A Contractors Evaluating Model: An International Case Study

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This research introduces a performance evaluation model contacting companies in order to provide a proper tool for company's mangers, owners, shareholders, and funding agencies to evaluate the performance of construction companies. The developed model can also help company's management to take proper management decisions.

The study presents a performance evaluation model that does not only concentrates on financial performance, but also on company size, macro-economic, and industry related factors as well. The developed model considers four construction contacting categories: (1) general building; (2) heavy; (3) special trade; and (4) real estate. It also considers the effect of company size, along with economical and industrial variables on its performance. Companies that perform business across categories are not considered in this study.

The developed model is generic and can be applied to any company in any market. Although the Egyptian market was used as a case study, the developed models and framework are general.

Keywords : Company performance, Financial ratios, Construction sectors, Heavy construction, Building construction, Real estate construction.

Introduction

A performance evaluation tool could be very useful for both multi-national and local construction companies to assess their performance in order to maintain their competitiveness in any market. Also, this evaluation tool is deemed essential for owners, shareholders, and funding agencies of the company, because it would clearly show its relative position in the market. Many models were developed to evaluate construction companies' performance, but non have incorporate economical and industrial variables together in their models.

This study presents a performance evaluation model that does not only concentrates on financial performance, but also on company size, macro-economic, and industry related factors as well. The developed model considers four construction contacting categories: (1) general building; (2) heavy; (3) special trade; and (4) real estate. It also considers the effect of company size, along with economical and industrial variables on its performance. The developed company performance model is generic and can be applied to any company in any market. Although the Egyptian market was used as a case study, it should be stressed that the developed models and framework are general.

Background

A number of construction companies' performance evaluation models have been developed along the previous five decades. They are dealing with this issue at three different levels: (i) construction industry, (ii) company, and (iii) project. Models at the construction industry level are used to measure the effect of economical, political, and social changes on the performance of construction industry as a whole. **Kangari (1988)** relates the changes in construction industry failure rate to some macrocosmic factors: average prime interest rates, amount of construction activity, inflation, and new business entering the construction industry. Most performance evaluation models for construction companies are based on their annual financial statements or reports. Different analytical techniques have been used to develop these ratios: (1) financial statement trend analysis; (2) financial statement structural analysis; and (3) financial statement ratio analysis. The most important variables that could be used in financial statement trend analysis to differentiate between failed and non-failed companies are: accounts receivable, under-belling, accounts payable, notes payable, total long-term debts, stock and retained earnings, cost of sales, and gross profit (**Basha and Hassanein, 1988 and Severson et al., 1994**). Financial statement structural analysis determines the proportion that each company's group or sub-group represents in the financial statement (**Hasabo, 1996**). A decomposition ratio is used to determine changes in the percentage of company's asset components in two consecutive years (**Hasabo, 1996**).

The model of **Kangari, R., Farid, F., and Elgharib, M. (1992)** used multiple regression analysis to evaluate the performance of construction companies. This study developed a performance grade (G) curve in which the relative financial situation of any construction company, satisfy model limitations, could be determined.

Another quantitative model based on financial ratios was developed by **Goda et al. (1999)**. The model objective was to develop standard financial ratios that reflect the performance of construction industry in Egypt. These standards could be used to compare the performance of the Egyptian construction industry with the international one. According to this study regression analysis had provided most reliable results than that produced using the supervised neural network.

Previous models that were developed by **Kangari R., Farid, F.; Elgharib, M., (1992);** and **Goda (1999)** focused mainly on evaluating the performance using financial ratios without considering the effect of macro-economic and industry related factors on the performance of construction companies. In addition, the model developed by **Goda 1999** did not consider the effect of company size on its performance. Therefore, the new developed model in this research accommodated the effect of macro-economic, industry related factors, and company size on the company performance.

Data Collection For Case Study

The financial data for construction companies were collected, in the time period (1992 – 2000), from the Authority of Money Market, Egyptian government in the form of: Annual Balance Sheets (**ABS**) and/or Annual Income Statement (**AIS**). Out of thousands of construction companies working in Egypt, only 122 companies are chosen because they are the registered companies in the Egyptian money market. Approximately, 415 financial statements along nine consecutive years (1992 – 2000) were collected. Based upon the ABS and AIS, financial ratios of the Egyptian construction companies were determined. Six financial ratios were considered in the developed model for the following reasons:1) These ratios reflects the various aspects of the company management. 2) Most of these ratios were included in previous similar studies. 3) They are strongly correlated to the performance of the construction companies. 4) International Standard Industrial Classification (SIC) includes most of these ratios. So, the performance of the construction companies could be compared at the international level. The six financial ratios considered are: (1) Current Ratio (**CR**), (2) Total Debt to Net Worth ratio (**TD/NW**), (3) Fixed Assets to Net Worth ratio (**FA/NW**), (4) Revenue to Working Capital ratio (**RV/WC**), (5) Net Profit to Total Assets ratio (**NP/TA**), and (6) Net Profit to Net Worth ratio (**NP/NW**).

