A Study of Operations Management Practices Among Companies Operating Out of Western India with the Objective of Drawing an Agenda for Corporate Action to Reduce Costs and Enhance Quality

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The key focus of operations management is providing highest quality possible at the least cost feasible. While there is some agreement on the definition of quality, the definition of productivity continues to present a challenge for companies and researchers. This paper looks at these two key aspects of operations management and studies the different practices of operations management in Indian companies operating out of the Western part of India. The objective of this research was to study the practices followed for key processes like production planning, layout planning, vendor management, process quality, raw material quality and understanding customer needs. Data from 36 companies was analysed using the Standard Normal Distribution to identify operational strength and areas for possible improvement. The strengths include a formal process for forecasting demand and production planning, quality of inspection/sampling of raw materials and focus on productivity and quality improvement. The opportunities for improvement include closer working with a limited number of vendors and scope for increased interaction between production staff and customers. Factory layout emerged as a grey area requiring further research.

Key Words: Operations, Quality, Productivity, Metrics, Vendor management

Introduction

Different authors have defined Operations and Operations Management in multiple ways with all definitions referring to inputs, a process that converts inputs into output. Goodson (2002) defines Operations as, "Any activity that transforms and adds value to an input stream. The input stream can be a physical entities, services, or flows. The valued added transformation produces products or services that are designed to meet a customer demand. Operations range from processing loan applications to production of computers, to designing buildings." Barnes (2008) defines Operations Management as being concerned with the management of resources and processes required by an organization to produce goods or services for customers. The importance of operations management stems from its impact on an organization's costs, product/service quality, availability, timeliness and reliability of goods and services. Samson and Singh (2008) define Operations Management as being concerned with most effectively designing, conducting and improving the organization's production process irrespective of sector, industry or whether the organization produces a product or service. The importance of operations management stems from the fact that it is the operations function that makes goods or services the organization sells and is also the function that employs most of the organization's resources in assets and people.

Littlefield and Shah (2008) of the Aberdeen Group (2008) use three KPIs to identify best-in-class performance in manufacturing operations management.

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These are on-time delivery, Overall-equipment effectiveness and Raw material utilization. On these metrics, the Best in class performances averages are: 97% on time delivery, 89% overall equipment effectiveness and 97% raw material utilization. The laggards (bottom 30% performers) averaged 80% on-time delivery, 66% overall equipment effectiveness and 71% raw material utilization. The report lists the following market pressures driving manufacturers to focus on MOM:

1. Need to reduce manufacturing cost;
2. Inaccurate demand forecasts;
3. Need to maximise profitability;
4. Manufacturing process complexity;
5. Product proliferation/configuration;
6. Shrinking product lifecycles.

The pressure to reduce manufacturing costs causes over two thirds of all manufacturers to implement continuous improvement programs (68%) with the other actions including Optimizing asset utilization (40%), Increasing visibility across manufacturing operations (39%), Optimizing material utilization (18%), Improving response time to adverse events (16%) and Increasing product velocity (17%). It is seen that reducing manufacturing costs remains at the top among pressure across many Aberdeen manufacturing benchmark reports. Wailgum (2010) cites the 2009 Next Generation Manufacturing Study to list six critical strategies for world-class manufacturing success as including:

a. Customer-focused innovation measured by percentage workforce devoted to new product development or percentage of annual sales from new products;
b. Advanced talent management to improve the organization's ability to recruit, hire, develop and retain talent to gain competitive advantage;
c. Systematic continuous improvement aimed at improving processes and efficiency with training playing an important part in achieving improvements;
d. Strong and agile supply chains supported by forward thinking management and staff with measurement systems to review the effectiveness of supply chains;
e. Ethical and sustainable practices; and
f. Global engagement as markets, competition and talent growth are no more confined to one place or country.

Haas (1987) compares the benefits of operational fine tuning of manufacturing productivity with basing manufacturing decisions on external tests of marketing performance and radically altering customer perceptions of adding value at lower cost and higher responsiveness. Defining strategic breakpoint as the definable point where an incremental enhancement in some value parameter (price, quality or service) causes a disproportionately large increase in volumes, Haas identifies eight inter related critical manufacturing decisions that can tilt the competitive balance in the companies favour. These are: (i) product design; (ii) process design; (iii) facility and plant configuration; (iv) information and control systems; (v) human resources; (vi) research and development; (vii) suppliers' roles and relationships; and (viii) organization. Achieving strategic breakpoints requires taking the interaction between these into account and continually re-evaluating and re-orchestrating their manufacturing decisions to support the company's strategic goals.

