The Impact of Information Technology on Manufacturing Strategies and Financial Performance

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Abstract: In this study, the impact of IT on financial performance for the different types and levels of business strategy is examined. According to their strategic advantages, after the clustering of firms the effect of IT on financial performance is estimated. To do this a cross-sectional study was held in the field of share market firms, in order to explore which, how and in what level manufacturing advantages have been adopted. For that purpose, cluster analysis and VACOR algorithm were used, to distinguish clusters of firms and estimate the effect of IT on financial performance, for each type and level of strategic choice. Return on Invested Capital (ROIC) has been used as a measure of performance in order to absorb the effect of cost, revenues and profits. It was found that the effect of IT on performance was observed to be greater for firms which emphasize a lower level of quality and innovation strategy. On the contrary, the effect of IT on financial performance was observed to be greater for firms which emphasize the higher level of flexibility strategy and the middle level of cost strategy.

Keywords: Cost benefit analysis, flexible manufacturing, information systems, Iran

INTRODUCTION

The oversupply of qualitative in demand resulted in a turnaround, from mass production to mass customization and niche market production (Theodorou, 1996; Coriat, 1990). Until 1980 many firms targeted at high profitability and efficiency, through competition on price, which was the most important strategic goal (Hill, 1993; Hirschorn, 1984). The distinguish of the mass production model ruled before 1970 was, fixed automation and dedicated machinery, mass consumption, homogeneous products and emphasis on quantity (Piore and Sabel, 1984), price competition and internal scale economies etc., (Coriat, 1990). This mass production model had a positive effect on cost and on the product’s price. Because of this trade off, manufacturing advantages were replaced by cost (Hayes, 1979). In sum today’s, the necessity of cost as well as innovative and quality oriented has adjusted this tradeoff. Because of its hard and inflexible character this model became obsolete (Theodorou, 1996; Kenney and Florida, 1993). The characteristics of inflexibility such as use of hard automation production for mass markets, uniformity in design, vertical integration (Kenney and Florida, 1993). But the diversification in demand increased the need for the range of production. Thus, products have to be produced in more variety and in fewer quantities. Theodorou (1996) suggested that changes in the design of products increased the need for flexibility. Gold (1981) and Talaysum et al. (1986) stated that Scale economies were replaced by scope economies, thus the cost of producing different quantities is higher than the cost of joint production:

\[ C(q_1, q_2) < C(q_1, 0) + C(0, q_2) \]

