

## **UNDERSTANDING THE LINKAGE BETWEEN QUALITY, PRODUCTIVITY & SAFETY: A SYSTEMATIC REVIEW OF VARIOUS INDUSTRIES**

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**Abstract:-** *Quality has become synonymous with the organization performance excellence. Productivity is regarded by most producers as one of the most important aspects of manufacturing whereas many safety specialists and academicians have argued that occupational safety is good for business. It has been realized in the last few decades that Quality & Productivity are complimentary to each other. Possibilities to integrate Productivity & Safety are also of increasing topical interest now a days some researchers have claimed that good safety performance leads to good manufacturing firm's operating performance. Today's economic climate characterized by increasing competition & structural turbulence will require a higher combined level of Quality, Productivity & Safety. The study examines the relationship between these aspects to suggest stronger safety climate that will result in better quality products with increased productivity and safety.*

**Key-words:** *Quality, Productivity, Safety, Manufacturing.*

### **1. INTRODUCTION**

#### **1.1 Quality:**

“The totality of features & characteristics of a product / service that bear on its ability to satisfy stated or implied needs.” (ISO 8402:1994)

Needs may include performance, usability, maintainability, reliability, dependability, safety, environment , aesthetics & economy.

Quality may also be defined as satisfying the customer's conformance of products to established quality standards and desired characteristics value of a product as defined by customers .

A work carried out by Golhar et.al,(1999) [24]in Canadian and US TQM firms suggested that the quality performance measures that should be used by manufacturing firms include overall customer satisfaction , customer complaints , customers retention, order processing time, defects produced reliability & cost of quality.

#### **1.2 Productivity:**

The term productivity is economically defined as ratio between output & input.(Mohanty,1998)[39]

As Productivity =output/input;

Output can be in the form of goods produced in terms of increased sales, production value, value added etc.

Input comprises the resources used to produce output like labour, capital etc.

On one hand Productivity is related to utilization of resources on the other hand it is related to the creation of value, therefore good productivity is achieved when activity of an organization & resources in product creation process create value for getting product. It is basically a measure of effectiveness & efficiency of organization in generating output with resources available.

Helms( 1996) [28] indicated that productivity is just a measurement that tells you how well you are doing as producer or how well as a machine. Productivity increases result from the growth in worker's abilities, the amount of capital investment the number & quality products, process inventions &the desire to work towards increasing productivity.

### **1.3 Safety:**

Safety describes the ability of system to function without harm or damage to property or environment.(OHS,1970)

Safety denotes continuing & healthful living without injury. Basically safety is freedom from risk up to a desired acceptable level. The word safety also refers to the precautions people take to prevent accidents, harm, danger, damage & loss. Safety also deals with improvements in working conditions for better health.

Industries have many hazardous situations or potentials of an accident. Many persons work as a team in an industry & safety is of interest to every individual, group of individuals or total organization. Hence safety management is an integral part of industrial management.

## **2.LITERATURE REVIEW**

Worldwide competition & pace of technological innovation simply will not permit distraction from industries' primary task of producing quality products at competitive prices. In present conditions of global business, one has to identify the competitive priorities such as Quality , safety , innovativeness & cost.

### **2.1 Linking Quality & Productivity :**

Present day industries are becoming more and more complex because they have to meet the requirement of increased production rate, high efficiency, optimization & sustainable development. In the remote past the main focus of the manufacturing industries was on productivity. Now a days an organization wants to compete with the worldwide pace of technological innovation. Thus for sustainable development one has to produce quality products as well. Hence possibility to integrate Quality & Productivity is of increasing topical interest in quality management.

Most of the researches have justified that both Quality & Productivity are interrelated. Without Quality product does not survive & without productivity organization does not survive. It has been justified in various case studies that Quality & Productivity are the two sides of a same coin.

