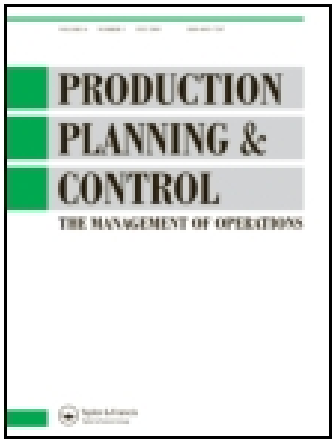

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How to compare performances of firms operating in different sectors?

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How to compare performances of firms operating in different sectors?

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This paper seeks to address the question 'How to measure different SMEs' performances comparatively?' An initial review reveals that the literature does not provide objective and explicit debate on the subject. Consequently, an approach is developed, informed by the literature, which is used to compare the performances of 37 SMEs. The consistency and reliability of the approach is tested, resulting in a ranking of the 37 firms according to their performances. Using cluster and factor analysis the paper demonstrates that leading indicators are somewhat redundant, and that lagging indicators have greater significance for the purpose of comparative measurement of different SMEs performances. Whilst the approach adopted here withstood internal and external validity tests and can be seen as a robust way of comparing SMEs performances, these results may be limited to this study.

Keywords: benchmarking; comparisons; measurement; performance; SMEs

1. Introduction to the research problem

Ever since Johnson and Kaplan (1987) published their seminal book, *Relevance Lost – The Rise and Fall of Management Accounting*, performance measurement gained increasing popularity (Neely 1999). Today, performance measurement and management practices are commonplace in all industrial, commercial and public sector organisations. Along with this increased interest in performance measurement, we have also witnessed an increasing interest in benchmarking in order to identify and drive improvement opportunities (Coulter *et al*. 2000). However, despite this attention to performance measurement and benchmarking the challenge of *how to compare the overall performance of different organisations from different sectors remains unresolved*. This is particularly prevalent in the case of SMEs due to their larger diversity (Zeinalnzehad *et al*. 2010, 2011).

The World Competitiveness Report (2009) provides some indication towards the type of measures that should be used to measure a firm's performance (such as revenue growth, profitability growth, productivity growth and so on)[1]. Other studies (Kratchman *et al*. 1974, Phillips 1997, Yamin *et al*. 1997, Collins 2001, Nohria *et al*. 2003, Länsiluoto *et al*. 2004) suggest the use of single indicators, particularly the return on investment measures. However, the comparison of the performances of different companies to one another using these measures in absolute terms becomes meaningless because one company may be operating a high growth sector and the other in a declining sector.

The literature contains performance comparisons of firms in different countries (Voss and Blackmon 1996, Andersen and Jordan 1998, Samson and Ford 2000) or performance comparisons between groups of firms, such as SMEs versus local firms versus large firms (Grando and Belvedere 2006). However, in all these cases, different contextual characteristics between different sectors[2] are not accounted for when comparing performances of firms from different sectors. The majority of studies, that compare the performances of firms from different sectors, focuses on particular processes or function such as supply the chain performance (Lewis and Niam 1995, Gunasekaran *et al*. 2001, Fynes *et al*. 2005, Sánchez and Pérez 2005, Yurdakul 2005, Kim 2007, Kojima *et al*. 2008, Akyuz and Erkan 2009) or manufacturing performance (Miller and Roth 1994, Bonvik *et al*. 1997, Bukchin 1998, Laugen *et al*. 2005) without paying much attention to overall performance of the firm. However, a key study recently published in the

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Journal of Management highlights that any such functional performance studies should be conducted in the context of overall performance and they call for more theoretically grounded research and debate for establishing measures appropriate to a given research context (Richard *et al*. 2009).

It appears that, although there are many studies measuring and comparing the performances of different firms from different perspectives (such as marketing, operations, finance and human resource management) and for different purposes, there is little or no informed scientific debate as to which measures are appropriate and how these measures should be combined and used in order to compare the business performance of different firms operating in different sector, whilst accounting for the industry specific factors (Ellis and Williams 1993, Reider 2000, Hawawini *et al*. 2003, Richard *et al*. 2009). Although this is an issue both for large and small organisations alike, the problem is more prominent in SMEs due to their greater diversity and sectoral focus (Zeinalnzehad *et al*. 2010, 2011). That is in many cases large organisations, particularly multinationals, operate across a number of sectors. Therefore, with this paper we seek to outline a method as well as initiating a scientific debate on appropriate measures, how they should be combined and used in order to measure different SMEs performance comparatively.

2. Research design

Figure 1 provides an overview of the research programme adopted in to pursue the research problem posed earlier.

First, we reviewed literature, including both SMEs and large companies and, covered a broad range of overlapping fields, including performance measurement, management control systems, benchmarking and performance management. We synthesised the literature in two main research streams: the performance measurement literature in general and the cross-industry benchmarking literature in particular.

Secondly, given the lack of scientific debate on measurement of different firms' performances comparatively, we used a Focus Group to review the literature conclusions and identify how and what to measure. As a result we identified nine key performance measures (i.e., revenue growth, market share growth, profitability growth, cash flow growth, value-added productivity growth, customer satisfaction new value streams investments and employee satisfaction and morale) that would enable the assessment of a SME's overall performance together with an approach for accounting for intersectoral differences. The focus group comprised of six academics with backgrounds in operations management, manufacturing, human resource management, management science, strategic management and psychology as well as four industrial members (two managing directors and two operations directors from four different SMEs) representing multidisciplinary operational and strategic views from both academic and industrial perspectives.

Thirdly, we empirically tested the proposed approach on a group of 37 SMEs[3] operating in different sectors including food and beverages, electronics, electrical equipment, plastic components, process and heavy engineering. In selecting the case-study organisations, SMEs with less than 50 people were avoided as according to Voss *et al*. (1998) they represent different levels of managerial capabilities. In fact, the 37 cases examined all had between 100 and 250 employees. For the purposes of our research a sample size of 37 was considered to be adequate with a KMO index of 0.82 and statistical significance of

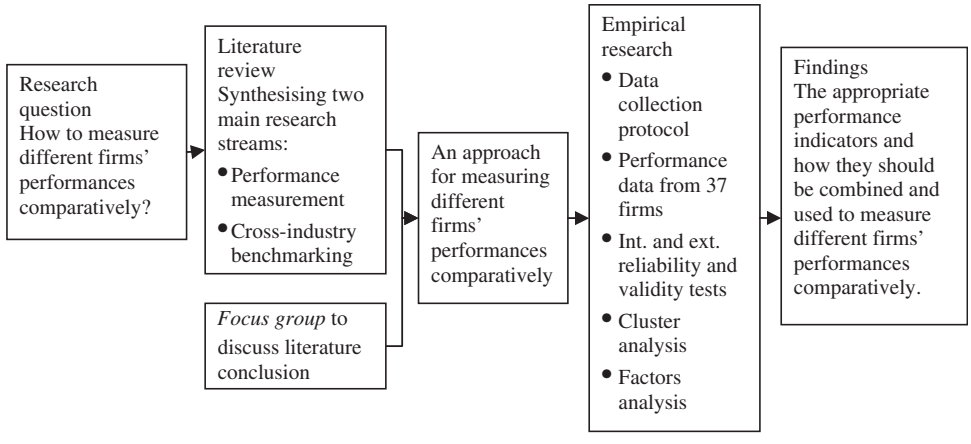

Figure 1. A synthesis of the research process.

Barlett's test (Hair *et al*. 2006, 2008) which is explained in further detail in Appendix 1. Section 5 of the paper outlines the empirical method employed and presents our findings. Appendix 1 provides further details on the data analysis methods employed. Finally, based on empirical evidence we are able have an informed debate on what measures to use and how to use these to measure firms' performances comparatively.

3. Background literature

The literature review presented in this section was conducted to establish the current knowledge pertinent to our research question. That is, *how to compare the overall performance of different SMEs from different sectors*. In order to identify the relevant papers, specific management databases, such as Business Source Premier, Web of Knowledge, Emerald Insight, Management and Organisation Studies, ABI Inform and Science Direct were searched using search phrases such as performance comparison, performance measurement in SMEs, benchmarking and performance benchmarking. We were primarily interested in post-1990 articles as this period represents the boom in performance measurement research (Neely 2005). Relevant articles were identified after a review of abstracts followed by full text reviews. The selected papers were analysed and integrated with key books relevant to our area of interest (Johnson and Kaplan 1987, Camp 1989, Fitzgerald *et al*. 1991, Lynch and Cross 1991, Maskell 1991, Karlof and Ostblom 1993, Reider 2000, Kaplan and Norton 2001, Neely *et al*. 2002, Watson 2007). For the purposes of this literature review, publications in conferences proceeding were omitted due to the volume of papers identified and their recognised minor relevance compared to the journal papers.