Design variability and scope economies can be accomplished by the implementation of Computer Aided Design systems (CAD) through the expanding of the range of production. In this model, higher priority was given to strategies like quality, flexibility, customer service, just in time supply management, etc., Consequently, a need has emerged to revise manufacturing strategy and manufacturing targets so that they would be prioritized in a different way (Skinner, 1974; Hayes, 1984). In this context investigation for manufacturing strategy is increased (Skinner, 1985; Swamidass and Newell, 1987; Adam and Swamidass, 1989). Accordingly, the manufacturing dimensions of cost and price are no longer cares of the manufacturing strategy about quality and innovation more than ever before. The advantage of these strategic goals according to Skinner (1996), Buffa (1986) and Wheelwright (1984) is: Cost, Quality, Flexibility, Dependability and Innovation. Some studies have been focused on quality only (Adam, 1994; Flynn et al., 1994) while others on productivity (Noble, 1997; Hayes and Clark, 1985). This advantage and its link with IT is not a rule that every firm must follow. Skinner (1996)
stated that one of the major problems for managers implementing manufacturing strategy ideas was inability of managers to step back and assess the coherence of their strategies. According to Skinner (1974) these advantages integrate manufacturing and business strategy. Skinner (1974) argued that to extend business and company goals for manufacturing, sympathetic cost, quality and flexibility goals must be developed. These manufacturing goals are realized and ongoing by a “pattern of decisions” (Hayes, 1984) and have to be arranged with business as well as each of the strategic advantages can be connected to IT which empower the achievement of those goals. Here we can refer to the cost strategy which supported with systems like design for manufacturability and computer aided design, Computer Aided Manufacturing (CAM), etc., Quality strategy can be supported by the technologies of quality planning, CAD and CAM, etc. Flexibility can be supported by capacity and materials requirement planning, optimized production technology, CAD/CAM, etc. Generally, integrated CAD/CAM systems can support all advantages depending upon the level of the utilization and the type of the application. Successful paradigms of IT strategic impact are reported (Ives, 1990; Feeny, 1990). Moreover, frameworks are developed in the sense of helping managers identify IT applications that create competitive advantage (Porter and Millar, 1985; Wiseman, 1985; Jayawardhena and Foley, 2000). While, regarding the concept of strategic alignment Luftman (1996) refers to the case of Bristol-Myers Squibb Co., a leader company in the pharmaceutical industry. The strategic alignment concept and its effect of IT on the business strategy are examined (Henderson and Venkatraman, 1993). On the other hand empirical research in IT and business strategy formulation was made by Galliers (1990). The final purpose was to decrease the lead time for the acceptance process on a credit card charge. That lead time was essential for the creation of competitive advantage as customers switch to competitors for transaction. A model describing how to choose specific IT applications in order to support strategic targets in a case study of a share market supply chain. Strategic goals as well as practices differentiate across countries (Horte et al., 1987, 1991; Gelders et al., 1994), Belgium; and India by (Nagabhushana and Shah, 1999) some of the studies have made interesting comparisons of manufacturing practices (Reitspergen and Daniel, 1990; Vastag and Whybark, 1994). Unfortunately, as far as Iranian share market was concerned, nothing has been reported yet. In this study, try has been made to fill in the gap and investigate the manufacturing priorities of Iran share market firms and within each priority the effect of IT on performance. A clustering of firms is made and for each cluster the relation of IT with financial performance is estimated.

**THE RESEARCH METHODOLOGY**

This study is focused on business strategy and the impact of IT (CAD/CAM) on financial performance for each type and level of strategy. The measurement was based on Likert (1932) scales and the focus was mainly on the four strategic advantages of cost, quality, flexibility and innovation. Most of the firms accepted dependability as an important strategy and commonly adopted the relative tactics. It is suggested that databases and networks systems are also included within the IT of CAD/CAM, for their proper use. The result of Strategic clusters from the VACOR algorithm and within each cluster, the effect of IT on performance was estimated using linear regression (Fig. 1).

For determining the strategic advantages (cost, quality, flexibility and innovation), the CEO of each firm was questioned for a specific tactics (Table 1 and 2). However, the main interest of the firm is on the price of the supplies and competes on price (decreasing operational and labor cost), according to theory, this should be done better on the cost strategy. Moreover, according to the general practice, the innovation strategy is adopted by those firms who usually develop new, innovatively designed products and use innovative promotion methods. Finally in a similar way, the firm that adopts the tactics of just in time is more flexible than the one which does not follow those techniques. Those tactics were determined from literature, with the providers of the IT systems, which have a very good feeling of the practices and the tactics adopted in the
Table 1: Strategy advantages

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Tactics/questions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost</td>
<td>Antagonize on price (M1), cheap supplies (M2), labor cost (M4), operational expenses (M13)</td>
</tr>
<tr>
<td>Quality</td>
<td>Stable quality in production (M5), quality control on the production line (M6)</td>
</tr>
<tr>
<td>Flexibility</td>
<td>Inventory level (M3), production lead time (M7), design flexibility/concurrency (M8), production flexibility (M9), quality flexibility (M12)</td>
</tr>
<tr>
<td>Innovation</td>
<td>Design innovation (M10), production innovation (M11), promotion innovative methods (M14)</td>
</tr>
</tbody>
</table>

