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Finance Function Performance Measurement-A Data Envelopment Analysis Approach

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Abstract: The practice of measuring performance of the finance function as a business support unit is not widespread. This study assessed the importance of measuring finance function performance, by ascertaining whether such measurement facilitates identification of the relative efficiency of business finance functions, and by establishing its impact, if any, on overall company performance. Focussing on a sample of companies in the South African Freight Forwarding industry, a performance metric was developed and implemented to measure finance function performance. Relative finance function efficiency was then evaluated using input-orientated data envelopment analysis (DEA) to identify 'best in class' performance and to benchmark participants' performance. Further, value chain DEA (VC-DEA) was applied to evaluate finance function efficiency simultaneously with overall company efficiency. Results show that implementation of the performance metric together with DEA facilitated the benchmarking of the finance functions of the sample group and the establishment of improvement targets for the finance functions determined as inefficient. In addition, a link between overall company performance and finance function performance in terms of inputs was confirmed; however, this link was not conclusively established as regards finance function performance in terms of outputs. The contribution of the study includes confirmation that implementation of the performance metric together with DEA facilitates the critical evaluation of finance function performance, thus establishing the importance of measuring the performance of the finance functions. In addition, incorporating the use of DEA in a performance framework for the finance function as a business support unit has extended the range of applications of DEA.

Keywords: *Finance function, performance measurement, data envelopment analysis*

1. Introduction

In order to manage business performance effectively, an appropriate performance measurement system needs to be in place. The beginnings of modern performance management are said to lie in the invention of double entry bookkeeping in the 15th century, centred on identifying profit and controlling cash flow (Morgan, 2004). Performance measurement, on the other hand, began with return on investment (ROI) as developed by the Du Pont Company (Lehtinen & Tuomas, 2010). In support of performance measurement, Neely (2004)argues that simply the act of deciding what to measure has value in that it forces management to be clear about its goals, and that having appropriate measures in place facilitates the communication of a well-defined structure for moving towards the achievement of these goals. Furthermore, he holds that having the correct measures in place with appropriate targets also allows for testing whether these objectives are being met.

In addition to much research relating to overall business performance measurement systems, there are empirical studies concerning measurement systems specifically designed to manage the performance of business support units. Examples include those related to the purchasing and supply chain management functions (PSM) (Das & Narasimhan, 2000; Easton, Murphy, & Pearson, 2002; Ellram, Zsidisin, Siferd, & Stanly, 2002; Narasimhan, Jayaram, & Carter, 2001; Saranga & Moser, 2010), and those related to the information technology (IT) function (Chen & Zhu, 2004; Ebrahimnejad, Tavana, Lotfi, Shahverdi, & Yousefpour, 2014; Mitra, Sambamurthy, & Westerman, 2011; Wang, Gopal, & Zionts, 1997).There is, however, evidence that performance measurement of the finance function as a business support unit is not commonplace (Shewell, 2011; Van Arnum, 2004). This lack of performance measurement is reported as making it difficult to identify whether the finance function is changing in line with identified shifts in the role and function of finance functions internationally (Shewell, 2011), and is seen as a primary barrier to finance improving its performance (Van Arnum, 2004). If companies do not set up measurements to establish baseline performance for the finance function then it is not possible to measure improvements (PricewaterhouseCoopers [PWC], 2015).

To the degree that finance function performance measurement is implemented, relevant business literature reveals that it is for the most part the preserve of consultancy companies and professional organisations (Accenture Management Consulting, 2014; Financial Executives Research Foundation [FERF], 2016; O'Connor, Schneider and Willman, 2015; PWC, 2015). In the South African context specifically, there is limited evidence of any such finance function benchmarking having taken place, with only one study identified, which was carried out by PricewaterhouseCoopers and focused on the insurance industry (PWC, 2014). There is, however, no evidence in the research literature that the efficacy of any such currently used finance function performance measures have been empirically tested either to establish how they relate to input–output efficiency of the finance function or to confirm that an efficient finance function adds value to the business as a whole.Focussing on the finance functions of a sample of companies in the South African Freight Forwarding industry, the main objective of this research was to establish the importance of measuring finance function performance. To this end, finance function performance measures confirmed by industry experts as being important and measurable were implemented, and data envelopment analysis (DEA) was applied to determine whether such performance measurement can (i)facilitate the identification of the relative efficiency of business finance functions, and (ii) establish the impact of such finance function efficiency on overall company performance.

