The Impact on the Operational Performance of World Class Manufacturing Strategies: A Company Application

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Abstract

Global commerce, rapidly-changing technologies and shortening product life-cycles, more and more, increase competition. Hence, most businesses face with considerable uncertainties and continual reformation, because the traditional approaches in production in our age are not sufficient enough. The Competitive environment today has considerably increased the interest in WCM that is World Class Manufacturing which is defined as business practices that can provide competitive advantages worldwide by using manufacturing competence as a strategic tool. The WCM strategic implementations during the operational performances were measured on the basis of Digalwar and Metri (2005) and Murugesan (2012) in a factory manufacturing plastic household textiles in İzmir. In addition, dimensions of WCM implementation were specified, the relationship between dimensions was studied in detail, and the results on the operational performances were analyzed.

Keywords: World Class Manufacturing, WCM, Operational Performance

1. Introduction

In the last three decades, the world has witnessed the emergence of effective forces which seek to reshape the economical and organizational communities, and has precipitated in the fundamental changes of the business strategy. These forces are represented by globalization, the emphasis on product and service quality, new technologies, changing economic and political structures, deregulations, and a new breed of sophisticated customers, who have changing requirements and expectations.

These driving forces have lead individuals and organizations to appreciate the importance of world class manufacturing-WCM (Digalwar and Sangwan, 2011).Because the global competitors operating in global markets almost always tend to have world class performance (Saxena and Sahay, 2000),continuous improvement has become a necessity for the survival of businesses in a highly competitive environment in the world. Local competition gradually loses its validity, because even the farthest businesses are forced to compete with each other. For all the reasons, it is not enough to produce at required quality for businesses, they should also have an organized structure appropriate to the production system developed (IpekgilDogan*et al*., 2009).

Many companies are coming to the realization that their survival depends on the capability to manage the production as a premier strategic function (Kasul and Motwani, 1995). In this context, WCM is a guide for businesses. In fact, as is the case with many other new concepts in management, there is no consistent definition of WCM. The term “world class” was coined by Hayes and Wheelwright (1984) to describe the capabilities which had been developed by some Japanese and German companies, as well as the US firms, which had competed equally with the Japanese and German firms.

The term “world class manufacturing” was used because these firms have achieved an outstanding performance in their global competition, resulting in their being described as “World Class” (Eid, 2009). World class manufacturing (WCM) was defined initially by Hayes and Wheelwright (1984) and Schonberger (1986) as a competitive strategy employing the best practices in quality, lean production, and concurrent engineering (Fullerton and McWatters, 2004). Schonberger (1986), developing the concept of WCM, focused on continuous improvement, adding the development of supplier relationships, product design and JIT. Gunn (1987) provides a strong emphasis on the role of technology in world class manufacturing, while Hall (1983) stresses that world class manufacturing is a fundamentally different way of operating an organization, rather than a set of techniques.

Giffi, Roth and Seal (1990) view quality and the customer as the primary focus of world class manufacturing, supported by a combination of manufacturing strategy and capabilities, management approaches, organizational factors, human assets, technology and performance measurement (Flynn et al., 1997). Hanson and Voss (1993) see world class manufacturing in terms of practice and performance. They define world class as having best practice in total quality, concurrent engineering, lean production, manufacturing systems, logistics and organization and practice. In addition it is having operational performance equaling or surpassing best international companies (Voss, 1995). Although the words may be rearranged and appear differently, the message is fundamentally the same – WCM is concerned with the competition between the best manufacturers in the world (Falah, 2003).

As a common philosophy focusing on production firstly, WCM includes more structural changes such as new production technologies, and both Just-In –Time- JIT and Total Quality Management-TQM. WCM, changing attitudes and beliefs, provides a combination between responding rapidly to customer demands and a high degree of customer focus (Lind, 2001). WCM determines which set of activities needs to be undertaken by identifying what is needed by the companies in order to compete globally.

Moreover, WCM itself involves many factors systematically related to promotion, for instance, raw materials, energy, machinery, labour and management. Furthermore, World class companies optimize the problem-solving abilities of their employees in applying both modern techniques and traditional engineering process (Salaheldin and Eid, 2007). Being the best in the world at manufacturing, an obsolete product does not make an organization world class. Increasingly turbulent task environments, characterized by truncated product life cycles and segmented consumer markets, require world class manufacturers to be flexible enough to satisfy changing market demands (Cook and Cook, 1994).

