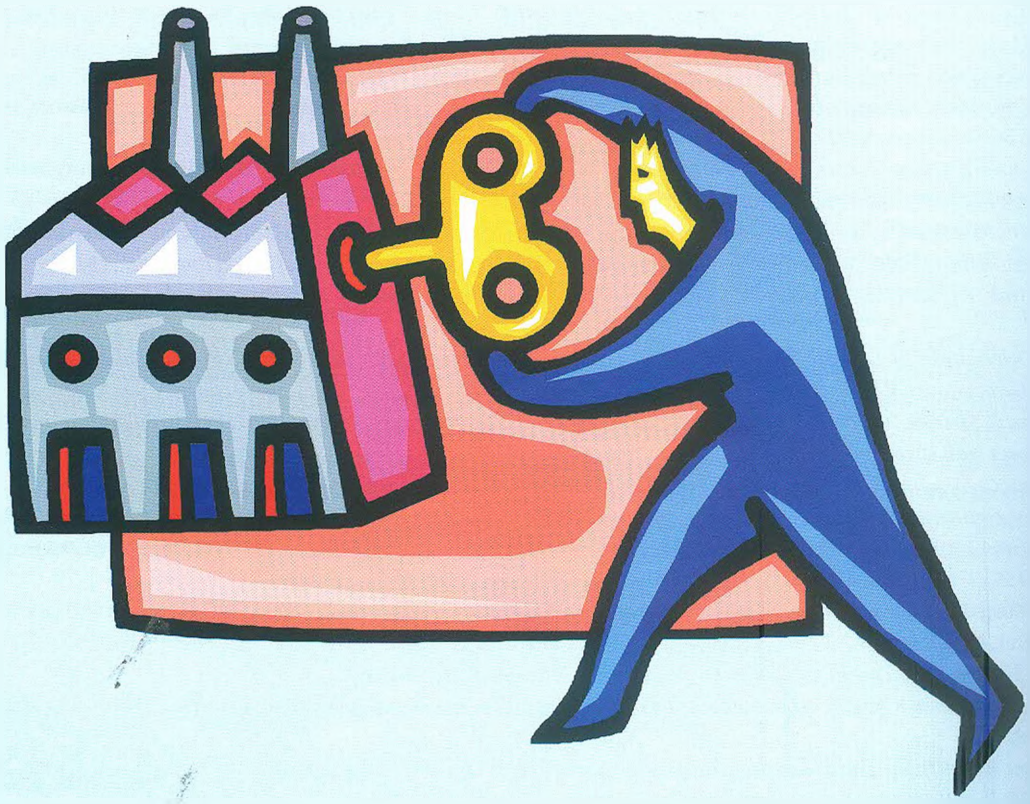
U.S. Manufacturing Industry:



A Study of Relationship Between the

Total Quality Management

ABSTRACT

Our to those who have not. Using article compares the performances of manufacturers who have won quality related awards various accounting indices as indicators of performance, we test few of the arguments being currently made in manufacturing strategy literature. Studies suggest that quality is now just a "qualifier," as opposed to being an "order winner" (Colyer, 2006; Hill 2000, page 36). To the extent, performance of award winners compared to non-winners is better, quality can still be considered to have conferred advantage. Furthermore, insignificant differences in performances reinforce the notion of quality as a qualifier. Another argument made in the literature is that companies that have implemented the TQM are also expected to be lean manufacturer (Hill, 2000 page 36; Easton and Jarrell, 1998; Hendricks and Singhal, 1997). We have used some financial indices as indicators of leanness to test the differences between quality award winners and non-winners.

Keywords: *Total Quality Management, Quality, Manufacturing, Performance*

and Organizational Performances

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INTRODUCTION

Total Quality Management (TQM) requires the attainment of excellence in manufacturing process, in order to provide customers with superior products (Day, 1994; Grant, 1991). With TQM, manufacturers have seen an increase in their market share and / or profitability. The success of Japanese manufacturers, starting 1980's, in wrestling market share in America, despite many advantages of American firms such as home ground, superior technology and deeper pocket was attributed to TQM (Grant, 1991; Hill 2000 page 37, 67).