The resultant literature covered a broad range of overlapping fields, including performance measurement, management control systems, benchmarking and performance management. The following sections provide a synthesis of the performance measurement literature in general, and the cross-industry benchmarking literature in particular.

3.1. *Performance measurement literature*

Contemporary approaches to performance measurement were born out of recognition of the inappropriateness of traditional approaches to performance measurement (Johnson and Kaplan 1987, Eccles 1991, Lynch and Cross 1991, Kaplan and Norton 1992, 1996, Neely *et al*. 1994, Ghalayini and Noble 1996, Ittner and Larcker 1998, 2003, Neely 1999). These include the intangible dimensions, such as public image and perception, customer satisfaction, employee satisfaction and attrition, skills levels, innovations in products and services, investments into training and new value streams and so on (see for instance Maskell 1991, Flynn *et al*. 1994, Kasul and Motwani 1995, Ahire *et al*. 1996, Atkinson and Waterhouse 1997, Francisco *et al*. 2003, Forslund 2007, McAdam and Hazlett 2008, Fullerton and Wempe 2009). Today, there is a general consensus that the old financial measures are still valid and relevant (Yip *et al*. 2009), but these need to be balanced with more contemporary, intangible and externally oriented measures.

The discourse on contemporary approaches to performance measurement highlights how shorter-term operational measures affect business performance and measures in the longer term. This debate led to the development of the notion of leading and lagging indicators, where the leading indicators are the indicators that provide an early warning of what may happen in the future and the lagging indicators communicate what has actually happened in the past (Bauly 1994, Neely *et al*. 1995, Nixon 1998, Bourne *et al*. 2000, Kaplan and Norton 2001, Anderson and McAdam 2004). The literature identifies a number of leading indicators that serve to predict future performance of an organisation. These include customer-oriented operational indicators, such as delivery performance, lead times, flexibility and quality performance (Maskell 1991, Lynn *et al*. 1997, Beamon 1999, Digalwar and Sangwant 2007), as well as human-resource-oriented indicators such as employee satisfaction and morale (Schlesinger and Heskett 1991, Heskett *et al*. 1994, Burke *et al*. 2005, Tuzovic and Bruhn 2005, Simmons 2008). In fact, authors such as Fitz-Enz (1993), Rucci (1998), Watkins and Woodhall (2001) and Rhian (2002) highlight the strong and complex relationship between employee satisfaction, customer satisfaction and overall performance. The notion of predictive performance measures takes the thinking behind leading and lagging performance measures further. In order for any performance indicator (leading or lagging) to be predictive a single point of measure would be meaningless and that prediction would need to be based around a time series of measures indicating how performance is changing in time, thus allowing one to predict what may lie in the future (Neely *et al*. 1995, Bourne *et al*. 2000).

The literature also contains many empirical studies that call for contingency-based approaches to performance measurement (Shirley and Reitspergerg 1991, Nanni *et al*. 1992, Ittner and Larcker 1998). Here the importance of the internal (such as strategy, objectives,

structures and culture) and external (such as customers, competitors, suppliers, legal, political and social) context of the organisation is recognised (Chenhall 2003, Garengo and Bititci 2007). This emphasis on contingency approach highlights the need to consider the contingency variables when comparing performance results of different companies. In short, company performance could not be considered in isolation from the characteristics and the needs of the industry and the environment in which a company operates (Reid and Smith 2000).

In the context of SMEs, the performance measurement literature highlights the characteristics of SMEs that differentiates them from larger organisations (Zeinalnzehad *et al*. 2010, 2011). These characteristics include, lack of formalised strategy, operational focus, limited managerial and capital resources, and misconception of performance measurement (Garengo *et al*. 2005, Fuller-Love 2006). This literature also suggests that SMEs require simple measures that provide focused, clear and useful information (Hussein *et al*. 1998, Laitinen 2002). As SMEs lack the resources needed to implement complex measurement systems a key requirement is that the number of measures used should be limited (Cook and Wolverton 1995, Hussein *et al*. 1998, Yeb-Yun 1999) without compromising the integrity of the performance measurement system (McAdam and Bailie 2002).

In summary, the performance measurement literature emphasises the need for adopting a balanced approach to performance measurement and the need for using leading and lagging indicators in a coordinated way ideally in a time series to make future performance more predictable. Although this provides useful guidance on what to measure and how to use these measures, it provides little guidance on how these measures and the firm specific contingency factors (such as sector characteristics) could be used to measure the performance of different firms comparatively.

3.2. *Cross-industry benchmarking literature*

Here, despite the diversity opinions in the literature, one common theme that binds this field together is that meaningful measurement is relative (Gregory 1993). That is, in order to be significant, each measurement needs to be compared against a point of reference (Czuchry *et al*. 1995, Vig 1995, Zairi and Youssef 1995, 1996, Yasin 2002, Dattakumar and Jagadeesh 2003). Although the literature proposes a variety of approaches to benchmarking, the widely accepted classification proposed by Camp (1989) makes distinctions between internal, competitive, functional and generic benchmarking. However, these all rely on comparison of similar processes, functions or firms. Watson (2007) recognises the weaknesses associated with local benchmarking and proposes an additional category called global benchmarking, which attempts to extend the boundary of the benchmarking geographically to get over the cultural and business process distinctions among companies. However, Watson's (2007) approach also does not address the cross-industry benchmarking issue. He argues that one of the main limitations of global performance benchmarking seems to be the need for focusing mainly on financial results. He also concludes that whilst benchmarking works well as a method of identifying the best performance in a specific industry, it does not work well across industries as the comparison becomes meaningless due to contextual factors. A view supported by Ellis and Williams (1993), Hawawini *et al*. (2003) and Reider (2000).

The literature also contains many studies investigating how best to benchmark, describing the necessary steps (Camp 1989, Karlof and Ostblom 1993, Spendolini 1993, Voss *et al*. 1994, Codling 1998, Freytag and Hollensen 2001). However, none of these studies proposes approaches to facilitate cross-industry benchmarking. Many of the benchmarking projects found in the literature focus on the following.

- Benchmarking within a specific sector – such as manufacturing (Miller and Roth 1994, Laugen *et al*. 2005); construction (Costa *et al*. 2006); transportation and logistics (De Koster and Warffemius 2005, Geerlings *et al*. 2006, Huo *et al*. 2008), water supply (Braadbaart 2007); metal-casting (Ribeiro and Cabral 2006); automotive (Delbridge *et al*. 1995, Sánchez and Pérez 2005); human resources (Rodrigues and Chincholkar 2006); information services (Ho and Wu 2006). These include international benchmarking networks such as: www.benchnet.com; www.benchmarkingnetwork.com; www.apqc.org; www.capsresearch.org (Andersen and Jordan 1998).
- Benchmarking a specific cross-industry measure, such as: days-sales-outstanding (www.icc.co.uk); annual-asset-based-lending (www.cfa.com) and financial performance (Kratchman *et al*. 1974, Länsiluoto *et al*. 2004).
- Benchmarking a single industry, to assess the competitiveness of that industry (Delbridge *et al*. 1995, Fowler and Campbell 2001,

Geerlings *et al*. 2006, Ribeiro and Cabral 2006, Braadbaart 2007, Hwang *et al*. 2008)
- Benchmarking a specific process, such as supply chain performance (Lewis and Niam 1995, Schmidberger *et al*. 2008, Yung and Chan 2003).

The literature raises an important point concerning performance versus practice benchmarking. Given the objective of our study, we restrict our interest to performance benchmarking that may be defined as quantitative comparisons of performance variables.

3.3. *Literature conclusions*

The literature does contain studies where the performances of different firms from different sectors have been compared using a scale (e.g., above-average, average and below-average) to account for intersectoral differences (e.g., Miller and Roth 1994, Laugen *et al*. 2005). However, the majority of these studies use these approaches as a research instrument and there seems to be little scientific research and debate to enhance our understanding of '*which measures to use*' and '*how to combine and use these measures*' to compare the overall performance of different SMEs. Despite this lack of specific debate, there is some general guidance as to the measures we should use to assess and compare the performance of different firms. That is the comparative measurement system should

- be balanced, including financial and non-financial measures;
- include both lagging (such as traditional financial measures) and leading measures (such as employee satisfactions, investments in new equipment, personnel, markets and so on);
- be based on a time series (e.g., indicating how profitability of an organisation has changed over a period of time);
- be sensitive to the contextual and environmental conditions the firms operate within and assess firms' performances within this context.

4. Performance comparison in SMEs: an empirical study

4.1. *The performance comparison approach*

The conclusions of the literature were reviewed with the Focus Group (see methodology section for further details) that identified two areas where decisions had to be made: '*What to measure*' and '*How to measure these comparatively*'.

