BENCHMARKING BEST MANUFACTURING PRACTICES:

A STUDY INTO FOUR SECTORS OF THE TURKISH INDUSTRY

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ABSTRACT

The study reported here is a benchmarking study conducted to quantify how well companies operating in various sectors of the Turkish industry match up to best practice, both in the practices they adopt and in the operational outcomes that result, and to test the hypothesis that the closer a company is to best practice, the more likely it is for that company to achieve higher business performance. The survey conducted in 1997 and 1998 included 82 companies from the Turkish electronics, cement, automotive sectors and part and component suppliers to the appliance industry. For data gathering, the Competitive Strategies and Best Practices Benchmarking Questionnaire is employed supported by some follow-up interviews and one-day site visits. Two small groups of companies are classified as leaders and laggers depending on how close they were to best practice. It is shown that the leaders have performed better than the laggers in adopting best manufacturing practices and in the achievement of high performance levels. The leaders also have achieved substantially higher business performance than the laggers. Furthermore, it is observed that large-sized companies outperform the rest both in terms of their success in implementing best manufacturing practices and in achieving high operational outcomes and that there is no appreciable difference between industrial sectors in implementing best manufacturing practices and in achieving high operational outcomes.

KEYWORDS: Sectoral Benchmarking, Business Excellence, Best Practices, Competition.

INTRODUCTION

Competitiveness, a widely used term, has been attached various meanings in different contexts. One of the main difficulties in describing and measuring competitiveness is that, it has differing objectives depending on whether it is used with reference to enterprises, industrial sectors, regions, nations, or blocks of nations. In this study, the focus is on enterprises. Competitiveness has been usually measured in financial and economical terms.

However, economic and financial data have a number of limitations in that they are at a high level of aggregation and often use proxies for managerial inputs and outputs. An alternative means of examining competitiveness of enterprises is to study the drivers of competitiveness, the operational practices and outcomes of individual enterprises (Voss *et al.*, 1995a).

This paper reports on a series of sectoral benchmarking studies on competitiveness based on the engineering approach (Hatzichronoglou, 1996), where a company's capacity to compete is expressed as its ability to search for, identify, and assimilate best practices. In this approach, best practices are defined as the industry, country, or worldwide practices related to customer focus, quality, flexibility, cost, innovation, and responsiveness that yield superior performance. This approach suggests a best practice paradigm in competitiveness which has recently gained great attention in business community and supported by a number of researches that show strong linkages between adoption of best practice and business performance.

The main aim of the study is to quantify how well companies operating in the electronics, cement, automotive, and appliances part and component (p&c) suppliers sectors of the Turkish industry match up to best practice, both in the practices they implement and in the operational outcomes that result, and to quantify the impact of this match up on overall business performance. It uses the Competitive Strategies and Best Practices Benchmarking Questionnaire to serve this objective. In this respect, it is a study along the lines of studies performed earlier in various countries and different sectors of industry (e.g., De Meyer et al., 1992; Kim and Arnold, 1996; Voss et al., 1993, 1994, 1995b, 1996; Whybark and Vastag, 1993; Vastag and Whybark, 1994; Australian Manufacturing Council, 1994; De Groote et al., 1996).

METHODOLOGY AND IMPLEMENTATION OF THE SURVEY

This study is mainly based on the application of the Competitive Strategies and Best Practices Benchmarking Questionnaire and the evaluation of its results. The questionnaire consists of the following five modules:

Competitive strategy module aims to assess the competitive strategies of the companies by addressing their competitive priorities, manufacturing objectives and action plans.

Manufacturing strategy module aims to capture the strategic management decisions reflected in the planning function and in the alignment of manufacturing operations with the central business mission, by focusing on aspects of planning, manufacturing structure and factory operations.

Practices module tries to identify the range of practices companies translate into action. It addresses six areas of practices: leadership, people management, customer focus, process and product quality, benchmarking, and technology.

Outcomes module and *Business performance module* aim to identify the outcomes of the practices and the resulting business performance. Outcomes refer to the operational measures of performance in the areas of cost, quality, flexibility, timeliness, and competitiveness. Business performance refers to financial measures such as cash flow, sales per employee and value-added per employee.

Among the modules described above, the results of the competitive strategy module will not be reported here.

In 1997, the Questionnaire has been applied to 27 member companies from the Turkish Electronics Industrialists Association, 25 member companies from the Turkish Cement Producers Association, and 10 member companies from the Automotive Manufacturers Association. In mid-1998, the questionnaire has been applied to 20 member companies from the Appliances Part and Component Suppliers' Association. The results of these surveys are displayed in the reports by Ulusoy et al. (1997a, 1997b, 1997c, 1999).

Two approaches have been employed for implementing the questionnaire. For the electronics, automotive, and cement sectors, the questionnaire forms have been distributed to a set of companies preselected jointly with the respective Association. Inquiries of the companies on certain items in the questionnaire were answered by phone and fax. A telephone traffic followed to ask the companies for the filled-in questionnaire forms. For this kind of implementation, we have achieved return rates of 60% for the electronics, 56% for the automotive and 64% for the cement sectors. In the case of appliances p&c suppliers sector, member companies preselected jointly with the Association have been approached for their approval to join the study. To those companies who agreed, the questionnaire has been explained either by a site visit or in small group meetings of companies. In hindsight, we can conclude that the second approach is the more effective one.

Structured follow-up interviews and one-day site visits have been made in several companies in each sector after the return of the filled-in questionnaire forms.

THE SAMPLE

The sample consists of 82 companies. The business nature of the sample is given in Table I. In the overall sample, majority of companies (64 %) are independent companies. Although the business nature distributions of the electronics, cement, and appliances p&c supplier companies are similar to the distribution of the overall sample, the automotive companies exhibit a different pattern. While 60 % of the automotive companies are subsidiaries of parent or holding companies, 10 % are independent.

Table I. Business nature of the sample by industrial sector

	Percentage of companies that are		
Industrial sector	Independent	Operating Unit	Subsidiary
Electronics	70 %	7 %	22 %
Cement	64 %	8 %	28 %
Automotive	30 %	10 %	60 %
Appliances P&C Suppliers	70 %	5 %	25 %
Overall Sample	63 %	7 %	29 %

Table II. Foreign capital contribution of the sample by industrial sector

Industrial sector	Percentage of companies with foreign capital	Average Percentage of foreign capital
Electronics	19 %	49 %
Cement	24 %	44 %
Automotive	60 %	46 %
Appliances P&C Suppliers	0 %	0 %
Overall Sample	21 %	46 %

The majority (79 %) of the companies in the overall sample have domestic capital only (Table II). The fraction of companies with foreign capital is 21 % and the foreign capital averages 46 %. The percentage of companies with foreign capital differs from industry to industry. The average fractions of foreign capital for the first three sectors do not differ significantly from each other.