With time, excellent manufacturing processes are emulated and superior products become standard. Now, overall quality level of every product has increased. Currently in manufacturing, many firms comply with ISO 9000 series standards which require manufacturers to follow better operational practices often associated with TQM, and consequently maintain a high quality in their products. Manufacturers seeking ISO certifications have increased significantly since 1990's (Colyer, 2006; Hill 2000, page 36). So it is said that quality, which was once "order winner" providing "competitive advantage" to increase sales and profitability, has now become "qualifier" (Hill, 2000). In this environment, a low quality manufacturer can find it very difficult to survive. However, excellence beyond certain level does not translate into high profit or sales growth (Hill, 2000 page 36). Thus, it is possible that (with time) the competitive advantage conferred by TQM has diluted.

In this study, we compare, the accounting indices related to productivity, profitability, and growth, for the manufacturers who have won awards in quality to those who have not. United States Federal government gives Baldrige award for excellence in quality management. Many state governments follow similar pattern. Beside, many private companies give awards to recognize quality management amongst their suppliers. The award criteria emphasize heavily on leadership, information and analysis, strategic quality planning, human resource utilization, customer focus and market focus etc. with small points given to actual financial performance (Rao, Solis and Raghunathan, 1999; Easton and Jarrell, 1998; Hendricks and Singhal, 1997). Thus this comparison, between companies deemed superior in quality (award winners) and other manufacturers (non-award winners), attempts to measure the direct impact of the difference in quality level to the difference in their financial performances (Easton and Jarrell, 1998; Hendricks and Singhal, 1997; Subedi and Maheshwari, 2007).

Our study follows the approach of Hendricks and Singhal (1997). However here, we have confined ourselves only to manufacturing industry (SIC codes 2000 to 3999). Moreover, in this study we have used data starting 1994. This use of recent data adds to the significance of our study. For example, starting 1990's the number of ISO certified manufacturers have increased dramatically. Secondly, as discussed above, the literature suggests that from 1990's onward quality has become "qualifier" rather than "order winner" (Colyer, 2006; Hill 2000, page 36). Here, by focusing solely on manufacturing industry, we are also able to test to what extent total quality management and lean manufacturing are related to each other (Chang and Lee, 1995). Thus by confining ourselves to the data of certain period and certain industry only, we have investigated issues which are quite different from those discussed by the aforementioned paper.

HEORY

TQM calls for process that brings the equipments and human skills together to deliver faultless output in an efficient manner. It uses tools such as statistical process control, and detects any unwanted variation. It requires that manufacturing process and products are right in the very first try. Recently, companies have moved to six-sigma process, which leaves almost no opportunity for random errors (Belhouse, 2008). While, inspection, rework, and rejection of poor quality items can also be used to deliver high quality goods to customers, TQM considers such practices to be waste of time and money (Li and Rajagopalan, 1998).

Setting up such process requires extensive training and empowerment of workforce, along with information sharing and teamwork. Workers should be able to identify mistakes, learn from them and continuously improve the manufacturing process so that errors are not repeated. Consequently, TQM can stir organizations through steep learning curves (Holweg and Pil, 2004, page 40-41; Hill, 2000 page 236, 242-246).

TQM is the outcome of leadership, organizational culture, and continuous interaction amongst the workers (Mukherjee, Lapre and Wassenhove, 1990). Therefore, TQM related capabilities are organization specific, path dependent, and difficult to replicate (Day, 1994; Grant, 1991; Diericks and Cool, 1989). These characteristics of TQM (such as path dependence, ability to go through steep learning curves as well as only limited replicability), explain the continuing advantage enjoyed by Japanese manufacturers long after their management practices are well understood (Fine, 1986).

Experts from award giving organizations make series on- the spot visits and evaluations on number of applicants. Award winners are deemed to be the ones who are determined by these experts to have excelled in quality related practices. So, these award winners (successful in applying TQM practices) should have competitive advantage manifested by have higher efficiency (lower cost of production, and lower level of inventory), and enjoy higher level of profitability and growth of market share (Easton and Jarrell, 1998; Hendricks and Singhal, 1997).

However, in recent years advent of other mitigating factors may have eroded the advantages of these award winners. For example, competitive pressures force every manufacturer (with or without quality management practices) to cut cost. Again, same pressure do not allow manufacturers (even with better products) to charge premium. Moreover, with the need to comply with ISO 9000 series, many manufacturers have to make there quality control regime at least acceptable.