In focusing on what to measure, it quickly became apparent that, as the focus of our main study was SMEs, we would be well advised to consider the key business measures these companies would use to assess their own performance. The measures identified largely comprised of traditional financially focused lagging indicators, as follows: revenue (sales), profits or profitability, cash-flow and sarket share.

In a wider context, in making comparison between different countries or sectors, productivity is also a commonly used measure. In fact, any change programmes would first show improvements in productivity before the results are seen in sales, profits or cash flow. Thus, the focus group considered productivity to be a leading indicator for revenue, profit and cash-flow measures, a view that is also supported by the literature (see for instance Maskell 1991, Misterek *et al*. 1992, Flynn *et al*. 1994, Ghalayini and Noble 1996, Parker 2000, Harter *et al*. 2002, Digalwar and Metri 2005). From a customer perspective, the focus group regarded it important to measure customer satisfaction as an all-encompassing indicator of customer facing performance of firms operating in different sectors and to different operating strategies.

Considering the emphasis on leading indicators suggested in the literature, such as introduction of new value stream, new investments, as well as employee satisfaction (Keegan *et al*. 1989, Fitzgerald *et al*. 1991, Lynch and Cross 1991, Kaplan and Norton 1992, Neely 1998, Rucci 1998, Watkins and Woodhall 2001, Neely *et al*. 2002, Rhian 2002), the approach shown in Figure 2 was adopted.

Bearing in mind the question 'how to measure these comparatively?', it was decided to use a relative scoring technique (as illustrated in Figure 2) allowing the performance of each organisation to be scored on a five point scale over a 10-year time period[4] with respect to its sector (Kirby 2005, Richard *et al*. 2009). This approach would allow comparison across sectors, considering relative performance, as illustrated in the following example.

Example: Company A operating in a high growth sector with a revenue growth of 20% may be growing *slightly above* its sector average and would score 4. Company B operating in a mature sector with a revenue growth of 5% may be growing *significantly above* its sector average would score 5. A cross-sector benchmarking study using absolute measures would have placed, in terms of performance, Company A significantly above Company B. Whereas the relative scoring approach employed here would place

		Rate the organisation's performance over the past 10 years against the indicators specified, with respect to the sector in which the organisation operates.				
		Well below average in sector	Below average in sector	Average in sector	Above average in sector	Well above average in sector
Lagging indicators	Revenue growth	1	2	3	4	5
	Market share growth	1	2	3	4	5
	Profitability growth (= Net profit / revenue)	1	2	3	4	5
	Cash flow growth					
	Value added productivity growth (= Gross Profit / total number of employees)	1	2	3	4	5
Leading indicators	Customer satisfaction	1	2	3	4	5
	New value streams – i.e. new products or services, new markets, etc	1	2	3	4	5
	Investments – R&D, new processes, skills, strategic assets/capabilities, intellectual property	1	2	3	4	5
	Employee satisfaction and morale	1	2	3	4	5

Figure 2. An approach for measuring firms' performances comparatively.

Company B above Company A effectively reversing the rank order.

The research team and the focus group recognised the subjective nature of this approach and overcome the limitations associated with this approach by independently triangulating and validating individual company scores using objective data for each organisation and the sector they operate within. The approach used for data collection, analysis and validation is summarised below and outlined in some detail in Appendix 1 and is consistent with previous such studies (Miller and Roth 1994, Laugen *et al*. 2005).

4.2. *Data collection and validation*

Given that, we were seeking to understand the performance of each firm relative to its sector and we decided to adopt a qualitative case study methodology based on structured interviews (Eisenhardt 1989, Eisenhardt and Graebner 2007). A case study protocol was developed that guided researchers through the case study interviews. Performance data were collected through face-to-face interviews from 37 European SMEs operating in different sectors as previously described in the methodology section. The interviews were conducted in pairs by a team of six researchers. For triangulation purposes secondary data in the form of internal reports and media publications were also used (Eisenhardt 1989, Miles and Huberman 1994). In each company, the managing director/general manager or his/her equivalent was interviewed as well as his/her direct reports. Typically, these included an Operations Director, Finance Director, Sales/Commercial Director and Product Development Director.

As the data collection interviews progressed, it became apparent that only a few of the 37 case study organisations collected and reported customer satisfaction data. It also became evident that a lot of the interviewees were not able to score their customer satisfaction performance relative to their sector. Thus, the customer satisfaction indicator was abandoned during the early stages of the research. Eventually data were collected from 37 firms against eight performance variables. In each company, these performance variables were rated by the five to eight managers considering their own organisation's performance over the past 10 years.

The reliability and validity of the data collected were tested using external and internal consistency checks using an independent researcher. External consistency of the performance rating given by the managers interviewed was tested against actual performance of these organisations. This was done by taking a sample of five firms from the research sample of 37 case studies. The actual performance information for the sample of five firms was obtained from the FAME and similar databases[5], as well as the companies own internal accounts. The team also had access to local industry databases as well as news stories to gather objective information against each of the eight performance variables. The actual values for the performance variables were compared to other companies in the same sector. As the consistency between self and independent assessment of each performance

variable was above 73%, it is considered that the data used are externally reliable and valid. Internal consistency was tested using Cronbach-alpha statistics that indicated strong internal consistency based on Cronbach's alpha value greater than 0.9191 (Oktay-Firat and Demirhan 2002, Salkind 2006). These results confirm that the performance ratings obtained from the 37 case studies are both internally and externally reliable and consistent (See A1 in Appendix 1).

4.3. *Findings: Which indicators are most useful?*

Factor analysis (Oktay-Firat and Demirhan 2000, Tabachnick and Fidell 2007) and Varimax Rotation[6] (Oktay-Firat and Demirhan 2001, Johnson and Wichern 2002, p. 505) was applied to the eight performance variables to identify a combination of variables that best explain the performance of these firms. This analysis (explained in greater detail in Appendix 1- A2) suggests that most of the eight performance variables are strongly related to each other. Although the weakest relationship is between profitability and new value streams, this correlation still remains significant.

Methods such as 'eigenvalues-greater-than-unity rule' (Kaiser 1960, Cudeck 2000, Everitt and Dunn 2001) and the Scree-Plot are common methods to decide which factors best describe the data. Analysis of the data using these methods and interpretation of the findings are fully detailed in Appendix 1. Considering the results of these methods it can be concluded that

- Lagging performance variables are more important than others as an indicator of overall performance[7].
- Profitability variable is the most important indicator to explain performance levels of the companies in the sample. As its coefficient is significantly greater than others, it can be used as a single 'surrogate' indicator by ignoring other variables.
- It may be argued that lagging indicators profitability, cash flow and value-added productivity may be used exclusively to measure and assess company performance with a reasonable degree of reliability and consistency.
- Leading performance indicators such as new value streams are less important for the purposes of performance comparisons as these variables serve to predict future performance rather than past performance.

The objective of this section was to determine useful indicators that would facilitate a reliable and consistent assessment of firms' performances. The analysis presented suggests that although all the indicators used are capable of representing firms' performances in a reliable and consistent way; it also presents an opportunity to decrease complexity by reducing the number of performance indicators. Thus, the proceeding comparative performance analysis is based on the most useful indicators for purposes of performance comparison amongst different SMEs. These are

- growth in profitability;
- growth in value-added productivity;
- growth in cash flow;
- growth in revenue;
- employee satisfaction; and
- growth in market share

4.4. *Findings: How can we group firms according to their performance?*

Having identified the most useful indicators for purposes of performance comparison, the next research challenge was how to rank or group firms according to their performance. This was achieved by using three different approaches, namely

- Total performance scores, where the scores (1 to 5) against each performance variable were simply added to determine the total score.
- Hierarchical clustering (i.e., the Ward method) applied to the data-set using SPSS 16.0 software. The dendrogram shown in Figure 3 illustrates the results of the hierarchical clustering using Ward's method.
- K-Means (quick clustering) also using SPSS 16.0 software.

Table 1 illustrates the ranking obtained from three different approaches used together with the final clustering decision. In compiling these results, the clustering results obtained from three different methods were interpreted as follows:

- companies with a total performance score of equal or greater than 20 were classified as high performers;
- companies with a total performance score of less than 10 were classified as low performers;
- companies with a total performance score between 10 and 20 were classified as medium performers.