Table 2: Percentages of answers to strategic advantages

<table>
<thead>
<tr>
<th>Level/question</th>
<th>M1 (%)</th>
<th>M2 (%)</th>
<th>M3 (%)</th>
<th>M4 (%)</th>
<th>M5 (%)</th>
<th>M6 (%)</th>
<th>M7 (%)</th>
<th>M8 (%)</th>
<th>M9 (%)</th>
<th>M12 (%)</th>
<th>M13 (%)</th>
<th>M14 (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>20.4</td>
<td>7.70</td>
<td>33.2</td>
<td>1.80</td>
<td>31.1</td>
<td>0.00</td>
<td>0.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>12.0</td>
<td>20.4</td>
<td>18.3</td>
<td>1.30</td>
<td>18.3</td>
<td>1.10</td>
<td>3.40</td>
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<td></td>
</tr>
<tr>
<td>3</td>
<td>37.5</td>
<td>20.4</td>
<td>5.50</td>
<td>22.7</td>
<td>9.80</td>
<td>5.50</td>
<td>1.10</td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>4</td>
<td>5.50</td>
<td>20.4</td>
<td>3.40</td>
<td>27.8</td>
<td>7.80</td>
<td>14.1</td>
<td>39.6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>1.30</td>
<td>5.60</td>
<td>14.1</td>
<td>26.8</td>
<td>7.80</td>
<td>63.1</td>
<td>35.4</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

market. Based on the evidence, according to its strategies, each firm is programming its tactics, based on the previously mentioned tactics; the clustering algorithm of Ascending Hierarchy Classification (AHC) was applied to distinguish firms according to the type and level of their strategy. Benzecri et al. (1985) and Likert (1932) suggested that the AHC algorithm, works with qualitative data and Likert scales as it is explained in the following section. In the second stage, the IT impact on performance was estimated within each strategic cluster by estimating a linear regression model. The target was to find out the clusters and also the level of each strategy, the effect of IT on performance is higher. Theoretically, the higher the fit of strategy with IT is the higher impact of IT on performance, (Fig. 1). Financial performance was measured using the measure of Return on Invested Capital (ROIC).

In this research sample was collected from 102 firms that which had similar organized departments of design and production. Those firms were selected because they adopt IT (CAD/CAM) for more than 5 years. This similarity refers to the type of formalization, coordination and cooperation, age and size, as well as firms have similar levels of hierarchy and span of control, type of communication and more important cellular oriented production. All these firms are using CAD for pattern analysis and CAM to cut process and those systems in most of the firms, are integrated with a Materials Requirement Planning system (MRPI). Data has been collected by using a questionnaire and completed by the CEO. Moreover, the supplier of CAD/CAM equipment helped to collect and test the questionnaire. The questionnaire had two parts; the first part asked the importance of the strategic choices. The second part asked about the tactics that each firm actually employed. According to their strategic advantages, those tactics were the main input to the clustering algorithm in order to distinguish the firms (Table 1 and 2).

The advantage of each firm was measured on a Likert scale and the rating (of each firm) was based on the importance of the tactic for the next 5 years in relation to competition. Therefore Likert scales were first introduced as a scale for attitude measurement. The left segment of the scale (low class of variable) shows the rare use of an action-tactic in contrast to the right part (high class of variable) (Table 1 and 2). The answers given by the firms are shown as percentages in Table 2. The left first vertical column indicates the Likert scale from 1 to 5 (Table 2). The second horizontal row indicates the strategic tactic that the CEO was questioned. The advantages were selected with the providers of the system and a pilot study of some firms in order to catch strategic context of the Iran share market. The original data matrix (102) is transformed to a matrix (102) by creating 3 new double variables (Xj) for each original variable (Mi), for low, medium and high values, by the following process: First new variable takes value 1 for value 1 or 2 of first original variable. Second new variable takes value 1 for value 3 of first original variable. Third new variable takes value 1 for value 4 or 5 of first original variable. Names of these new variables are X1, X2, X3, X4 . . . . . . X102. In the first part of the research we apply the AHC algorithm developed by Karakos (1991); which is
originally developed by Benzecri (1973). The objective of AHC is the division of the homogeneous groups of the firms, in terms of the total strategic targets; each of them is significantly different from the rest. Thus, a hierarchy of firms’ divisions is indicated by the tree-diagram where each junction symbolizes the subdivisions of the population of firms of our sample. The original data matrix (102) is transformed by creating 3 new variables ($X_j$) for each original variable ($M_i$), as described above. Next we construct the matrix of distances (AHC) where the conjunction of clusters are made using distance matrix $n \times n$, (Jambu, 1978; Kaufman and Rousseuw, 1990). Groups are searched and defined through the object of research, taking into account the significant of all variables are that better distinguished each strategic group (tree diagrams).