WCM companies are those companies which continuously outperform the industry's global best practices, and intimately know their customers and suppliers as well as knowing their competitors' performances and knowing their own strengths and weaknesses. All of the qualities above form the basis of – continually changing – competitive strategies and performance objectives (Greene, 1991). Adopting effective management practices, capable of keeping pace with the changing technological environment, is particularly important to success in global markets. WCM requires continuous improvement because world standards constantly change (Cook and Cook, 1994). Companies engaged in WCM practices focus on improving operations, elimination of waste, managing customer relationships, creating lean organizations and implementing green practices, among others (Haleem *et al.*, 2012).

World class enterprises include both total quality and characteristics of learning organizations (Hodgetts*et al*., 1994). Such improvements cannot be achieved with traditional methods. They require fundamentally rethinking and radically redesigning business processes and practices. This is the essence of world class performance (Kearney, 1997).Hence, partnering with an organization with world class capabilities can offer access to new technology, tools and techniques that the organization may not currently possess; more structured methodologies, procedures and documentation; and a competitive advantage through expanded skills (Ghodeswar and Vaidyanathan, 2008).

Effectively managing and measuring the product development process is widely seen as a means of ensuring business survival through reduced time to market, increased quality and reduced costs. There is usually very little information available to managers to guide them on introducing performance measures to assist with product development (Driva *et al*., 1999).

A problem which is common to attempts to define the concept of world class manufacturing is how to interpret the measures within the operating context of the firm (Harrison, 1998). Literature on the performance measures of world class manufacturing is very limited. The only reason for this could be the fact that no single best practice framework exists for the implementation of world class manufacturing principles, as each framework will necessitate the creation of different performance measures. The only common factors that could be identified from the literature are cost, quality, and reliability/throughput. The main aim of world class manufacturing is the pursuit of maximum efficiency for the production system in order to maximize the organization's profitability (Mey, 2011).

WCM Implementation Strategies

For businesses in order to survive and be followed as the leader, they require having a structure that continuously learns and applies what is learnt. The other values, businesses should have, include problem-solving, lean thinking, team working, loyalty, vivid participation and regular communication. WCM is the model that provides businesses to compete globally and systematically improve their power for competition on the base of these values above. An improvement in the road map way with well-defined paths is one of the most important tools to the success for all world class manufacturers. Therefore, in order to achieve the objective of WCM model, some strategies ought to be evaluated within the concept of the continuous improvement. The strategies into WCM models created by some researchers are tabulated in Table 1.

The Effect of WCM Implementation Strategies on the Operational Performance: A Company Application

1.1 The Aim of the Study

The main objective of the study is to investigate the effect of WCM implementation criteria on the operational performance. Hence, the objectives are as follows:

- To determine the strategies of WCM implementation,
- To analyze the effect of the strategies of WCM implementation on the operational performance,
- To determine the level of relationship between all the strategies.

1.2 The Research Method

For this study, a surveying method was used in order to obtain data, and also a questionnaire was used as a data collection tool. The study has been carried out with a survey on employees of a firm, which was established in 1996, producing plastic household textiles. The firm is a large-scale company exporting 98% of its products to 48 countries. In 2010, it started to adopt WCM activities namely and formed teams of TPM, quality, environment, health& safety, and Kaizen. The survey consists of three parts. In the first part, the demographics of the respondents are questioned. In the second, the percentage of the employees' perception about the WCM strategies is measured. Finally, in the third part, the company's operational activities are in question. In summary, the existence of a significant relationship between WCM strategies and operational performance is tested in this survey.

1.3 The Findings

Socio-demographic characteristics of the participants, the reliability analysis, the factor analysis and the regression/correlation analysis are actively used within the scope of the research findings.

1.3.1 The Participants' Socio-Demographic Characteristics

In this part, the participants were asked their job titles and overall period in the company. All of the white collar employees, and the blue collar workers who are at least first degree operators were surveyed. 56.8% of the participants are white, 43.2% are blue collar workers. Looking at the distribution of employees according to years of work in the firm; the rates of employees who work less than 1 year is 17%, between 1-3 is 40.5%, between 4-6 is 19%, between 7-10 is 15% and more than 11 years is 8.1%. Overall, the company has 120 employees, but 74 individuals answered the questionnaire as the rest were not able to. The response ratio is 62%.