Economic data were collected from the Egyptian Ministry of Foreign Trade (2003) (Egyptian government) reports published quarterly. Data, as shown in **Table 1**, include: inflation rate ***(IFN)*** and average annual interest rate ***(ITR)*** as macro-economic variables. On the other hand, average work capacity (AWC), average work demand, (AWD), and their difference (AWF) are used as industry related variables.

Model Development And Application To Case Study

The model development process passes through various steps: data preparation, mathematical formulation, model building, and model validation. The flow of these steps is illustrated in **Figure 1**.

Financial Data Preparation

The process by which the data collected are prepared to mathematical models formation is illustrated in the flow chart shown in **Figure 2**.

Normalizing Financial Data

Some financial ratios are calculated in terms of time; however, others are calculated in terms of percentages. Mathematical formulation of such type of data will result in a bias to the larger values of ratios (**Kangari**, **R., Farid, F., and Elgharib, M. H., 1992**). In order to overcome this problem, normalizing the values of different ratios would make them non-biased. **Table 2** shows normalization coefficient ***(fn)*** for various construction sectors.

Company-Size Effect

Comparing performance of a small company with the overall industry average is inappropriate because financial structure and characteristics of small companies are different from those of well-established, large companies **(Kangari, R., Farid, F., and Elgharib, M., 1992)**. This problem can be overcome by adjusting the normalized ratio value by size-factor (Z_i). The size factor Z_i for any single ratio X_i is obtained by dividing the median of that ratio, for the whole construction sector, by its median in similar subgroup size. **Table 3** shows size-factor Z_i values for all ratios based on company's total asset ***TA***.

Mathematical Formulation

Regression analysis is used to develop the performance model for the following reasons (**Goda, 1999**):

- Its simplicity, reliability, and suitability for the problem under study.
- Discriminate analysis is used to discriminate between failed and no-failed companies.
- Although unsupervised neural network technique seems to be suitable to current problem, it needs a quite large data set for each single year.

Mathematical Formulation procedures are used to develop the Company (Sc), the Economy (Se), and the Industry (Si) Performance Scores. The **MINITAB** statistical package is used to develop the required models. The values of macro-economic and industry related variables for nine consecutive years of records are shown in **Table 1**.

Mathematical Formulation of Company Performance Score (Sc):

The company performance score ***Sc***, according to **Kangari R., Farid, F., and Elgharib, M. (1992),** is defined as "*a performance grading system for assessing the position of a company within the overall construction industry and which, is very difficult to be assigned a certain value*". The ***Sc*** method is applied by **Goda (1999),** and current study.

Preliminary values of **100**, **0**, **-100** are assigned to the company performance score ***Sc*** for the upper, median, and lower quartiles of the previously prepared financial ratios as shown in **Table 3**, respectively. By using regression analysis technique, both assigned values and the quartiles of the ***Sc*** for the previously prepared data are considered. The model is developed using multiple linear regression as shown in equation 1:

$$Sc = C_0 + \sum_{i=1}^{6} C_i X_{ni} \qquad (1)$$

where: ***Sc*** = Company performance score (assumption: ***Sc*** = 100 for upper quartile, ***Sc*** = 0 for median, and ***Sc*** = -100 for lower quartile), C_0 = regression constant, C_i = regression coefficient of variable *i*, X_{ni} = regression variable represent prepared financial ratio *i*, and ***i*** = an integer subscript equals 1 to 6 according to the six financial ratio chosen earlier.

The value of X_{ni} can be calculated using equation 2 as follows:

$$X_{ni} = S_i \sqrt{Z_i f_{ni} |X_{si}|} \qquad (2)$$

where: X_{ni}= Normalized value of ratio i, X_{si}= Standard value of ratio i, S_i= Sign correction factor (set equal to –1 if X_{si} is negative and +1 otherwise), Z_i= Company size factor, f_{ni}= Normalization coefficient, and $|X_{si}|$= Absolute value of standard financial ratio ***i***.

By substituting equation 1 in **2**, the final regression equation **3** is determined:

$$Sc = C_0 + \sum_{i=1}^{6} C_i S_i \sqrt{Z_i f_{ni} |X_{si}|} \qquad (3)$$

Table 4 shows the values of regression constant C_0 and coefficient C_{is} of regression variables X_{is} for each construction sector. The value of C_2, C_4, and C_6 (except real-estate sector) has a negative sign. This can be interpreted to an inverse relation between these financial ratios and the company performance score ***Sc***.

Mathematical Formulation of Economy performance Score (Se):

The development of economy performance score **(Se)** passes through of five steps as follows:

1- Sort the economical variables: inflation, and interest rate in ascending order from the best to the worst.

2- Assign nine values equal **100, 75, 50, 25, 0, -25, -50, -75**, and **-100** for economy performance score **Se** within the nine available years, respectively.