As regards what constitutes the finance function, the main roles of the accounting and finance function have been listed as follows: recording transactions and reporting thereon; financial management, which includes finance mix and dividend policy; and management accounting, which includes activities such as investment analysis, budget preparation, management reporting and variance analysis (Johnston, Brignall, & Fitzgerald, 2002). Boisvert (2001b), on the other hand, has identified five key roles that suggest a broader view of the role of the finance function than that of Johnston et al. (2002), in that he indicates that decision-support activities for the finance function should encompass direct involvement in strategic and operational decision-making throughout a firm. This research defined the finance function as incorporating not only the more traditional roles as outlined by Johnston et al. (2002), but also strategic and business partnering roles as discussed in the literature (Boisvert, 2001a; Boisvert, 2001b; Court, 2005; Lenihan & O'Malley, 2002; Van der Stede & Malone, 2010). This wider definition of the finance function was selected to ensure that performance measures selected could support the transformation of the finance function into a broader more strategic business partner.

The remainder of this paper is organised as follows. In section 2 the literature pertaining to finance function performance measurement and to the application of DEA as it relates to business support units is summarised. Section 3 outlines the methodology followed and the model applied, and section 4 outlines the results of the application of an input-orientated DEA model to the finance function performance data as a means to analyse the relative efficiency of the finance function. In Section 5 the impact of finance function performance on overall company performance is analysed through the application of VC-DEA. Section 6 concludes with an evaluation of the insights gained as regards the potential value to be derived from finance function performance measurement coupled with an implementation of DEA.

2. Literature Review

Value of performance measurement: Much has been written on the value of measuring performance. Reported benefits include that having appropriate measures in place assists in strategy implementation by translating strategy into achievable goals and communicating a structure for achieving such goals (Lehtinen & Tuomas, 2010; Neely, 2004). Furthermore, it allows for the linking of different measures such that strategic goals can be achieved, but also allows for conflicting goals to be identified and aligned (Neely, 2004). The value of having a consistent standard of measurement across organisations is another proposed benefit of implementing a performance measurement system (Morgan, 2004).Performance measurement is, however, not without its challenges. Such systems can result in unintended behavioural consequences, such as when disappointing data is used in a judgmental way, or performance data is seen as a source of power and control (Neely, 2004). Further challenges include a focus on minimising variances as opposed to improving processes, and the fact that much measurement is based on historical measures, leading to reactive behaviour on the part of managers (Kaplan, 1984; Morgan, 2004). It is in response to these challenges that academics

and practitioners concentrated on developing measurement frameworks that align performance measurement with corporate strategy (Lehtinen & Tuomas, 2010).

A number of performance measurement models exist, including those referred to as the balanced measurement frameworks, designed to encourage businesses to implement a balanced set of performance measures (Brown, 1996; Fitzgerald, Brignall, Silvestro, Keegan, Eiler, & Jones, 1989; Lynch & Cross, 1992). However, the most well-known of these is that put forward by Kaplan and Norton (1996a), which proposes a four-faceted approach to performance measurement, including both operational and financial measures. As regards finance function performance measurement specifically, there are extant finance function performance benchmarks reported in the business literature, with a number of consulting groups and business organisations conducting benchmark studies by collecting and comparing data internationally across multiple industries (including, Accenture Management Consulting, The Hackett Group, FERF, PWC). However, many companies do not independently measure the performance of their finance functions (Van Arnum, 2004). These accepted performance benchmarks provide a basis from which to evaluate what measures may be combined to constitute an effective performance metric for the finance function in any industry.

Data envelopment analysis in performance measurement: In managing through the use of performance measurement, a key challenge is to shift the focus from justifying individual figures to learning from the current situation, and applying the findings to identifying how the targets can be achieved (Neely, 2004). In a similar vein, Kaplan and Norton (1996b) indicate that many managers become caught up in local improvement plans and reorganisations, without linking them to specific targets or to improved financial performance. This assertion by Kaplan and Norton gives credence to the argument that it is important to be able to link improving finance function performance to the future financial performance of the company overall. DEA has been identified as a potential method for establishing the relative efficiency of finance functions, and identifying whether the performance of the finance function can be linked to overall company performance.

DEA is a mathematical programming tool used in evaluating performance. In its current form, DEA was first introduced in 1978, and has since been recognised as an excellent methodology for performance evaluations (Cooper, Seiford, & Zhu, 2004). As such, Cooper et al. indicate that DEA has been used in evaluating the performance of many different types of business units and activities in the ensuing years. The original Charnes, Cooper, Rhodes (CCR) DEA model (Charnes, Cooper, & Rhodes, 1978) utilises linear programming to produce an efficiency measure for a decision-making unit (DMU), requiring only that the DMUs convert similar inputs to similar outputs and that these can be quantified. In terms of the model, any DMU measured as having an efficiency score of 1 is considered to be relatively efficient, and any with a score less than one is relatively inefficient (Elkins, 2003). Inefficiency means, in reference to its peer group, either its outputs could be increased without increasing inputs, or inputs could be decreased without decreasing outputs.

