

Optimization on the Financial Management of Construction Companies with Goal Programming Model [†]

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Abstract: Financial management is important for construction sector as the construction companies contribute to the development of the country. Malaysia encourages the construction sector to develop an advanced infrastructure related to transport and housing. Financial management is a multi-criteria decision making (MCDM) problem since the companies have to consider multiple goals in order to achieve the optimal decision. Therefore, goal programming is proposed in financial management to solve optimization in MCDM problems. According to the past studies, there has been no comprehensive study conducted on the optimization and comparison among the construction companies with goal programming model. Thus, this study aims to propose a goal programming model to optimize and compare the financial management of listed construction companies in Malaysia for benchmarking purpose. Six goals of financial management, namely total assets, total liabilities, equity, profit, earnings, and optimum management item of the construction companies are examined in this study. The results of this study show that the goal programming model is able to determine the optimal solution and goal achievement for each construction company. Besides, the model value can be further enhanced according to the optimal solution of goal programming model. This study provides insights to the listed construction companies in Malaysia to identify the potential improvement based on the benchmarking and optimal solution of goal programming model.

Keywords: goal programming; financial management; optimal solution; potential improvement; benchmarking

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1. Introduction

Construction companies contribute to the development of the country. However, construction companies face many financial issues such as delayed payment, contractual issues, abuse of the Defects Liability Period, and the inability to adopt the Building Information Modelling system to plan their project cashflows [1]. Financial management in the construction industry is very important to develop advance infrastructure such as in transportation, housing, and commercial areas for the country. The accuracy of forecasting profit from construction projects is low because companies tend to suffer losses for reworks. If a construction company make consecutively losses in the projects, the company may face bankruptcy [2]. Several studies proposed the development of digital technology tools to support financial planning and decision making in the construction companies [3–5]. Therefore, financial management is very important for the construction companies.

Financial management is a multi-criteria decision making (MCDM) problem since the companies have to consider multiple goals in order to achieve the optimal decision.

Therefore, goal programming (GP) is proposed in financial management to solve optimization in MCDM problems. GP was started by Charnes et al. [6] and further developed by Charnes and Cooper [7]. In GP, a goal is the objective function with aspiration level. The goals then become the soft constraints for optimization. Soft constraints are deviational variables which show the incremental or decremental values to achieve the constraint values. The deviations should be minimized for optimality [8].

GP helps to identify the additional resources required or the reduction of cost to meet the goal. GP also determines the degree of achievement of the goals with the current inputs. According to the past studies, there has been no comprehensive study conducted on the optimization and comparison among the construction companies with goal programming model. Thus, this study aims to propose a goal programming model to optimize and compare the financial management of listed construction companies in Malaysia for benchmarking purpose. The next section shall explain the data and methodology, followed by results and discussion, and finally, the conclusion.

2. Data and Methodology

This paper studies the financial management of the listed construction companies in Malaysia, namely DKLS, TRCS, and HSL from 2017 to 2021. Table 1 lists the goals of the study.

Table 1. Financial management goals of the listed construction companies.

Goal	Explanation
I	Maximize total assets
II	Minimize total liabilities
III	Maximize equity
IV	Maximize profit
V	Maximize earnings
VI	Maximize optimum management item

The financial management goals of the listed construction companies are to maximize total assets, equity, profit, earnings, and optimum management item while minimizing total liabilities. Negative deviation in total assets, equity, profit, earnings, and optimum management item show underachievement of these goals. On the other hand, the companies with positive deviation in total liabilities have underachieved this goal because surplus in total liabilities increases the business risk caused by financial distress [9].

