dynamic cost	Dynamic profit
Target revenue	**Correlation**	1	.983**	.595**	.974**	.958**	.607**
	Sig		.000	.006	.000	.000	.005
Target cost	**Correlation**	.983**	1	.438	.966**	.981**	.489*
	Sig	.000		.053	.000	.000	.029
Target profit	**Correlation**	.595**	.438	1	.541*	.401	.863**
	Sig	.006	.053		.014	.080	.000
Dynamic income	**Correlation**	.974**	.966**	.541*	1	.979**	.641**
	Sig	.000	.000	.014		.000	.002

		Target revenue	Target cost	Target profit	Dynamic income	Dynamic cost	Dynamic profit
Dynamic cost	**Correlation**	.958**	.981**	.401	.979**	1	.473*
	Sig	.000	.000	.080	.000		.035
Dynamic profit	**Correlation**	.607**	.489*	.836**	.641**	.473*	1
	Sig	.005	.029	.000	.002	.035	

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

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

Table 2 correlation calculation results show that target income target cost, target income dynamic income, target income dynamic cost, target cost dynamic income, target cost dynamic cost, target profit dynamic profit, dynamic income dynamic cost, dynamic income dynamic profit and other variables are combined at 0.01 level (double tail), with significant correlation; target income - Target profit, target income dynamic profit, target cost dynamic profit, target profit dynamic income, dynamic cost dynamic profit and other variables are at 0.05 level (double tail), with significant correlation. The significance of all variable combinations of the results is less than 0.05, indicating that there is statistical significance of the difference. Therefore, it is beneficial to study and analyze the variable combinations with significant correlation to find out the law of engineering cost control and guide the engineering construction practice. At the same time, this paper focuses on the law of cost correlation, always taking cost as independent variable and other variables as dependent variable.

4.2.2 One Way Anova

Discrete random variables usually mean (expected value) to describe the overall characteristics. It is a weighted average of all possibilities of uncertain conditions, measures the overall trend of event results and variance is a digital feature describing the average degree of deviation of random variables from the mean. ANOVA is a method and technique to distinguish the causes of variation among several data groups that can be compared with each other [15-16]. Analysis of variance is essentially a quantitative analysis of the causes of variation of observations.

In order to study the impact of different regions and enterprise management and control methods on the target cost of North China, South China, East China and central China, the target cost data variables of the four regions are described and counted according to the region number. The North China region is numbered 1, the South China region is numbered 2, the East China region is numbered 3, and the central China region is numbered 4 (Table 3). First of all, the average target cost of East China is the lowest (8.8680), while the average target cost of North China is the highest (10.5500), but the average value of the four regions has little difference. Secondly, the standard deviation of target cost in East China is the lowest (1.71525), while that in North China is the highest (4.17155). The maximum, minimum and 95% confidence intervals of the four regions are also presented in the table.

Table 3. Statistical Description

Target cost

	N	Mean	Std. Deviation	Std. Error	95% confidence interval of mean		Minimum	Maximum
					Lower Bound	Upper Bound		
1	**North China** 5	10.5500	4.17155	1.86557	5.3703	15.7297	6.29	15.74
2	**South China** 5	9.1660	3.07367	1.37459	5.3495	12.9825	5.85	12.68

3	**East China** 5	8.8680	1.71525	.76708	6.7382	10.9978	7.37	11.66
4	**Central China** 5	9.6220	3.62570	1.62146	5.1201	14.1239	6.07	15.49
Total	20	9.5515	3.07654	.68794	8.1116	10.9914	5.85	15.74

Table 4 shows the results of Levene variance homogeneity test, and Levene statistics is 1.577. P value of significance is 0.234 > 0.05, so the variance of this group of data is homogeneous.

Table 4. Test of Homogeneity of Variance

Target cost

Levene statistics	df1	df2	Sig.
1.577	3	16	.234

Table 5 shows the results of one-way ANOVA, and the trend test is carried out. The results show that the analysis statistics of target cost ANOVA between different regions f = 0.251, P = 0.859 > 0.05. It is considered that there is no significant difference in target cost between different regions.

Table 5. Analysis of Variance

Target cost

			Sum of squares	Freedom	Mean square	F	Sig.
Between Groups	**(combination)**		8.089	3	2.696	.251	.859
	Linear Term	**Contrast**	2.375	1	2.375	.221	.644
		Deviation	5.714	2	2.857	.266	.770
Within Groups			171.748	16	10.734		
Total			179.837	19			

Table 6. Multiple Comparative Analysis

Dependent variable: target cost

	(I) N	(J)N	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
LSD	1	2	1.38400	2.07212	.514	-3.0087	5.7767
		3	1.68200	2.07212	.429	-2.7107	6.0747
		4	.92800	2.07212	.660	-3.4647	5.3207
	2	1	-1.38400	2.07212	.514	-5.7767	3.0087
		3	.29800	2.07212	.887	-4.0947	4.6907
		4	-.45600	2.07212	.829	-4.8487	3.9367
	3	1	-1.68200	2.07212	.429	-6.0747	2.7107
		2	-.29800	2.07212	.887	-4.6907	4.0947
		4	-.75400	2.07212	.721	-5.1467	3.6387
	4	1	-.92800	2.07212	.660	-5.3207	3.4647
		2	.45600	2.07212	.829	-3.9367	4.8487
		3	.75400	2.07212	.721	-3.6387	5.1467

The LSD method is used for observation, and table 6 shows the results of comparison between the two groups in four regions. The significance p value > 0.05 indicates that there is no significant difference. The s-n-k method is used for testing. Table 7 shows that the four regional data variables of target cost are all collected into a subset, which is consistent with the result of LSD method, and it can be mutually confirmed that the four regional data variables of target cost have no significant difference.