1.3.2 Validity and Reliability Analysis

As a result, a new scale has been developed in order to find out the employees' perception about the applicability of WCM implementation strategies in the firm, because some of the studies Where were only prepared to test the levels of firms in different sectors, but there was no study to measure the perceptions of employees of a particular company. Therefore, in order to form a scale which includes white and blue-collar workers, the studies of Digalvar & Metri (2005) and Murugesan(2012) were taken as the main criteria, but considering the particularly, a new scale is developed.

The WCM implementation strategies which are created during a pilot study are applied to five white and five blue collar workers, and alongside necessary corrections were made on variables. As a result of the reliability analysis of all the variables, overall Cronbach's alpha value was identified as 0.927 ($p<0.001$). Factor analysis was applied to the WCM implementation criteria.

As shown in Table 2, implementation criteria are grouped under 8 factors according to the factor analysis.
Factor analysis was applied in order to prove the structural validity of the data-set of WCM implementation criteria. As a result of the factor analysis, Kaiser-Meyer-Olkin sample value was emerged as .760 ($p<0.001$) and the total variance explained was found to be 74.773.

Variance percentage defined by the first factor is 14.407 and expressed by 5 variables. Examined the expressions under the factor, it is understood that the variables are associated with "Customer and Supply Management". The variables of highest factor weight of "customer satisfaction measured is ".883". The variables of the factor weight of "to respond quickly to customer complaints" are ".828" in line. The eigenvalue of the factor is 7.533. According to this factor, the people who fill in the questionnaire gave an average value of 3.08.

Variance percentage defined by the second factor is 14.225 and is expressed by 6 variables. Examined the expressions under the factor, it's understood that the variables are associated with "Total Productive Maintenance", and its eigenvalue is 2.88. According to this factor, the people who fill in the questionnaire gave an average value of 3.40. Variance percentage defined by the third factor is 10.572 and expressed by 3 variables. Examined the expressions under the factor, it's understood that the variables are associated with "Environment, Health and Safety" and its eigenvalue is 2.543. According to this factor, the people who fill in the questionnaire gave an average value of 3.97.

Variance percentage defined by the fourth factor is 7.968 and expressed by 2 variables. Examined the expressions under the factor, it is understood that the variables are associated with "Quality Management" and its eigenvalue is 2.016. According to this factor, the people who fill in the questionnaire gave an average value of 3.54. Variance percentage defined by the fifth factor is 7.775 and expressed by 3 variables. Examined the expressions under the factor, it is understood that the variables are associated with "Facility Control" and its eigenvalue is 1.560. According to this factor, the people who fill in the questionnaire gave an average value of 4.18. The high value of the factor average may be caused by intensifying on most recent 5'S activities.

Variance percentage defined by the sixth factor is 7.508 and expressed by 2 variables. Examined the expressions under the factor, it is understood that the variables are associated with "Innovation &Technology" and its eigenvalue is 1.377. According to this factor, the people who fill in the questionnaire gave an average value of 3.87. The variable with the highest factor weight is "entering the market with innovative products" (.806).
Variance percentage defined by the seventh factor is 6.807 and expressed by 3 variables. Examined the expressions under the factor, it is understood that the variables are associated with "Process Management" and its eigenvalue is 1.240. According to this factor, the people who fill in the questionnaire gave an average value of2.81. To be low in the factor average indicates that the process-based structuring could not be passed to the functional structuring yet. The last factor "Leadership" is expressed by 2 variables. Variance percentage defined is 5.510. The eigenvalue is 1.036 and the average was found as 3.66.

1.3.3 The Relationship between the Factors

In the examination of the relationship between the various factors, there seems to be strong relationships between TPM and QUAL ($p<0.001$ and $r= 0.765$), and between CSCM and PM ($p<0.001$ and $r= 0.752$).

1.3.4 The Priorities of the Operational Performances

Being in consultation with a number of middle and upper-level managers, 10 operational performance criteria which were emphasized on the most recent studies were defined by the method of brainstorming. Looking at those criteria, the lowest operational performance criterion appears to be the purchasing relationship with the suppliers (2.64). This condition may well be caused by the fact that the company might recently have started using systematical purchasing procedures with the suppliers. A very high operational performance criterion can be regarded as the ability of producing a global product that could be shaped in accordance with the different preferences of different countries (4.25). Exporting 98% of a company's products can be considered as an indicator of the successful capabilities in this area.

1.3.5 The Impact on the Operational Performance of WCM Implementation Strategies

The effect of WCM implementation strategies on the operational performance was investigated by multi-linear regression analysis and stepwise method. Operational performance was used as dependent variable, and WCM strategies were used as independent variables.