Each of these issues is elaborated in the following paragraphs.

Quality and Cost

It is expected that implementation of total quality management reduces total cost of production. Getting things right in the very first attempt eliminates rework, scrap and waste (Hill, 2000 page 67; Holweg and Pil, 2004, page 40-41). This is why gurus like Deming considered quality to be free (Hendricks and Singhal, 1997). Reducing the rework, which

took about twenty percent of the time and cost and one quarter of space for car manufacturers, was one of the motivations to adopt total quality management in Toyota. Today Japanese car manufacturers have highest percentage of 'first-time correct' ratio. This gives them the cost advantage over their American rivals (Holweg and Pil, 2004, page 40-41; Womack, Jones and Roos, 1990, page 57-58, Hill, 2000, page 57). Based on these observations one can expect the award winners to have lower production cost compared to other manufacturers.

However, manufacturing is a complex undertaking. Production requires coordination of machines, technology and human activities (Hill, 2000, page 159). Adoption of TQM requires new process and routines to replace old ones. The transition can be difficult. For example, when Toyota started to embark on TQM it had to stop assembly line very often. So, at least at the beginning adoption of TQM can increase the cost (Womack, Jones and Roos, 1990, page 57-58). This may mitigate some of the cost advantages of adoption of TQM.

Moreover, many manufacturers are required be ISO certified, and following strict quality management regimes (Colyer, 2006; Hill 2000, page 36). Again, manufacturing is a very competitive business. In many cases manufacturing industry has overcapacity. To remain viable, manufacturers (even those who are not adopting any quality management programs) have been cutting cost drastically (Hill 2000, page 36 and 55). With emergence of some developing economies as viable outsourcing posts, American manufacturers are getting historic opportunity (and pressure) to outsource in order to reduce costs. Whole of American manufacturing industry have become more efficient (Fishman, 2006, page 127-128; Friedman, 2006 pages 321, 340). These may be another mitigating factor to the cost advantage of award winners.

Quality and Inventory

TQM demands lower inventory. Inventory that is not be used immediately can be consider waste (Hill, 2000, page 67). Moreover, TQM requires immediate detection of defect and identification of its source in order to learn from it. In make-to-inventory environment there is no immediate detection, and defects can be repeated many time before it is even noticed. With no cushion of inventory, defects and its source can be immediately identified (Cachon and Terwiesch, 2006). Based on these observations, one can expect the award winners to have lower levels of inventory compared to other manufacturers.

However, other competing issues have to be considered as well. First, American manufacturing industry as whole has gone lean, meaning they have less inventory compared to what they had in the past (Gaur, Fisher and Raman, 2005).

Secondly, as stated above quality is now considered just a qualifier. On the other hand, delivery reliability, delivery speed, flexibility are the order winners. Manufacturers focusing on these objectives may require inventory. Volume flexibility requires finished goods inventory. Product flexibility, on the other hand, requires intermediate products as inventory. Some level of inventory is also required when delivery cycle and production cycle do not match each other (Hill, 2000, page 62, 68; Holweg and Pil, 2004, page 61, 80).

Furthermore, inventory level is also influenced by the hierarchy in supply chain. The assemblers on the top are mostly lean, and demand just-in-time supply from their suppliers. On the other hand, their suppliers have to keep inventory to be able to supply to their customers' demand in a short notice. In addition, producers of steel roles and the rubber resins do not produce in small batches. Consequently, suppliers who have to manufacture parts from raw materials such as steel or rubber generally have higher quantity of raw material in stock (Holweg and Pil, 2004, page 61, 80).

Quality and Growth

TQM requires the excellence in manufacturing process to be geared towards satisfying customers' need. Here customer is the king. Success of Japanese manufacturers starting 1980's have shown that the practice of linking customers' need with excellence in manufacturing process results in growth in sales (Grant, 1991; Day, 1994; Hill 2000 page 37, 67). Based on this argument, one can expect the award winners to have levels of sales growth compared to other manufacturers.

The counter argument for this is quality is now just a qualifier. Here, quality level by itself cannot result in increased sales. In addition, manufacturing is intensely competitive. Many sectors of manufacturers have production capacity above demand (Hill 2000, page 36 and 55). Overall, increasing sales is very difficult.