DEA, as originally developed, was designed to measure the efficiency of business systems as a whole without considering the internal structure of the business, often referred to as a 'black box' approach (Chen & Zhu, 2004; Kao, 2014). However, some evidence arose to suggest that in order to understand the efficiency of a DMU it was necessary to study the efficiency of its component processes (Kao, 2014). Wang et al. (1997) were among the first to address this issue, when they demonstrated the use of DEA to assess the marginal benefits of information technology on corporate performance in the banking industry. Following from this study many more complex cases have been studied where the business system is separated into more processes, either with a series or parallel structure, or some mix of these (Kao, 2014). One such study by Chen and Zhu (2004) developed a DEA-based methodology, which allows for the identification of the efficient frontier in two-stage processes where there are intermediate measures of performance. Chen and Zhu (2004) explain that the original DEA model can measure the efficiency at stage one and at stage two, but it cannot accommodate a process in two stages with intermediate performance measures in one application.

The Chen and Zhu model has been adopted by, among others, Saranga and Moser (2010), who term the model value chain DEA (VC-DEA).They utilised it to evaluate the performance of 120 international firms with respect to purchasing and supply chain management. The model was also adopted by Chiu and Huang (2011),

who evaluated the operational and profitability efficiencies of tourist hotels in Taiwan using the model. More recently the model has been applied in evaluating the impact of IT and risk performance in commercial banks in Taiwan (Wang & Lu, 2015). Kao (2014) summarised a wide range of network DEA studies that were based on problems identified and the models that have been developed and applied to them. The most recent studies with regard to network DEA focus on the stage weights applied in the model, and their impact in determining stage and overall efficiencies (Ang & Chen, 2016; Despotis, 2016; Guo, Shureshjani, Foroughi & Zhu, 2016). These studies reveal an emphasis on refinements in the theory, whereas the purpose here is to review existing network DEA applications in order to determine their usefulness in performance measurement systems for support units within businesses.

As is demonstrated through the application of the model by Saranga and Moser (2010) to the purchasing and supply chain management functions, and by Chen and Zhu (2004) themselves to information technology, it appears that the VC-DEA model is ideally suited to incorporation into performance measurement frameworks for support functions such as the finance function. Although the model does not allow for the identification of the impact of other exogenous inputs on overall company performance, it does allow for the relative efficiency of the finance function as a support DMU to be directly and simultaneously linked to the relative efficiency of the business as a whole. Saranga and Moser (2010) contend that a key challenge in measuring performance of support functions, such as PSM, is that they are not seen as directly adding value to products and services, making their value add difficult to measure. If the aim is to measure the performance of the finance function as a support function and to identify whether it adds value to the business as a whole, and not to unpack all the factors contributing to overall business efficiency, then it is contended that the Chen and Zhu (2004) VC-DEA model is fit for this purpose.

3. Methodology and Model

This research focussed on the finance function of companies in the South African Freight Forwarding industry. In order to identify relevant performance measures, selected companies were targeted to participate by responding to a semi-structured questionnaire and in follow-up interviews designed to identify and define the most important and measureable finance function performance measures in the context of the industry, and also to identify and define the most commonly used measure of overall company performance. Potential finance function measures were established with reference to relevant literature regarding finance function performance measurement (Accenture Management Consulting, 2014; FERF, 2013; Institute of Management and Administration, 2005).

The top-ranked measures identified were then further analysed, and they were categorised as either primary or secondary measures. A distinction is made between leading and lagging measures of performance (Kaplan and Norton, 1996b; Nørreklit, 2000). In the case of the finance function's input and output measures, those measures that for the most part have the characteristics of lagging indicators, were designated as primary measures. Six such primary measures of finance function performance were identified, and one primary measure of overall company performance. The finance function input measures identified are: *finance function cost as a % of revenue,* and *finance staff per million ZA rand of revenue.* The primary finance function output measures are: *average days' sales outstanding, business days to close and report, number of general ledger accounts reconciled at least quarterly,* and *customer billing error rate.* Finally, the identified measure of overall company performance was *net profit as a percentage of turnover.*