Table III. Company size of the sample by industrial sector

Industrial sector	Percentage of companies that are Small-Sized	Medium-Sized	Large-Sized
Electronics	52 %	26 %	22 %
Cement	8 %	84 %	8 %
Automotive	0 %	30 %	70 %
Appliances P&C Suppliers	30 %	55 %	15 %
Overall Sample	23 %	48 %	29 %

In the classification of the sample by company size, a widely accepted scale is used. According to that scale, companies with total number of employees less than 100, between 100 and 499, and more than or equal to 500 are considered to be small-sized, medium-sized, and large-sized companies, respectively. In the overall sample, 71% of the sample consists of small and medium-sized companies (SME's) (Table III). The distribution of companies with respect to their total number of employees differs across the industrial sectors.

Table IV. Total sales of the sample by industrial sector

Industrial sector	Percentage of companies with total sales (million USD) Less than 10	10 - 50	50 - 100	More than 100
Electronics	63 %	11 %	4 %	22 %
Cement	12 %	60 %	16 %	12 %
Automotive	0 %	0 %	20 %	80 %
Appliances P&C Suppliers	75 %	15 %	0 %	10 %
Overall Sample	42 %	26 %	9 %	23 %

The companies in the sample are classified with respect to their annual total sales. In the overall sample, 42 % of the companies have total sales less than 10 million USD and 23 % have total sales more than 100 million USD (Table IV). With respect to the total sales of companies, the automotive companies are the largest and the appliances p&c supplier companies are the smallest ones in the sample. While 80 % of the automotive companies have total sales more than 100 million USD, 75 of the appliances p&c supplier companies have total sales less than 10 million USD.

Table V. Export sales of the sample by industrial sector

	Percentage of companies with export sales (million USD)				
Industry	0	< 1	1 -10	10 –20	>20
Electronics	41 %	22 %	19 %	0 %	19 %
Cement	52 %	12 %	16 %	16 %	4 %
Automotive	0 %	0 %	50 %	40 %	10 %
Appliances P&C Suppliers	30 %	40 %	15 %	0 %	15 %
Overall Sample	36 %	21 %	21 %	10 %	12 %

The companies in the sample are also classified with respect to their annual export sales. In the overall sample, 36 % of the companies have no export sales and only 12 % have export sales more than 20 million USD (Table V). The automotive companies of the sample are more export oriented than the rest of the sample. While half of the automotive companies of the sample have export sales more than 10 million USD, more than half of the electronics, cement, and appliances p&c supplier companies have either no export sales or have export sales less than one million USD.

MEASURING AGAINST BEST PRACTICE

Measuring against best practice is achieved in three steps. In the first step, a *best practice scorecard* is created by plotting on a map the strategy/practices index vs. operational outcomes index position of each company. In the second step, the surveyed companies are categorized into five groups according to their relative positions on the best practice scorecard. They are identified as *leader*, *lagger*, *medium-performer*, *promising*, or *won't go the distance companies* as defined in Voss *et al.* (1995b). In the third step, a series of statistical analysis is carried out to demonstrate that the categories are in fact different from each other both in implementing best manufacturing practices and in achieving high operational outcomes. Further analyses are carried out to see the relationship of business profiles in terms of industrial sector, company size, nature of business, and foreign investment with the five categories defined above. Since the sample is composed of companies from four different industrial sectors and of varying sizes, two statistical analyses are conducted to see whether the industrial sector and company size affect the adoption of best practice, and if they do, how.

The strategy/practices index allows an overall assessment of a company's adoption of the manufacturing strategy and practices modules of the questionnaire, and the operational

outcomes index allows assessment of the extent to which practices has been converted into operational outcomes in terms of cost, quality, flexibility, timeliness, and competitiveness. The questions inquiring the employment, sales, value-added, and pre-investment cash flow levels are used to calculate the measures of business performance (Figure 1).

In order to obtain the values for the strategy/practices index and the operational outcomes index, the responses given to the selected questions included in the questionnaire are used to construct the indices and to calculate the measures of business performance. Each item appearing under the column of manufacturing strategy/practices and under the column of outcomes in Figure 1 is considered to be equally weighted in its contribution to its respective index, such that the maximum total score that can be attained on an index becomes 100. Moreover, each question associated with each item is considered to be equally weighted in its contribution to the score of that item.

Manufacturing Strategy	**Practices**	**Outcomes**	**Business Performance**
Planning Focused Strategies Factory Operations	Leadership People Management Customer Focus Process and Product Quality Technology Benchmarking	Cost Quality Flexibility Timeliness Competitiveness	Employment Sales Value-added Cash Flow
Strategy/Practices Index		**Operational Outcomes Index**	**Measures of Business Performance**

Figure 1. Construction of best practice indices and business performance measures

Best Practice Scorecard of the Sample

The best practice scorecard is constructed to measure the proximity of the companies to best practice. The horizontal axis of the scorecard shows the score on the strategy/practices index, and the vertical axis shows the score on the operational outcomes index. Each of the 82 companies in the sample is plotted as a single point on the best practice scorecard after calculating their individual scores on these indices (Figure 2).

The average score of the overall sample on the strategy/practices index is 73 with a minimum value of 50, a maximum value of 98, and a standard deviation of 9.44. The

average score on the operational outcomes index is 68 with a minimum value of 54, a maximum value of 90, and a standard deviation of 7.58.

A company's overall practices/performance index is the sum of its scores on the strategy/practices index and on the operational outcomes index. Therefore, it has potentially a maximum value of 200. The overall practices/performance index is used to measure how close a company is to best practice. The minimum and the maximum scores attained by the sample on the overall practices/performance index are 112 and 177, respectively. The average value is 141 with a standard deviation of 14.86. The majority of the surveyed companies have scores between 120 and 160, out of 200.