Quality and Profitability

Profit margin can be increased by lowering cost and/ or increasing price. Overall profitability can be increased by increasing sales and/ or lowering cost and/ or increasing price. The arguments for cost and sales made above are valid here as well. With higher quality manufacturers can be expected to command premium prices (Hendricks and Singhal, 1997). However, the notion of quality as qualifier suggests that premium price cannot be expected just for high quality.

Besides, manufacturers are mostly under pressure to decrease prices. In auto-industry buyers ask their part suppliers to decrease price by 5 to 10% every year (Liker and Choi, 2004). Similarly, big and powerful buyer Wal-Mart demands products at very low price (Fishman, 2006, pages 79-109). The big sellers have themselves seen their margins erode. For example Ford's average rate of return for 30 years (even before the current debacle) was meager 2.4%. Nowadays, Cars are sold with heavy price discounts and cash backs (Holweg and Pil, 2004, page 96). Similarly, Wal-Mart's margin is below 3% as well (Fishman, 2006, page 30). So when overall margins are compressed, it is not very likely that higher quality manufacturers (the award winners) have higher profitability compared to their competitors.

ESEARCH METHOD

In this empirical research, we compare the performances of manufacturers (i.e. organizations with SIC code from 2000 to 3999) who won quality related awards with similar manufacturers who did not win quality related awards. As noted above this study adopts research method followed by Hendricks and Singhal (1997).

For the purpose of this study, the list of relevant awards was taken from Hendricks and Singhal (1996). The names of manufacturers winning award were collected from the

websites of award givers, and also using keyword search in LexisNexis. News items confirming the winning of award was searched in the LexisNexis, before including any organization in the list of award winners. Each winner (even those which have won award multiple times) was included only once in our list. In total, there are about fifty manufacturers in the list. Table 1 gives the distribution of years of winning quality awards. Finally, for each award winners in the list, one manufacturer belonging to same industry (i.e. first two digits of SIC code are same) was picked as benchmark. CompuServe (Research Insight) database was used to down load the accounting indices used here for the comparison.

TABLE 1 (See Appendix)

For our purpose, the year that organizations won award was considered year zero. It can be assumed that year "-1" is the year when most award winners finish the implementation of the organizational improvements they deem necessary to win the award. Fast improvements during the implementation take place in the years before year "-1" or zero. Similarly, the advantages that are sustained after the implementation can be seen from the performances after the year zero. Data in our study are collected for years -7 to year +5 for all firms.

In this study, we calculated the difference in "unexpected performance" between the award winners and the control group. The "unexpected performance" is measured as the difference between the performance at the beginning and the end of the comparison period. Annual as well as long term differences in the unexpected performances between each of the award winners and its counterpart in the control group are measured here. If there is not significant difference then the average in the difference between these matched pair should be zero. The appropriate tests, to see whether the differences are significant or not, are matched pair t-test and its non-parametric counterpart such as Wilcoxon Singed ranked test for dependent data.

While t-test requires the data to be normally distributed the non-parametric test does not have any such requirements. Again, the t-test measures the difference in mean while the non parametric version measures the difference in median. Since the data we collected for our performance measures were not normally distributed, the non-parametric test is considered suitable for our purpose.

MPIRICAL RESULTS

Non-parametric tests were performed to measure the differences in performances, between the award winners and the companies in the control group. The relevant performance measures compared are: total cost, inventory level, growth, and profitability.

Total Cost

The total cost is measured as cost of goods sold plus the administrative cost. In this case, the difference in unexpected improvement in total costs divided by sales, for the awar winners and the benchmark company, are measured. E dividing total cost by sales, we partially offset the effects acquisitions, spin-offs, or size differences between the awar winner and its benchmark company. The desire improvement would be a reduction in cost. Here, the nu hypothesis states that the difference in unexpecte improvements in cost is zero. Likewise, alternative hypothes is that the difference in unexpected improvements in cost negative. So, the positive impact of the total quali management in award winners can be seen if the nu hypothesis is rejected.

Two types of tests are done here. One is the annual test, whe the difference in unexpected improvements is measure annually. It can be argued that the positive impact of tot quality management may take a little longer to be manifeste So, a longer period view is taken in another test. The detail which is shown in Table 2. In most of these cases (except for th year – 5 to -4) the difference in the unexpected improvemen in cost was not significant.