Table 1: Descriptive statistics of all input and output variables

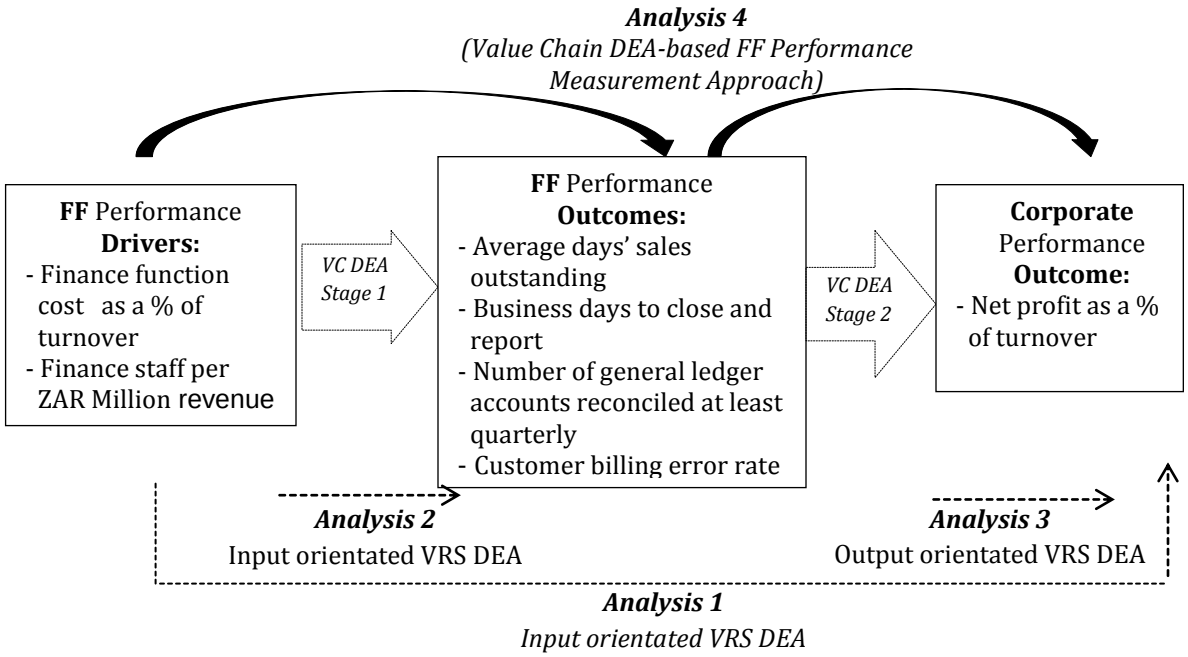
Variable	Mean	Std. dev	CV	Minimum	Maximum	Lower quartile	Median	Upper quartile
Finance function cost as a % of turnover	7.8%	5.4%	0.7	0.9%	22.4%	3.4%	6.6%	10.2%
Finance staff per R' million of revenue	2.2	2.6	1.2	0.07	9.6	0.2	1.7	2.8
Average days sales outstanding	36.0	12.1	0.3	9.1	56.1	28.0	35.5	42.0

Number of general ledger accounts reconciled at least quarterly	73.7%	33.6%	0.5	10.0%	100.0%	42.1%	100.0%	100.0%
Customer billing error rate	6.3%	4.5%	0.7	0.7%	21.00%	3.9%	5.0%	8.0%
Business days to close and report	10.5	8.9	0.8	2.0	41.00	5.0	10.0	13.0
Net profit as a percentage of turnover	16.0%	10.6%	0.7	3.0%	35.00%	5.2%	13.8%	27.0%

For the industry analysis of finance function performance, attention was focussed on these primary measures, which were collated into a performance measurement instrument designed to collect the performance data. This instrument was distributed to 35 companies, which were identified in the relevant industry directly through the agency of the South African Association of Freight Forwarders, but also through a call for participation placed on its website. A total of 19 usable responses were received. For the application of DEA as an operation management technique, a sample size equal to two to three times the number of input and output measures to be analysed is recommended (Chen and Zhu, 2004; Golany and Roll, 1989; Zhu, 2014). The study included seven input and output measures, and therefore the sample size was considered satisfactory given the methodology used. Data collected relate to the period ending 31 December 2015. Descriptive statistics in respect of the measurement data so collected are reported in Table 1.

4. Results

Figure 1: Summary of DEA analyses



Source: Developed by study authors, adapted from Saranga and Moser, 2010

Based on this measurement data, DEA was implemented to confirm the importance of such measurement and employed to establish the relative efficiency of the finance functions and to identify whether efficiency of the finance function had any identifiable impact on overall company performance.DEA was selected as a methodology due to its advantages over other approaches such as statistical regression analysis, which include its empirical orientation and the non-necessity of prior assumptions in DEA, prior assumptions being inherent in these other approaches. Furthermore, studies of benchmarking practices using DEA show inefficiencies in some of the most profitable firms, and so DEA provides a better vehicle for establishing benchmarks than using profitability as a criterion (Cooper et al., 2004). Furthermore, a benefit over single input-output ratio analysis is thatDEA allows for multiple performance dimensions to be combined in a single measure of efficiency. More specifically, for a business support unit such as the finance function, applying the

value chain DEA model (VC-DEA) (Chen & Zhu, 2004; Saranga & Moser, 2010) was determined to be appropriate, given this model's capability of linking performance of the intermediate process to overall company performance. Mirroring the approach of Chen and Zhu and Saranga and Moser, for comparative purposes, four analyses were conducted here: first, measuring efficiency of conversion of finance function inputs into overall company outputs (Analysis 1); and second, measuring the efficiency of conversion of finance function inputs into finance function outputs (Analysis 2). For both of these analyses, an input-orientated VRS DEA model was implemented. Next, an output-orientated VRS DEA model was implemented to measure efficiency of conversion of finance function outputs into overall company outputs (Analysis 3). Finally, these analyses were compared with VC-DEA (Analysis 4), which aims simultaneously to minimise finance function inputs and maximise overall company output (Ebrahimnejad et al., 2014). The four comparative analyses employed as described here are depicted in Figure 1.