3- Use Regression analysis to develop the regression equation **4** for **Se**

$$\mathbf{Se} = C_0 + C_1 X_1 + C_2 X_2 \qquad (4)$$

where: C_1 & C_2 = Regression coefficient of variables X_1 & X_2 respectively, X_1 = inflation, and X_2 = interest rate.

Statistical analysis showed that excluding X_1 variable from equation **5** generate best results (**Neter** et al., 1996; **Lapin,** 1983; and **Little,** 1978). Then, equation **5** is developed as follows:

$$\mathbf{Se} = 271 - 22.7\ \mathbf{ITR} \qquad (5)$$

4- Apply equation **8** on the values of economy variables.

5- Normalize the calculated values of **Se** (equation **5**) using equation **6** to be within the range –100 to 100 as follows:

$$\mathbf{Se}_{mod.} = 200*((Se-Se_{min})/(Se_{max}-Se_{min}))-100 \qquad (6)$$

Mathematical Formulation of Industry performance Score (Si):

Similar to economy performance score **Se**, the development of industry performance score (**Si)** passes also through of five steps:

1- Sort the annual work demand **AWD** in descending order and annual work capacity **AWC** in ascending order. This is because the best situation for a company occurs when market demand exceeds the supply (i.e. **AWD-AWC** become positive).

2- Assign nine values equal **100, 75, 50, 25, 0, -25, -50, -75**, and **-100** for industry performance score **Si** within the nine available years, respectively.

3- Using Regression analysis develop the regression equation **7** for **Si** as follows:

$$\mathbf{Si} = C_0 + C_1 X_1 \qquad (7)$$

where: C_0 = regression constant, C_1 = regression coefficient for X_1, and X_1 = (AWF) difference between annual work demand AWD and annual work capacity AWC.

Regression analysis generate equation **8** as shown below:

$$\mathbf{Si} = 13 + 1.49 * \mathbf{AWF} \qquad (8)$$

4- Apply equation **11** on the values of economy variables.

5- Normalize the calculated values **Si** based on equation **8** using equation **9** to be within the range –100 to 100 as shown below:

$$\mathbf{Si}_{mod.} = 200*((Si-Si_{min})/(Si_{max}-Si_{min}))-100 \qquad (9)$$

After normalization, two models were developed as shown in equations 10 & 11 (**Se** and **Si**):

$$\mathbf{Se = 317 - 23.8 * ITR} \qquad (10)$$

$$\mathbf{Si = 64.5 + 3.01 * AWF} \qquad (11)$$

Performance Index (PI) Model Building:

The performance index (**PI**) is developed by combining the effect of company, economy, and industry related factors. These factors are represented in the model using (**Sc**)**,** (**Se**), and (**Si**), respectively. The combination process was performed based on **Hasabo** (**1996**), which reported that the responsibility of company failure carried out by three major factors: macro-economic (**35-40**%), industry (**10-15**%), and company related factors (**40-45**%). These factors are used to formulate the performance index (**PI**). Macro-economic, industry, and company's related factors are represented by the normalized value of **Se**, **Si**, and **Sc**, respectively. The **PI** value can be determined from equation **12** as follows:

$$\mathbf{PI} = 0.5\ \mathbf{Sc} + 0.375\ \mathbf{Se} + 0.125\ \mathbf{Si} \qquad (12)$$

When a company has the best **Sc** value **(Sc = +100)** during a year that has the worst values of both **Se and Si (Se = -100** and **Si = -100),** it will be assigned the best value for performance index (**PI = +100)**. This company might have a good financial performance during a fiscal year that has bad economical and industrial circumstances. In such case, this company has a good financial and managerial performance; however, it deserve to survive in business. On the other hand, a company might have the worst **Sc** value **(Sc = -100)** during a year that has the best values of both **Se** and **Si (Se = +100** and **Si = +100).** This company will be assigned the worst value of performance index (**PI = -100).** Therefore, the company made bad financial performance during a fiscal year that has good economical and industrial circumstances. Therefore, the company has a weak financial and managerial performance that needs suitable remedial actions to survive in business.

Model Significance and Validation:

The developed model has to be validated to test its prediction capabilities. The validation process mainly concerns the developed equation for company performance score (**Sc**). The collected data set is divided into: model building (70%) and validation (30%) sub-sets. The validation data sub-set consists of approximately, **139, 80, 74,** and **142** observations for General Building Construction, Heavy construction, Special Trade, and Real Estate companies' sectors, respectively. Results from the application of validation data sub-set are compared to that of the application of model building sub-set. **Table 5** shows that the mean of model results is around 0.0 (-0.12); however the mean of validation data sub-set is -1.76. This means that the developed models are robust in representing various construction sectors with a validation of 93.18% (1.76-0.12/1.76). The average standard deviation for the model results is 79.13; however, it is 37.58 for validation results, which shows more than 50% enhancement in the validation results. This also shows that the developed models are robust in representing construction sectors. In conclusion, based upon the results in **Table 5**, the developed models show acceptable results in general; however, the deviation is almost within 10% range in various sectors.