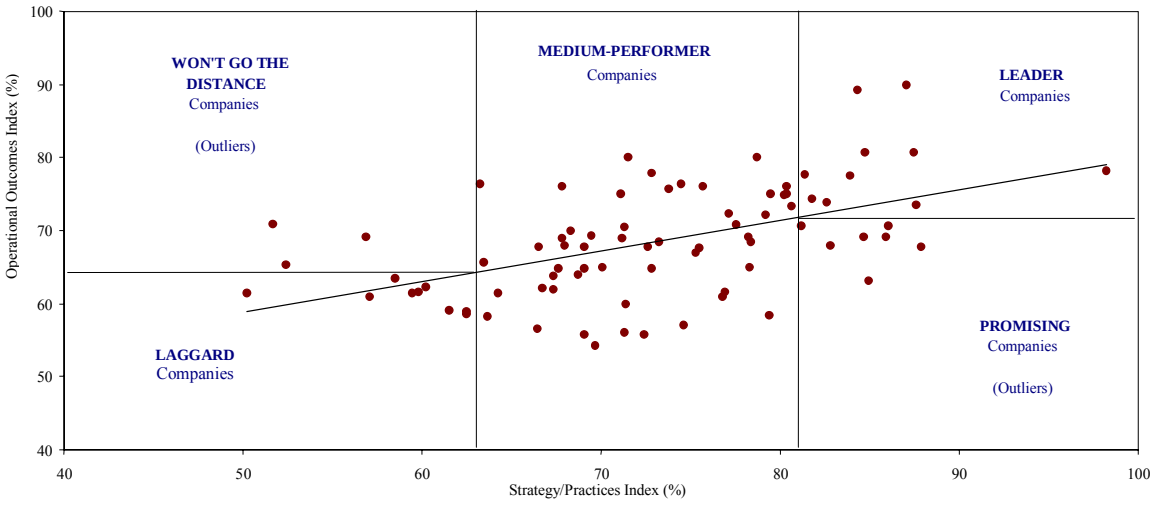

Figure 2. Best scorecard of the sample

Categorisation of the Sample with respect to Best Practice Adoption

In order to categorize the surveyed companies according to their proximity to best practice, first, a linear regression analysis is performed on the distribution of companies depicted in the best practice scorecard of the sample (Figure 2). In the linear regression analysis, operational outcomes index is considered as the dependent variable, and the strategy/practices index as the independent variable. The regression line fitted to the distribution is:

*Operational outcomes index = 37.955 + 0.418 * Strategy/practices index*

The coefficient of determination (r^2) for the distribution is approximately 27 %. This demonstrates that the practices described in the model are significant determinants of the operational outcomes sought. However, there are other factors such as the market in which the company operates, the product line manufactured by the company, and other factors

which might also affect the operational outcomes of a company and thus, should not be ignored in the final analysis.

To divide the overall sample into subgroups with respect to their best practice adoption, two 90 degrees angles are drawn intersecting the upper most and the lowest tips of the regression line. The 90 degrees angle at the upper most tip is moved down along the regression line until approximately 10 per cent of the companies are covered. These companies are called the leader companies. To identify the laggard companies, the 90 degrees angle at the lowest tip is moved up along the regression line until approximately 10 per cent of the companies are covered. The vertical lines of the 90 degrees angles are extended to the horizontal borders of the plot to identify the companies in the upper left rectangle as won't go the distance and those in the lower right rectangle as the promising companies (Figure 2). The promising and the won't go the distance companies are considered as the outliers. The companies left in the middle are called the medium-performers. The most crowded category is the category of the medium-performers which covers 65 % of the sample. The outliers, namely the promising and the won't go the distance companies, together represent 13 % of the sample. While 11 % of the companies fall into the category of the leader, 12 % fall into the category of the lagger companies.

Best Practice Adoption of the Sample by Category

Best practice adoption is a function of the strategy/practices index and the operational outcomes index. The statistics (average, minimum and maximum scores, and the standard deviation) on the strategy/practices index, operational outcomes index, and on the overall practices/performance index of the companies in each category are tabulated in Table VI, Table VII, and Table VIII, respectively.

Table VI. Statistics on the strategy/practices index by category

	Strategy/Practices Index (out of 100)			
Category	Minimum	Maximum	Mean	Standard Deviation
Leader	81	98	86	5
Lagger	50	62	59	4
Medium-performer	63	81	72	5
Promising	81	88	85	2
Won't go the distance	52	57	54	3
Overall sample	50	98	73	9

On the strategy/practices index, the leader companies have an average total score of 86, whereas the lagger companies have 59 (Table VI). On the operational outcomes index,

the leader and the lagger companies have an average total score of 80 and 61, respectively (Table VII). This implies that to be a leader, all-round excellence is needed, and there are no short cuts. The won't go the distance companies achieve an average score on the operational outcomes index equal to those of the medium-performers and the promising companies, but with a lower average score on the strategy/practices index. Moreover, while the average score on the operational outcomes index of promising companies is equal to those of the medium-performers and the won't go the distance companies, their average score on the strategy/practices index is significantly higher.

Table VII. Statistics on the operational outcomes index by category

	Operational Outcomes Index (out of 100)			
Category	Minimum	Maximum	Mean	Standard Deviation
Leader	74	90	80	6
Lagger	59	64	61	2
Medium-performer	54	80	68	7
Promising	63	71	68	3
Won't go the distance	65	71	68	3
Overall sample	54	90	68	8

On the overall practices/performance, the distinction between the best practice adoption of the categories is seen more clearly (Table VIII).

Table VIII. Statistics on the overall practices/performance index by category

	Overall Practices/Performance Index (out of 200)			
Category	Minimum	Maximum	Mean	Standard Deviation
Leader	156	177	165	8
Lagger	112	123	120	3
Medium-performer	122	159	140	10
Promising	148	157	153	3
Won't go the distance	118	126	122	4
Overall sample	122	177	141	15

Validating the Differences in Best Practice Adoption of the Categories

As discussed earlier, a company's adoption of best practice is measured by its implementation of best manufacturing practices and achievement of high operational outcomes; that is, in terms of their total scores on the strategy/practices index and on the operational outcomes index. A higher total score on the strategy/practices index implies more successful implementation of best manufacturing practices, and a higher total score on the operational outcomes index implies more successful achievement of operational

outcomes. Based on this method, it is assumed that the leader companies are performing better than the medium-performers, and that the medium-performers, in turn, are performing better than the lagger companies in adopting best practice. This assumption is trivial when the implementation of best manufacturing practices is considered. This is because, the ranges of possible total scores on the strategy/practices index a leader company, a lagger company, and a medium-performer could get are non-overlapping and wide enough (Figure 2). Therefore, to validate the assumption, a series of hypothesis tests are conducted only on the operational outcomes indices of these categories. These tests are meaningful from the statistics viewpoint, since although the ranges of possible total scores on the operational outcomes index a leader and a lagger company could get are non-overlapping and wide enough, a medium-performer could get every possible value on this index. The won't go the distance and the promising companies are excluded from the hypothesis tests, since they are considered as outliers.

Two hypothesis tests are set on the operational outcomes indices of the leader, medium-performer, and the lagger companies to see whether these categories differ statistically from each other in achieving operational outcomes. The details of the statistical tests are given in Appendix 1. The results are as follows:

- Leaders are performing better than medium-performers in achieving high operational outcomes.
- Medium-performers are performing better than laggers in achieving high operational outcomes.

These results together with the fact that they also apply for implementing best manufacturing practices by definition, imply that the assumption saying that these categories differ from each other in terms of best practice adoption is statistically validated.

Business Profile of the Sample by Category

The business profiles of the companies in each category are analysed in terms of the industrial sector they belong to, their nature of business, foreign capital contribution and company size. The results are shown in Table IX through Table XI, respectively.

The cement companies of the sample form 50 % of the leader and 57 % of the promising companies (Table IX). Sixty-six % of the won't go the distance companies are the electronics companies. Majority (66 %) of the appliances p&c supplier companies fall into either lagger or won't go the distance category.