The key focus of operations management is providing highest quality possible at the least cost feasible. This paper looks at these two aspects of operations management and studies the different practices of operations management in Indian companies. Several studies have been carried out the world over but there is a relative dearth of such studies for companies in the Western part of India. The objective of the study was

to study the practices followed for key processes like production planning, layout planning, vendor management, process quality, raw material quality and understanding customer needs. This study will add to the existing body of knowledge on operations management. The remaining part of this paper is organized as follows: It begins with review of existing relevant research on productivity, quality and related operational issues. That is followed by listing the key hypotheses and describing the research methodology. Finally, the data and analysis are presented based on which conclusions are drawn and recommendations made.

Literature Survey

Eccles (1991) discusses the shift from financial figures to performance based measures including quality, market share and other non-financial figures in organizations as purely financial measures have an adverse impact on the long term competitiveness of companies and its ability to meet long term strategic objectives. The OECD Manual authored by Schreyer (2001) lists reasons for measurement of productivity as including tracing of technology change, measuring efficiency, assessing real cost saving, benchmarking of production processes and gauging standard of living. The definitions of productivity include:

- Quantity index of gross output/quantity index of gross input as measure of labour productivity;
- Quantity index of value added/ Quantity index of labour input as measure of labour productivity, based on value added;
- Quantity index of value added/ Quantity index of combined labour and capital input as measure of Capital-labour multi factor productivity;
- Quantity index of value added/ Quantity index of capital input as measure of capital productivity based on value added;
- Quantity index of gross output/ Quantity index of combined inputs as measure of KLEMS multifactor productivity.

These definitions apply to companies as well as countries and each of them has its advantages and limitations with none of them meeting all possible requirements under all conditions with multifactor productivity measures finding relatively greater acceptance on account of its including multiple factors that have a role in determining productivity. The applicable definition of productivity measure, therefore, differs depending upon the context. Lyons, Barlow and Rathore (2001) explain the limitation of measuring labour productivity on account of labour cost constituting only about 15% of the total manufacturing cost so stopping at the relatively easy to measure, labour productivity, is insufficient for meaningful decision making. Based on a study of three companies with differing volume/variety characteristics, the study shows that besides labour, material costs and energy costs are important to measure with efficiency of raw material consumption being a more reliable indicator of performance. Baldwin (2004) defines labour productivity as the amount of output produced per unit of labour input with GDP providing a measure of output and number of workers or number of labour hours providing a measure of input at a national level. Houseman (2006) discusses different measures of labour productivity that include:

- $(Q_t/Q_0)/(L_t/L_0)$ where (Q_t/Q_0) represents output in the period under consideration divided by output in the base period and (L_t/L_0) represents labour input in the period under consideration divided by labour input in the base period. As regards US manufacturing sector, output is measured as the constant dollars shipments, from manufacturing establishments adjusted for inventory change and net of intra-industry shipments. Labour productivity increase could be the result of increased output due to increased efficiency or due to technology improvements. It could also be the result of

substitution of other inputs for labour as happens during outsourcing. When manufacturers outsource work, labour productivity increases because outsourced labour is not employed in the manufacturing sector and, therefore, not included in the denominator.

- $\ln (A_t/A_{t-1}) = \ln (Q_t/Q_{t-1}) - \{w_k [\ln (K_t/K_{t-1}) + w_l [\ln (L_t/L_{t-1})] + w_{ip} [\ln (IP_t/IP_{t-1})]\}$. Multifactor Productivity measures productivity as the change in productivity to all inputs used in the production process collectively and not just change in labour productivity. The factors considered in multifactor productivity are capital, labour, energy, materials and purchased business services. The left hand side of the equation denotes change in multifactor productivity. As regards the right hand side of the equation Q is a measure of output as given by constant dollar shipments net of inventory change and intra industry shipments, L is the sum of labour hours, K is a measure of capital calculated on the basis of flow of services from capital equipment, structures, land and inventory. Last, IP measures Intermediate Purchases including material and energy inputs and purchased business services. The three weights used in the equation are computed as the average share of production costs in the adjoining periods, (t) and (t-1). Multifactor productivity, therefore, measures the percentage change in output minus the weighted average of percentage change in all inputs with the weights derived from the average factor share in the periods in question. Outsourcing by manufacturers reduces the manufacturer's labour and capital inputs but increases purchased inputs. This increase is however, difficult as well as expensive to measure accurately. The underlying assumptions for productivity estimates using this model include the assumption that differences in factor prices solely reflect differences in factor productivity. This is an over simplification that makes the measure ill equipped to capture the dynamic adjustment process underlying productivity changes thus reducing the usefulness of the measure despite its otherwise great strengths.