Development of Company Performance Grade (G):

The **PI** of a construction company should be compared to other companies in the same construction sector in order to determine the relative position of such company within the industry. Performance Grade **(G)** is the percentage of companies that have **PI** below that of the company under consideration (**Kangari, R., Farid, F., and Elgharib, M., 1992**). Therefore, the **G** index is equivalent to the cumulative distribution function of the **PI** for all construction companies in the same construction sector.

In **Fig. 3**, a comparison between the (**G**) index values for different construction sectors is shown. According to the performance grade **G**, the pioneer position in Egyptian construction industry belongs to Heavy construction sector with only **65%** of its companies under **PI** = zero.

The developed models were applied to El-Yasmin International for Trade and Contracting Company as an example. In **Table 6**, company performance score **Sc**, company performance index **PI**, and finally the performance grade **G** were determined for the nine consecutive years. The **G** index values for the nine consecutive years are shown in **Figure 4**. The list of corrective actions related to various **G** index values is shown **Table 7**. The company looked fine in the early 90's; however, the **G** index curve started to decline in the mid 90's. It reached the lowest level (bad situation) between 1995 and 1997 (**G** < 20%). The situation started to improve from 1996 to its high value in 1999. However, the G index value for the year 2000 was within the average performance range that needs considerable changes in management policies. This shows the power of the developed **G** index in assessing company's performance for its management in order to take the proper remedial actions.

Summary and Conclusions:

This research developed a performance evaluation model for construction companies (Egyptian case study). A performance index (**PI**) is developed using three performance scores: company financial (**Sc**), economical (**Se**), and industrial (**Si**). The developed **PI** did not provide proper evaluation of the company performance relative to other competitors within the industry. Therefore, a company grade (**G**) index is developed using cumulative distribution of the **PI** values. The **G** index shows percentage of companies below the industry average and situation of a specified company under consideration. According to regression analysis, inflation has no effect on the economy score **(Se)**. In addition, the volume of demand alone or the volume of supply alone do not yield a proper evaluation of industry performance score **(Si)**, which is best presented by considering the gap between supply and demand. The **G** index for the Egyptian construction industry shows that the pioneer position belongs to heavy construction sector with only **65%** of its companies under **PI = zero**. The developed model is validated, which shows robust results.

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NOTATIONS

AWC	=Average Work Capacity
AWD	=Average Work Demand
AWF	= Difference between Average Work Demand and Average Work Capacity
Coeff.	=Coefficient
FA	=Fixed Assets
fni	=Normalization Coefficient
GDP	=Gross Domestic Product
IFN	=Inflation
ITR	=Interest
m	=Arithmetic Mean
NP	=Net Profit
NW	=Net Worth
PI	=Performance Index
RV	=Revenue
Sc	=Company Performance Score
Sc_{mod}	=Normalized Value of Company Performance Score
s	=Standard Deviation
Se	=Economy Performance Score
$Se_{mod.}$	=Modified Value of Economy Performance Score
Si	=Industry Performance Score
$Si_{mod.}$	=Modified value of Industry Performance Score
TA	=Total Assets
TD	=Total Debt
WC	=Working Capital
Xn	=Normalized ratio
Xs	=Standard ratio

Table 1: Values of Macro-economic and Industry-related Variables

Year of record	Macro-economic Variables		Industry-related Variables		
	IFN	ITR	AWD	AWS	AWF
	(1)	(2)	(3)	(4)	(5)=(3)-(4)
1992	21.1	17.5	9.8	1.3	+8.5
1993	11.1	15.2	11.8	2.9	+8.9

1994	9	12.2	13.4	0.8	+12.6
1995	9.3	10.7	16.1	1.3	+14.8
1996	7.3	10.2	18.6	7.6	+11.0
1997	6.2	9.2	22.3	11.1	+11.2
1998	3.8	9.1	27.6	51	-23.4
1999	3.8	11.9	28.8	17.3	+11.5
2000	2.8	11.1	29	4.1	24.9

Table 2: Normalization Coefficient *(fn)* for Various Construction Sectors.