TABLE IX. Industrial sector distribution of the sample by category

	Industrial Sector			
Category	Electronics	Cement	Automotive	Appliances P&C Suppliers
Leader	10 %	50 %	30 %	10 %
Lagger	22 %	33 %	11 %	33 %
Medium-performer	40 %	25 %	8 %	28 %
Promising	14 %	57 %	29 %	0 %
Won't go the distance	66 %	0 %	0 %	33 %
Overall sample	34 %	30 %	12 %	24 %

In the overall sample, 63 % of the companies are independent companies (Table X). Hence, one would expect that, most of the companies in each category are also independent. However, it is interesting to find out that 60 % of the leader companies are subsidiaries of parent or holding companies.

Table X. Business nature of the sample by category

	Nature of Business		
Category	Independent	Operating unit	Subsidiary
Leader	40 %	0 %	60 %
Lagger	78 %	6 %	6 %
Medium-performer	66 %	9 %	25 %
Promising	57 %	0 %	43 %
Won't go the distance	66 %	0 %	34 %
Overall sample	63 %	7 %	29 %

Table XI. Existence of foreign capital contribution by category

	Foreign contribution in the company	
Category	Yes	No
Leader	50 %	50 %
Lagger	11 %	89 %
Medium-performer	17 %	83 %
Promising	19 %	81 %
Won't go the distance	0 %	100 %
Overall sample	21 %	79 %

In the overall sample, the percentage of companies with foreign capital contributions is only 21 %. However, it is observed that while 50 % of the leader companies have foreign capital contribution, this ratio is 11 % for the laggers (Table XI).

In the overall sample, 71 % of the companies are small- or medium-sized companies. It is found that while 50 % of the leaders are large-sized, all of the laggers are small- or medium-sized companies (Table XII).

Table XII. Company size of the sample by category

	Company Size		
Category	Large	Medium	Small
Leader	50 %	40 %	10 %
Lagger	0 %	78 %	22 %
Medium-performer	19 %	51 %	30 %
Promising	57 %	29 %	14 %
Won't go the distance	0 %	33 %	66 %
Overall sample	29 %	48 %	23 %

Effect of Industrial Sector on Best Practice Adoption

The sample used in the study is composed of 82 companies from four different industrial sectors. Hence, it would be interesting to see whether industrial sector affects best practice adoption. Figure 3 shows the average scores of the companies by industrial sector on both the strategy/practices index and on the operational outcomes index as a bar chart. The length of a bar indicates the average score on the overall practices/performance index, which actually measures out of 200, how close a company is to best practice.

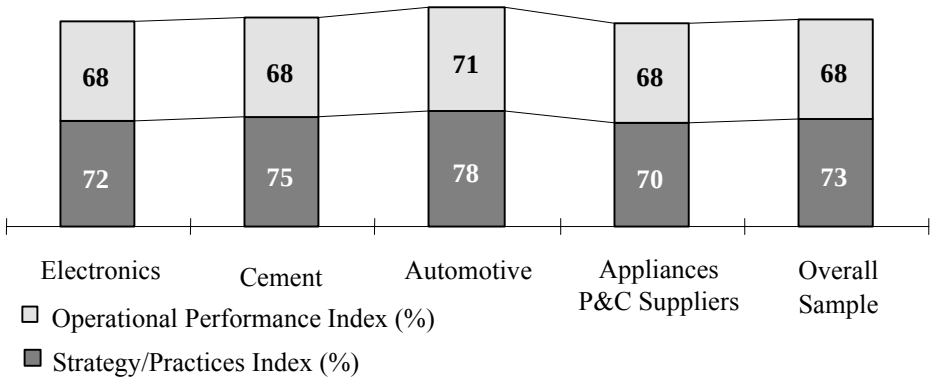

Figure 3. Best practice adoption of the sample by industrial sector

To investigate statistically the effect of industrial sector on best practice adoption, two hypothesis tests are conducted using the analysis of variance technique for the four sectors: one on the strategy/practices index and one on the operational outcomes index. The details of the statistical tests are given in Appendix 2. The following results are obtained:

- Industrial sector doesn't affect implementing best manufacturing practices.
- Industrial sector doesn't affect achieving high operational outcomes.

The variation across industrial sectors is greater than the variations in practices and outcomes within each sector. The same result was reported in the study by the Australian Manufacturing Council (1994).

Effect of Company Size on Best Practice Adoption

Here, it is investigated whether there is a significant relationship between company size and the adoption of best practice. Figure 4 shows the average scores of the companies by company size category on both the strategy/practices index and on the operational outcomes index as a bar chart. The length of a bar indicates the average score on the overall practices/performance index, which actually measures how close a company is to best practice adoption.

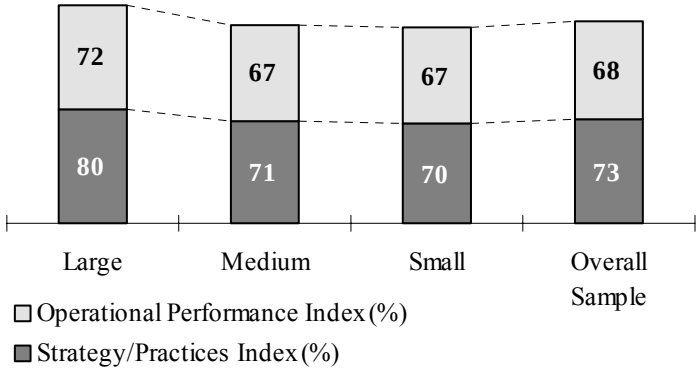

Figure 4. Best practice adoption of the sample by company size

To investigate statistically the effect of company size on best practice adoption, two hypothesis tests are conducted using the analysis of variance technique for the three company size categories: one for the strategy/practices index and one for the operational outcomes index. The details of the statistical tests are given in Appendix 3. From the results of the two hypothesis tests, the following conclusions are reached:

- Company size affects the implementation of best manufacturing practices.
- Company size affects the achievement of high operational outcomes.

In fact, the variation in practices and outcomes within each industrial sector is greater than the variation across sectors.

The source of differences on both indices is actually the category of large-sized companies. In order to validate these observations, six hypothesis tests are conducted: three

on the strategy/practices index and three on the operational outcomes index of the company size categories with the following results.

- Large-sized companies are better than medium-sized and small-sized companies in implementing best manufacturing practices.
- Medium-sized and small-sized companies do not differentiate themselves in implementing best manufacturing practices and in achieving high operational outcomes.
- Large-sized companies are better than medium-sized and small-sized companies in achieving high operational outcomes.

IMPLEMENTATION OF BEST MANUFACTURING PRACTICES

Implementation of best manufacturing practices is measured by means of calculating a strategy/practices index. Figure 5 shows the average total scores on the index out of 100 attained by the leaders, laggers, and by the overall sample.