Therefore this is very important for qualitative variables that need to be clustered. The dendrograms transformed into a tree-diagram that projects the clusters of the firms as well as the variables that characterize the distinction of clusters. The number of classes in the dendrogram is ‘2n-1’, but only three or four clusters are enough for the explanation of results. Among the results and the VACOR tables we seek those variables that mainly contribute to the division and characterization of the clusters. The VACOR tables show the forecast of the structural variables and tactics in every class and uses the correlation (COR $[X]$) to show how classes C ($X$) and junctions JCT ($X$) are distinguished. The higher the correlation value, (COR $[X]$) the importance of that variable for the characterization of the cluster: the presence (+) of a variable in a class is indicate from a high value in column JCT($X$), besides, a small value indicate absence (-) of that variable. Thus, its interchange is distinguished by strong presence or strong absence of some of the variables. Furthermore, it can be seen how the division of a class in two interchanges is interpreted. This is determined by the correlation of the differences of the interchanges (COR $[C(X-Y)]$). The higher value of COR $[C(X-Y)]$, the importance of that variable for that division. In order to determine the advantage of a variable the value of that variable on column: $C(X-Y)$ must be taken into description. A negative value on that column implies advantage of that variable for the right forecast $(Y)$; a positive value implies advantage for the left junction $(X)$. Each strategic advantage is determined from a number of variables (tactics) (Table 1) and a clustering of the firms for each strategic advantage of cost, quality, flexibility and innovation will be shown.

Separation in strategic clusters:

VACOR results: In this research, strategic clusters of firms according to their tactics and applying the clustering algorithm will be indicated. Finally, each strategy will be presented on a scale from ‘1’ to ‘3’, where level ‘1’, indicates the low adoption of that strategy, ‘2’ medium and level ‘3’ the high great on that strategy. Firms will be distinguished in groups according to the greats of their strategy. According to cost strategy, the clustering of the firms has been based on the following four variables (Table 1): competence on price, low price provider, labor cost responsiveness and operational cost responsiveness. The tree-diagram in Fig. 2 has been obtained from the VACOR tables. It is observed that the division of forecast 83 into classes 82 and 80 (Fig. 2) is interpreted by the respective advantage as well as the presence in class 82 of high responsive to firms in labor cost ($X_{39}$), high responsibility in operational cost ($X_{12}$), a middle level of perception to compete on price ($X_2$) and supply from the cheaper source ($X_5$).

Firms in class 90 on the contrary are distinguished from the advantage as well as the existence of a low perception to compete on price ($X_1$), a low perception to cheaper source supplies ($X_4$) and a medium level of labor cost responsibility ($X_{11}$). It is clear that labor cost and operational expenses are the two major problems for the firms in cluster 82. Moreover, it seems that firms in cluster 80 exceeded cost problems and expert the cost priority, as their intention is not to compete on cost and on products price. Furthermore, class 82 is separated in junction 81 and 78. Firms in cluster 81 are distinguished from product’s price competition and from usual problems with their operational expenses. On the other hand, firms in cluster 88 are distinguished from product’s price competition and from usual problems with their operational expenses. From all the above a scale can be created that will measure the great of cost strategy for each firm (Fig. 3).