Sahay (2005) discusses productivity in an engineering service organization and measuring it using a multifactor productivity model using the formula: TPI (Total Productivity Index) = PIKPT (Productivity Index for Key Terminal Parameters) + PISKT (Productivity Index of sub-key terminal parameters (development indicators)). This simple formula, however, brings in a requirement of good judgement in estimating weights of static and dynamic indicators of key terminal parameters as well as weight of the sub-key terminal parameters. Rogers (1998) discusses the issues with measuring productivity when there are multiple inputs and outputs. Measuring output presents a challenge because accurate value of price deflators may not be available, output quality may improve despite static or decline prices (as in the case of personal computers), inventory levels may change or a part of output may be given away for promotions etc. Similarly measuring labour quality also presents a challenge because education or skill levels are important factors in determining labour quality but category-wise data on these is difficult to find. Finally measuring capital presents the biggest challenge with the data requirement again becoming very difficult to meet, if not impossible. Shipulki (2009) discusses reducing labour and material costs through change of design using Design for Manufacturing and Assembly (DFMA), a methodology to change a design to reduce the cost of making parts while retaining the product function. To be successful, business methodologies require tools, businesses, processes and infrastructure to realize benefits in a sustainable manner. The benefits from DFMA are quantified as:

- Normalised profit as measured by price minus cost per square foot of the factory floor space used to

produce the product increased from $1 in 2003 to $7 in 2008 (600% increase). This increase resulted from new product design with reduced material and labour requirement (50% reduction) leading to reduced floor space requirement; and

- Normalised warranty cost per unit decreased from $4 in 2003 to $1 in 2008, this reduction in warranty cost indicating improved product quality & robustness.

Arora (2006) defines quality as a product's ability to meet customer's needs and expectations and, for electronics products, includes characteristics like performance, reliability, safety and appearance. These characteristics vary depending upon the product in question and good quality is a result of: clearly fixing product specifications, preparing product design including functional qualities, electrical and physical properties etc.; Planning to manufacture all the way from method of manufacturing to planning quality control checks; Actual manufacturing; Correction of quality deficiencies and Coordination among different teams to ensure that high quality of products are being produced. Mitra (2009) defines it as "quality is the degree of excellence or superiority, is a combination of attributes, properties or characteristics that give each commodity value in terms of intended use." This definition is close to the definition of perceived quality by Cole and Flynn (2009) who define perceived quality as "……. the customer's subjective judgement (overall feeling) about the general excellence of a product or service with respect to its intended purpose, relative to alternatives …." and bring out the importance of quality in customer's purchase decisions through an October 2008 survey based on a representative sample of US population. In this survey 86% of the US population listed quality as the most important factor they would be thinking of in their next car purchase compared to 82% placed safety at the top and 74% placed fuel economy at the top. The study traces the move of American customers away from US car manufacturers, towards Japanese car makers. The move started on account of better fuel economy of Japanese cars during the oil shock (1979-80) but continued on account of higher reliability and quality. The reasons for this move include American automakers' misplaced confidence, a corporate culture focused on financial measures and cost reductions, less collaborative relationship with suppliers and the lure of reaping huge profits from sales in particular truck segments. The lessons drawn include the need to demonstrate convincing superiority, and not par performance, over competition by the company on parameters that matter to customers. Li, Chen and Cheung (2000) define quality as the degree to which a product lives up to its performance, endurance, maintainability, and other attributes that a customer expects to receive from the product. The study presents the TQM view of quality, as applicable to software development, wherein productivity gains can be achieved through improved quality, quality needs to be defined and judged by the customer, quality must be measured by customer satisfaction, building quality into products requires effective product design and process control and not just focus on inspections, the goal of processes should be zero defects, quality needs to apply to all phases of the product life cycle and not just production, the responsibility for quality lies with the management and not workers, and management must strive for long term, quality oriented relationships with suppliers.