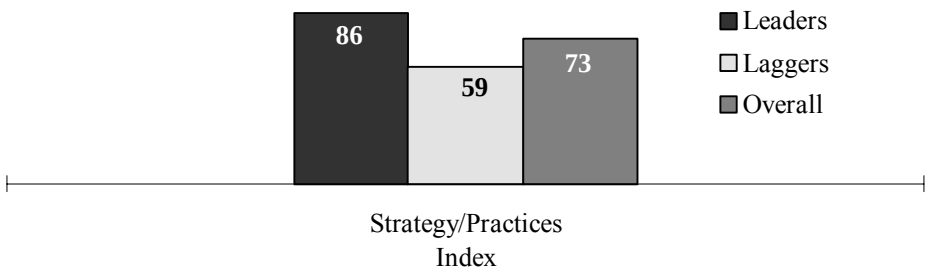

Figure 5. Average total scores on the strategy/practices index

By definition, strategy/practices index is an index that measures the companies in terms of their manufacturing strategies and practices. While the scores on planning, focused strategies, and factory operations contribute to the strategy part of the index, the scores on leadership, people practices, customer focus, product and process quality, benchmarking, and technology contribute to the practices part. The scores of the leader companies are significantly higher than those of the lagger companies on each component of the strategy/practices index except in the area of focused strategies. The gap between the leader and the lagger companies is largest in the area of factory operations. Meanwhile, the gap between the overall sample and the laggers is largest in the area of factory operations but smallest in the area of planning and focused strategies.

Transforming an organisation to achieve and sustain best practices requires an appropriate manufacturing strategy. Systematic and participative planning processes, focused strategies, and factory operations were the three key elements the questionnaire related to the manufacturing strategy. On the practices related to planning, companies in each category achieved higher scores. In the overall, while best practices for planning are generally followed, there is a lack of alignment between the manufacturing strategy and the business strategy. The leader companies, by far, performed better than the lagger companies in adopting best manufacturing practices related to factory operations.

On the practices related to focused strategies, whether leader or lagger, they all achieved lower scores. The scales of both capacities and orders received are relatively small quantities. Thus the companies usually opt for one or more of the product, market, and technology proliferations in order to increase their total volume and to reach a certain scale.

Despite the fact that benchmarking is reported as widely practiced, interviews demonstrated that the concept is far from being uniformly understood. Majority of companies claiming that they practiced benchmarking are in fact practicing benchmarking at the simplest possible level. That is, most of the benchmarking applications are ad hoc observations of competitors' products and services mostly by means of product benchmarking, which is widely practiced, attending trade shows, and site visits or are comparisons of the performance with the previous year. Information needed for benchmarking against a competitor is generally obtained from the customers and material and equipment suppliers. These findings suggest that higher levels of benchmarking is a new concept for many companies in the sample, regardless of them being a leader or a lagger.

ACHIEVEMENT OF HIGH OPERATIONAL OUTCOMES

The extent of achieving high operational outcomes is measured by means of calculating an operational outcomes index. This index is constructed by the responses given to the selected questions incorporated in the performance/outcomes module of the *Competitive Strategies and Best Practices Benchmarking Questionnaire*. The purpose of these questions is to assess companies' operational performance in terms of cost, quality, flexibility, timeliness, and competitiveness. Figure 6 shows the average total scores on the

operational outcomes index out of 100 attained by the leaders, laggers, and by the companies in the overall sample.

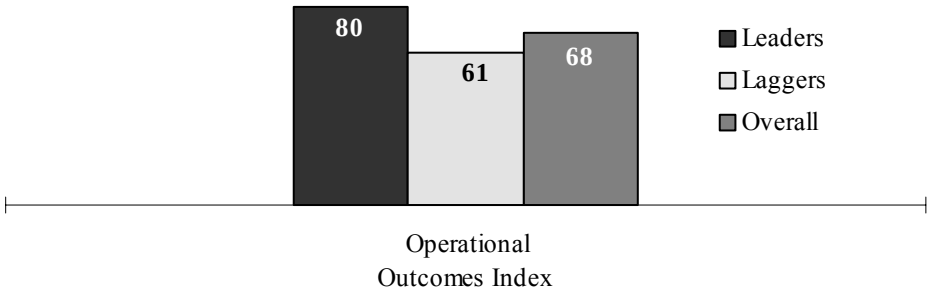

Figure 6. Average total scores on the operational outcomes index

Operational Outcomes in Terms of Performance Attributes

In the survey, companies are required to assess their operational performance in terms of customer satisfaction, employee morale, process changeover time, productivity, and technological competitiveness. It was found that, in general, the leader companies are far better than the lagger companies in the achievement of high performance levels in the above listed performance attributes.

Operational Outcomes in Terms of Performance Indicators

In the survey, companies are required to indicate the percentage of delivery full on time to customers, proportion of production operators involved in process improvement / problem solving teams / quality circles, and ratio of quality control inspectors to direct production operators on a predetermined scale 1 to 5, where 1 indicates the least desirable range and 5 the most desirable range. The results are depicted in Figure 7,8, and 9, respectively. In the figures, the numbers indicate the percentages of companies within specified range of values. It is found that, in general, the leader companies are far better than the lagger companies in the achievement of high operational outcomes.