The following shows the GP formulation [9–13]:

$$\min x = d_1^- + d_2^+ + d_3^- + d_4^- + d_5^- + d_6^- \tag{1}$$

subject to:

Goal I:

$$\sum_{m=1}^n h_{mn}k_m + d_1^- - d_1^+ = g_1 \tag{2}$$

Goal II:

$$\sum_{m=1}^n h_{mn}k_m + d_2^- - d_2^+ = g_2 \tag{3}$$

Goal III:

$$\sum_{m=1}^n h_{mn}k_m + d_3^- - d_3^+ = g_3 \tag{4}$$

Goal IV:

$$\sum_{m=1}^n h_{mn}k_m + d_4^- - d_4^+ = g_4 \tag{5}$$

Goal V:

$$\sum_{m=1}^n h_{mn}k_m + d_5^- - d_5^+ = g_5 \tag{6}$$

Goal VI:

$$\sum_{m=1}^n h_{mn}k_m + d_6^- - d_6^+ = g_6 \tag{7}$$

where

x = objective function,

d_y^+ = positive deviational value when goal $y = 1,2,3,4, \dots, z$,

d_y^- = negative deviational value when goal $y = 1,2,3,4, \dots, z$,

h_{mn} = weightage of goal in year $m = 1,2,3,4, \dots, n$,

k_m = goal in year $m = 1,2,3,4, \dots, n$,

g_y = target value when goal $y = 1,2,3,4, \dots, z$.

In this study, the computational work of GP model is performed using LINGO, which is an optimization software [14–17].

3. Results and Discussion

Table 2 presents the financial data of DKLS, TRCS, and HSL from 2017 to 2021.

Table 2. Financial data of DKLS, TRCS and HSL (trillion MYR).

Goals	DKLS	TRCS	HSL
Total assets	2.8434	5.3093	5.6836
Total liabilities	0.7812	3.1716	1.6126
Equity	2.0621	2.1376	4.0711
Profit	0.0488	0.1155	0.2300
Earnings	0.9908	3.8487	2.9637
Optimum management item	6.7264	14.5828	14.5610

From Table 2, the maximum values of total assets (5.6836), equity (4.0711), profit (0.2300), earnings (3.8487), and optimum management item (14.5828) serve as the target values of the respective goals. The target value of total liabilities is the minimum value among DKLS, TRCS, and HSL, which is 0.7812. Tables 3–5 tabulates the optimal solution of DKLS, TRCS, and HSL.

Table 3. Optimal solution of DKLS (trillion MYR).

Goal	Target Value	Model Value	d_i^-	d_i^+	Achievement
Total assets	5.6836	11.4722	0.0000	5.7886	Achieved
Total liabilities	0.7812	2.4736	0.0000	1.6924	Not Achieved
Equity	4.0711	8.9986	0.0000	4.9275	Achieved
Profit	0.2300	0.3380	0.0000	0.1080	Achieved
Earnings	3.8487	3.8487	0.0000	0.0000	Achieved
Optimum management item	14.5828	27.1331	0.0000	12.5503	Achieved

Based on Table 3, DKLS has achieved the goals for total assets, equity, profit, earnings, and optimum management items. DKLS has overachieved in total assets, equity, profit, and optimum management item, with positive deviations of 5.7886, 4.9275, 0.1080, and 12.5503 trillion MYR respectively. DKLS has underperformed in total liabilities as there is a surplus of 1.6924 trillion MYR. DKLS should reduce its total liabilities from 2.4736 to 0.7812 trillion MYR.

Table 4. Optimal solution of TRCS (trillion MYR).

Goal	Target Value	Model Value	d_i^-	d_i^+	Achievement
Total assets	5.6836	6.3049	0.0000	0.6213	Achieved
Total liabilities	0.7812	3.1714	0.0000	2.3902	Not Achieved
Equity	4.0711	3.1336	0.9375	0.0000	Not Achieved
Profit	0.2300	0.2300	0.0000	0.0000	Achieved
Earnings	3.8487	5.6203	0.0000	1.7716	Achieved
Optimum management item	14.5828	18.4594	0.0000	3.8766	Achieved

TRCS has achieved the total assets, profit, earnings, and optimum management item goals. TRCS shows outperformance in total assets (0.6213), earnings (1.7716), and optimum management item (3.8766). TRCS has not attained the total liabilities and equity goals. TRCS should bring down its total liabilities by 2.3902 trillion MYR, from 3.1714 to 0.7812 trillion MYR. TRCS can increase its equity by 0.9375 trillion MYR to reach 4.0711 trillion MYR.