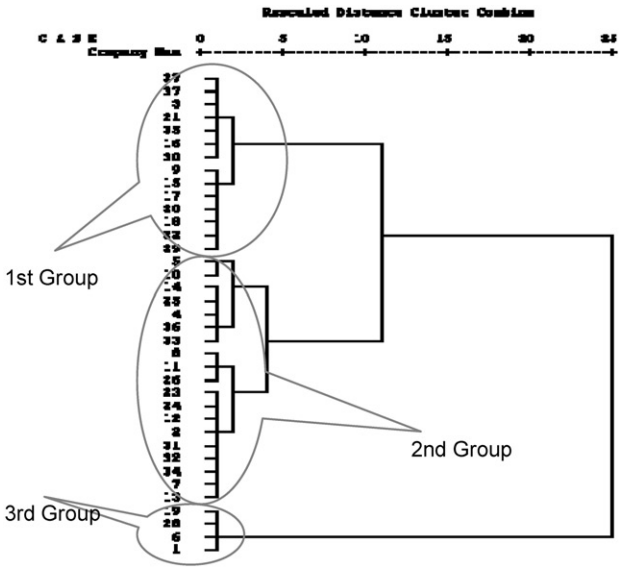

Figure 3. Results of the hierarchical clustering analysis (Dendrogram).

The final clustering decision was reached by comparing the clusters across the three sets of results, that is, total score, K-means and hierarchical clustering. Although there were high degrees of consistency between the three sets of results, in three cases (numbers 13, 23 and 6) there were conflicts as highlighted in Table 1. These conflicts were resolved by looking at the majority grouping. For example, in the case of company 13 K-Means and hierarchical clustering techniques both place the company into the second cluster, which is associated with medium performers (see total performance clusters). Thus, even though the total performance clustering approach places them into the high-performance category with a score of 20; they were classified as a medium performer.

At the time of submission of this paper for review, three of the four low performing companies had already gone out of business, mainly due to the credit-crunch and the global economic recession experienced in the second half of 2008 and 2009. In contrast, during the same period, some of the high performers, in pursuit of their growth strategies were making strategic investments into new markets and/or businesses. This anecdotal, but significant, insight serves to further strengthen the validity of the performance clustering presented above.

5. Discussion and conclusions

In this paper, our objective was to explore how we can measure firms' performances comparatively. In the previous section, we presented our work that included a review of the pertinent literature, the development of a framework for measuring different companies' performances comparatively and the results of the empirical study we conducted with 37 SMEs. We would summarise the key insights gained from this work as follows.

The literature gives clear guidance as to the nature of the measures that should be used to measure a firm's performance. It is clearly stated that there should be a balance between financial and non-financial indicators, as well as a balance between lagging and leading indicators. However, our findings seem to contrast with the guidance given in the literature.

Lagging indicators are highlighted as the most relevant for the purpose of comparing firms, performance. Although this finding appears to conflict with the views that emerge from the literature, this result was somewhat expected as the objective of the exercise was to compare firms' performances comparatively based on results achieved over the preceding years rather than to predicting their potential future performances. An exception to this conclusion is the employee satisfaction indicator. This indicator, although classified as a leading indicator, provides significant contribution towards explaining overall performance of firms. Further investigations would be required to explore the relationship between employee satisfaction and firm performance.

Based on the conclusions and assumption outlined above, in order to describe the performance of firms adequately, we only need to focus on five financial indicators. These are revenue, market share, profitability, cash flow and value-added productivity. However, based on the results further simplification would be possible by focusing on only three measures (i.e., value-added productivity, cash flow and profitability) or even by just focusing on profitability. This result suggests that, depending on the context of research (Richard *et al*. 2009) it is possible to simplify the performance measurement problem for comparative purposes to one, three or five performance indicators as appropriate. These are

• Profitability	• Profitability • Value-added productivity • Cash flow	• Profitability • Value-added productivity • Cash flow • Revenue • Market share

Based on our empirical analysis and contrary to the literature and focus group opinion, leading, customer oriented, indicators such as delivery, lead-time, quality and responsiveness were considered to be meaningless

Table 1. Firms clustered according to performance.

Case number	Total performance		Ward's dendrogram clusters(*)	K-Means results		Final clustering decision
	Scores	Clusters		Clusters	Distances	
15	24	High	1	1	1.254	High
16	24	High	1	1	0.987	High
18	24	High	1	1	1.356	High
22	24	High	1	1	1.356	High
9	23	High	1	1	1.763	High
20	23	High	1	1	1.114	High
29	22	High	1	1	1.306	High
30	22	High	1	1	0.879	High
17	21	High	1	1	1.254	High
21	21	High	1	1	0.757	High
35	21	High	1	1	0.757	High
3	20	High	1	1	0.879	High
13	**20**	**High**	**2**	**2**	**2.043**	**Medium**
27	20	High	1	1	0.879	High
37	20	High	1	1	0.879	High
11	19	Medium	2	2	1.583	Medium
23	**19**	**Medium**	**2**	**1**	**1.519**	**Medium**
31	19	Medium	2	2	1.083	Medium
2	18	Medium	2	2	0.916	Medium
7	18	Medium	2	2	1.227	Medium
8	18	Medium	2	2	1.133	Medium
12	18	Medium	2	2	1.548	Medium
24	18	Medium	2	2	1.397	Medium
34	18	Medium	2	2	0.786	Medium
6	**17**	**Medium**	**3**	**3**	**1.620**	**Low**
25	17	Medium	2	2	0.533	Medium
32	17	Medium	2	2	0.975	Medium
14	16	Medium	2	2	1.133	Medium
33	16	Medium	2	2	1.685	Medium
4	15	Medium	2	2	1.843	Medium
5	15	Medium	2	2	1.181	Medium
26	15	Medium	2	2	1.781	Medium
36	14	Medium	2	2	2.439	Medium
10	13	Medium	2	2	2.274	Medium
1	8	Low	3	3	1.768	Low
19	6	Low	3	3	0.791	Low
28	5	Low	3	3	1.061	Low

when comparing across different contextual settings with different operational strategies.

The only leading customer oriented indicator, that we identified as relevant during our study (i.e., customer satisfaction), was subsequently abandoned as a result of SMEs' inabilities to score or position their customer satisfaction performance with respect to their sector. It is envisaged that the same problem also may have applied to other leading customer oriented indicators should we have tried to collect these data, unless of course the firms were part of a sector wide benchmarking club utilising these measures.

The leading indicators were identified as relevant but surplus to purpose, as the analysis showed that this group of measures, with the exception of employee satisfaction, only made a marginal contribution towards describing the performances of the firms. As discussed above, given the aim to compare companies' performances over the preceding years, the lagging indicators are able to provide adequate comparative data without the need for more predictive future focused leading indicators

The use of a scoring system highlighted the possibility to carry out a reliable assessment of SMEs performance. The literature also suggests that the performance of firms should be compared over a period of time and be sensitive to contextual factors, such as sectoral and operational differences. With respect to the time period over which performance should be compared, the literature (Kirby 2005,

Richard *et al*. 2009) suggests a 10-year timeframe as a minimum. As this research was not longitudinal in nature (a key limitation of the research method employed), when collecting data, the firms were asked to evaluate their performance over a 10-year timeframe, using a scoring system. The scores were deemed a reliable assessment of actual performance. The quality of data was ensured through the involvement of a number of managers from each firm, along with the independent external validation of the data. Whilst this paper demonstrates that it is indeed possible to measure different SMEs performances comparatively, there are some questions over the reliability and repeatability of these types of comparative measures. The approach adopted here withstood internal and external validity tests and can be seen as a robust way of comparing SMEs' performances. However, these results may be limited to this particular study and the repeatability of the study remains to be seen.

Richard *et al*. (2009, p. 745) in summarising their research challenges in performance measurement state that *'without the ability to link managerial prescriptions based on theory to practical and observable and justifiable performance outcomes, management research will be little more than informed speculation'*. In fact, they suggest that performance measurement is a multidisciplinary issue spanning across all disciplines of management (such as finance, marketing, operations and human resources). They argue that various researchers working in their own disciplines using functional performance measures (such as market share in marketing, schedule adherence in operations and so on) need to link their discipline focused performance measures to overall organisational performance.

This paper contributes to this debate by identifying the most significant five performance indicators that enable us to articulate and compare SMEs overall performance, thus providing a framework for linking functional performance measures and indicators to firms' overall performance. It also suggests that these five indicators may be further reduced to three or even down to a single profitability indicator. Clearly, profitability is highlighted as the most important performance indicator to explain performance of the SMEs investigated. Despite the emphasis placed on soft measures in today's literature, this finding is consistent with Dawkins *et al*. (2007) finding that growing relevance is being placed on the profit measure. Furthermore, this paper, in seeking to rank firms' performances comparatively, contributes to the debate on how overall performance may be conceptualised in a comparative context by identifying the appropriate indicators and how they should be combined and used in order to measure different SMEs performance comparatively.