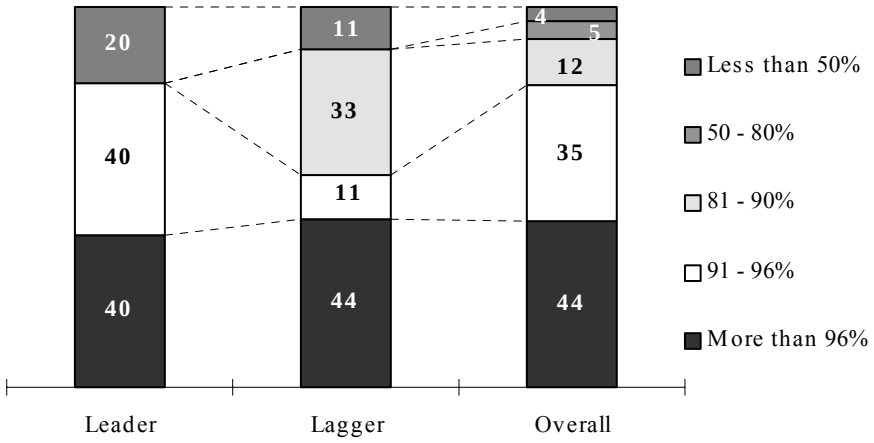

Figure 7. Delivery full on time to customers

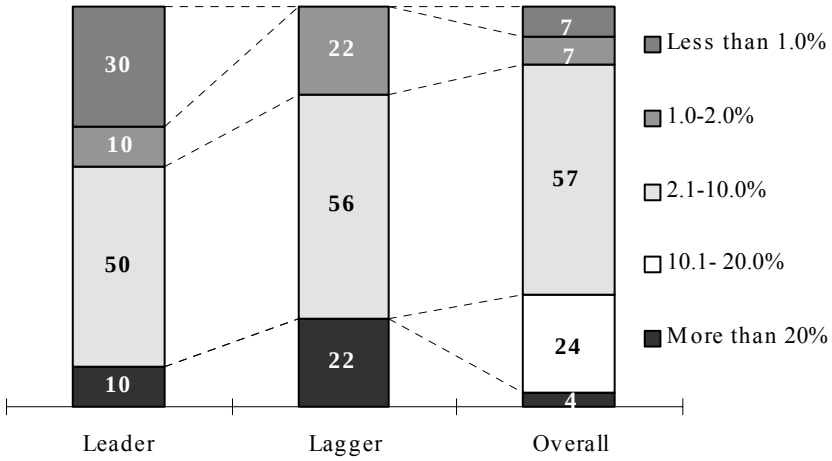

Figure 8. Ratio of quality control inspectors to direct production operators

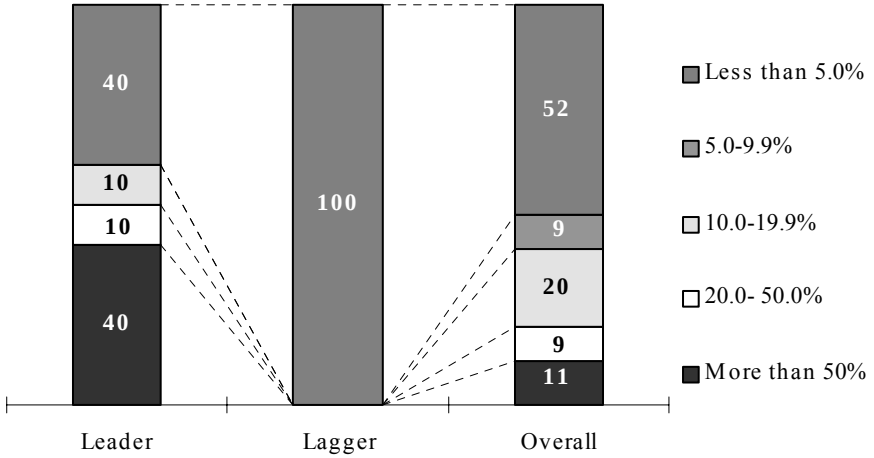

Figure 9. Proportion of production operators involved in process improvement / problem solving teams

IMPACT OF BEST PRACTICE ADOPTION ON BUSINESS PERFORMANCE

This section examines the business performance of the leaders and the laggers in terms of average annual growth in total sales per employee, average annual growth in value-added per employee in the last three years, and the level of pre-capital investment cash flow to quantify the impact of best practice adoption on the business performance. The importance of practices and outcomes in relation to company success is also reported.

The hypothesis to be tested here is the following: *The closer a company is to best practice, both in the practices it adopts and in the operational outcomes that result, the more likely it is to achieve higher business performance*.

This hypothesis is strongly supported by the data on the business performance of the leaders and the laggers. It is shown that the leaders have achieved substantially higher business performance than the laggers.

Average annual growth in total sales per employee, average annual growth in value-added per employee, and the level of pre-capital investment cash flow are considered as the three measures of business performance. Value-added per employee is a widely-used indicator of employee productivity. Total sales per employee is an indicator of growth. A high level of pre-capital investment cash flow indicates a healthy growth of the business.

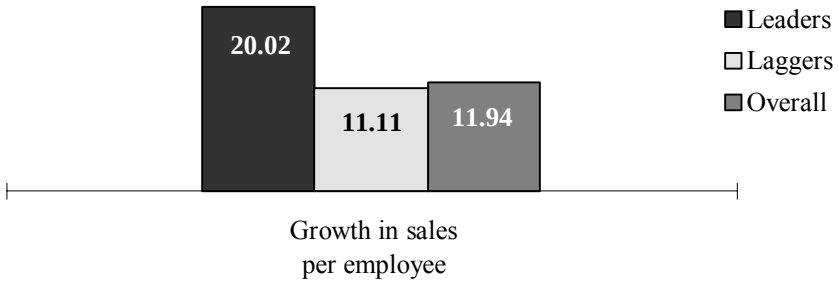

FIGURE 10. Average annual growth in total sales per employee in the last three years

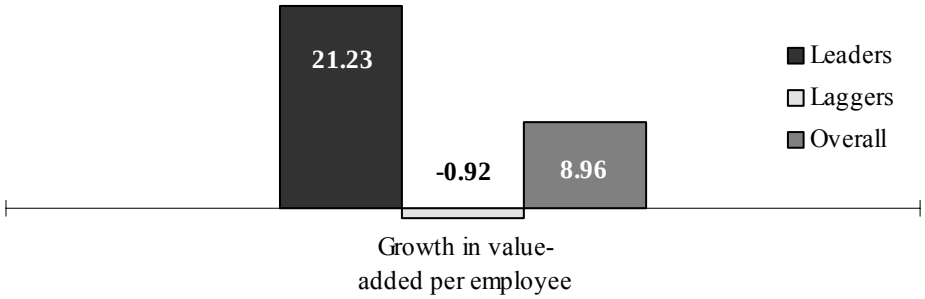

FIGURE 11. Average annual growth in value-added per employee in the last three years

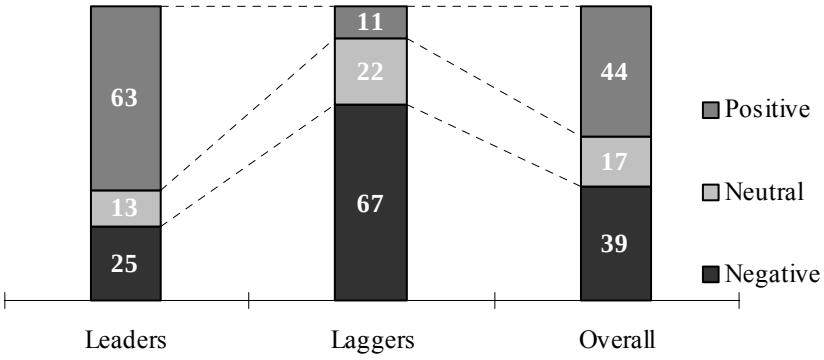

Figure 12. Pre-capital investment cash flow levels

The results of the business performance analysis of the leader and the lagger companies reassured that implementation of best manufacturing practices and achievement of high operational outcomes have a positive impact on business performance. The leaders have achieved higher growths in sales per employee (Figure 10) and value-added per employee over the last three years (Figure 11), and had positive pre-capital investment cash flows (Figure 12). Besides, majority of the leader companies increased their level of cash flows in the last two years.

The average annual growth in employment for the leader and the lagger companies is also analysed. As Figure 13 shows, the overall sample had nearly 13 % of growth in the total number of employees. While the lagger companies experienced almost 17 % employment growth, the leader companies had approximately 11 %. As it is reported in the company size distribution of the sample by category (Table XII), while 50 % of the leaders are large-sized, all of the lagger companies are either small- or medium-sized with less than 500 employees.