Quality includes actual quality data expressed as error rates, cost of quality components, and customer satisfaction, and productivity expressed as net profit as a percent of sale, financial performance includes return-on-assets (ROA) and annual sales growth. Study shows combination of quality improvement and productivity improvement techniques lead to the highest organization performance.

Researchers suggest that both Quality & productivity have a synergic relationship. When Quality deteriorates at either end of the link, productivity reduces.

Deming (1982; 1986)[15] argued that improvements in quality do create corresponding improvements in productivity by reducing cost, errors, rework, and delays.

Both Quality and Productivity movements are pursued in organization to maximum profitability or return on the investment. Improved quality is commonly thought to reduce cost, as doing things correctly the first time eliminates waste. An approach towards improvements, total quality management (TQM), that is popular today has its roots in eliminating waste, reducing variations and continually improving. (Crosby, 1979 , 1984 ; Deming, 1986 , Juran, 1982 , 1989)

Both Productivity and Quality are vitally interrelated. Efforts to improve quality, if effective and efficient, can have significant impact on productivity (Sink D.S., Keats, 1982) [53]

Quality is an important determinant of profitability; high quality & high return on investment usually go together, Quality & market share are related, a strategy of quality & productivity improvement usually leads to increased value, high quality & high productive performers usually win the race. ( Garvin D.A. ,1984)[20]

According to Mohanty (1998)[39], "it is productivity (value addition) and quality (value enhancement) that determine competitiveness . To remain competitive, organization need to integrate and synergize both productivity and quality. Mohanty (1998)[40] points out that productivity and quality have many common ideologies, some of which are rooted in system thinking. Additionally, Mohanty indicates that productivity and quality are both based upon such common characteristics as continuous improvement hard outcome; data based decision making; participative culture; and focus on application of tools, techniques and method for innovation. As a result, Mohanty argues that a focus on quality improvement does create corresponding positive effects upon productivity as well.

Govindaraju M. et. Al.(2001)[25]in their studies confirmed that in the present era of competitiveness related pressures, many organizations continuously seek ways to simultaneously improve productivity and quality. The desired outcome is to provide the customers with the highest quality product on time and at lowest possible cost.

Also Lee et al. (2001) [36] carried out their work on survey data from 373 Chinese companies, and affirmed the positive correlation between quality and productivity performance.

kontoghiorghes C.(2003)[32] in their studies highlighted the close association between quality and productivity performance in a service environment and suggested that investment in quality should indeed result in productivity gains.

An effective way to improve productivity is through total quality improvement, which must be a comprehensive effort carefully linked to the strategic planning process.( Untawale S.P. , Akant S.S.) [60]

Numerous research papers have explored production system design, quality and productivity are interrelated.(Kim J., Gershwin S.B., 2004) [31] According to Pangtey V.S. & Jeyaraman N.[37] as far as software industry is concerned Quality & Productivity are interlinked.TQM is a factor that can improve quality & is a holistic approach towards continuous improvement in all organizations. In the last three decades, the increasing competitiveness of the global market has caused an ever increasing pressure on both Quality of products & Productivity of the systems producing the products. The relevant benefits in manufacturing lines can be achieved from an integrated analysis of quality & production logistics .(Colledani M. et.al. 2009)[11]. Quality management practices affect productivity & profitability in electronics & electrical industry.(Agus A. et.al. , 2009)[2].It is said that QM has the potential to not only increase competitiveness& organizational effectiveness but also improve product quality & organizational performance.Several studies have succeeded in providing evidence that TQM has a positive impact on financial performance & overall performance. (Agus ,2001)[2]. Deming in 1986 argued that improvements in quality do create corresponding improvements in productivity by reducing costs, errors, rework & delays.

A study by Halevy & Naveh (2000) [26] concluded that productivity for the nation of Israel was reduced by a variety of non quality factors in both private & government sectors.

Another case study by Gudgel & Feitler (2000) [22]documented a quality management intervention in a manufacturing firm that resulted in concurrent improvements of 57% in Quality & 81% in Productivity.