Construction Sector	Financial Ratio					
	CR X_1 (1)	TD/NW X_2 (2)	FA/NW X_3 (3)	RV/WC X_4 (4)	NP/TA X_5 (5)	NP/NW X_6 (6)
General Building	30	15	1	60	15	5
Heavy Construction	45	25	1	15	20	5
Special Trade	45	50	1	20	10	5
Real Estate	25	15	1	60	15	5

Table 3: Size Factor Z_i Value Based on company's Total Asset ***TA***

Construction Sector	Ranges of Total Assets (millions)	Financial Ratio					
		CR (1)	TD/NW (2)	FA/NW (3)	RV/WC (4)	NP/TA (5)	NP/NW (6)
General Building	TA>100	1.109	0.643	0.903	0.164	0.216	1.891
	100>TA>50	0.922	1.172	1.515	1.621	1.596	1.263
	50>TA>10	1.004	0.550	0.505	0.869	1.000	0.583
	10>TA>1	0.808	1.773	2.680	2.240	0.778	0.647
	1>TA	1.098	0.560	0.498	0.098	1.120	0.482
Heavy Construction	TA>100	0.660	5.327	1.037	6.450	1.086	0.853
	100>TA>50	0.874	1.250	1.432	1.134	1.017	1.052
	50>TA>10	1.038	0.680	0.866	0.607	1.003	0.981
	10>TA>1	0.963	1.168	1.085	2.038	1.171	1.198
	1>TA	1.208	0.330	0.751	0.065	0.682	0.304
Special Trade	TA>100	1.100	1.066	0.579	2.450	1.367	3.076
	100>TA>50	0.939	1.086	1.036	0.981	0.961	0.698
	50>TA>10	0.987	0.605	1.019	0.682	0.653	0.571
	10>TA>1	0.984	0.519	5.747	0.602	0.603	0.427
	1>TA	-	-	-	-	-	-
Real Estate	TA>100	0.997	1.640	1.008	0.471	1.059	4.750
	100>TA>50	0.910	1.797	1.357	1.076	0.834	1.122
	50>TA>10	0.819	0.315	0.725	3.583	1.736	0.719
	10>TA>1	1.181	0.436	0.737	0.841	0.578	0.536
	1>TA	1.294	0.586	1.553	0.369	0.686	1.097

Table 4: Regression Constants and Coefficients.

Construction Sector	Regression Constant C_0 (1)	CR	TD/NW	FA/NW	RV/WC	NP/TA	NP/NW
		C_1 (2)	C_2 (3)	C_3 (4)	C_4 (5)	C_5 (6)	C_6 (7)
General Building	33.00	-2.72	-18.50	12.90	-2.20	4.53	0.12
Heavy Construction	-14.00	-15.50	-5.36	24.80	-8.17	7.63	-0.73
Special Trade	-379.00	39.40	-6.73	20.00	-0.84	0.42	-1.23
Real Estate	-222.00	24.20	-3.60	14.20	-4.51	4.45	1.36

Table 5: Validation of Developed models.

Construction sector	Model Building data sub-set results			Validation data sub-set results		
	Mean (1)	Standard Deviation (2)	Variance (3)	Mean (4)	Standard Deviation (5)	Variance (6)
General Building	-0.26	80.72	6516.99	8.39	37.00	1368.89
Heavy Construction	0.19	78.88	6222.96	-6.41	36.08	1301.74
Special Trade	-0.06	78.53	6167.30	4.07	41.45	1717.70
Real Estate	-0.34	78.37	6142.16	-13.09	35.79	1281.27
Average of sectors	-0.12	79.13	6262.35	-1.76	37.58	1417.40

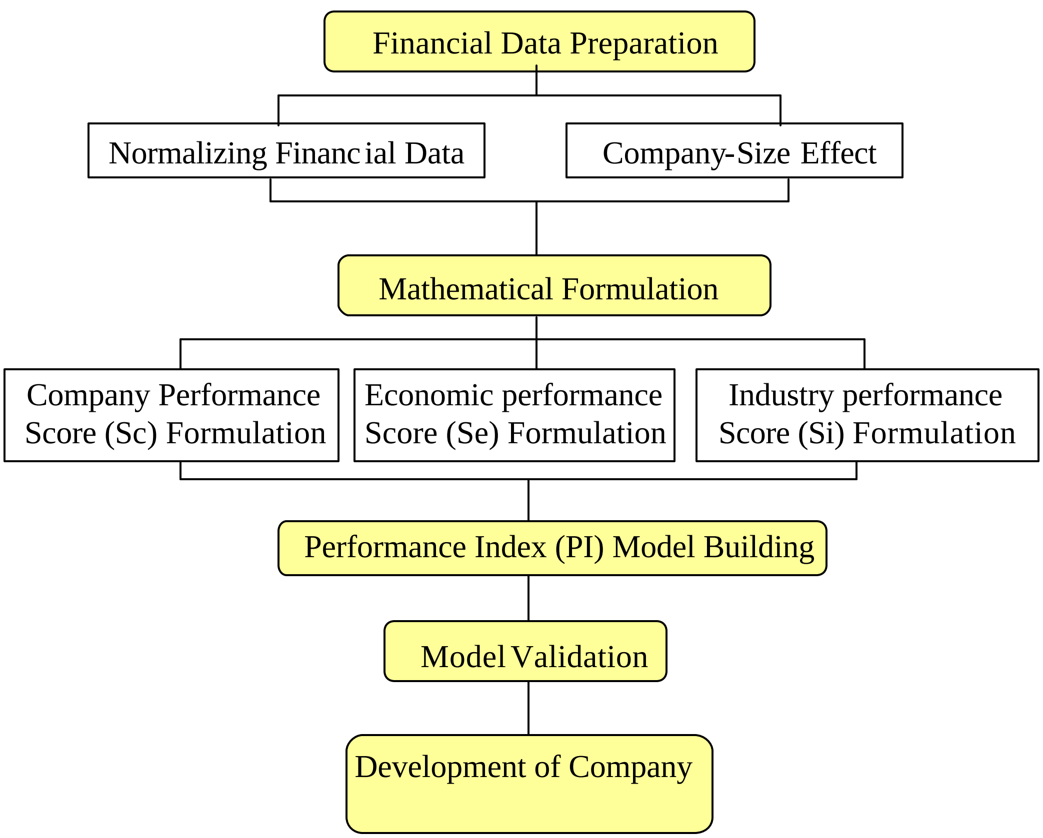
Table 6: Performance Grade **G** for Jasmine International for Trade and Contracting.