In this application, three out of the four finance function output measures (*average days' sales outstanding, business days to close and report* and *customer billing error rate*) have the objective of minimising the output level. However, the basic premise underlying DEA is to maximise outputs relative to inputs. Different approaches to accounting for this anomaly in output measures were identified and considered. The approach adopted was to introduce a linear monotone decreasing transformation vector for these outputs (Seiford and Zhu, 2002; Hua and Bian as cited in Zhu and Cook, 2010), the advantages being that it maintains the integrity of the production process and preserves convexity (Seiford and Zhu, 2002). Accordingly, a vector was selected that was large enough to ensure the transformed output values would be greater than zero. Having translated the data as described, the resultant efficiency scores for the four comparative DEA models are as shown in Table 2.

Table 2: Comparative efficiency scores - analysis 1 to 4

Comparative results	**Analysis 1**	**Analysis 2**	**Analysis 3**	**Analysis 4**	
Respondent number	**FF Inputs → Overall profit**	**FF Inputs → FF Outputs**	**FF Outputs → Overall profit**	**Efficiency1**	**Efficiency2**
2.1	1.0000	1.00000	2.25606	1.00000	3.50275
2.2	0.1016	0.08825	4.83623	0.07537	6.25000
2.3	1.0000	1.00000	1.00000	0.63979	1.66619
2.4	0.9394	1.00000	1.82487	0.81167	3.01274
2.5	1.0000	1.00000	1.80848	0.94864	2.65511
2.6	0.2937	1.00000	1.00000	0.07083	1.66667
2.7	0.6010	1.00000	1.00000	0.62267	11.66667
2.8	1.0000	0.25000	1.62791	0.25000	1.62791
2.9	0.8806	1.00000	2.87984	0.66720	6.73077
2.10	0.5538	0.40571	1.00000	0.09659	1.29438
2.11	0.2422	0.10791	1.00000	0.03803	1.09787
2.12	0.1216	1.00000	1.00000	0.09907	7.95455
2.13	1.0000	0.14167	1.00000	0.14167	1.00000
2.14	0.9266	1.00000	1.08500	0.28333	2.05882
2.15	0.4829	0.37030	1.00000	0.08374	1.28299
2.16	0.6682	1.00000	1.66249	0.24286	2.53623
2.17	1.0000	1.00000	6.25575	1.00000	11.66667
2.18	0.3176	1.00000	6.65128	0.27331	8.75000
2.19	1.0000	0.74000	1.02215	0.43895	1.20042
Number efficient	7	12	8		

Relative efficiency of the finance function as a business unit: To address the first sub-objective, which is to assess the relative finance function efficiency among respondent companies using DEA, in the first instance Analysis 2 is considered, in effect evaluating the function as a standalone process. This analysis measures the conversion of finance function inputs into finance function outputs, and utilises an input-orientated approach. The objective of the input-orientated DEA approach is to reduce the level of inputs for a given level of outputs, using the peer group as a potential benchmark. An efficiency score of one reflects optimum efficiency, whereas a score of less than one denotes inefficiency relative to the peer group. In terms of Analysis 2, 12 out of 19 (63%) of the finance functions of respondent companies were identified as relatively efficient in the finance function activity. Given their outputs, and in comparison with the input/output relationships of others in the set, their inputs were at an optimum level. While the reported results for *finance cost as a percentage of revenue* for these efficient units ranges from a low of 0.85% (respondent 2.17) to a high of 12% (respondent 2.6), and the results for *number of finance function staff per million rand of revenue* range from a low of 0.076 (respondent 2.1) to a high of 9.56 (respondent 2.14), they have all nonetheless been determined as efficient. This performance rating is because DEA compares the input/output relationship of each respondent against the input/output relationship of those in the set and not against an imposed target or an average.

Table 3: Deriving performance targets in DEA – examples from Analysis 2

		Input measures		Output measures			
Respondent number	Weighting	Finance function cost as a % of revenue	Finance function staff per R' million revenue	Average days sales outstanding	Number of general ledger accounts reconciled at least quarterly	Customer billing error rate	Business days to close and report
Current 2.2		16%	2.8	33	62%	8.70%	10
Peers							
2.4	0.067	5.50%*	0.16*	33**	83%**	8%**	5**
2.9	0.311	1.66%*	0.32*	28**	20 %	2.86%**	10**
2.17	0.622	0.85%*	0.22*	35.5	100 %**	4.20%**	10**
Target 2.2		1.41%	0.247	33.00	73.98%	4.04%	9.67
Current 2.19		14.00%	0.2	34	27 %	21.00%	15
Peers							
2.1	0.143	6.56%*	0.076*	40	10%**	3.98%**	15**
2.4	0.857	5.50%*	0.16*	33**	83%**	8%**	5**
Target 2.19		5.65%	0.148	34	85.43%	7.43%	6.429