On the left-hand of the scale is the cluster of firms that usually encounter problems regarding their
Fig. 3: Achievement on cost advantage

<table>
<thead>
<tr>
<th>Low</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>78</td>
<td>81</td>
</tr>
<tr>
<td>80</td>
<td>83</td>
</tr>
</tbody>
</table>

Fig. 4: Clustering results of quality strategy

Two clusters 78 and 82 are observed in Fig. 4. Cluster 78 is distinguished in relation to cluster 82 by low frequency of quality instability and by application of detection methods of defectives in production. From these elements we can get the conclusion that firms in cluster 78 are doing better in the quality advantage than firms in cluster 82 due to achievements of stable quality and methods of detection of defectives.

Fig. 5: Achievement on quality advantage

of defective detection methods in production (Table 1 and 2). Using the VACOR algorithm the results were produced and translated in the tree-diagram (Fig. 4).

Fig. 6: Clustering results of flexibility strategy

Five variables were selected for the flexibility advantage of the firms. Those are: the level of stock in the end products, the production time, design flexibility, frequency to produce for (small) niche markets and order acceptance for small quantities (Table 1 and 2). The tree-diagram in Fig. 6 was created from VACOR tables.
Fig. 7: Achievement on flexibility advantage

better on the quality strategy. Five variables were selected for the flexibility advantage of the firms. Those are: the level of stock in the end products, the production time, design flexibility, frequency to produce for (small) niche markets and order acceptance for small quantities (Table 1 and 2). The tree-diagram in Fig. 6 was created from VACOR tables.

Four clusters can be observed ‘80’, ‘75’, ‘77’ and ‘78’. Frequency of acceptance for small orders seems to be the main reason for the distinction of clusters ‘80’ and ‘75’. Firms in cluster ‘80’ are distinguished by frequent acceptance of small orders in relation to firms in cluster ‘75’. Cluster ‘77’ and ‘78’ are distinguished due to the frequency of production for small niches. Firms in cluster ‘77’ very often serve niche markets as opposed to firms in cluster ‘78’, which accept small orders rather infrequently. Therefore, the variables of end products stock, production time and design flexibility are not participating in the division of our sample into clusters. Small order acceptance and production for niche markets has shown to be the most important variables for the distinction of the clusters. Based on the tree-diagram and its interpretation the scale in Fig. 7 can be constructed for the case of flexibility.

Firms that belong in clusters ‘80’ and ‘75’ are more able to accept orders for small quantities in a higher frequency than those in clusters ‘77’ and ‘78’. It means that a more flexible structure enables those firms to bypass problems of quantity variability (Theodorou, 1996). Among those clusters (80, 75) firms who belong in cluster ‘80’ seem to be more flexible for the same reason. So cluster ‘80’ is rated with 4 and cluster ‘75’ with 3. Also firms in cluster ‘77’ are rated with 2 and those in ‘78’ with 1, since in cluster ‘77’ firms are able to produce more frequently for niche markets (Fig. 7). In the case of innovation strategy, three variables were used: frequency of innovation in design, frequency of innovative production techniques and the adoption of innovative promotion methods (Table 1 and 2). From the VACOR algorithm three clusters emerged: ‘80’, ‘81’ and ‘79’ (Fig. 8).

Firms in cluster ‘80’ are distinguished by the frequent adoption of innovative promotion and the frequent innovation in design. Compared to the other clusters, firms in cluster ‘80’ seem more innovative than the rest and are rated with 3. Also cluster ‘79’ seems more innovative compared to ‘81’ since those firm more frequently innovative techniques in production (Fig. 9).

The information technology effect on financial performance: The estimation about cost strategy is shown in the Table 3. The impact of IT on performance is higher in the middle levels of cost strategy. On the contrary, a lower effect is indicated in the level of strong adoption and strong absence of that strategy. The explanation is first, that IT cannot be used only as a cost-cutting tool in order to increase performance and second that the high levels of cost strategy discourage the adoption of the rest of the strategic
Fig. 9: Achievement on innovation advantage