Lai et al (2009) examine the question why quality is improving continuously based on the case study method and conclude that explaining quality improvement requires an integrated perspective of institutional theory as well as resource based view of the firm with quality improvement being the result of core competencies like self-reinforcing human capital based on a cognitive trust-based hereditary institution. Various approaches have been suggested for delivering high quality products

or services or achieving high performance by different studies. Weinstein (2009) analysis of the centrality of aligning current operations and strategic goals for long term success of organizations highlights the frequent failure of management to translate organization strategy into action and impact of imposing metrics in organizations where strategy and performance are not aligned. Strategy implementation must be evaluated through financial as well as non financial metrics defined at the highest level of the organization based on the needs of customers as well as different stakeholders and flowing down to all levels/functions. Despite the clear role of quality in customer decision making, achieving high quality continues to challenge manufacturers and service providers. Mergen and Stevenson (2009) point out the benefits of improved quality through a comparison of revenue increase from increased expenditure on customer service being 10-12 times the revenue increase through increased advertising expenditure. Ozdemir and Hewett (2010) discuss how customers with different collectivist tendencies place different levels of importance on multiple aspects of service experience to determine their behavioural intent and that service providers in different industries are likely to observe differences in the collectivism's impact on importance of intention determinant. Service quality itself has various definitions. Some define it as an overall evaluation of service (Taylor and Baker, 1994 cited in Ozdemir and Hewett, 2010:5) while others define it as a multidimensional construct formed through evaluating multiple service attributes (Parsuraman et. al. 1988 cited in Ozdemir and Hewett, 2010:5). Yet another definition accepts the suggestion that there are several major dimensional antecedents of service quality (Brady et. al. 2002 cited in Ozdemir and Hewett, 2010:5). Sharma and Bagaria (2008) discuss how software companies can benefit from TQM to suggest that quality is an attitude or a mind-set and not an event. It requires all team members producing error-free output even at the cost of speed of delivery that is more than made up by reduced rework or defects. Hammer (2007) identifies two features for delivering high performance by companies. The first is five interdependent process enablers that include: Process design, people who execute the process, a process owner, information and management systems that support the process and process metrics used to track process performance. The second feature that makes possible higher levels of the first feature is four enterprise capabilities, namely, leadership, enterprise culture and values, level of skill or expertise for process redesign and mechanism for managing complex projects and change initiatives. These two features can be evaluated using the PEMM framework (The Process and Enterprise Maturity Model) that permit assessment of how well processes will deliver and the organizational readiness to put process enablers in place.

Differences are seen in what are the main obstacles in achieving high quality or inhibitors of peak performance. Wiele, Williams and Dale (2000) examine the fad, fashion, and fit theory using the case of Total Quality Management with the first stage of fad requiring clear definition and measurement as achieved by ISO 9000 and quality award models. The second stage of fashion requires widespread major pressure for widespread adoption that, in the case of TQM came from customers' demand that suppliers get themselves ISO 9000 certified. The stage of fit into normal management practice requires effecting the way of working within the whole organization so that the organizational performance is effected in a positive way and can happen only when there is a strong intrinsic employee motivation allied to knowledge of what has to be done along with emotional involvement to implement TQM. There is a lack of consensus on how to go about resolving quality problems. Budyansky (2009) discusses the causes of inefficient results in the quality domain as including: (a) lack of universal definition of quality

that could be applied to any objective coupled with absence of unambiguously defined and effective rules of measurement and quality evaluation; (b) absence of methodology to transition from physical parameters to quality parameters or for fulfilment of quasi-objective analysis and synthesis; and (c) absence of common QA technology. Despite these limitations corporations have tried various initiatives for quality improvements. In implementing corporate quality initiatives, Fotopoulos et. al. (2010) find that process quality management and employee involvement are influenced first by the 'soft' side of TQM including quality management and customer focus and then by quality improvement tools and techniques that make up the 'hard' side of TQM. Psychogios and Priporas (2007) discuss constituents of the 'soft' of TQM as including total employee involvement, continuous improvement, training, teamwork, empowerment, top management commitment/support, democratic management style, customer satisfaction and culture change while the 'hard' side includes Statistical Process Control, ISO 9000 Series, pareto-analysis, matrix diagram, histograms, tree decision diagram, critical path analysis and fishbone diagram. The study brings out managerial awareness of TQM as being low as regards the 'soft' side of TQM when compared to the 'hard' side of TQM leading to TQM being viewed primarily from the technical point of view. A similar differentiation is made by Azizi (2007) citing Fenghueih and Chen (2002) on implementation of TQM involving 'soft' TQM that includes 14 points of Deming's Philosophy, 10 steps of Juran and 14 steps of Crosby and 'hard' TQM made up of the tools and techniques (Fenghueih and Chen, 2002 cited in Azizi, 2007:332). The study provides an evaluation criteria for quality tools as including ability to increase customer satisfaction, ability to reduce failures, ability to reduce quality costs, ability to enhance quality, time to institutionalise as culture and ease of use. The critical techniques of TQM evaluated include five core techniques, two lean techniques and two tools for design and planning. The overall satisfactory ranking of these nine tools puts Failure mode effect analysis (FMEA) at the top. The remaining eight tools in decreasing order of satisfactory grade are (FMEA followed by) Quality Function Deployment, Kaizen, Statistical Process Control, Advanced Product Quality Planning (APQP), Production Part approval Process (PPAP), Measurement System analysis (MSA), and Management and Planning Technique (includes affinity diagram, relations diagram, tree diagram, matrix diagram, matrix diagram, matrix data analysis, process decision program chart and arrow diagram). Sebastianelli and Tamimi (2003) investigate what makes TQM work. The study further cites Glover (1993) on three patters of TQM failures: weak concept, flawed design or ineffective implementation and identifies five barriers to TQM success listed below:

- Inadequate human resource development and management especially to tackle quality issues;
- Lack of planning for quality at the level of strategic plans, measuring quality or linking to compensation;
- Lack of leadership for quality due to excess management layers or lack of management commitment;
- Inadequate resources for TQM as seen by unrealistic timelines or employee resistance to change;
- Lack of customer focus as seen by quality and quality plans not being adequately customer driven.

Differences also exist on the real obstacles to improvement efforts. Hamilton and Smith (1993) point to policies based on which day-to-day decisions are taken as being the real culprits or inhibitors to improvements when these policies are not in-synch with new strategies for quality and productivity since they are not questioned by those with the power to change them. Sousa and Aspinwall (2010) point to TQM failures in SMEs as resulting from inadequate management commitment, inadequate expertise in quality

management among employees coupled with inadequate training, organization culture resisting change, inadequate customer focus, lack of required resources and organization structure not supporting TQM requirements. Further, measuring quality requires addressing all areas of an organization as well as its environment and a performance management system for the SME must provide greater benefits than its cost, and also contribute to other management objectives besides being integrated with these.

Companies adopt different methods for quality and productivity/cost improvements. The extent of improvement and time required to achieve the same depends upon the approach adopted for improving quality. Fazel (2003) discusses the differences between TQM and BPR (Business Process Re-engineering). A study of 29 companies show that the implementation time for TQM is significantly larger than that for BPR (Business Process Re-engineering) while the magnitude of change companies expect from BPR is higher than from TQM though the difference is not statistically significant. The overall impact on profitability was positive for TQM as well as BPR. Subedi and Maheshwari (2007) compare the performance of 15 Malcolm Balridge National Quality Award winners with 30 companies of similar size and in similar industry to find that the award winners witness higher increase in earnings and sales growth suggesting TQM has a positive impact on the bottom line but TQM may not always give companies advantage in cost or commanding a premium price. Garvin (1991) cites May 1990 report of General Accounting Office (GAO) to bring out that there is no one single approach to implementing TQM applicable to all companies under all conditions and that there exists a cause-and-effect relationship between the TQM practices built in the Malcolm Balridge Award criteria and company performance as indicated by employee relations, customer satisfaction, productivity or profitability. Byrnes and Fifer (2010) discuss reducing healthcare costs and improving quality of treatment for cardiac services to find that any hospital's quality improvement efforts require four conditions:

- Passion in the medical director to review and improve physician performance;
- Partnership and quality leadership among departmental leaders (medical and nursing directors);
- Identification of improvement opportunities based on accurate and reliable data;
- Linking performance and quality data to financials.

The role of vendors or suppliers and quality of raw material supplied play a very important role in end product/service quality that is the basus of customer satisfaction or lack of it. Hill, Zhang and Gilbreath (2011) discuss the key factors that lead to success of Lean Sigma programs known to have proven effective in improving quality, productivity, cost, customer satisfaction, sales and profitability in many organization. These include: customizing lean sigma for the organization and its unique features; developing suitable teams and organization structure; using the lean sigma program to develop future leaders of the organization; using best practices in different aspects of Human relations for the lean sigma program; using lean sigma programs and tools to drive product innovation; ensuring that lean sigma projects are fact-based and aligned to organization's strategic objectives besides being well managed using a clear project charter, stakeholder analysis, risk management and high accountability for leaders and teams; ensuring alignment and integration between the lean sigma programme and lean thinking; extending the lean sigma programme to suppliers and other supply chain partners; and validate the benefits of lean sigma projects in terms of hard and soft financial benefits as well as qualitative benefits to ensure continued credibility of the program. Kovach and Cho (2011) discuss applying lean six sigma for continuous

quality improvement in the food industry and reduce variations caused by four factors that include poorly designed machinery for staff and operation environment for food products, random variations inherent to any process, measurement flaws (can be responsible for up to 25% defects in food products), and low quality raw material from vendors/suppliers.