Year (1)	Sc (2)	Se (3)	Si (4)	PIT (5)	G (6)
1992	14.70	-100.00	89.80	33.62	97.1
1993	18.71	-45.24	91.30	14.91	87.8
1994	40.19	26.19	95.50	-1.66	69.8
1995	-12.12	61.90	100.00	-41.77	14.9
1996	6.43	73.81	97.60	-36.66	20.0
1997	0.47	97.62	97.90	-48.61	9.6
1998	12.18	100.00	-39.50	-26.47	32.8
1999	42.77	33.33	-88.00	19.89	91.3
2000	-2.92	52.38	-100.00	-8.60	59.8

Table 6: Management Courses of Action Suggested by performance Grade (Kangari, R., Farid, F., and Elgharib, M. 1992)

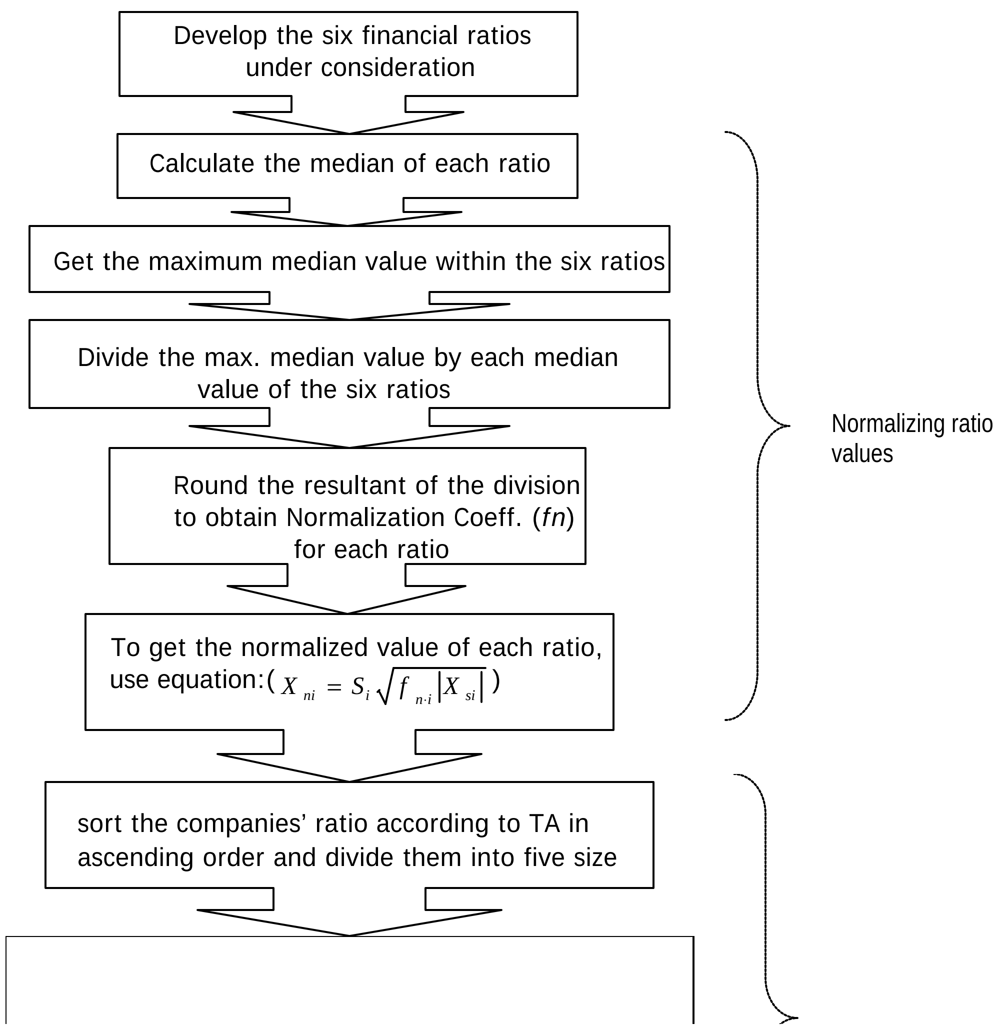
Performance grade G range (%)	**Management action (2)**