advantages and prominently that of flexibility. IT is adopted in order to cut labor cost but the firms in our sample did not approach the adoption of IT in this way. To the contrary, CAD/CAM increased the need for specialized personnel, although labor saving can be made in the cutting process especially through CAM implementation. The measure of ROIC is a good estimate of performance for both profits and revenues and ROIC is calculated as a ratio among profits and total invested capital. Thus, in our estimation earnings and profits are 'weighted' in a simple index. Furthermore, ROIC is an important indicator for the long term growth of the firm and for competitive advantage, especially, when it is greater than the Weighted Average Cost of Capital (WACC). Therefore, ROIC is a static metric of performance and a more dynamic indicator could be used, but this index is more appropriate for a dynamic analysis and the other variables of our model should also be handled in a similar way. Market share or revenues growth could also be used, but these criteria would be biased, as they exclude the effect of cost which is important in our analysis. The equation that is estimated has one independent variable which is the value of information technology. An accepted estimate can be indicated from that equation, regarding the effect of IT on performance for each strategic cluster, without losing the impact of other important variables (structure, age, size, etc.). The effect of those variables would be significant if they had significant variation in the sample used. Instead, the firms of the sample have some important similarities like age, size and the number of employees. So, we can exclude all the similar variables and assume that the effect of this independent variable (IT) on performance is a good estimator. Additionally, in the regression equation both dependent and independent variables are quantitative and their causal-effect relation is better estimated for the different strategic clusters than if we had qualitative variables. The t-student measure and the significance level are indicated in the following relevant regression tables (Table 3-6). One important observation is that there is no strategic cluster, where IT has a negative effect on performance. Therefore, information technology has a positive impact on performance. That brings the question to strategic clusters and for level of strategy, which IT have a higher impact on performance. According to

![Image](image-url)

Table 3: IT and cost fit/impact on performance

<table>
<thead>
<tr>
<th>Cost strategy</th>
<th>C (constant)</th>
<th>IT</th>
<th>R²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class 78 = 1</td>
<td>1.213 (0.763)</td>
<td>2.57 (0.0280) [eit = 0.40]</td>
<td>0.653 (0.0220)</td>
</tr>
<tr>
<td>Class 81 = 2</td>
<td>-0.850 (0.567)</td>
<td>22.4 (0.0118) [eit = 1.15]</td>
<td>0.643 (0.0118)</td>
</tr>
<tr>
<td>Class 80 = 3</td>
<td>0.689 (0.730)</td>
<td>6.81 (0.0157) [eit = 0.73]</td>
<td>0.679 (0.0140)</td>
</tr>
<tr>
<td>Total</td>
<td>0.197 (0.765)</td>
<td>9.01 (0.0007) [eit = 0.83]</td>
<td>0.754 (0.0007)</td>
</tr>
</tbody>
</table>

Test homogeneity of errors variance: Levene Statistic = 1.465 (0.135) (significance level in parenthesis)

Table 4: IT and flexibility fit/impact on performance

<table>
<thead>
<tr>
<th>Flexibility strategy</th>
<th>C (constant)</th>
<th>IT</th>
<th>R²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class 78 = 1</td>
<td>1.345 (0.043)</td>
<td>0.6500 (0.0650) [eit = 0.08]</td>
<td>0.6070 (0.0760)</td>
</tr>
<tr>
<td>Class 77 = 2</td>
<td>1.028 (0.067)</td>
<td>12.530 (0.0170) [eit = 0.76]</td>
<td>0.6540 (0.0160)</td>
</tr>
<tr>
<td>Class 75 = 3</td>
<td>1.230 (0.062)</td>
<td>12.170 (0.0130) [eit = 0.66]</td>
<td>0.6550 (0.0120)</td>
</tr>
<tr>
<td>Class 80 = 4</td>
<td>-2.220 (0.113)</td>
<td>12.693 (0.0140)</td>
<td>0.7354 (0.0140)</td>
</tr>
<tr>
<td>Total</td>
<td>0.167 (0.739)</td>
<td>9.0100 (0.0005) [eit = 0.93]</td>
<td>0.8210 (0.0005)</td>
</tr>
</tbody>
</table>

Test homogeneity of errors variance: Levene Statistic = 3.387 (0.022) (significance level in parenthesis)

