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A note on‘‘A case study approach for developing a project performance evaluation system”

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Abstract The major aim of this research is benchmarking Honeywell Federal Manufacturing &Technologies projects using Data Envelopment Analysis (DEA) technique and to compare the results with that of published recently in Qing Cao, James J. Hoffman Qing Cao, James J. Hoffman. (2011). A case study approach for developing a project performance evaluation system. International Journal of Project Management, Vol. 29, 155–164]. Data for 20 projects at Honeywell Federal Manufacturing & Technologies used to conduct the analysis of relative efficiency. My findings indicate that (1) the efficiency of Honeywell Federal Manufacturing & Technologies reported in in Qing Cao, James J. Hoffman (2011) is incorrect, hence, readers should take extra caution of using such results, (2) the corrected efficiency scores suggest that there is potential for significant improvements in Honeywell Federal Manufacturing &Technologies.

Keywords: Data Envelopment Analysis (DEA), Likert Scale, Sensitivity Analysis.

1 Introduction

In a recent paper published in the International Journal of Project Management [1], Qing Cao, and James J. Hoffman (hereafter, Cao and James) have analyzed Honeywell Federal Manufacturing & Technologies (hereafter, FM&T) using non-parametric Data Envelopment Analysis (DEA) methodology. Cao and James pointed out that despite the the multidimensional nature of the project performance, cost and schedule performance measures still remain as the most widely used methods of project performance evaluation by organizations in the real world. Hence, one of the aims in the Cao and James studies was measuring efficiency levels at the FM&T projects which are an important issue for managers and investors as well as for customers. Hence, Cao and James used the DEA technique to benchmark the FM&T projects when it is one of the first publications in the area of practice projects and it is essential to acknowledge Cao and James works for such analysis.

Cao and James also suggested sensitivity analysis was performed to seek the causes of inefficient projects and to identify factors of efficiency that could be targeted for improvement.

By investigating the data used in Cao and James I found that in some cases the data imputed incorrectly to the software. I think that the incorrect results in Cao and James mislead the engineering projects sectors as well as the customers, and it is essential to correct the

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results. Hence, I recalculated efficiency using appropriate data and reported the proper scores in this paper.

The rest of this paper organized as follows: Sections 2 and 3 explain data envelopment analysis and data issues in measuring efficiency of projects. Section 4 includes the correct results for benchmarking FM&T projects. Section 5 concludes the paper.

2 Data envelopment analysis (DEA)

DEA is a non-parametric method of measuring efficiency of Decision Making Units (DMUs) such as hospitals, banks, universities, etc., initially introduced by Charnes et al., 1978[2]. DEA compares a set of homogeneous DMUS relatively and assigns an efficiency score to each DMU by finding the distance of each unit with that of its peers on the best practice (frontier). Those units that lie on the frontier are recognized as efficient, and those that do not, as inefficient. The definition of frontier is very dependent to the selection of input output variables and the efficiency score is very dependent to the DEA model used [3]. Two basic DEA models are CCR (constant returns to scale DEA of Charnes et al., 1978) and BCC (variable returns to scale DEA model of Banker et al., 1984). These two models are explained in Cao and James (page 159) .

In this paper, I do not aim to investigate in further details about DEA, but make some comments on the results published in Cao and James, since I believe that incorrect efficiency scores reported not only mislead the engineering projects sector and customers, but also it undermines the DEA methodology too.

3 Data issues in measuring efficiency of FM&T projects

Cao and James included all of the data used in the analysis(page 160) ,when I compare this data with the results(page 161) , I found that there are some genuine errors in the data set used in Cao and James studies which cause the published results be invalid. for instance the efficiency score of project 1 (0.89) is higher than project 17 (0.52) then the project 1 is more efficient, by looking back to the table 3 in Cao and James (page 160) and observing the input and output values , it is clearly understood that this result is not valid.

In DEA, I personally use Likert scale variables with caution, but in Cao and James paper, the two variables, Priority and Technical Complexity, are used wrongly in the original paper. In DEA, more inputs means more outputs, unless the output/input is undesirable, So one easy solution to correct these variables is to recode the value of “1 to 9” to “9 to 1”(for Priority variable) and “1 to 3” to “3 to 1”(for Technical Complexity variable). An alternative is to consider these two variables as undesirable variable, but I prefer the first solution.

Given the above highlighted issues, the efficiency scores for the same dataset is computed and presented in the next section.

4 Efficiency scores for the FM&T projects

To make my results comparable with Cao and James, I used the same set of projects and the same set of input output variables as in Cao and James studies except changing the value of

Priority and Technical Complexity that mentioned in previous section. my findings alongside with Cao and James’s results are reported in Table 1.

Table 1 Efficiency of FM&T projects, a comparison

project	Cao and James results Input-oriented CRS efficiency	Rank	correct results Input-oriented CRS efficiency	Rank
1	0.897550743	6	0.370231203	18
2	1	1	0.158207283	20
3	0.848012471	9	1	1
4	1	1	0.217083019	19
5	0.668733017	10	0.410037511	17
6	1	1	0.640255009	12
7	0.464834237	14	0.479378694	15
8	1	1	0.519080036	14
9	0.364514813	19	0.615428247	13
10	0.394327834	16	1	1
11	0.643736812	12	1	1
12	1	1	0.844985226	10
13	0.872831147	7	1	1
14	0.663136536	11	1	1
15	0.269733505	20	1	1
16	0.858475894	8	1	1
17	0.527102004	13	0.69281649	11
18	0.458286126	15	1	1
19	0.38209947	17	0.457154918	16
20	0.374718106	18	0.961420678	9

The new ranking set for each project is reported in the last column of Table 1. As an example take ‘‘project 1” which its efficiency score is 89.75% (in Cao and James) while its correct efficiency score is 37.02% .

Sensitivity analysis was used to determine the causes of the inefficient projects, this analysis explained in Cao and James (page 160). table 2 presents new input slacks for the FM&T projects. The informational value of the slacks reveal from an input standpoint how and to what degree the inefficient project teams can make their projects efficient (page 160, Cao and James).

Table 2 New sensitivity analysis

project	Effort	project staffing	**Input slacks** priority	no of engineer	complexity
1	262.570147	0	0.3049	0	0
2	9.49243697	0	0.27686	0	0.11865546
3	0	0	0	0	0
4	0	8.49E-03	0.44949	0	0.35039753
5	105.803346	0	0	0.437373345	0
6	192.183212	0	0	0.213418336	0
7	0	3.70E-02	2.07167	0	0.22258211
8	0	0	0.74044	0	0

project	Effort	project staffing	**Input slacks** priority	no of engineer	complexity
9	182.782189	0	0	1.230856495	0
10	0	0	0	0	0
11	0	0	0	0	0
12	0	0	3.59524	0.510230695	1.90526621
13	0	0	0	0	0
14	0	0	0	0	0
15	0	0	0	0	0
16	0	0	0	0	0
17	35.6800492	0	2.59806	0	1.21242886
18	0	0	0	0	0
19	117.717391	0	1.37146	0	0.45715492
20	0	2.46E-02	0.69373	0	0.90788274

5 Conclusions

This study aimed to benchmark the projects using DEA technique and to compare the results with that of recently published (Cao and James, 2011). This study overcame with some data issues in measuring efficiency of FM&T projects and highlighted the importance of encouraging increased efficiency throughout the project organization using the new results.

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