Although, in this paper our unit of analysis were focused on SMES, based on the nature of the study, the indicators used and the nature of the above findings we would also argue that our findings would be equally relevant to firms of all sizes. We believe this would be particularly so when attempting to compare performances of firms operating in different distinct industrial sectors where performance comparison based on actual performance values (such as turnover, profitability, cash flow, market share, employee satisfaction, etc.) would be meaningless due to sectoral differences.

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Notes

1. The background to some of these measures and the academic debate on this area is further discussed in the background literature section of this paper.
2. For example, at a given time, one sector may be growing rapidly whilst other shrinking. Thus, comparing performances of firms operating in these two sectors would be meaningless unless we account for sectoral differences.
3. Independent companies employing less the 250 people and with turnover not exceeding €50 m or with a balance sheet total not exceeding €43 m.
4. According to Kirby (2005) and Richard *et al*. (2009) in performance studies, a 10-year timeframe is the minimum appropriate timeframe to overcome random variation.
5. FAME is a database that contains information for companies in the UK and Ireland. For FAME and similar databases covering other regions visit http://www.bvdinfo.com/Products/Company-Information/National.aspx
6. Varimax is the most commonly used of all the rotation techniques available and is applied to further differentiate the level of importance between principal components (Oktay-Firat and Demirhan 2001, Johnson and Wichern, 2002, p.505).
7. The analysis detailed in Appendix 1 identifies two groups (or components) of indicators that explain overall performance. The dominant group, Component 1, comprising mainly lagging indicators explain majority of the variation in performance (50.04%) when compared to component 2 (27.92%) comprising of mainly of leading indicators. This conclusion was arrived as a result of interpretation of this data using literature that was backed up with other analysis as explained and justified in full detail in Appendix 1.

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References

Ahire, S., Golhar, L., and Damodar, Y., 1996. Quality management in large versus small firms. *Journal of Small Business Management*, 34 (2), 1–15.

Akyuz, G.A. and Erkan, T.E., 2009. Supply chain performance measurement: a literature review. *International Journal of Production Research*, 35 (1), 1–19.

Andersen, B. and Jordan, P., 1998. Setting up a performance benchmarking network. *Production Planning and Control*, 9 (1), 13–19.

Anderson, K. and McAdam, R., 2004. A critique of benchmarking and performance measurement. Lead or lag? *Benchmarking: An International Journal*, 1 (15), 465–483.

Atkinson, A. and Waterhouse, J.H., 1997. A stakeholder approach to strategic performance measurement. *Sloan Management Review*, 38 (3), 25–37.

Bauly, J.A., 1994. Measures of performance. *World Class Design to Manufacture*, 1 (3), 37–40.

Beamon, B.M., 1999. Measuring supply chain performance. *International Journal of Operations & Production Management*, 19 (3/4), 275–292.

Bonvik, A.M., Couch, C.E., and Gershwin, S.B., 1997. A comparison of production-line control mechanisms. *International Journal of Production Research*, 35 (3), 789–804.

Bourne, M., *et al*., 2000. Designing, implementing and updating performance measurement systems. *International Journal of Operation and Production Management*, 20 (7), 754–771.

Braadbaart, O., 2007. Collaborative benchmarking, transparency and performance. *Evidence from The Netherlands water supply industry*. *Benchmarking: An International Journal*, 14 (6), 677–692.

Bukchin, J., 1998. A comparative study of performance measures for throughput of a mixed model assembly line in a JIT environment. *International Journal of Production Research*, 36 (10), 2669–2685.

Burke, R.J., Graham, J., and Smith, F., 2005. Effects of reengineering on the employee satisfaction-customer satisfaction relationship. *TQM Magazine*, 17 (4), 358–363.

Camp, R.C., 1989. *Benchmarking: the search for industry best practices that lead to superior performance*. Wisconsin: ASQC/Quality Press.

Cattell, R.B., 1966. The scree test for the number of factors. *Multivariate Behavioral Research*, 1 (2), 245–276.

Chenhall, R.H., 2003. Management control systems design within its organizational context: findings from contingency-based research and directions for the future. *Accounting, Organizations and Society*, 28 (2–3), 127–168.

Codling, B.S., 1998. Benchgrafting: a model for successful implementation of the conclusions of benchmarking studies. *Benchmarking for Quality Management & Technology*, 5 (3), 158–164.

Collins, J., 2001. *From good to great*. London: Random House Business Books.

Comrey, A.L. and Lee, H.B., 1992. *A first course in factor analysis*. Hillsdale, NJ: Lawrence Erlbaum Associates Publishers.

Cook, R.A. and Wolverton, J.B., 1995. A scorecard for small business performance. *Journal of Small Business Strategy*, 6 (2), 1–18.

Costa, D.B., *et al*., 2006. Benchmarking initiatives in the construction industry: lessons learned and improvement opportunities. *Journal of Management Engineering*, 22 (4), 158–167.

Coulter, J., Baschung, N.S., and Bititci, U.S., 2000. Benchmarking for small to medium sized enterprises. *Production Planning and Control*, 11 (4), 400–408.

Cudeck, R., 2000. Exploratory factor analysis. *In*: H.E.A. Tinsley and S.D. Brown, eds. *Applied multivariate statistics and mathematical modeling*. USA: Academic Press, 266–296.

Czuchry, A.J., Yasin, M., and Darsch, J., 1995. A review of benchmarking literature. *International Journal of Product Technology*, 10 (1/2), 27–45.

Dattakumar, R. and Jagadeesh, R., 2003. A review of literature on benchmarking. *Benchmarking: An International Journal*, 1 (6), 176–209.

Dawkins, P., Feeny, S., and Harris, M.N., 2007. Benchmarking firm performance. *Benchmarking: An International Journal*, 14 (6), 693–710.

De Koster, M.B.M. and Warffemius, P.M.J., 2005. American, Asian and third-party international warehouse operations in Europe: a performance comparison. *International Journal of Operations and Production Management*, 25 (8), 762–780.

Delbridge, R., Lowe, J., and Oliver, N., 1995. The process of benchmarking: a study from the automotive industry. *International Journal of Operations and Production Management*, 15 (4), 50–62.

Digalwar, A.K. and Metri, B.A., 2005. Performance measurement framework for world class manufacturing. *International Journal Applied Management and Technology*, 3 (2), 83–102.

Digalwar, A.K. and Sangwant, K.S., 2007. Development and validation of performance measures for world class manufacturing practices in India. *Journal of Advanced Manufacturing Systems*, 6 (1), 21–38.

Eccles, R., 1991. The performance measurement manifesto. *Harvard Business Review*, 59 (1), 131–137.

Eisenhardt, K.M., 1989. Building theories from case study research. *Academy of Management Review*, 14 (4), 532–550.

Eisenhardt, K.M. and Graebner, M.E., 2007. Theory building from cases: opportunities and challenges. *Academy of Management Journal*, 50 (1), 25–32.

Ellis, J. and Williams, D., 1993. *Comparative financial analysis. Corporate strategy and financial analysis: managerial, accounting and stock market perspectives*. London: Financial Times/Pitman Publishing.

Everitt, B.S. and Dunn, G., 2001. *Applied multivariate data analysis*. London: Arnold.

Fitz-Enz, J., 1993. *Benchmarking staff Performance. How staff Department can enhance their value to the customer*. San Francisco: Jossey-Bass Publishers.

Fitzgerald, L., *et al*., 1991. *Performance measurement in service businesses*. London: CIMA.

Flynn, B.B., Schroeder, R.G., and Sakakibara, S., 1994. A framework for quality management research and an associated measurement instrument. *Journal of Operations Management*, 11 (3), 339–366.

Forslund, H., 2007. The impact of performance management on customers' expected logistics performance. *International Journal of Operations and Production Management*, 27 (8), 901–918.

Fowler, A. and Campbell, D., 2001. Benchmarking and performance management in clinical pharmacy. *International Journal of Operations and Production Management*, 21 (3), 327–350.

Francisco, M., *et al*., 2003. A framework to create key performance indicators for knowledge management solutions. *Journal of Knowledge Management*, 7 (2), 46–62.

Freytag, V. and Hollensen, S., 2001. The process of benchmarking, benchlearning and benchaction. *The TQM Magazine*, 13 (1), 25–34.

Fuller-Love, N., 2006. Management development in small firms. *International Journal of Management Reviews*, 8 (3), 175–190.

Fullerton, R.R. and Wempe, W.F., 2009. Lean manufacturing, non-financial performance measures, and financial performance. *International Journal of Operations & Production Management*, 29 (3), 214–240.

Fynes, B., Voss, C., and De Burca, S., 2005. The impact of supply chain relationship quality on quality performance. *International Journal of Production Economics*, 96 (3), 339–354.