Thus we can see that operating costs of award winners were n significantly lower compared to other manufacturers.

TABLE 2 (See Appendix)

Inventory Level

Unexpected improvements in inventory levels are compare Table 3 shows results of two comparisons difference changes in inventory level and (inventory / sales) betwee award winners and the control group. With successf implementation of total quality management manufacture are expected to reduce the inventory level and inventory/ sal level. The details of the tests are shown in table 3. It shows th the differences in the difference in inventory are significant f years 'negative 4 to negative 3' and '4 to 5'. Similarly, th differences in inventory/sales are significant for yea 'negative 2 to negative 1' and '4 to 5'. Moreover, the differenc are also found to be significant when longer period a considered. They are significant for the year 'negative six negative 1' and 'negative 4 to negative 1'.

TABLE 3 (See Appendix)

Table 4 also reports the results for improvement in inventor turnover. It is expected that inventory turnover will be high when successful total quality management is implemente Here, the null hypothesis states that the difference unexpected improvements in inventory turnover is zero. An the alternative hypothesis in this case states that the differenc in unexpected improvements in inventory turnover is positiv So, rejection of null hypothesis would mean that awar winners are leaner (with better inventory management). Tabl 4 shows that the inventory turnover is significantly higher f award winners for year 'negative 3 to negative 2', 'year 3 to and '4 to 5'. Again, the differences are also found significant f the periods 'negative six to negative 1', 'negative 4 to negativ 1' and 'negative 3 to negative 1'.

TABLE 4 (See Appendix)

Summing up, we find some evidence that award winners have done better in inventory management compared to other manufacturers. Improvements are also evident when longer terms are considered. Further, most of the improvements seem to take place in years before year zero.

Growth

Growth is measured in terms of improvements in sales with respect to number of employees and total assets employed. The differences in unexpected improvements in sales, sales/ employees and sales/total assets, are compared between the award winners and the benchmark company are measured here. Moreover, sales/ employees and sales/total assets can also partially mitigate the impact of acquisitions, spin-offs and the size differences between the award winner and its benchmark. The desired performance for award winners would be to have positive difference in unexpected improvements. Here, the null hypothesis states that the difference in unexpected improvements in sales (or sales/ employee or sales/ total assets) is zero. And, alternative hypothesis is that the difference in unexpected improvements in sales (or sales/ employee or sales/ total assets) is positive. So, null hypothesis will be rejected if award winners grow faster than their competitors. Table 5 shows the details of the comparisons.

TABLE 5 (See Appendix)

The Table shows that the change in sales is significantly higher for award winners for years 'negative 6 to negative 5', 'negative 5 to negative 4' and '3 to 4'. The difference is also significant when longer period (negative 6 to negative 1) is compared. Similarly, changes in sales/ employee is significantly higher for award winners for years 'negative7 to negative 6', 'negative 2 to negative 1' and '3 to 4'. The difference is also significant for the year 'negative 3 to negative 1'. However, the difference change in sales/ total asset is not significantly higher.

So, when growth is measured in terms of improvement in sales or sales/employee there is some evidence that award winners grow faster compared other manufacturers. Moreover, arguments can also be made that advantage in growth for award winners take place mostly before the year "-1". It is evident when longer periods are used to compare growth.

Profitability

Profitability is measured by operating income. In this case, the differences in unexpected improvements in operating income, operating income/ employees, operating income/sales and operating income/total assets, are compared between the award winners and the benchmark company. Here, sales/ employees and sales/total assets partially mitigate the impacts of acquisitions, spin-offs and the size differences between the award winner and the benchmark company. The award winners are expected to have higher level of unexpected improvements compared to benchmarks. The alternative hypothesis here states that the difference in unexpected improvements is positive. So, null hypothesis will be rejected if award winners operating income compared to their competitors. Table 6 shows the details of the comparisons.

TABLE 6 (See Appendix)

The Table shows that the change in operating Income is significantly higher for award winners for years 'negative 6 to negative 5' and '3 to 4'. The difference is also significant when longer period (negative 6 to positive 3) is compared. Similarly, changes in OI/ sales are significantly higher for award winners for years 'negative 6 to negative 5' and 'negative 5 to negative 4'. The difference is also significant for the year 'negative 6 to negative 1'. Again, the difference change in OI/ total asset is significant for year 'negative 2 to negative 1' and also for longer period 'negative 3 to negative 1'. However, there were no significant differences in changes in OI/employee.