(1)	
$80 < G \leq 100$	Total management satisfaction; company policy is set on the ideal track; no adjustment actions required.
$60 < G \leq 80$	No danger is anticipated in the near future, management policy is quite satisfactory, may need minor adjustment action.
$40 < G \leq 60$	Company's performance is within the average performance range; management policy needs considerable changes; may be difficult to complete and keep the business a float; financial trends are to be watched continuously.
$20 < G \leq 40$	Company is in critical condition; typically due to inadequate financial management; immediate changes are required in company's policies; management should be changed if it fails to take quick recovery measures; if this situation continues for the next year, the company will fail.
$0 < G \leq 20$	Company has reached lowest performance level in industry; very low probability that management can succeed in salvaging the company in this competitive business; the company has a high probability of bankruptcy in the near future; should consider going out of business.



Performance Grade (G)

Figure 1: Flow Chart of Mode Development Process.



sectors

obtain the median of the construction sector and divide it by the value of median for each sector size to obtain the size coeff. (fz).

Adjusting ratios with size coeff.

Multiply the size coeff. (fz) by the normalized value of the same ratio to obtain final adjusted value of each ratio

Mathematical Formulation

Figure 2: Flow Chart of Data Preparation Process.

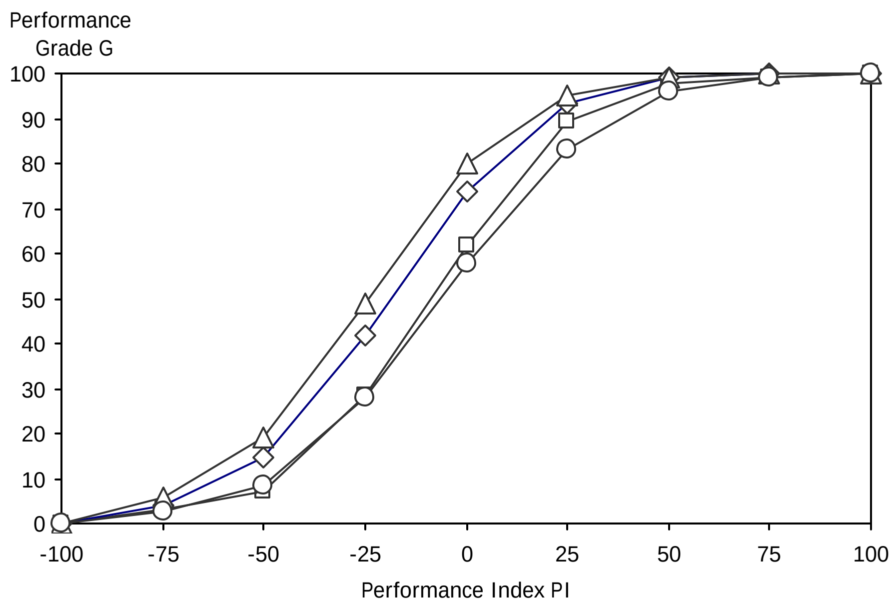
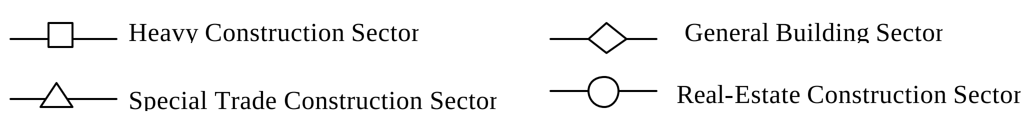


Figure 3: Values of Performance Grades (G) for Different Construction Sectors.



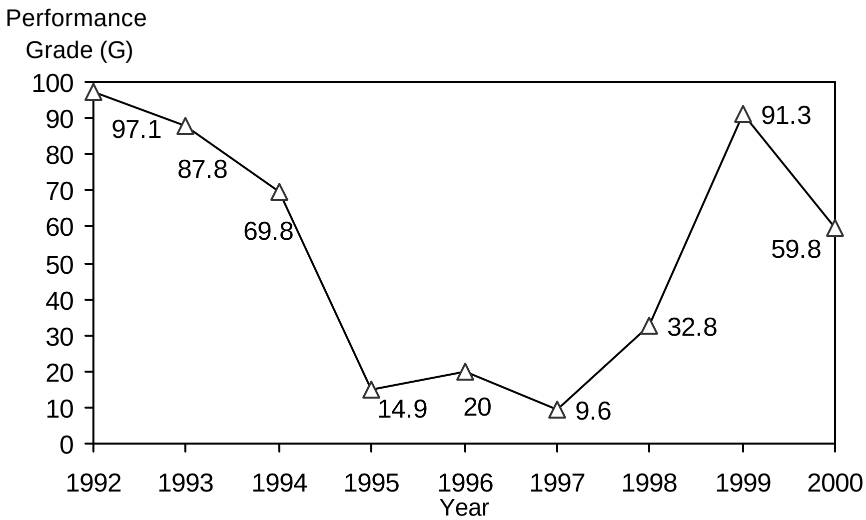


Figure 4: Company Performance Grade **G** for El-Yasmin International for Trade and Contracting Company.