Table 5: IT and innovation fit/impact on performance

<table>
<thead>
<tr>
<th>Innovation strategy</th>
<th>C (constant)</th>
<th>IT</th>
<th>R²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class 81 = 1</td>
<td>-1.130 (0.041)</td>
<td>23.32 (0.0000) [eit = 1.20]</td>
<td>0.765 (0.0000)</td>
</tr>
<tr>
<td>Class 79 = 2</td>
<td>1.400 (0.302)</td>
<td>2.230 (0.0340) [eit = 0.41]</td>
<td>0.675 (0.0350)</td>
</tr>
<tr>
<td>Class 80 = 3</td>
<td>0.414 (0.807)</td>
<td>8.730 (0.0620) [eit = 0.83]</td>
<td>0.767 (0.0630)</td>
</tr>
<tr>
<td>Total</td>
<td>0.201 (0.765)</td>
<td>9.010 (0.0005) [eit = 0.88]</td>
<td>0.834 (0.0005)</td>
</tr>
</tbody>
</table>

Test homogeneity of errors variance: Levene Statistic = 2.2350 (0.061) (significance level in parenthesis)

Table 6: IT and quality fit/impact on performance

<table>
<thead>
<tr>
<th>Quality strategy</th>
<th>C (constant)</th>
<th>IT</th>
<th>R²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class 82 = 1</td>
<td>-0.900 (0.670)</td>
<td>13.76 (0.0740) [eit = 1.02]</td>
<td>0.565 (0.0740)</td>
</tr>
<tr>
<td>Class 78 = 2</td>
<td>1.230 (0.310)</td>
<td>3.810 (0.3900) [eit = 0.43]</td>
<td>0.045 (0.3900)</td>
</tr>
<tr>
<td>Total</td>
<td>0.197 (0.852)</td>
<td>9.010 (0.0005) [eit = 0.93]</td>
<td>0.231 (0.0006)</td>
</tr>
</tbody>
</table>

Test homogeneity of errors variance: Levene Statistic = 1.711 (0.151) (significance level in parenthesis)
Venkatraman (1989) matching perspective of strategic fit\( \text{ROIC} = f(\text{IT} \mid \text{strategy}) \).

In the cluster analysis section, the most important variables for the distinction of flexibility were the ability to produce in niche markets and the ability to accept orders in small quantities, i.e., the impact of IT on performance is higher for the firms which can accept more easily small orders and produce for niche markets. Thus, investment on IT has a higher impact on ROIC for the firms whose competitive target is flexibility. Therefore the rigid and inflexible character of the mass production model was the main reason for the outdated of that model. Indeed, the demand diversification increased the need for expanding the range of production, producing high variety in small orders and for niche markets in order to accommodate the changes in design. Computer aided design and manufacturing systems allows firms through automated procedures to increase the number of models produced with low cost and also decrease dramatically the time to market. Those systems have an integrated database with costing data which automatically calculate the cost of new models when the designers make changes in the products’ design. Moreover, that procedure can be automated by the CAM system which integrates the cutting process. Cutter’s job is not lost because his experience is important and cannot be simulated yet by expert systems, just the context of that job is changed through automation. All these systems, allow for low cost, frequent changes in design as they dramatically decrease the setup cost of machines. Thus, this technology decreases time to market and enables a flexible strategy of accepting small orders, targeting at specific design needs in order to produce for niche markets. This strategy seems to be a necessity in the new industrial environment. Thus, the firms which accommodate that strategy can gain higher performance (ROIC) through IT investment. In sum, in all cost clusters no negative effect of IT on performance is observed. The adoption of cost strategy discourages the achievement of the other strategic advantages which are important for the competition. Furthermore, in the level of complete absence of cost strategy, IT has no high effect on performance (in relation to the medium level), as those systems have significant positive effect to profitability due to cost. We can see the results of IT on performance in each cluster of flexibility (Table 4).