The comparisons show that there is some evidence that profitability of award winners are higher compared to other manufacturers, when profitability are measured in terms of operating income, operating income / sales and operating income/ total assets. Again, when longer term periods are considered there is some evidence that most of the improvements during the implementation of quality programs (pre year zero period).

ISCUSSIONS AND CONCLUSION

In this study, we compared the differences in unexpected performances between the award winners and the benchmark companies in the manufacturing industry (in the United States). Here, award winners are taken as proxies for manufacturers with superb total quality management practices. While desirability of total quality management is beyond doubt, the extents of benefit that TQM can bestow to organizations are always argued upon.

Recently, it is also argued that some of the advantages of high quality manufacturing may have eroded. Competition have forced manufacturer to reduce cost and inventory level (Hill, 2000; Gaur et al., 2005). It must also have eroded manufacturers' ability to charge high price for higher quality and / or gain market share. Furthermore, (Colyer 2006) manufacturers are forced to comply with ISO 9000, making the observance of some of the quality practices universal. So, it is said quality has become "qualifier" (a requirement to be in market) not "order winner" (earning higher profit and market share) (Hill, 2000).

Our results show that award winners do not have lower operating cost compared to the control group. However, in terms of other results such as inventory, growth and profitability the results are mixed. There were some compelling evidences (especially when long term results were compared), that award winner can improve their positions vis-à-vis the control group. The improvements were evident mostly in the pre-year zero (before the award was granted) period. So, it can be deducted that implementation of TQM lead to some improvements in these areas. On the other hand, on the basis of award winners' inability to have cost

advantages, and also to sustain advantages in other areas such as inventory growth and profitability beyond the year "-1" (i.e. when TQM implementation is done) can be indicator of a very stiff competition in manufacturing. These results can also validate the argument that quality is more of a "qualifier" in the competitive marketplace.

Before coming to firm conclusion, some of the limitations of this paper have also to be discussed. First, taking award winners as surrogates for manufacturers with excellent TQM practices can be acceptable. However, it is also possible that manufactures with excellence in TQM practice have not bothered to apply for award, and some of them are the part of our control group. It is difficult to verify when only secondary data is considered.

Secondly, as discussed above while adoption of TQM influences inventory management, it also depends on manufacturers' position in supply chain, their need to maintain flexibility and also on the types of raw material they use (Hill, 2000; Howleg and Pil, 2004. So, even though our results show that award winners have lowered the level of inventory (at least during the implementation period) compared to those in control group, it is not very clear how much of those improvements can be attributed to implementation of TQM alone. Future research should consider all these issues along with quality management to come to a firm conclusion regarding the level of inventory.

However, the results here should not be taken as evidence of futility of investing in TQM. First quality is important even it is only a "qualifier". More importantly, the competitive advantage for companies known for excellence in quality (such as Toyota) comes not from one time implementation of TQM but from continuous improvement and abilities to move to the next level of excellence (Fine, 1986). The advantages in profitability, growth and inventory management that award winners seem to get for few years should be utilized to gain further improvements in order to sustain competitive advantage.

Furthermore, the advantages of total quality management is often described in terms of intangible such as, knowledge creation, teamwork, flexible work force, and increased in workers morale etc. Now, there is increasing consensus that key to organizations' ability to sustain and grow in increasingly uncertain and competitive environment lie on these intangibles (Mukherjee et al., 1990, Day, 1994). And, accounting indices used for comparisons here, cannot take these intangibles into account. Future research will have to develop proper metrics to measure these intangibles, and also use them for the comparisons similar to one done here.