* = Input less than inefficient respondent **= Output better than or equal to inefficient respondent

In addition to determining the efficient finance functions, the model also establishes targets for improvement, which would enable inefficient finance functions to move onto the efficiency frontier. The targets are in essence a weighted average of the input and output measurements of efficient finance functions whose outputs most closely correspond with the given outputs of the inefficient finance function, and who therefore form the standard setting group for the inefficient unit. Efficiency targets can be better understood by examining some examples in more detail. Respondent 2.2 has a target *finance function cost as a percentage of revenue* of 1.41%, as compared with its current 16%, and a target *number of staff per million rand of revenue* of 0.247 staff per million compared with its current level of 2.8 staff per rand million. The targets for respondent 2.2 were established as a weighted average of the inputs of respondents 2.4, 2.9, and 2.17. These efficient functions all have inputs measurements lower than respondent 2.2, whilst achieving superior outputs in the majority of cases. On the other hand, another inefficient respondent, respondent 2.19, has output measures that are all currently inferior to respondent 2.2 examined above. This respondent's target *finance function cost as a percentage of revenue* is 5.65% (current 14%) and its target *number of staff per*

million rand of revenue is 0.148 staff per million (current 0.2 staff per rand million). The targets in this case are established with reference to efficient respondents 2.1 and 2.4. These two units have lower inputs than respondent 2.19 whilst at the same time achieving better outputs in most measurements. This comparative analysis of targets for respondents 2.2 and 2.19 is shown in Table 3.

The individual input targets for the seven inefficient functions in Analysis 2 range from 0.85% (respondent 2.8 and 2.13) to 5.651% (respondent 2.19) for *finance function cost as a percentage of revenue*, and 0.1480 staff per rand million (respondent 2.19) to 0.9737 staff per rand million (respondent 2.1) for *number of staff per million rand of revenue*. The range in these results reflects the individualised nature of the targets, and the fact that they are set in relation to relative outputs. A reported benefit of using DEA is that it allows for the benchmarking of DMUs in relation to peers, rather than in comparison to an average or an imposed target. Instead of the respondents all being compared to an imposed target or the overall best performer, which may be considered unachievable for some, they are compared to comparators that are achieving the same or better outputs with less inputs. In conclusion, application of the input-orientated VRS DEA model to evaluate finance function efficiency shows that implementing performance measurement does enable benchmarking of the performance of the finance function in relation to industry peers.

Establishing finance function impact on overall company performance: The second sub-objective in confirming the importance of measuring finance function performance, was to determine if a link could be established between finance function efficiency and overall company performance. Referring to the DEA analyses reported above, Analysis 1, 3 and 4 all aim to link finance function performance with overall company performance. Some earlier attempts to incorporate intermediate processes in performance measurement followed approaches similar in nature to Analysis 1, 2 and 3 as described by Chen andZhu (2004) and Saranga andMoser (2010). The validity of these approaches in determining the impact, if any, of finance function performance on overall company performance was also tested. It was shown that companies efficient in finance function activities (Analysis 2) are not always efficient in converting finance function input into overall company profits (Analysis 1), and that in applying Analysis 1 and 3, finance functions can be established as adding to overall company efficiency whilst not being efficient in themselves (Analysis 2). These problems and inconsistencies arising from the ways in which Analysis 1 and 3 accommodate intermediate processes in performance evaluation, provided the impetus for the development of VC-DEA (Chen & Zhu, 2004), and having been confirmed in this study, further justified the use of VC-DEA in this case.

The VC-DEA model returns efficiency scores for stage one (conversion of finance function inputs into finance function outputs) and stage two (conversion of finance function outputs into overall company outputs). The model "looks to minimise the inputs and simultaneously maximise the final output given the level of intermediary inputs" (Saranga and Moser, 2010, p.202). In terms of the VC-DEA model, only firms that return an efficiency score of 1 in both stage one and stage two are considered efficient when the process is viewed as a whole. In addition, the model provides targets for the intermediary measures (in this case finance function outputs), which, if met, would result in the two stages being efficient.

The results of the application of VC-DEA to the finance function performance data in this case, are shown in Table 2 as Analysis 4. In this analysis, no companies are found to be efficient when the process is viewed as a whole, given that no companies have an efficiency score of 1 at both stage one and stage two. Two companies (respondent 2.1 and 2.17) are found to be efficient at stage one, but not at stage two. Further interrogation of the targets returned in respect of these two companies shows that only an improvement in their overall company profits is required in order for them to be efficient when the process is viewed as a whole. That is, they are efficient in terms of finance function inputs and outputs. In contrast, all but these two companies are required to improve on the finance function inputs employed in order to generate the optimum intermediary outcomes and overall company profits, as is indicted by the targets returned by the model in respect of finance function inputs (stage 1) shown in Table 4. This finding demonstrates that improvement in finance function input performance is required in order to improve overall company performance for these 17 companies in the set, and, therefore, shows that finance function input performance is a determining factor in overall company performance.