According to a research by Westlund A. et.al. (2001), [62] in Swedish pharmacies, employee satisfaction, customer satisfaction, & productivity interact to promote economic return & cost efficiency.

Productivity& Quality are intimately linked. As far as the manufacturing based view is concerned , both Quality & Productivity focus upon the same ends, shortening the production cycle, the cost reduction , preventing defects, conforming to requirements , improving human potentials& finally the value based view where Quality & Productivity are actually defined in terms of cost &price.Both are pursued in organizations to maximize profitability or return on investments. The emphasis is always to provide market leadership, cost leadership, product differentiation & business supremacy.

Quality & Productivity management tends to focus on improving the technological processes & on promoting human- social interactions .To improve such technological processes, both share common view of using innovative tools, techniques & methods.

## **2.2 Linking Productivity& Safety :**

As we move into third millenium the world progresses from mere growth to development, causing Occupational Safety &Health to be mounting concerns . The rapid growth of industries globally has raised concern on safety & health issues at workplace. First concern of any management in industry is to do business profitably .It is important for management to understand that safety & health programming embraces profitable ways of operating effectiveness to achieve corporate goals.[8]

It has been noticed that more attention to safety increases productivity in long run as it reduces direct & indirect costs & therefore improves profit.

Though Productivity is regarded by most producers as one of the most important aspects of manufacturing but many safety specialists and academicians have argued that occupational safety is good for business

As pointed out by Heinrich, lack of safety programs lead to industrial accidents. Accident results in loss of profit as cost of accident includes both direct & indirect costs contributing to the total cost of accidents. More attention to safety increases productivity as it reduces direct & indirect costs & therefore increases profit.

According to the studies carried out in selected industries by Shikdar A.et.al. 2003[51], there exists a significant correlation between productivity indicators and health & organizational attributes. The studies carried out by Das A. et. al. [61] supports the anecdotal evidence that good safety is good business. As safety deteriorates, product quality & plant performance, based on internal & external measures suffers. Employees who do not feel safe at work are not likely to do their jobs as well.

Now a days most developing countries are concerned on improving worker productivity, occupational health & safety (OHS) (Ashraf A. Shikdar, Naseem M. Sawaqed, 2003)[51].

Maudgalya et.al.(2008)[38] in their studies stated that the potential for productivity improvements have been found in many areas of safety. They worked on 18 case studies of industries and concluded that improvement in industrial safety performance results in improvement in plant operations & maintenance which inturn increases productivity.

The research work carried out by Simo Salminen, Jorma Saari (1995)[50], suggested that improving machines & equipments , providing more spacious work sites & initiating better housekeeping would best increase both productivity & safety.

Safety climate has been reported to have an effect on business .Krause (2000)[34] reported that a positive change in safety spills over & affects the entire organization,from productivity & quality to morale & culture.

The studies carried out by Evans D.et.al. (2005) [19] in Wood manufacturing industry revealed that productivity climate is a useful factor in understanding employee safety related incidents. Also, fostering a climate for safety should reduce safety related events & injuries reduce the associated costs. (Demetrice D. Evans et. al., 2005)[19]

Preventing accidents are necessary for improving predictable plant capacity.It is noticed that accidents not only cause human sufferings, but also economic losses (Salminen S. et. al. 1995) [50]. Eliminating accidents, removing causes of production interruptions should be approached from the man as well as from machine side. (Abdul Raouf S.I., 2004) [1].Developing safety conscious workers, making equipment reliable& safe can be used to achieve an increase in productivity.

Choi S.D.et.al.2006, [9]carried outstudies in roofing industries. It was found that lack of safety programs causes both direct & indirect losses to the organization. Loss of productivity & disruption of schedule appeared to be most expensive indirect costs from the survey.

It is extremely difficult to attain company objectives without giving proper consideration to safety.