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Appendix

Table 1	
year	of award winners
2006	1
2005	1
2004	19
2003	2
2002	7
2001	2
1999	3
1998	4
1997	3
1996	4
1995	4
1994	1

Table 2			
Test of median = 0.000000 versus median < 0.000000			
Change in Cost/Sales			
Annual Change			
Years	N	M1-M2	P
-7 to -6	29	-0.00654	0.265
-6 to -5	35	-0.00780	0.320
-5 to -4	**37**	**-0.03193**	**0.009***
-4 to -3	39	0.01553	0.889
-3 to -2	43	-0.00362	0.379
-2 to -1	44	-0.00648	0.361
-1 to 0	43	-0.1048	0.1 96
0 to 1	43	0.007702	0.713
1 to 2	35	0.00429	0.650
2 to 3	23	-0.00856	0.257
3 to 4	15	-0.00553	0.444
Longer Period Change			
-6 to -1	39	-0.00049	0.486
-4 to -1	40	0.01209	0.707
-3 to -1	44	0.003188	0.604
-1 to 1	44	0.01358	0.804
-6 to 2	28	-0.00003	0.505
- 6 to 3	16	-0.00883	0.368

* Difference is statistically significant

Table 3						
Test of median = 0.000000 versus median < 0.000000						
	Change in Inventory			Change in Inventory/Sales		
Annual Change						
Years	N	M1-M2	P	N	M1-M2	P
-7 to -6	32	0.08830	0.841	32	0.090205	0.926
-6 to -5	37	0.06727	0.821	38	-0.05892	0.132
-5 to -4	42	0.04602	0.746	41	-0.04551	0.215
-4 to -3	**43**	**-0.1107**	**0.030***	42	-0.01132	0.416
-3 to -2	47	0.003967	0.527	44	0.01458	0.581
-2 to -1	**45**	**0.0226**	**0.645**	**45**	**-0.05906**	**0.093***
-1 to 0	44	0.1436	0.974	44	0.09448	0.991
0 to 1	43	-0.01871	0.361	43	0.005185	0.555
1 to 2	36	0.02973	0.711	37	0.04848	0.829
2 to 3	22	-0.06477	0.182	22	-0.1035	0.115
3 to 4	18	0.04485	0.620	17	0.06583	0.715
4 to 5	**14**	**-0.1714**	**0.019***	**11**	**-0.2582**	**0.009***
Longer Period Change						
-6 to -1	37	0.1769	0.817	**40**	**-0.1725**	**0.064***
-4 to -1	**40**	**-0.01565**	**0.455**	**43**	**-0.1296**	**0.059***
-3 to -1	43	0.1075	0.890	46	-0.04627	0.232
-1 to 1	41	0.1967	0.988	44	0.1304	0.943
-6 to 2	28	0.4517	0.905	31	-0.04147	0.323
-6 to 3	17	0.2765	0.682	18	-0.01042	0.483

*Difference is statistically significant

Table 4			
Test of median = 0.000000 versus median > 0.000000			
Change in Inventory Turnover			
Annual Change			
Years	N	M1- M2	P
-7 to -6	31	-0.02498	0.725
-6 to -5	34	0.007842	0.466
-5 to -4	40	0.03100	0.279
-4 to -3	42	-0.02041	0.632
-3 to -2	**43**	**0.06082**	**0.087***
-2 to -1	45	-0.00806	0.589
-1 to 0	45	-0.05642	0.946
0 to 1	44	-0.06412	0.963
1 to 2	37	-0.00656	0.578
2 to 3	23	0.005184	0.458
3 to 4	**19**	**0.06622**	**0.040***
4 to 5	**13**	**0.1652**	**0.054***
Longer Period Change			
- 6 to - 1	**32**	**0.1548**	**0.051***
- 4 to - 1	**39**	**0.1127**	**0.096***
- 3 to - 1	**41**	**0.1227**	**0.023***
- 1 to 1	42	-0.1256	0.996
- 6 to 2	23	0.001187	0.506
- 6 to 3	13	-0.1029	0.758