Table 5, show the results of innovation. Higher impact is observed in the low levels of innovation strategy. Innovation needs a high investment with no immediate return (strategic investment), thus it increases the cost and decreases the profitability in the short-run. A similar effect was observed also for the quality strategy, except that we have only two clusters. What was observed in the quality clusters was that the higher impact of IT on performance was in the cluster of low quality (Table 6).

Therefore low quality means firms with unstable quality and infrequent quality detection. That estimation probably arises from the nature of the IT that was examined. Moreover, the firms that adopt quality systems have an immediate higher impact on cost because the targets of quality and innovation need a high direct investment with no returns in the short-run, usually profitability and performance is examined.

The firms are structured in a way that quality innovation and cost are negatively related. Additionally, another reason is that application of quality systems usually lead to high formalization and standardization of procedures which are not compatible with flexibility and the characteristics of information technology. This standardization and formalization impact could be validated if we had included in our analysis. Thus, IT effect on performance is not high, in the case of firms which adopt intensively the strategies of quality and innovation, but in both clusters there is no negative effect. Generally, there is no negative effect of IT on performance in all strategic levels but different levels of positive impact on performance were found. In practice the inflexible and non-computer familiar workers are substituted for the flexible and specialized personnel of CAD/CAM systems. The suppliers of CAD/CAM systems are funded from EEC to operate centers for vocational education where they educate the users of those systems. Thus, they undertake the cost of specialization and education in order to provide both the technology and the user. Generally, when flexibility is increased so does the impact of IT on performance. That means the more intensive the strategy of flexibility, the higher the impact of IT on performance. The highest impact is observed in the higher level of flexibility.

CONCLUSION

In this research the IT’s impact on performance was examined under different types and levels of strategy, using the measure of Return on Invested Capital (ROIC). This measure is an important financial ratio for the long term growth of the firm (especially in relation to WACC) and ‘weights’ revenues and cost in relation to invested capital. In each strategic cluster the effect of IT on performance was estimated. Moreover, it was found that in all of the strategic clusters performance was increased by the adoption of information technology. Specifically, the Iran manufacturing firms which is accepted by share market that apply IT technology when they focus on a portfolio
of flexibility and cost strategy have a higher effect on performance. Information technology generally decreases the cost of various processes but greater effect on performance is noticed when it is related with flexibility strategy. Variations in customer preferences and opportunities through the capabilities of Information technology to accommodate them seem to change the strategic direction of the firms. The strategic portfolio of the firm, as well as the relation among strategic advantages changed significantly. Firms can increase performance if information technology and business strategy fit. Information technology made the adoption of flexibility targets easier while it leads to cost decreases. Specifically, the impact of IT on performance is higher for the moderate implementation of cost strategy. For many firms, acceptance of small quantity orders and production for small and niche markets is unachievable, because this strategic advantages increase dramatically the various types of costs as well as the time to market. In sum, a steady increasing impact was observed only in the case of flexibility. The higher adoption and implementation of strategy flexibility is the higher impact of IT on performance. That effect was not observed in the rest of the strategic advantages. In the case of innovation and quality, the effect of IT on performance was observed in the low level indicating the trade-off with cost. In the case of cost strategy the higher impact was observed in the moderate class because high cost cluster discourage the adoption of the rest of the strategic advantages and IT was not used as a cost and labor saving technology. A dynamic analysis is required in order to examine the effect of structural change by inserting the time effect. Furthermore, investment in (CAD/CAM) systems has a high fixed cost which moderates the effect on return on invested capital. Thus, a short-run increase in cost is expected when the company starts to focus on quality and innovation strategy. A longer period should be taken after IT implementation in order to examine the strategies of quality and innovation more carefully. This research opens the ground for further analysis which should include other important variables of the alignment model like: business structure, uncertainty of the environment and contingencies like: age and size of the firm, etc. Moreover, results might be validated by increasing the number of the firms and including firms from different branches and extending the time period of the study applying a dynamic systems approach. Finally, the quality strategy is incompatible with the flexibility strategy and the character of information technology, due to standardization and formalization effect which quality systems require. This effect can be affirmed by the examination of business structure, but this can be done in a future research.

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