Garengo, P., Biazzo, S., and Bititci, U., 2005. Performance Measurement Systems in SMEs: a review for a research agenda. *International Journal of Management Reviews*, 7 (1), 25–47.

Garengo, P. and Bititci, U., 2007. Towards a contingency approach to performance measurement: an empirical study in Scottish SMEs. *International Journal of Operations and Production Management*, 27 (8), 802–825.

Geerlings, H., Klementschitz, R., and Mulley, C., 2006. Development of a methodology for benchmarking public transportation organisations: a practical tool based on an industry sound methodology. *Journal of Cleaner Production*, 14 (2), 113–123.

Ghalayini, A.M. and Noble, J.S., 1996. The changing basis of performance measurement. *International Journal of Operations and Production Management*, 16 (18), 63–80.

Grando, A. and Belvedere, V., 2006. District's manufacturing performances: a comparison among large, small-to-medium-sized and district enterprises. *International Journal of Production Economics*, 104 (1), 85–99.

Gregory, M.J., 1993. Integrated performance measurement: a review of current practice and emerging trends. *International Journal of Production Economics*, 30 (1), 281–296.

Gunasekaran, A., Patel, C., and Tirtiroglu, E., 2001. Performance measures and metrics in a supply chain environment. *International Journal of Operations and Production Management*, 21 (1/2), 71–87.

Hair, J.R., *et al*., 2006. *Multivariate data analysis*. Englewood Cliffs, New Jersey: Prentice-Hall International, Inc.

Hair, J.F., *et al*., 2008. *Multivariate data analysis*. Upper Saddle River, NJ: Prentice Hall.

Harter, J.K., Schmidt, F.L., and Hayes, T.L., 2002. Business-unit-level relationship between employee satisfaction, employee engagement, and business. *Journal of Applied Psychology*, 87 (2), 268–279.

Hawawini, G., Subramanian, V., and Verdin, P., 2003. Is performance driven industry- or firm- specific factors? A new look at the evidence. *Strategic Management Journal*, 24 (1), 1–16.

Heskett, J.L., *et al*., 1994. Putting the service-profit chain to work. *Harvard Business Review*, 72 (2), 163–174.

Ho, C.-T. and Wu, Y.-S., 2006. Benchmarking performance indicators for banks. *Benchmarking: an International Journal*, 13 (1/2), 147–159.

Huo, B., *et al*., 2008. Understanding drivers of performance in the 3PL industry in Hong Kong. *International Journal of Operations & Production Management*, 28 (2), 772–800.

Hussein, M., Gunasekaran, A., and Laitinen, E.K., 1998. Management accounting system in Finish service firms. *Technovation*, 18 (1), 57–67.

Hwang, Y.D., Lin, Y.C., and Lyu, J., 2008. The performance evaluation of SCOR sourcing process: the case study of Taiwan's TFT-LCD industry. *International Journal of Production Economics*, 115 (2), 411–423.

Ittner, C.D. and Larcker, D.F., 1998. Innovations in performance measurement: trends and research implications. *Journal of Management Accounting Research*, 10 (1), 205–237.

Ittner, C.D. and Larcker, D.F., 2003. Coming up short on nonfinancial performance measurement. *Harvard Business Review*, 81 (11), 88–95.

Johnson, H.T. and Kaplan, R.S., 1987. *Relevance lost – the rise and fall of management accounting*. Boston, MA: Harvard Business School Press.

Johnson, R.A. and Wichern, D.W., 2002. *Applied multivariate statistical analysis*. London: Pearson Education International.

Kaiser, H.F., 1960. The application of electronic computers to factor analysis. *Educational and Psychological Measurement*, 20 (1), 141–151.

Kaplan, R. and Norton, D., 1992. The balanced scorecard: the measures that drive performance. *Harvard Business Review*, 70 (1), 71–79.

Kaplan, R. and Norton, D., 1996. Using the balanced scorecard as a strategic management system. *Harvard Business Review*, 74 (1), 75–85.

Kaplan, R. and Norton, D., 2001. *The strategy-focused organisation, how balanced scorecard companies thrive in the new business environment*. Cambridge, MA: Harvard Business School.

Karlof, B. and Ostblom, S., 1993. *Benchmarking – a signpost to excellence in quality and productivity*. London: John Wiley & Sons.

Kasul, R.A. and Motwani, J.G., 1995. Performance measurements in world-class operations. *Benchmarking for Quality Management and Technology*, 2 (2), 20–36.

Keegan, D.P., Eiler, R.G., and Jones, C.R., 1989. Are your performance measures obsolete? *Management Accounting*, 70 (12), 45–50.

Kim, W.S., 2007. Organizational structures and the performance of supply chain management. *International Journal of Production Economics*, 106 (2), 323–345.

Kirby, J., 2005. Toward a theory of high performance. *Harvard Business Review*, 83 (7/8), 30–39.

Kojima, M., Nakashima, K., and Ohno, K., 2008. Performance evaluation of SCM in JIT environment. *International Journal of Production Economics*, 115 (2), 439–443.

Kratchman, S.H., Malcom, R.E., and Tward, R.D., 1974. An intra-industry comparison of alternative income concepts and relative performance evaluations. *Accounting Review*, 49 (4), 682–689.

Laitinen, E.K., 2002. A dynamic performance measurement system: evidence from small Finnish technology companies. *Scandinavian Journal of Management*, 18 (1), 65–99.

Länsiluoto, A., *et al*., 2004. Industry-specific cycles and companies' financial performance comparison using self-organizing maps. *Benchmarking: An International Journal*, 11 (3), 267–286.

Laugen, B.T., *et al*., 2005. Best manufacturing practices: What do the best-performing companies do? *International Journal of Operations & Production Management*, 25 (2), 131–150.

Lewis, J.C. and Naim, M.M., 1995. Benchmarking of aftermarket supply chains. *Production Planning and Control*, 6 (3), 258–269.

Lynch, R. and Cross, K., 1991. *Measure up! Yardsticks for continuous improvement*. Cambridge, MA: Blackwell Publishers.

Lynn, B.B., *et al*., 1997. World-class manufacturing project: overview and selected results. *International Journal of Operations and Production Management*, 17 (7/8), 671–685.

Maskell, B., 1991. *Performance measurement for world class manufacturing: a model for American companies*. Cambridge, MA: Productivity Press.

McAdam, R. and Bailie, B., 2002. Business Performance measure and alignment impact on strategy: the role of business improvement models. *International Journal of Operations and Production Management*, 22 (9), 972–966.

McAdam, R. and Hazlett, S.A., 2008. Developing a conceptual model of lead performance measurement and benchmarking. *International Journal of Operations & Production Management*, 28 (12), 1153–1185.

Miles, M.B. and Huberman, A.M., 1994. *Qualitative data analysis: grounded theory procedures and techniques*. London: Sage Publications.

Miller, J.G. and Roth, A.V., 1994. A taxonomy of manufacturing strategies. *Management Science*, 40 (3), 285–304.

Misterek, S.D.A., Dooley, K.J., and Anderson, J.C., 1992. Productivity as a performance measure. *International Journal of Operations & Production Management*, 12 (1), 29–45.

Nanni, A.J., Dixon, R., and Vollmann, T.E., 1992. Integrated performance measurement: management accounting to support the new manufacturing realities. *Journal of Management Accounting Research*, 4 (Fall), 1–19.

Neely, A., 1998. *Measuring business performance*. London: The Economist Books.

Neely, A., 1999. The performance measurement revolution: why now and what next? *International Journal of Operations and Production Management*, 19 (2), 205–228.

Neely, A., 2005. The evolution of performance measurement research: developments in the last decade and a research agenda for the next. *International Journal of Operations & Production Management*, 25 (12), 1264–1277.

Neely, A., Adams, C., and Kennerley, M., 2002. *The performance prism: the scorecard for measuring and managing stakeholder relationship*. London: Prentice Hall.

Neely, A., Gregory, M., and Platts, K., 1995. Performance measurement system design, a literature review and research agenda. *International Journal of Operations and Productions Management*, 15 (4), 80–116.

Neely, A., *et al*., 1994. Realising strategy through measurement. *International Journal of Operations and Production Management*, 14 (3), 140–152.

Nixon, B., 1998. Research and development performance measurement: a case study. *Management Accounting Research*, 9 (3), 329–355.

Nohria, N., Joyce, W., and Roberson, B., 2003. What really works. *Harvard Business review*, 18 (7), 42–55.

Oktay-Firat, S.Ü. and Demirhan, A., 2000. Analysis of the performance of the banks in 1998 by using multivariate statistical methods. *In*: *International conference in economics IV*, 13–16 September, METU-Ankara, Turkey.