While reducing the number of suppliers has several benefits and is often practiced by successful companies, the challenges involved also require to be addressed. Choi and Linton (2011) discuss the benefits of having reduced number of first tier suppliers for original equipment manufacturers as including better speed of introducing new products, bigger volume discounts, reduced expenses as well as risks in developing/ producing subsystems and reduced management effort for managing a large number of suppliers. The dangers involved are like the other side of the coin and include: (a) Reduced control over costs due to reduced competition at the supplier level (excessive dependence a small number of suppliers); (b) Reduced visibility/ access to technology developments that comes from direct interaction with lower level suppliers leading to delays in integrating such advances into new products to stay ahead of competition; (c) Missing out on market information available with lower tier suppliers. All these can impact the company's ability to operate in a sustainable manner. Shi (2007) examines the different risks that a business process outsourcing (BPO) client faces on account of outsourcing and the causes of outsourcing project failures. These include (a) the client side issues like cost saving mirage where cost savings are over estimated and hidden costs not taken into account, mismatch between client and vendor's pace of technology change or client being low on process maturity to be able to manage the subcontracted assignment in question; (b) vendor side issues like low competence to handle the project, reduced competence due to staff turnover, leakage of confidential information due to weak security practices or poorly stated requirements; and (c) mutual relationship problems as seen through imprecise specifications, misaligned language or culture, difficulties in knowledge transfer or process calibration and architectural styles of the two not being compatible.

Study Hypothesis and Methodology of the Study

The present study relates to how companies handle their operations function by adopting exploratory research based on empirical observations and questionnaire based survey. The primary data collected for this study was based on a structured survey questionnaire. As collecting data from companies is a challenge with companies often not agreeing to share information about their operations, a large number of companies were contacted to seek time for a personal interview and 43 firms provided data. A majority of these firms were located in and around Udaipur though some of them were from states outside of Rajasthan. The data were collected by conducting face to face interviews with the respondents. Senior officials from these firms were targeted as potential respondents for the study. The focus was on collecting information from higher levels of management as this level has better access to accurate data about the organization. This conducting of interviews was done over a period that stretched to over 12 months. In some cases, the respondents refused to answer a question or two on account of confidentiality of data or non availability of good data. From the 46 responses, 10 were rejected primarily due to inconsistency in their responses leaving a sample of 36 firms whose responses were then analysed. The results of this analysis are presented below. Given the size of the sample, the standard normal distribution was used to analyse the data and draw conclusions about the population for a level of significance of 5% ($\alpha = 0.05$).

The following hypotheses were tested in the study:

Conclusions And Recommendations:

The conclusions have been summarized in tabular form below:

HYPOTHESIS	REJECTED/ NOT REJECTED	CONCLUSION
H_{01}: Majority of the companies have a formal process for forecasting annual demand	Not Rejected	Majority of the companies have a formal process for forecasting annual demand
H_{02}: In majority of the cases, factory layouts are optimal with men/material rarely moving back and forth	Unable to arrive at a valid conclusion	Further study required
H_{03}: In majority of the cases, companies depend upon several vendors for their raw material needs	Not Rejected	In majority of the cases, companies depend upon several vendors for their raw material needs
H_{04}: In majority of the cases, raw material inspection is based on documented and formal sampling plans	Not Rejected	In majority of the cases, raw material inspection is based on documented and formal sampling plans
H_{05}: Majority of the companies have initatives aimed improving employee productivity	Not Rejected	Majority of the companies have initatives aimed improving employee productivity
H_{06}: In majority of the companies, production staff regularly meet/interact with their customers	Rejected	In majority of the companies, production staff do not meet /interact with their customers regularly

While the companies suggest adequate levels of planning in terms of annual demand, quality of raw material purchased or focus on productivity through organizational initiatives, the existing of a large number of competing vendors instead of few vendors working closely to understand the company's precise needs and the frequency of meeting/interactions between production staff with their customers represent two areas of improvement for the industry. Companies could consider reducing the number of suppliers weighing the benefits of reduced number of supplier against increased risk and dependence on a smaller number of suppliers. However, the exact number of suppliers would be a subjective decision of the company since the risks of reducing the number of suppliers would be a function of multiple factors that would be difficult, if not impossible, to quantify. As regards, production staff interacting with customers is concerned, there are hardly any risks associated with increased interaction. Thus, there is little hesitation in recommending increased interaction between production staff and customers for improved appreciation of each other's needs and limitations.