Table 7. Target Cost

	N	Number of cases	Subset for alpha = 0.05
			1
S-N-K[a]	3	5	8.8680
	2	5	9.1660
	4	5	9.6220
	1	5	10.5500
	Sig.		.848

Means for groups in homogeneity subset is displayed.
a. Use Harmonic Mean Sample Size = 5.000.

According to the above analysis process, single factor ANOVA is used to analyse the target income, target profit, dynamic income, dynamic cost and dynamic profit respectively. It is found that there is no significant difference in the variable data of the four regional groups.

4.2.3 Paired Samples Test

In order to study the relationship between the target value and the dynamic value, three pairs of paired data variables, target profit - dynamic profit, target income - Dynamic Income and target cost - dynamic cost, are selected for paired sample t-test (Table 8). The results show that the average value of the three paired data variables is negative, and the dynamic value has a certain degree of growth compared with the target value; the target profit dynamic profit statistics $t = -1.10$, P value = $0.282 > 0.005$, it is considered that there is no significant difference in the average value of the target profit dynamic profit in general; the target income dynamic income statistics $t = -3.28$, P value = $0.004 < 0.005$, it is considered that the target income Dynamic Income in general The statistics of target cost dynamic cost $t = -3.63$, $P = 0.002 < 0.005$. It is considered that the average of target cost dynamic cost is significantly different in general.

Table 8. Paired Samples Test

	Pairing difference					t	Sig.
	Mean	Std. Deviation	Std. error Mean	95% Confidence Interval of the Difference			
				Lower	Upper		
Target profit – Dynamic profit	-.12	.47	.11	-.34	.10	-1.10	.286
Target revenue - Dynamic revenue	-.64	.88	.20	-1.05	-.23	-3.28	.004
Target cost – dynamic cost	-.53	.65	.15	-.83	-.22	-3.63	.002

According to the above analysis method, this paper calculates the target profit, dynamic profit, target income, dynamic income, dynamic cost intra group and inter group relationship in North China, South China, East China and central China. Because the layout problem is not fully displayed, but the following data results will be comprehensively analysed considering all the calculated results.

4.3 Data Results

4.3.1 Regional Impact Differences

There are differences in the cost setting values due to condition differences in North China, South China, East China and central China, but the overall cost tends to average. As shown in Tables 1, 3 and 6, the average cost of East China is the lowest (8.8680), while that of North China is the highest (10.5500). Although the average cost of the four regions has changed, the overall difference is not obvious. Based on the data of income, profit and profit rate, the development of each region is unbalanced. The target cost dynamic cost data p value is less than 0.005, which shows that the development level of each region is inconsistent, and the cost setting value is also different, but the overall trend is average.

4.3.2 Cost Control Variance

There is a significant difference between the target value and the dynamic value, and the dynamic control is not effective. The inherent cost control mode needs to be changed urgently. As shown in Table 1 and table 3, the maximum and minimum values of projects in North China, South China, East China and central China are quite different; the data results show that there is no significant difference between the target cost and the target income within the group, but the p value of the comparison between the target cost and the dynamic income is less than 0.005, showing significant difference (see Table 8), indicating that the target setting is not clear, and the mismatch with the dynamic control is not conducive to the whole process At the same time, the target profit dynamic profit significance p value > 0.005 shows that the profit difference is not significant, indicating that the target setting and process management defects lead to limited profit space.

4.3.3 Differences in Management Mode

There are significant differences in cost control modes in the engineering industry, and there is a lack of unified, collaborative and benchmarking standard control modes. See Table 1, 3, etc. for the project profit margin of North China, South China, East China and central China, the difference between the maximum value and the minimum value is significant; see Table 8, etc. for the target income dynamic income statistics $t = -3.28$, P value = $0.004 < 0.005$, target cost dynamic cost statistics $t = -3.63$, P value = $0.002 < 0.005$, there are significant differences between the groups, indicating that the management mode of the project is inconsistent and needs to be changed Reform and innovation, build a unified, coordinated and benchmarking standard model to improve industry profits.

5. Measures and suggestions

The analysis of the above calculation results shows that the regional advantages are not obvious, the development of the engineering industry is basically balanced, the determination of management objectives and the dynamic management and control process are generally not combined with big data, the combination and utilization of modern digital means are too inefficient, the informatization degree of management mode is insufficient, and the efficiency is low, so the profit rate cannot be guaranteed well. Based on the results of comprehensive data, the following suggestions are put forward:

(1) Give full play to the unique regional economic advantages, optimize the industrial structure of new formats, tap the advantages of industrial development, make full use of the role of big data analysis, build regional industrial chain enabling engineering cost optimization and upgrading, and establish a unified industry management standard as the guidance of industry development.

(2) Comprehensive data observation and analysis show that the investment mode of high investment and high return is no longer applicable, lack of standardized target cost measurement system, and weak dynamic control of cost in the whole cycle. It is necessary to innovate the cost control path to realize the fine control of the whole life cycle of engineering cost.

(3) The concentration of engineering industry has increased sharply, the management and construction of large-scale enterprises tend to be standardized, the traditional real estate enterprises have experienced a bottleneck period of development, and the differences in management modes have gradually polarized. In order to develop the engineering industry, we must strive for innovation in the operation mode, diversified development, fit in with the advantages of real estate enterprises, slow down and improve the quality, optimize the layout, and build a cost-saving project management and control mode.

Conclusion

Big data has led to profound changes in engineering management and redefined the cost control mode. It will be a new measure of management and control to deeply explore the deep adaptation mode of big data analysis and engineering cost control, establish standardized engineering cost control to solve the problems of disunity, incoordination and benchmarking, and optimize and improve the implementation path of cost saving. Due to the limitations of data collection, the process of calculation and analysis needs to be improved.

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