As a result of the analysis, it is observed that the dimensions of WCM implementation explain 86% of the variance of the dependent variable operational performance. It is well understood that operational performance is formed mostly based on these factors. The relationship between the two variables was tested by variance analysis.

$F(1.74)=49.469, p<0.001$ (Model 1)

$\hat{Y}= \text{Constant} + \beta 1X1+\beta 2X2+\ldots+\varepsilon$ (Model 2)

This expression shows how much the strategies of WCM implementation affect the operational performance of the company.

The first three models were examined;

The strategy with the highest effect on the operational performance is seen as TPM ($\beta=.635$; $t=10.245$; $p<0.001$). In addition to TPM, the second highest effect belongs to environment, health& safety strategy (TPM: $\beta=.509$; $t=9.624$; $p<0.001$, EHS: $\beta=.325$; $t=6.572$; $p<0.001$).

The third model shows that in addition to TPM and EHS, CSCM strategy has a significant effect on the operational performance(TPM: $\beta=.401$, $t=7.726$; $p<0.001$, EHS: $\beta=.319$; $t=7.340$; $p<0.001$, CSCM: $\beta=.188$; $t=4.698$; $p<0.001$).

Conclusions and Recommendations

In this study, the impact of WCM implementation strategies on the operational performance of a firm is analyzed. It is well understood that many firms are trying to implement many of WCM strategies. It's important that WCM implementation strategies have to be revised by taking into account the effects of these strategies on the operational and managerial performances of the firms.

With respect to the responses given by the blue and white collars workers who participated in the survey, descriptive statistics, validity and reliability analysis, factor analysis and regression/correlation analysis were performed. WCM implementation strategies of the firm were collected by 8 factors namely CSCM-Customer & Supply Chain Management, TPM-Total Productive Maintenance, EHS-Environment and Health and Safety, QUAL-Quality, FCL-Facility Control, INV-Innovation & Technology, PM-Process Management, LEAD-Leadership.

Examined the relationship between 8 factors, there found some significant and strong relationship between CSCM and PM, and also between TPM and QUAL factors. It is thought that the result of this finding was positively affected by highlighting the importance of good & information flowing from supplier to the customer in a good condition during the activities in the firm. It is observed that WCM strategies have a high effect on the operational performance identified by the managers ($R=0.927$; $R^2=0.856$). The two WCM strategies having the biggest effect on the operational performance are TPM and EHS.

Considering the order-based production structure and raw material-based product structure of the firm, obtained statistical results become more important. In order to meet the orders in time, fast mold changes, planned maintenance practices and the efforts to reduce duration of production are thought to be unavoidably achieved targets. Likewise, the use of chemicals which contain high degree risk in production forces the "environment, health and safety regulations" to be the main priority. With regards to the firm that started WCM implementations three years ago, it is important that they ought to monitor their strategies as frequently as possible. Hence, the same firm could easily self-evaluate and also create more efficient WCM strategies, which can be another study subject for the future.

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Table 1: The Strategies into WCM Models Created by some researchers

AUTHOR	YEAR	Developed/Implemented Strategies of WCM Models
(Maskell)	1991	A New Approach on Product Quality Just-In-Time (JIT) Flexible Approach to Customer Requirements Changes in the Labor Management
(Steinbacher & Steinbacher)	1993	Total Employee Involvement Total Quality Management (TQM) Total Productive Management (TPM) Just-In-Time (JIT)
(Roth & Miller) (Cua, McKone, & Schroeder)	1992 2001	Total Quality Management (TQM) Just-In-Time (JIT) Total Productive Management (TPM) Computer Integrated Manufacturing (CIM) Quality Control Factory Automation Employee Involvement
(Mylnek, Vonderembse, Rao, & Bhatt)	2005	Employee Development Total Quality Management (TQM) Supplier Development Just-In-Time (JIT) Product Development Customer Focus
(Digalwar)	2005	Top Management Commitment Customer Service Price/Cost Leadership Quality Facility Control Speed Innovation and Technology Flexibility Vendor and Material Management Global Competitiveness Environmental, Health and Safety
(McLeod)	2008	Organization and Culture Logistics Production Systems (lean manufacturing, process design, TQM)
(Murugesan, Kumar, & Kumar)	2012	Management Commitment, Customer Focus, Employee Involvement, Continuous Process Improvement, Supplier Partnership, Performance Management Training and Education, Cross-functional Teams, Empowerment & Teamwork.