Limitations of the study and Scope for Further Research:

The companies that gave responses to the questionnaire are primarily from the textile, cement, mining, oil, and

metallurgy sector. Individual differences between the sectors has not been a part of this study and could be considered for a deeper analysis on the subject. Analysis of research data also brought out one apparent contradiction in layout of the factory. While 13 of the 36 respondents reported that men and material often moved back and forth in the production process, 32 of the 36 respondents said that the factory layout optimized movement of men and materials. The difference is so large that this requires further study to understand how optimized factory layout can still have a very large number of respondents stating that men and materials were moving back and forth in the production process. Finally, the recommendation of reducing the number of suppliers who can work closely with the company needs to be balanced against increased risk on account of greater dependence on a smaller supplier list.

References:

Arora SC (2006), "Product Quality: A Guide for Small and Medium-Sized Enterprises", Working Paper, *United Nations Industrial Development Organization*. This was last accessed at the URL http://www.unido.org/fileadmin/media/documents/pdf/tcb_product_quality.pdf

Azizi A (2007), "Satisfactory Prediction of Performance of Total Quality Management Critical Techniques", Proceedings of the 13th Asia Pacific Management Conference, Melbourne, Australia, 2007, 332-337.

Baldwin John R (2004), "Productivity: The Evolution of Statistics Canada's Propgramme", Economic Analysis Methodology Paper series: National Accounts, Catalogue no. 11F0026MIE - No. 002, ISSN: 1709-7177, ISBN: 0-662-37253-0.

Barnes, David (2008) "Operations Management: An International Perspective", Pub: Cengage Learning EMEA.

Budyansky Arkady (2009), "Improved quality tactic", *Total Quality Management*, Vol. 20, No. 9, September 2009, 921-930.

Byrnes John and Fifer Joe (2010), "The people structure of quality improvement" *Healthcare Financial Management*, March 2010, pp 64-70.

Choi Thomas and Linton Tom (2011), "Don't Let Your Supply Chain Control Your Business", *Harvard Business Review*, December 2011, pp 112-117.

Cole Robert E and Flynn Michael S (2009), "Automotive Quality Reputation: Hard to Achieve, Hard to Lose, Still Harder to Win Back", *California Management Review*, Vol. 52, No.1, Fall 2009, CMR.BERKELEY.EDU, pp 67-93.

Eccles Robert G (1991), "The Performance Measurement Manifesto", *Harvard Business Review*, January-February 1991, pp 131-137.

Eugene Goodson R (2002), "Operations Management, Glossary"

Fazel Farzaneh (2003), "TQM vs. BPR", *Quality Progress*, October 2003, pp 59-62.

Fotopoulos Christos V, Psomas Evangelos L and Vouzas Fotis K (2010), "Investigating total quality management practice's inter-relationships in ISO 9001:2000 certified organization", *Total Quality Management*, Vol. 21, No. 5, May 2010, 503-515.

Garvin David A (1991), "How the Balridge Award Really Works", *Harvard Business Review*, November-December 1991, pp 80-93.

Haas Elizabeth A (1987), "Breakthrough Manufacturing", The McKinsey Quarterly, Spring 1987 reprinted with special permission from the March-April issues of *Harvard Business Review*.

Hammer Michael (2007), "The Process audit", *Harvard Business Review*, April 2007.

Hamilton Bruce E and Smith Preston G (1993), "Implementing TQM on a Shoestring", *Journal of Management Consulting*, Vol. 7, No. 4, Fall 1993, pp 11-19.

Hill Arthur V, Zhang Weiyong and Gilbreath Glenn H (2011), "Discipline Your Lean Sigma Programs", *Industrial Engineer*, June 2011, pp 48-52.

Houseman Susan (2006), "Outsourcing, Offshoring, and

Productivity Measurement in U.S. Manufacturing", Upjohn Institute Staff Working Paper No. 06-130; A revised version of this paper was published in *International Labour Review*, 146 (1-2 : 61-80, 2007. This was last accessed at the URL http://www.upjohn.org/publications/wp/06-130.pdf.

Kovach Tina and Cho Rae (2011), "Better Processes Make Good eats", *Industrial Engineer*, pp 36-40.