Oktay-Firat, S.Ü. and Demirhan, A., 2001. Analysis of the performance of the commercial banks. *In*: *International conference in economics V*, 10–13 September, METU-Ankara, Turkey.

Oktay-Fırat, S.Ü. and Demirhan, A., 2002. The financial performance of the commercial banks transferred to the saving deposit insurance fund, SDIF: analysis and Comparison. *İktisat İşletme ve Finans Dergisi*, 17 (199), 87–100.

Parker, C., 2000. Performance measurement. *Work Study*, 49 (2), 63–66.

Phillips, J.J., 1997. *In action: measuring return on investment*. Alexandria, Virginia: American Society for Training and Development.

Preacher, K.J. and MacCallum, R.C., 2002. Exploratory factor analysis in behavior genetics research: factor recovery with small sample sizes. *Behavior Genetics*, 32 (2), 153–161.

Reid, G.C. and Smith, J.B., 2000. The impact of contingencies on managerial accounting systems development. *Management Accounting Research*, 11, 427–450.

Reider, R., 2000. *Benchmarking strategies: a tool for profit improvement*. New York: Wiley.

Rhian, S., 2002. Dispelling the modern myth. *International Journal of Operations and Production Management*, 22 (1), 30–50.

Ribeiro, L.M. and Cabral, J.A.S., 2006. A benchmarking methodology for metalcasting industry. *Benchmarking: An International Journal*, 13 (1/2), 23–35.

Richard, P.J., *et al*., 2009. Measuring organisational performance: towards methodological best practice. *Journal of Management*, 35 (3), 718–804.

Rodrigues, L.R. and Chincholkar, A.M., 2006. Benchmarking the HR practices of an engineering institute with public sector industry for performance enhancement. *International Journal of Training and Development*, 9 (1), 6–20.

Rucci, A.J., Kirn, S.P., and Quinn, R.T., 1998. The employee–customer-profit chain at Sears. *Harvard Business Review*, 76 (1), 82–97.

Salkind, N.J., 2006. *Exploring research*. 3rd ed. Upper Saddle River, NJ: Pearson Prentice Hall.

Samson, D. and Ford, S., 2000. Manufacturing practices and performance: comparisons between Australia and New Zealand. *International Journal of Production Economics*, 65 (3), 243–255.

Sánchez, A.M. and Pérez, M.P., 2005. Supply chain flexibility and firm performance: a conceptual model and empirical study in the automotive industry. *International Journal of Operations and Production Management*, 25 (7), 681–700.

Schlesinger, L.A. and Heskett, J.L., 1991. Customer satisfaction is rooted in employee satisfaction. *Harvard Business Review*, 69 (6), 148–149.

Schmidberger, S., *et al*., 2008. Ground handling services at European hub airports: development of a performance measurement system for benchmarking. *International Journal of Production Economics*, 117 (1), 104–116.

Shirley, D.J. and Reitsperger, W.D., 1991. Linking quality strategy with management control systems: empirical evidence from Japanese industry. *Accounting Organizations and Society*, 16 (7), 601–618.

Simmons, J., 2008. Employee significance within stakeholder-accountable performance management systems. *TQM Magazine*, 20 (5), 463–475.

Spendolini, M.J., 1993. How to build a benchmarking team. *Journal of Business Strategy*, 14 (2), 53–67.

Tabachnick, B.G. and Fidell, L.S., 2007. *Using multivariate statistics*. Boston, USA: Pearson.

Tuzovic, S. and Bruhn, M., 2005. Integrating customer orientation, employee compensation and performance management: a conceptual framework. *International Journal of Business Performance Management*, 7 (3), 255–274.

Vig, S.N., 1995. Benchmarking: a select bibliography. *Productivity*, 36 (3), 521–534.

Voss, C. and Blackmon, K., 1996. The impact of national and parent company origin on world-class manufacturing: findings from Britain and Germany. *International Journal of Operations and Production Management*, 16 (11), 98–115.

Voss, C., *et al*., 1998. Made in Europe: small companies. *Business Strategy Review*, 9 (4), 1–19.

Voss, C.A., Chiesa, V., and Coughlan, P., 1994. Developing and testing benchmarking and self-assessment frameworks in manufacturing. *International Journal of Operational and Production Management*, 14 (3), 83–100.

Watkins, C. and Woodhall, M., 2001. *The measurement of employee satisfaction in handbook of performance measurement*. London: GEE Publishing.

Watson, G.H., 2007. *Strategic benchmarking reloaded with six sigma: improve your company's performance using global best practice*. Hoboken, New Jersey: John Wiley & Sons.

World Competitiveness Report Yearbook., 2009. Yearbook IMD. Available from: http://www.imd.ch [Accessed 9 May 2010].

Yamin, S., *et al*., 1997. A study of competitive strategy, organisational innovation and organisational performance among. *International Journal of Production Economics*, 52 (81), 161–172.

Yasin, M.M., 2002. The theory and practice of benchmarking: then and now. *Benchmarking: An International Journal*, 9 (3), 217–243.

Yeb-Yun, L.C., 1999. Success factors of small- and medium-sized enterprises in Taiwan: an analysis of cases. *Journal of Small Business Management*, 36 (4), 43–56.

Yip, G.S., Devinney, T.M., and Johnson, G., 2009. Measuring long-term superior performance: the UK's long-term superior performers 1984–2003. *Long Range Planning*, 42 (3), 390–413.

Yung, W.K.C. and Chan, D.T.H., 2003. Application of value delivery system (VDS) and performance benchmarking in flexible business process reengineering. *International Journal of Operations and Production Management*, 23 (3), 300–315.

Yurdakul, M., 2005. Development of a performance measurement model for manufacturing companies using the AHP and TOPSIS approaches. *International Journal of Production Research*, 43 (21), 4609–4641.

Zairi, M. and Youssef, M., 1995. A review of key publications on benchmarking: part I. *Benchmarking for Quality Management and Technology*, 2 (1), 65–72.

Zairi, M. and Youssef, M., 1996. A review of key publications on benchmarking: part II. *Benchmarking for Quality Management and Technology*, 3 (1), 45–59.

Zeinalnzehad, M., Sahran, S., and Mukhtar, M., 2010. Benchmarking implementation and cluster approach in manufacturing SMEs: a review. *Advanced Materials Research*, 139–141, 1640–1643.

Zeinalnzehad, M., Sahran, S., and Mukhtar, M., 2011. Management of industrial clusters: a focus on SMEs. *Advanced Materials Research*, 199–200, 1712–1715.

Zhao, N., 2009. The minimum sample size in factor analysis. Available from: http://www.encorewiki.org/display/~nzhao/The+Minimum+Sample+Size+in+Factor+Analysis [Accessed 23 March 2009].

Appendix 1: Data collection, validation and analysis in detail

A.1. *Data reliability and validation*

Table A1 illustrates the consistency between self and independent assessment of each performance variable is above 73%. Consequently, the data may be considered as externally reliable and valid.

Internal consistency was tested using Cronbach-alpha statistics (Oktay-Firat and Demirhan 2002, Salkind 2006, p. 112). For the eight performance variables used, Cronbach's alpha value was greater than 0.9191. This value indicates that performance ratings used have strong internal consistency, as reliability coefficients above 0.8 are considered reliable (Salkind 2006, p. 110). Also as explained in the next section, Cronbach's alpha values were calculated for both first and second components (factors) in order to determine reliabilities of lagging and leading indicators and found as 0.9261 (six variables) and 0.8524 (two variables) respectively.

A.2. *Which indicators are most useful?*

Factor analysis was used as a data reduction tool to assists with the reduction of the number of variables, that is, performance indicators (Hair *et al*. 2006). There are several suggestions concerning the appropriate sample size for applying factor analysis (Comrey and Lee 1992, Preacher and MacCallum 2002). Measure of sampling adequacy (MSA) and Bartlett's test of sphericity (Bartlett's test) are two different measures that are frequently used in order to check the adequacy of sample size in factor analysis (Hair *et al*. 2006, Zhao 2009). The use of Bartlett's test is recommended only if there are fewer than five cases per variable (Tabachnick and Fidell 2007). In this study, since the ratio of number of cases (37) to the number of variables (8) is less than 5, Bartlett's test has been used. In addition, Kaiser–Meyer–Olkin (KMO) test measures sampling adequacy. KMO can be interpreted as 'meritorious' when the KMO index is 0.80 or above and as 'middling' when it is between 0.70 and 0.80 (Hair *et al*. 2006). According to Tabachnick and Fidel (2007), Hair *et al*. (2008) and Zhao (2009) a KMO index over 0.60 is sufficient for establishing sampling adequacy. A KMO index of 0.828 together with the statistically significant result of Bartlett's test ($\chi^2 = 210.878$, $df = 28.000$, $p = 0.00$) suggest that the sample chosen and the set of variables are conceptually valid and appropriate to study with factor analysis.