Table 5. Optimal solution of HSL (trillion MYR).

Goal	Target Value	Model Value	d_i^-	d_i^+	Achievement
Total assets	5.6836	6.3270	0.0000	0.6434	Achieved
Total liabilities	0.7812	1.7031	0.0000	0.9219	Not Achieved
Equity	4.0711	4.6234	0.0000	0.5523	Achieved
Profit	0.2300	0.3113	0.0000	0.0813	Achieved
Earnings	3.8487	3.8487	0.0000	0.0000	Achieved
Optimum management item	14.5828	16.8136	0.0000	2.2308	Achieved

HSL has achieved the total assets, equity, profit, earnings, and optimum management item goals because there is no negative deviation from the target value. HSL has outperformed in the total assets, equity, profit, and optimum management item goals by 0.6434, 0.5523, 0.0813, and 2.2308 trillion MYR respectively. However, HSL has not reached the goal for total liabilities because there is an excess of 0.9219 trillion MYR. HSL should bring down its total liabilities from 1.7031 to 0.7812 trillion MYR.

Table 6 highlights the summary of the target and model values of DKLS, TRCS, and HSL.

Table 6. Summary of target and model values (trillion MYR).

Goals	Target Values	Model Values		
		DKLS	TRCS	HSL
Total assets	5.6836	11.4722	6.3049	6.3270
Total liabilities	0.7812	2.4736	3.1714	1.7031
Equity	4.0711	8.9986	3.1336	4.6234
Profit	0.2300	0.3380	0.2300	0.3113
Earnings	3.8487	3.8487	5.6203	3.8487
Optimum management item	14.5828	27.1331	18.4594	16.8136

DKLS, TRCS, and HSL have achieved the total assets, profit, earnings, and optimum management item goals because negative deviation is not present. TRCS has not reached the equity goal because of the presence of negative deviation of 0.9375 trillion MYR. TRCS should have 4.0711 trillion MYR in equity. DKLS, TRCS, and HSL have not attained the total liability goal because there are positive deviations of 1.6924, 2.3902, and 0.9219 trillion MYR respectively. All the companies should maintain their total liabilities at 0.7812 trillion MYR.

Table 7 shows the comparison of deviations between target values and model values for DKLS, TRCS, and HSL.

Table 7. Comparison of deviations between target values and model values (trillion MYR).

Goals	Target Values	Deviations		
		DKLS	TRCS	HSL
Total assets	5.6836	0	0	0
Total liabilities	0.7812	1.6924	2.3902	0.9219
Equity	4.0711	0	0.9375	0
Profit	0.2300	0	0	0
Earnings	3.8487	0	0	0
Optimum management item	14.5828	0	0	0

Based on the Table 7, zero deviations indicate the achievement of goals. The positive values of deviations signify underachievement of the goals from the target values. DKLS, TRCS, and HSL have 1.6924, 2.3902, and 0.9219 trillion MYR in excess for total liabilities. The equity of TRCS is 0.9375 trillion MYR lower than the target value of 4.0711 trillion MYR.

4. Conclusions

The objective of this study is to propose a goal programming model to optimize and compare the financial management of the listed construction companies in Malaysia for benchmarking purpose. DKLS, TRCS, and HSL have achieved the total asset, profit, earnings, and optimum management item goals. TRCS has not reached the equity goal. All the three companies have not attained the total liability goal. The construction companies in Malaysia should reduce their reliance on debt financing for better financial stability. This study provides insights to the listed construction companies in Malaysia to identify the potential improvement based on the benchmarking and optimal solution of the GP model. This study can also serve as an early detection of possible financial risk in the construction companies to allow the management to draft relevant strategies for continuous improvement.

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