Table 2: Factor Analysis (Dimensions of WCM Implementation)

	Factor Loading	**Croanbach ∝**	**Eigenvalues**	**Total Varience Explained**	**M**
1. FACTOR-Customer Relationship and Supply Chain Management		0.856	7.533	14.407	3.08
C&SCM1	.883				
C&SCM2	.828				
C&SCM3	.770				
C&SCM4	.648				
C&SCM5	.595				
2.FACTOR-Total Productivity Maintenance		0.847	2.884	14.225	3.40
TPM1	.874				
TPM2	.793				
TPM3	.708				
TPM4	.644				
TPM5	.642				
TPM6	.492				
3. FACTOR-Environmental, Health, Safety Management		0.784	2.543	10.572	3.97
EHS1	.846				
EHS2	.841				
EHS3	.748				
4. FACTOR-Quality		0.599	2.016	7.968	3.54
QUAL1	.791				
QUAL2	.715				
5. FACTOR-Facility Control		0.641	1.560	7.775	4.18
FCL1	.828				
FCL2	.729				
FCL3	.649				
6.FACTOR-Innovation &Technology		0.642	1.377	7.508	3.87
INV1	.806				
INV2	.771				
7.FACTOR-Process Management		0.714	1.240	6.807	2.81
PM1	.681				
PM2	.556				
PM3	.511				
8.FACTOR-Leadership		0.532	1.036	5.510	3.66
LDR1	.729				
LDR2	.354				

Table 3: Correlation Analysis (Service Quality Level)

	CSCM	TPM	EHS	QUAL	FCL	INV	PM	LEAD
CSCM	1	.478(**)	.199	.218	.156	.269(*)	**.752**(**)	.058
TPM	.478(**)	1	.364(**)	**.765**(**)	-.002	.274(*)	.490(**)	.341(**)
EHS	.199	.364(**)	1	.431(**)	.186	.279(*)	.225	.422(**)
QUAL	.218	.765(**)	.431(**)	1	-.044	.135	.437(**)	.383(**)
FCL	.156	-.002	.186	-.044	1	.290(*)	-.089	.094
INV	.269(*)	.274(*)	.279(*)	.135	.290(*)	1	.031	.180
PM	.752(**)	.490(**)	.225	.437(**)	-.089	.031	1	.233(*)
LEAD	.058	.341(**)	.422(**)	.383(**)	.094	.180	.233(*)	1

P<0,001

Table 4: Operational Performance Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Planned Maintenance	74	1.00	5.00	3.6486	1.13996
Fast Mold Change	74	1.00	5.00	3.1757	1.69090
Lean Manufacturing Practices	74	1.00	5.00	2.9595	1.71567
Production Times	74	1.00	5.00	3.6486	1.52991
Delivery Deadlines	74	1.00	5.00	3.8514	1.29997
Flexible Manufacturing Practices	74	1.00	5.00	3.4730	1.50089
Supplier Relationships	74	1.00	5.00	2.6486	1.97541
Total Equipment Efficiency	74	1.00	5.00	3.8784	1.44253
Risk Analysis	74	1.00	5.00	3.5676	1.39550
Ability of Global Production	74	1.00	5.00	4.2568	1.00765

Table 5: Regression Table

		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
Model		B	Std. Error	Beta	B	Std. Error
1	(Constant)	1.329	.222		5.974	.000
	TPM	.635	.062	.770	10.245	.000
2	(Constant)	.467	.220		2.125	.037
	TPM	.509	.053	.617	9.624	.000
	EHS	.325	.049	.421	6.572	.000
3	(Constant)	.279	.197		1.415	.162
	TPM	.401	.052	.485	7.726	.000
	EHS	.319	.043	.413	7.340	.000
	CSCM	.188	.040	.281	4.698	.000
4	(Constant)	.286	.189		1.513	.135
	TPM	.362	.052	.438	6.985	.000
	EHS	.313	.042	.406	7.515	.000
	CSCM	.141	.042	.210	3.347	.001
	PM	.104	.039	.170	2.686	.009
5	(Constant)	-.120	.210		-.570	.571
	TPM	.333	.049	.404	6.837	.000
	EHS	.284	.040	.368	7.167	.000
	CSCM	.107	.040	.160	2.660	.010
	PM	.134	.037	.218	3.613	.001
	INV	.166	.048	.180	3.489	.001

a Dependent Variable: Operational performance