Factor analysis (Oktay-Firat and Demirhan 2000, Tabachnick and Fidell 2007) and Varimax Rotation (Varimax is the most commonly used of all the rotation techniques available and is applied to further differentiate the level of importance between principal components (Oktay-Firat and Demirhan 2001, Johnson and Wichern, 2002, p.505)) (Oktay-Firat and Demirhan 2001, Johnson and Wichern 2002, p. 505) was applied to the eight performance variables to identify a combination of variables that best explain the performance of these firms. The correlation matrix in Table A2 illustrates that most of the variables are strongly related to each other. Although the relatively weakest relationship is between profitability and new value

Table A1. Comparison of self-assessed ratings v. independently-assessed values.

	Co A		Co B		Co C		Co D		Co E		
Performance variables	Self-rating	Actual	Self-rating	Actual	Self-rating	Actual	Self-rating	Actual	Self-rating	Actual	Consistency per variable
Revenue Growth	4	√	5	<	4	√	5	√	1	√	80%
Market Share	4	√	4	√	3	√	4	√	2	√	100%
Profitability Growth	3	√	3	√	3	N/A	4	√	1	√	100%
Value Added	3	>	5	√	4	N/A	3	√	3	√	75%
Cash Flow	4	<	3	√	4	<	3	√	1	√	60%
New Value Streams	2	√	4	√	3	√	4	√	2	√	100%
Investments	2	√		<	3	√	4	√	2	√	80%
Employee Satisfaction	4	√	4	√	4	√	4	√	1	√	100%
Consistency per company	73%		73%		81%		100%		100%		

Notes: Key: "√" means self rating agrees with actual assessment.
"<" means self rating should be less by one point.
">" means self rating should be greater by one point.

Table A2. Results of factor analysis showing correlations among the performance measures.

	Revenue	Market share	Profitability	Value added productivity	Cash flow	New value streams	Investments	Employee satisfaction
Revenue	1.000							
Market share	0.724	1.000						
Profitability	0.615	0.642	1.000					
Value added productivity	0.601	0.649	0.758	1.000				
Cash flow	0.643	0.753	0.779	0.779	1.000			
New value streams	0.302*	0.535	0.269**	0.479	0.505	1.000		
Investments	0.512	0.665	0.376*	0.511	0.450*	0.743	1.000	
Employee satisfaction	0.666	0.675	0.644	0.557	0.675	0.463*	0.509	1.000

Notes: No star = strongest correlation with significance level < 0.001,
One star (*) = strong correlation with a significance level < 0.05.
Two star (**) = lowest correlation with a significance level < 0.10.

streams, this correlation still remains statistically significant at the level of 0.1.

In deciding how best to interpret the data 'eigenvalues-greater-than-unity rule' and the scree-plot methods were employed (Kaiser 1960, Cattell 1966, Cudeck 2000, Everitt and Dunn 2001, Tabachnick and Fidell 2007) together with some personal judgement from the focus group (Cudeck 2000). Figure A1 illustrates the eigenvalues before and after varimax rotation as well as the scree-plot for the data. Results show that two principal components (components 1 and 2 with eigenvalues greater than 1) explain cumulatively 77.97 % (50.04% and 27.92%, respectively) of the total variability of performance in the sample.

Component	Eigenvalues before rotation			Rotation sums of squared loadings		
	Total	% of Variance	Cumulative (%)	Total	% of Variance	Cumulative (%)
1	5.157	64.466	64.466	4.003	50.042	50.042
2	1.080	13.504	77.970	2.234	27.928	77.970
3	0.571	7.142	85.112			
4	0.397	4.962	90.074			
5	0.280	3.500	93.574			
6	0.245	3.060	96.634			
7	0.159	1.982	98.616			
8	0.111	1.384	100.000			

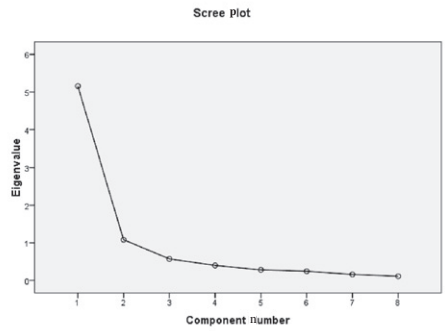

Figure A1. Eigenvalues of factor analysis and corresponding scree-plot.

	Components	
	1	2
Profitability	0.911	0.066
Cash flow	0.854	0.296
Value added Productivity	0.792	0.314
Revenue	0.786	0.248
Employee satisfaction	0.734	0.360
Market share	0.727	0.508
New value streams	0.191	0.913
Investments	0.311	0.871

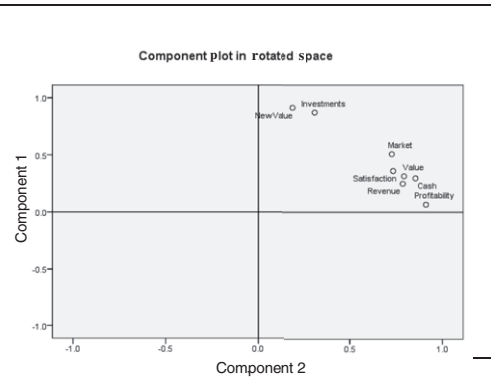

Figure A2. Coefficients of the variables and the corresponding component plot.

The component plot in Figure A2 shows the contribution of each performance variable towards each one of the two principal components and illustrates how the performance variables relate to one another based.

As to the labelling of the components, according to Hair *et al*. (2006) the decision is based primarily on the subjective opinion of the researchers. This analysis shows that the two principal components are sufficient to represent all performance variables and that these results are consistent with the performance measurement literature, that is, the first principal component may be primarily labelled as 'lagging indicators' with the exception of employee satisfaction indicator. Similarly, the second principal component may be labelled as 'leading indicators'. The literature on factor analysis also suggests that the researcher has the option of examining the factor matrix and selecting the variable or variables with the highest factor loading on each factor to act as a surrogate variable that is representative of that factor (Hair *et al*. 2006, Tabachnick and Fidell 2007). Considering these results it can be concluded that

- Lagging performance variables included in the first principal component are more important than others to indicate the performance of the companies in the sample.
- Profitability variable is the most important performance indicator to explain performance levels of the companies in the sample. As its coefficient is significantly greater than others, it can be used as a single 'surrogate' performance indicator by ignoring others.
- As rule of thumb (Oktay-Firat and Demirhan 2001, 2002, Tabachnick and Fidell 2007, p. 625) the first one, two or three variables that have highest loading (variables with loadings of 0.32 and above) in the principal component can be used to

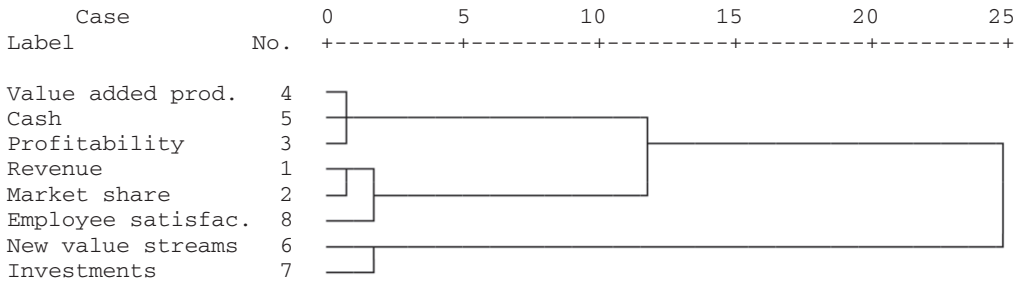

Figure A3. Dendrogram for performance variables using Ward's method.

represent all the remaining variables. Therefore, providing an opportunity to avoid complexity by reducing the number of variables that are required to measure the performance of an organisation. In this case, for the following reasons, it would be possible to omit employee satisfaction from the first principal component.

In the literature, employee satisfaction is classified as a leading indicator. Thus, it does not naturally fit with the rest of the lagging indicators in this group.
The employee satisfaction variable has one of the lowest loading coefficients.

Hierarchical Clustering using Ward's method (At this stage, several hierarchical clustering algorithms were used: complete linkage, average linkage, nearest neighbour linkage methods which use Euclidean distance (similarity) matrix. Results obtained from all methods were approximately same. Ward's method was considered most suitable as it minimises information losses that could arise from joining two groups (Johnson and Wichern 2002, p.690)) to discover natural groupings of performance variables (Johnson and Wichern 2002) shows that employee satisfaction is clearly distant from other variables in first principal component (Figure A3).