As regards stage 2, only one company (respondent 2.13) is found to be efficient. For this company, only an adjustment to its finance function inputs is required in order for it to be efficient across the process. Moreover, as regards finance function outputs, the intermediary output targets (see Table 4) are for the most part referencing the current intermediary output performance of this respondent, it being the only efficient unit at stage 2. However, many units are currently achieving intermediary output performance superior to the efficient unit, and therefore targets returned for these units are in fact inferior to their current performance, effectively showing that they should be able to achieve higher profitability without requiring improvement in finance function outputs. An example of this is in the measure *average days' sales outstanding* where the efficient unit had one of the highest current *average number of days sales outstanding*, and therefore 16 out of the 19 (84%) companies are reflected as not needing to improve performance in this regard to achieve overall process efficiency. Only in one measurement, where the performance of the efficient unit matched the maximum recorded performance, *number of general ledger accounts reconciled at least quarterly,* do all inefficient units have to either maintain their performance (if already at the maximum) or improve their performance in order to achieve overall system efficiency.

To summarise the results in respect of the impact of finance function performance on overall company performance, finance function input targets for units reported as inefficient at stage 1 reflect that an improvement in input performance is required to achieve system efficiency. In contrast, finance function output targets for units determined as inefficient at stage 2 are in some cases inferior to current performance, thus showing that improvement in performance in terms of these outputs is not required to achieve system efficiency. Therefore, it can be concluded that finance function input performance is linked to system efficiency, whereas for finance function output performance this link is not conclusively proved. In concluding that finance function outputs are, for the most part, not a contributing factor in overall company performance, it is nonetheless noted that the profitability performance of the stage 2 efficient unit (respondent 2.13) in the data set is significantly higher (more than two standard deviations above the mean) than others in the set. It is also noted that the study is cross-sectional in nature in that data have been collected for a particular period (the year and/or month ended 31 December 2015, as relevant). Accordingly, although companies were asked to validate their data post collection (making the conclusion valid in respect of the particular data set), in order to check for robustness of this conclusion, an alternative was considered where the tails of the profitability measure were removed. The results of this check showed that removing outliers from the sample did impact on the number of companies being determined efficient overall (two respondents were now efficient at both stage 1 and stage 2). However, in respect of targets for finance function (intermediary) output performance, the results remained mixed in terms of whether an improvement in such output performance was necessary for achieving efficiency in terms of final company profit (stage 2 efficiency).

5. Conclusion

To examine the importance of measuring performance of the finance function, DEA was applied to evaluate utilising such measurement to establish relative finance function performance within the peer group, and to examine whether a link between finance function efficiency and overall company efficiency could be identified. In order to establish benchmarks for the finance function as a standalone business unit, input-orientated VRS DEA was applied (Chen & Zhu, 2004; Saranga & Moser, 2010). The efficient companies relative to the peer group were identified, and targets for improving efficiency in the units identified as inefficient were unpacked. Therefore, performance measurement was shown to facilitate the establishment of relative efficiency of companies in the peer group. In terms of this model, 12 of the 19 respondent company finance functions were found to be efficient. Following the approach of Chen and Zhu, Saranga and Moser, and others, various approaches to linking the performance of the finance function to overall company performance using DEA were then evaluated. It was established that using either an input-orientated VRS DEA to evaluate efficiency of conversion of finance function inputs to overall company profits, or an output-orientated VRS DEA approach to evaluate conversion of finance function outputs to overall company profits, both were deficient in that they gave contradictory results. This deficiency provided the rationale to adopt the Chen and Zhu VC-DEA approach to evaluate the link between finance function performance and overall company performance.

The results of the VC-DEA application showed that achieving overall process (system) efficiency for companies determined as inefficient in stage one, required an improvement in finance function inputs, and therefore demonstrated a link between finance function input performance and overall company performance. Those companies found to be inefficient in stage two, required an improvement in overall company profits. The model also, however, returned targets in respect of intermediate (finance function) outputs. Here it was found that improvements in these intermediary outcomes were not always required in order to achieve efficiency throughout the process. Therefore, the results in respect of the link between finance function outputs and overall company performance are mixed.

The implementation of DEA in this study has facilitated the critical evaluation of the importance of performance measurement of the finance function in the freight forwarding industry, whereas the value of performance measurement is reported as being difficult to isolate (Neely, 2004). Furthermore, it has facilitated the critical evaluation of the value added by the finance function as a business support unit; whereas establishing the value added by support functions has been reported as particularly difficult because they do not directly add value to the business (Saranga & Moser, 2010). In addition, applying VC-DEA to performance measurement of the finance function has extended the range of DEA applications.