It might be interesting to examine the average annual change in the ratio of the number of direct workers to the number of total employees. As shown in Figure 14, while the ratio is decreased at an average annual rate of 1.35 % in the leader companies, it is decreased by 0.65 % in the lagger companies during the last three years. This implies that, the number of direct workers in the total number of employees is increasing more steeply in the leaders than in the laggers. While the leader companies are trying to increase the fraction of their white-collared (indirect) employees, the lagger companies are trying to increase the fraction of their blue-collared (direct) employees.

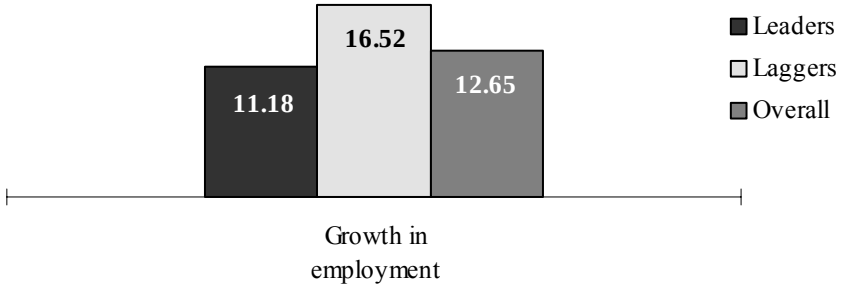

Figure 13. Average annual growth in employment in the last three years

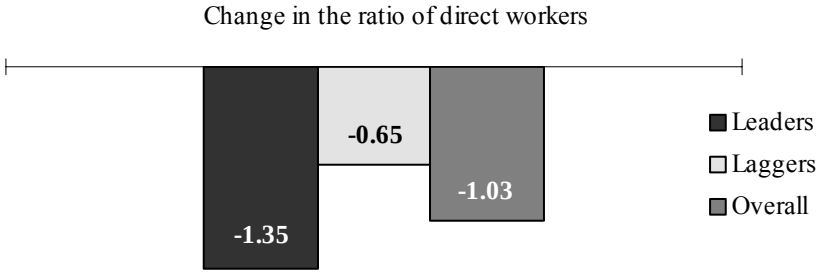

FIGURE 14. Average annual change in the ratio of number of direct employees to total number of employees in the last three years

6. SUMMARY AND SOME MANAGERIAL IMPLICATIONS

The study reports on a series of sectoral benchmarking studies in the electronics, cement, automotive, and appliances p&c suppliers sectors of the Turkish manufacturing industries. The study involves the examination of to what extent prevailing best manufacturing practices are adopted and high operational outcomes are achieved by a sample of companies from these four sectors. The investigated companies are later classified as the leader, lagger, medium-performer, promising and the won't go the distance companies depending on how well their practices and operational outcomes match up to best practice.

The study is based on the results obtained from the application of the *Competitive Strategies and Best Practices Benchmarking Questionnaire* to a total of 82 companies followed by structured interviews and site visits. The companies are segregated according to their success in adopting universal best practice. Ten leaders and nine laggers stand out from the rest of the sample. Each of these groups are later analysed closely to find out: (i) how well they implemented the best manufacturing practices in planning, focused strategies, factory operations, leadership, people management, customer focus, process and product quality, technology, and benchmarking; (ii) their success in achieving high operational outcomes in terms of cost, quality, flexibility, timeliness, and competitiveness; (iii) whether adopting best practice correlated positively with business performance measured by average annual growth in total sales per employee, average annual growth in value-added per employee, and the level of pre-capital investment cash flow.

The key findings of the study and some managerial implications can be summarized as follows:

- Large-sized companies outperform the rest both in terms of their success in implementing best manufacturing practices and in achieving high operational outcomes. Medium-sized and small-sized companies do not differ in those aspects.
- There is no appreciable difference between industrial sectors in implementing best manufacturing practices and in achieving high operational outcomes.
- It is clearly revealed that the leaders in adopting best practice are rewarded by higher business performance. They have achieved 20 % average annual growth in sales per employee in the last three years compared with 11 % achieved by the laggers; have achieved 21 % average annual growth in value-added per employee in the last three years

compared with a decrease of 1% obtained by the laggers; and have achieved higher levels of cash flow and have increased their level of cash flow in the last two years.

- More emphasis needs to be put by the top management to align the manufacturing strategy with the business strategy.
- Relative to foreign competitors, ability to adopt product and/or volume changes rapidly is stated to be a key advantage. It is indeed a challenge to preserve this flexibility as the scale of the operations increases. Another key advantage over foreign competitors as stated by the companies is customer service within Turkey. Customer service is evaluated here in terms of the density of the distribution network and the availability and quality of the after sale service. It is important to develop manufacturing strategies such that these advantages are not lost.
- Another notable finding is that the traditionally held view of having low unit cost as an advantage against foreign competition seems to be unfounded. In the overall sample, only 51% of the companies reported lower unit cost relative to their foreign competitors. Among others, reducing defective rates and production downtime will help considerably in reducing unit cost.
- More effort is needed by the companies to involve their employees in quality improvement activities in order to reduce their finished product defect rate, which is considered by 79% of the companies to be higher than their foreign competitors. This will also help in reducing the unit cost.
- Preventive maintenance and total productive maintenance programs need to be taken more seriously and to be adopted more widely by the companies in order to reduce lost capacity due to production downtime.
- For securing the continuous flow of high quality-low cost critical inputs into their manufacturing process, the companies need to create strategic partnerships with their suppliers which provide these critical inputs.
- The integration of customers and suppliers into supply chain activities should be facilitated.
- Scale is a major issue for manufacturing industries in Turkey. Besides trying to become export oriented and trying to become part of global extended enterprises, the companies need to look for all different possible modalities to join their resources together with other

companies domestic or foreign so as to reach sizes with more chance for sustainable competition.

In general, despite good intentions and long term initiatives in implementing best manufacturing practices, companies are not yet very successful in converting their practices into improved operational outcomes. Among others, the above stated measures can help them to achieve that. They are definitely not a complete list of measures to be recommended. A more detailed treatment of these can be found in Ulusoy (2000).

ACKNOWLEDGEMENT

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APPENDICES

A.1. Validating the Differences in Best Practice Adoption of the Categories

Hypothesis Test # 1:	Hypothesis Test # 2:
H_o: $\mu_{Leaders} = \mu_{Medium\text{-}performers}$	H_o: $\mu_{Medium\text{-}performers} = \mu_{Laggards}$
H_1: $\mu_{Leaders} > \mu_{Medium\text{-}performers}$	H_1: $\mu_{Medium\text{-}performers} > \mu_{Laggards}$

A t-test with the assumption that the variances are equal is performed for each hypothesis test. The statistics of the two t-tests are tabulated in the following table.