* Difference is statistically significant

Table 5

Test of median = 0.000000 versus median > 0.000000

	Change in Sales			Change in Sales/Employee			Change in Sales/Total Assets		
Annual Change									
Years	N	M1-M2	P	N	M1-M2	P	N	M1-M2	P
-7 to -6	31	0.01965	0.316	**27**	**0.05131**	**0.027***	31	-0.01955	0.725
-6 to -5	**38**	**0.09470**	**0.008***	32	-0.009146	0.628	36	0.04742	0.175
-5 to -4	**43**	**0.09218**	**0.036***	37	0.03738	0.135	43	0.04026	0.148
-4 to -3	47	-0.06132	0.883	41	-0.09293	0.986	47	-0.08840	0.956
-3 to -2	51	-0.02542	0.675	45	-0.01905	0.63 3	51	0.01576	0.352
-2 to -1	49	0.04892	0.183	**46**	**0.05871**	**0.079***	48	-0.05875	0.884
-1 to 0	48	0.006446	0.469	46	-0.03831	0.781	48	-0.05172	0.932
0 to 1	45	-0.01824	0.654	43	0.02807	0.204	46	-0.009185	0.574
1 to 2	37	-0.03447	0.840	33	-0.7471	0.987	37	0.0 1006	0.393
2 to 3	23	-0.02981	0.648	22	0.03335	0.269	24	-0.007177	0.574
3 to 4	**19**	**0.1459**	**0.028***	**16**	**0.06312**	**0.094***	19	-0.002915	0.540
4 to 5	15	-0.04525	0.761	12	-0.03013	0.722	13	-0.04406	0.712
Longer Period Change									
-6 to -1	**37**	**0.3702**	**0.019***	31	0.054 91	0.225	39	-0.09084	0.866
-4 to -1	45	0.02506	0.402	38	-0.03670	0.761	44	-0.1809	0.999
-3 to -1	49	0.09339	0.155	**41**	**0.06911**	**0.060***	48	-0.005594	0.539
-1 to 1	45	0.02020	0.424	41	0.005668	0.454	45	-0.05937	0.893
-6 to 2	29	0.2406	0.280	22	-0.1279	0.810	28	-0.04206	0.671
-6 to 3	17	0.4291	0.172	16	-0.05880	0.651	17	-0.1526	0.941

* Difference is statistically significant

Table 6

Test of median = 0.000000 versus median > 0.000000

	Change in Operating Income (OI)			Change in OI/Employee			Change in OI/Sales			Change in OI/Total Asset		
Annual Change												
Years	N	M1-M2	P	N	M1-M2	P	N	M1-M2	P	N	M1-M2	P
-7 to -6	32	0.05489	0.304	24	0.1020	0.192	**31**	**0.1149**	**0.062***	27	0.05255	0.270
-6 to -5	**36**	**0.1505**	**0.067***	30	-0.1502	0.895	36	0.05777	0.144	32	-0.03062	0.683
-5 to -4	35	0.05879	0.209	32	0.08576	0.187	**40**	**0.1762**	**0.001***	33	0.01861	0.422
-4 to -3	40	0.005597	0.465	34	-0.01744	0.534	41	0.002493	0.495	37	-0.05090	0.653
-3 to -2	39	0.06325	0.219	31	0.07203	0.231	41	0.04967	0.230	37	0.06645	0.244
-2 to -1	41	0.05608	0.298	31	0.08581	0.186	36	0.1153	0.416	33	0.01216	0.457
-1 to 0	40	0.02830	0.397	30	0.1407	0.125	37	0.04530	0.234	**32**	**0.1666**	**0.024***
0 to 1	38	-0.05856	0.783	31	-0.1638	0.862	37	-0.006417	0.536	34	-0.08516	0.848
1 to 2	38	0.009379	0.437	25	-0.02119	0.616	31	-0.04579	0.803	30	-0.1414	0.931
2 to 3	21	-0.01410	0.674	18	-0.06419	0.808	21	-0.01213	0.569	20	0.04856	0.307
3 to 4	**20**	**0.2861**	**0.008***	13	0.07993	0.147	16	0.02475	0.388	15	0.01172	0.466
4 to 5	11	0.1157	0.312	9	0.08672	0.239	12	0.06431	0.205	12	-0.09084	0.855
Longer Period Change												
-6 to -1	34	0.2897	0.126	28	0.01723	0.432	**33**	**0.1680**	**0.060***	34	0.1671	0.141
-4 to -1	39	-0.01758	0.546	30	0.1114	0.242	35	0.04310	0.292	38	0.06443	0.291
-3 to -1	39	0.07328	0.272	28	0.1181	0.209	36	0.04135	0.273	**35**	**0.02553**	**0.032***
-1 to 1	41	-0.04373	0.622	27	0.1669	0.104	34	0.01222	0.425	36	-0.1690	0.948
-6 to 2	32	0.3247	0.192	20	0.001169	0.507	25	0.08767	0.180	26	-0.1367	0.863
-6 to 3	**18**	**0.7540**	**0.028***	15	-0.06027	0.534	15	0.002879	0.489	18	-0.1699	0.912

* Difference is statistically significant