Table 4: VC-DEA actual vs target performance

	Finance function inputs				Intermediary finance function outputs								Overall company output	
Respondent number	Finance function cost as a % of revenue		Finance function staff per R' million revenue		Average days sales outstanding		Number of general ledger accounts reconciled at least quarterly		Customer billing error rate		Business days to close and report		Net profit %	
	Act.	Tgt.	Act.	Tgt.	Act.	Tgt.	Act.	Tgt.	Act.	Tgt.	Act.	Tgt.	Act.	Tgt.
2.1	6.6%	6.6%	0.08	0.08	40.0	52.7	100%	100%	4.0%	4.9%	15.0	15.0	9.9%	34.7%
2.2	16%	1.2%	2.80	0.21	33.0	55.6	62%	100%	8.7%	4.6%	10.0	12.0	5.6%	35.0%
2.3	9.4%	6.0%	0.14	0.09	38.7	54.0	100%	100%	2.0%	4.8%	2.0	13.6	20.9%	34.8%
2.4	5.5%	4.5%	0.16	0.13	33.0	55.1	83%	100%	8.0%	4.7%	5.0	12.5	11.6%	34.9%
2.5	6.2%	5.9%	0.10	0.10	42.0	39.7	100%	100%	12.3%	4.7%	5.0	13.5	13.1%	34.8%
2.6	12%	0.9%	5.00	0.22	9.1	55.6	10%	100%	6.0%	4.6%	2.0	12.0	21.0%	35.0%
2.7	8%	5.0%	0.20	0.13	35.0	38.7	75%	100%	0.7%	4.6%	20.0	12.0	3.0%	35.0%
2.8	3.4%	0.9%	1.86	0.22	56.1	55.6	100%	100%	7.3%	4.6%	13.0	12.0	21.5%	35.0%
2.9	1.7%	1.1%	0.32	0.21	28.0	55.6	20%	100%	2.9%	4.2%	10.0	12.0	5.2%	35.0%
2.10	8.8%	0.9%	2.40	0.22	49.5	55.6	100%	100%	6.5%	4.6%	6.0	12.0	27.0%	35.0%
2.11	22.4%	0.9%	7.16	0.22	27.8	55.6	42%	100%	7.3%	4.6%	41.0	12.0	31.9%	35.0%
2.12	8.6%	0.9%	3.23	0.22	17.7	55.6	100%	100%	3.9%	4.6%	2.0	12.0	4.4%	35.0%
2.13	6.0%	0.9%	1.73	0.22	55.6	55.6	100%	100%	4.6%	4.6%	12.0	12.0	35.0%	35.0%
2.14	3.0%	0.9%	9.56	0.22	21.0	35.5	60%	100%	5.0%	4.6%	12.0	12.0	17.0%	35.0%
2.15	10.2%	0.9%	2.78	0.22	42.0	55.6	20%	100%	2.5%	4.6%	9.0	12.0	27.3%	35.0%
2.16	3.5%	0.9%	1.91	0.22	41.0	55.6	100%	100%	4.1%	4.6%	5.0	12.0	13.8%	35.0%
2.17	0.9%	0.9%	0.22	0.22	35.5	55.6	100%	100%	4.2%	4.6%	10.0	12.0	3.0%	35.0%
2.18	3.1%	0.9%	1.17	0.22	46.0	55.6	100%	100%	8.0%	4.6%	6.0	12.0	4.0%	35.0%
2.19	14.0%	6.2%	0.20	0.09	34.0	53.9	27%	100%	21.%	4.8%	15.0	13.7	29.0%	34.8%

Performance measurement together with an application of DEA has made it possible to determine the relative efficiency of the companies' finance functions and to establish finance function input and output targets for

the companies in the set. In addition, simply providing comparative performance data for companies gives them valuable additional information for decision-making that was not previously available in this industry. It is recommended, therefore, that the industry body consider the implementation of the metric, and make the resultant data available on an ongoing basis as one of the value-add services it provides to members. There is also scope to carry out similar analyses in other industries or across industries to investigate the importance of finance function performance measurement across a broader spectrum and thereby increase the likelihood of such measurement being adopted by business more generally.

It is acknowledged that there are limitations to the study that impact the scope of the conclusions. The range of finance function performance measures selected was limited, although being based on rigorous analysis of industry inputs in this regard. There could be other drivers of finance function performance that are impacting finance function efficiency and that could be found to link to overall company performance. Extending the number of measures included in the analysis could allow for further discrimination of efficiency. Related to this limitation is that only a small proportion of companies in the industry responded to the call to provide performance data for the application of the DEA model. The small size of the sample does limit the number of inputs and outputs included in a DEA application, and increasing the size of the sample would allow for the extension of the number of inputs and output measures included in the analysis. Therefore extending the analysis in respect of both the number of input and output measures and the size of the sample are both avenues for further study.

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