	Category		
Statistics	Leader	Medium-performer	Laggard
Mean	79.5991	67.5734	60.8697
Variance	34.5209	47.3522	2.7616
Number of observations	10	53	9
	Hypothesis Tests		
	# 1	# 2	
Degrees of freedom	61	60	
t-value	5.1733	2.8896	
t-critical one-tail ($\alpha = 0.05$)	1.6702	1.6706	

The outcomes of the statistical analyses reveal that H_o should be rejected, and that leaders are performing better than medium-performers, which in turn, are performing better than laggards in achieving high operational outcomes. In fact, in both tests, the t-statistics value is greater than the one-tail t-distribution value at 0.05 level of significance.

A2. Investigating the Effect of Industrial Sector on Best Practice Adoption

To investigate statistically the effect of industrial sector on best practice adoption, two hypothesis tests are conducted using the analysis of variance technique for the four sectors:

one on the strategy & practices index and one on the operational outcomes index in the form:

$$H_o: \mu_{Electronics} = \mu_{Cement} = \mu_{Automotive} = \mu_{App.\ P\&C\ Suppliers}$$

$$H_1: \mu_i \neq \mu_j \text{ for at least one pair } (i,j)$$

For both tests, a single factor analysis of variance is conducted to test the hypotheses. The statistics of the two F-tests are tabulated in the following table.

Statistics on the Hypothesis Test Set for the Strategy & Practices Index

Groups	Count	Sum	Average	Variance
Electronics	27	1932.69	71.11	84.36
Cement	25	1877.79	75.11	104.66
Automotive	10	776.06	77.61	82.82
Appliances P&C Suppliers	20	1393.71	69.68	61.30

ANOVA

Source of Variation	SS	df	MS	F	P-value	Fcrit
Between Groups	597.30	3	199.10	2.3476	0.0791	2.7218
Within Groups	6615.03	78	84.81			
Total	7212.32	81				

Statistics on the Hypothesis Test Set for the Operational Outcomes Index

Groups	Count	Sum	Average	Variance
Electronics	27	1827.37	67.68	63.72
Cement	25	1711.37	68.45	68.89
Automotive	10	708.40	70.84	56.95
Appliances P&C Suppliers	20	1362.26	68.11	39.68

ANOVA

Source of Variation	SS	df	MS	F	P-value	Fcrit
Between Groups	75.22	3	25.08	0.4274	0.7340	2.7218
Within Groups	4576.61	78	58.67			
Total	4651.83	81				

The outcomes of the statistical analyses reveal that H_o cannot be rejected, inasmuch as F-values computed are less than the $F_{critical}$-value at 0.05 level of significance. Hence, it is concluded that industrial sector does not have a significant effect the implementation of best manufacturing practices and achievement of high operational outcomes.

A3. Investigating the Effect of Company Size on Best Practice Adoption

To investigate statistically the effect of company size on best practice adoption, two hypothesis tests are conducted using the analysis of variance technique for the three

company size categories: one for the strategy & practices index and one on the operational outcomes index in the form:

$$H_o: \mu_{Small} = \mu_{Medium} = \mu_{Large}$$

$$H_1: \mu_i \neq \mu_j \text{ for at least one pair } (i,j)$$

For both tests, a single factor analysis of variance is conducted to test the hypotheses. The statistics of the two F-tests are tabulated in the following table.

Statistics on the Hypothesis Test Set for the Strategy & Practices Index

Groups	Count	Sum	Average	Variance
Large	19	1517.45	79.87	29.38
Medium	41	2923.08	71.30	90.11
Small	22	1539.71	69.99	88.82

ANOVA

Source of Variation	SS	df	MS	F	P-value	F_{crit}
Between Groups	1214.26	2	607.13	7.9964	0.0007	3.1123
Within Groups	5998.07	79	75.93			
Total	7212.32	81				

Statistics on the Hypothesis Test Set for the Operational Outcomes Index

Groups	Count	Sum	Average	Variance
Large	19	1375.96	72.42	59.99
Medium	41	2757.60	67.26	57.63
Small	22	1475.65	67.08	41.33

ANOVA

Source of Variation	SS	df	MS	F	P-value	F_{crit}
Between Groups	398.93	2	199.46	3.7051	0.0290	3.1123
Within Groups	4252.90	79	53.83			
Total	4651.83	81				

The outcomes of the statistical analyses reveal that H_o should be rejected, inasmuch as F-values computed are greater than the $F_{critical}$-value at 0.05 level of significance. Hence, it is concluded that there is a significant relationship between company size and both the implementation of best manufacturing practices and achievement of high operational outcomes. In fact, the variation in practices and outcomes within each industrial sector is greater than the variation across sectors.

In order to find out the sources of differences on both indices, three hypothesis tests each are conducted both on the strategy & practices index and on the operational outcomes index of the company size categories, in the respective forms:

Hypothesis Test # 1:	Hypothesis Test # 2:	Hypothesis Test # 3:
H_o: $\mu_{Large} = \mu_{Medium}$	H_o: $\mu_{Medium} = \mu_{Small}$	H_o: $\mu_{Large} = \mu_{small}$
H_1: $\mu_{Large} > \mu_{Medium}$	H_1: $\mu_{Medium} \neq \mu_{Small}$	H_1: $\mu_{Large} > \mu_{small}$

A t-test is performed for each hypothesis test. The statistics of the three t-tests for the strategy & practices index are tabulated in the following table.

	Category		
Statistics	Large	Medium	Small
Mean	79.87	71.30	69.99
Variance	29.38	90.11	88.82
Number of observations	19	41	22
	Hypothesis Tests		
	# 1	# 2	# 3
Degrees of freedom	58	61	39
t-value	3.6586	0.5227	4.0264
t-critical one-tail ($\alpha = 0.05$)	1.6716	1.6702	1.6853

The outcomes of the first and the third hypothesis test reveal that H_o should be rejected (t-statistics values are greater than the one-tail t-distribution value at 0.05 level of significance). However, the outcome of the second hypothesis test reveals that H_o cannot be rejected (t-statistics value is less than the one-tail t-distribution value at 0.05 level of significance).

The statistics of the three t-tests for the operational outcomes index are tabulated in the following table.

	Category		
Statistics	Large	Medium	Small
Mean	72.42	67.26	67.08
Variance	59.99	57.63	41.33
Number of observations	19	41	22
	Hypothesis Tests		
	# 1	# 2	# 3
Degrees of freedom	58	61	39
t-value	2.4339	0.0944	2.4127
t-critical one-tail ($\alpha = 0.05$)	1.6716	1.6702	1.6853

The results of the three hypothesis tests are the same for the the operational outcomes index as they are for the strategy & practices index.

The results of the hypothesis tests reveal that large-size companies are performing better than the medium- and the small-size companies both in implementing best manufacturing practices and achieving high operational outcomes. Yet, there is no significant difference between the medium- and the small-size companies from those aspects.

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