Definition of Ratios Mentioned in Model (Dun & Bradstreet 2001)

Name	Function	Formula
Current Ratio	Measures the degree to which current assets over current liabilities. *The higher the ratio, the more likely the company will be able to meet its liabilities. A ratio of 2 to 1 (2.0) or higher is desirable.*	Current Assets ÷ Current Liabilities
Total Debt to Net Worth Ratio	Shows how all of the company's debt to the equity of the owner or stockholders. *The higher this ratio, the less protection there is for creditors.* *If the total liabilities exceed net worth then creditors have more at stock than stockholders.* *The difference between this ratio and current liabilities to net worth ratio is that it pinpoints the relative size of long-term debt, which can burden a firm with substantial interest charges.*	Total Liabilities ÷ Net Worth
Fixed Assets to Net Worth (%)	Shows the percentage of assets centered in fixed assets compared to total equity. *Generally the higher this percentage is over 75%, the more vulnerable a concern becomes to unexpected hazards and business climate changes. Capital is frozen in the form of machinery and the margin for operating funds becomes too narrow to support day-to-day operations.*	Fixed Assets ÷ Net Worth

Revenues to Working Capital ratio	Measures the number of times working capital turns over annually in relation to net sales. Should be viewed in conjunction with the assets to sales ratio. *A high turnover rate can indicate overtrading (excessive sales volume in relation to the investment in the business). A high turnover may indicate that the business relies extensively upon credit granted by suppliers or the bank as a substitute for an adequate margin of operating funds.*	Revenues ÷ Working Capital
Return on Total Assets ratio (%)	The key indicator of profitability. *A high percentage tells you the company is well run and has a healthy return on assets.*	Net Profit ÷ Total Assets
Return on Net Worth ratio (%)	Measures the ability of a company's management to realize an adequate return on the capital invested by the owners.	Net Profit ÷ Net Worth

Ratio Name		Reference mentioned in				
		a	b	c	d	e
Current Ratio= $\frac{\text{current assets}}{\text{current liabilities}}$	*Liquidity*	✖	✖	✖	✖	✖
Quick Ratio= $\frac{\text{current assets - inventory}}{\text{current liabilities}}$	*Liquidity*	✖	✖	✖	✖	✖
Total Debt / Total Asset= $\frac{\text{total debt}}{\text{total assets}}$	*Leverage ratios*		✖		✖	
Total Debt / Net Worth= $\frac{\text{total debt}}{\text{net worth}}$	*Leverage ratios*	✖	✖	✖		✖
Current Liabilities / Net Worth	*Leverage ratios*					✖
Current Liabilities / Inventory	*Leverage ratios*					✖
Turnover of total assets= $\frac{\text{revenue}}{\text{total assets}}$	***Activity ratios***		✖		✖	✖
Revenue / Receivable= $\frac{\text{revenue}}{\text{recievables}}$	***Activity ratios***	✖	✖	✖	✖	✖
Quality of Inventory= $\frac{\text{revenue}}{\text{inventory}}$	***Activity ratios***	✖			✖	✖
Revenue/ Working Capital= $\frac{\text{revenue}}{\text{working capital}}$	***Activity ratios***		✖	✖		✖
Revenue / Net Worth= $\frac{\text{revenue}}{\text{net worth}}$	***Activity ratios***	✖	✖	✖		
Revenue / Fixed Assets= $\frac{\text{revenue}}{\text{fixed assets}}$	***Activity ratios***				✖	
Fixed Assets / Net Worth= $\frac{\text{fixed assets}}{\text{net worth}}$	***Activity ratios***		✖	✖		✖
Company Overhead = $\frac{\text{total overhead}}{\text{revenues}}$	***Activity ratios***					
Cost of good sold / Sales	***Activity ratios***					
Creditors / Sales	***Activity ratios***					✖
Working capital / Total Assets	***Activity ratios***					
Return on Revenues= $\frac{\text{profit}}{\text{revenues}}$	***Profitability ratios***	✖				✖
Profit / Total Assets= $\frac{\text{profit}}{\text{total assets}}$	***Profitability ratios***		✖	✖	✖	✖
Profit / Net Worth= $\frac{\text{profit}}{\text{net worth}}$	***Profitability ratios***	✖	✖	✖	✖	✖
Profit /W. capital= $\frac{\text{profit}}{\text{working capital}}$	***Profitability ratios***	✖				✖

Where: a = Adrian, b = Van Horne, c = Robert Morris Associate, d = Brigham, and e = Dun & Bradstreet