Lai Kuei-Kuei, Lui Tju-Hsin and Kao Fang-Chen (2009), "Why is Quality Improving continuously? An Integrated Perspective of Institution Theory and the Resource-based view of the Firm", *Total Quality Management*, Vol. 20, No. 10, October 2009, 1111-1122.

Li Eldon Y, Chen Houn-Gee and Cheung Waiman (2000), "Total Quality Management in Software Development Process", *The Journal of Quality Assurance Institute*, Vol. 14, No.1, January 2000, pp 4-6 and 35-41.

Littlefield, Matthew and Shah, Mehul (2008), Manufacturing Operations Management, The Next Generation of Manufacturing Systems, January 2008 by Aberdeen Group.

Lyons Andrew, Barlow Neil, Rathore Ajay (2001), "Give a Prod to Productivity Measurement", *Control*, May 2001, pp 14-15.

Mitra SK (2009), Presentation on "Effects of Potassium on Quality and Storage life of Fruit Crops", presentation made at IPI-OUAT-IPNI International Symposium, 5-7 November 2009. This was last accessed at http://www.ipipotash.org/udocs/Mitra.pdf.

Mergen Erhan A and Stevenson William J (2009), "Can't fix service quality? Read this", *Total Quality Management*, Vol. 20, No. 681-686.

Ozdemir V Emre and Hewett Kelly (2010), "The Effect of Collectivism on the Importance of Relationship Quality and Service Quality for Behavioral Intentions: A Cross-National and Cross-Contextual Analysis", *Journal of International Marketing*, Vol. 18, No. 1, 2010, pp 41-62.

Psychogios Alexandros G and Priporas Constantinos-Vasilios (2007), "Understanding Total Quality Management in Context: qualitative Research on Managers' Awareness of TQM Aspects in the Greek service Industry", *The Qualitative Report*, Volume 12, Number 1, March 2007, 40-66, http://www.nova.edu/ssss/QR/QR12-1/psychogios.pdf

Rogers Mark (1998), "The Definition and Measurement of Productivity", Melbourne Institute Working Paper No.9/98. It was last accessed at http://melbourneinstitute.com/wp/wp98n9.pdf.

Sahay BS (2005), "Multi-factor productivity measurement model for service organization", *International Journal of Productivity and Performance Management*, Vol. 54, No. 1, pp 7-22.

Samson Danny and Singh Prakash J (2008), "Operations Management: An Integrated Approach", Cambridge University Press, Edited by Samson Danny and Singh Prakash J, Preface pp xxi.

Schreyer, Paul (2001) "Measuring Productivity", OECD Manual, Measurement of Aggregate and Industry Level Productivity Growth. This was last accessed at the URL http://www.oecd.org/dataoecd/59/29/2352458.pdf.

Sebastianelli Rose and Tamimi Nabil (2003), "Understanding the obstacles of TQM Success", QMJ, Vol. 10, No. 3, © 2003, ASQ, pp 45-56.

Sharma Devyani and Bagaria Saurabh, (2008) "Living Total quality Management-(The Agile Way)" This was last accessed at http://www.test2008.in/Test2008/pdf/Devyani%20Sharma%20-%20Living%20Total%20Quality%20Management%20Agile%20way.pdf.

Shi Yuwei (2007), "Today's Solution and Tomorrow's Problem: THE BUSINESS PROCESS OUTSOURCING RISK MANAGEMENT PUZZLE", *California Management Review*, Vol.

49, No. 3, Spring 2007.

Shipluski, Mike (2009), "Resurrecting Manufacturing", *Industrial Engineer*, July 2009, pp 24-28.

Sousa Sergio and Aspinwall Elaine (2010), "Development of a performance measurement framework for SMEs", *Total Quality Management*, Vol. 21, No. 5, May 2010, 475-501.

Subedi Deepak and Maheshwari Suneel (2007), "*Impact of Total Quality Management* (TQM) on Profitability and Efficiency of Balridge award Winners", Delhi Business Review, Vol. 8, No.1, (January-June 2007), pp 55-62.

Wailgum Thomas, "Bridging the Manufacturing Gap", *Business NH Magazine*, March 2010, pp 38-41.

Wiele Van Der A, Wilkiams ART and Dale BG (2000), "*Total Quality Management*: Is It a Fad, Fashion or Fit?" QMJ, Vol.7, No.2, © 2000 ASQ, pp 65-79.

Weinstein Larry (2009), "Achieving Top Quality", *Strategic Finance*, November 2009, pp 46-51.