### **2.3 Linking Quality & Safety:**

In the past few decades the marked improvement in workplace safety levels has resulted in fewer accidents than before, thus making it less effective to argue that money spent on workplace safety is not a good business. As we move into third millennium the world progresses from mere growth to development, causing Occupational Safety &Health to be mounting concerns.To understand the relation between occupational safety performance & quality of a product has now become a subject of elusive undertaking.

The presence of safety culture positively contribute to the business bottom line by eliminating non-profit generating costs & also promote participative & involved workforce. All such things promote Quality manufacturing.

According to Krause (1994) [34] Safety management & Quality improvement are essentially two sides of the same coin. Doing job according to a defined set of standards integrates Quality & Safety, as a net result it increases productivity. Doing job right with high quality & productivity would provide a safer work environment because safer behaviours are exhibited.

It has been pointed out by Anthony et.al. that manufacturing firms which typically used to focus on productivity & yield quality as the primary drivers for influencing operating performance, are now centering attention on occupational safety performance .

Anthony Veltri et. al. [61] collected the data from nineteen manufacturing firms &concluded that good safety performance leads to good manufacturing firm's operating performance. With the decrease in safety performance quality gets worst. When safety perceptions are positive, internal reliability & durability performance improves. Internal reliability & durability are a measure of quality describing internal measures that will show up externally at the customers. Safety perception disconnect is related to operational performance. Safety affects internal measures most. As disconnect increases, & safety climate deteriorates, product quality suffers. There is more scrap & rework as a result of which reliability & durability of products decreases. Such outcomes reveal that employees who do not feel safe in their jobs are not likely to do their jobs well, which is in line with the core concepts of total quality management

The work carried out by Luis M. et al.[17] in construction companies show that there exist similarities between two types of systems: quality system & safety system. An accident is the result of chain of events, in the same way a product or service defect results from a set of non-conforming factors in a production process. It needs to be approached in the same way as defects. Further he concluded that in construction companies safety management can be included in the sphere of quality management, if a TQM approach is adopted, comprising requirements from all the relevant stakeholders, not only the customers.

According to Gretchen A. M.,[30] Safety and quality are a lot alike. He carried out work in agriculture industries & concluded that they have many common characteristics. Also Krause [34], stated that behavior based safety management & quality improvement are the two sides of the same coin.

According to Terry L. Hardy [27] there exists a link between safety & quality; also Quality management principles & cost models can be adapted to analyze safety cost. Although quality is not safety, quality engineering & management techniques help to improve safety; they can improve the bottom line through safety improvements. It concludes that safety improvements can help improve an operator's financial position in large part because most of the safety improvements will likely also lead to quality & reliability improvements

On one hand, a safety-driven risk analysis initiative is based on the elimination of unplanned events that may expose the worker to an unexpected operating condition & cause a higher degree of variability in the process. On the other hand a quality initiative is based on eliminating variability in the process, as unplanned events frequently result in lost time & "out of family" product, which must be scrapped or reworked. Thus, though safety & quality have different outcomes, they both rely heavily on the implementation of process controls which reduce variability in the production process, thus reducing the probability of quality failures as well as probability of safety events.( case studies of Safety & productivity, 2001 ; T. Maudgalya et. al.)[38].By eliminating process variability that can result in unplanned events, the probability of a quality failure as well the probability of safety event, both are minimized. Results support that good safety is good business. Safety & Quality go hand in hand

#### **2.4 Linking Quality, Productivity & Safety :**

Productivity alone cannot depict the overall performance of manufacturing system. Quality, Productivity & Safety has become critical measures of total manufacturing performance of a production system for justifying the investment.

The complete evaluation of economic viability of a system cannot be done on the basis of only one measurement variable such as productivity or profit because it does not help in identifying specific areas that need management's attention.

Workplace safety level improvement has resulted in marked accidents deterioration during past few decades. T. Maudgalya et. al. [38] reviewed 18 case studies of National Safety Council & carried out research to study the impact of safety investment on productivity, quality & cost efficiency. It was concluded in their study that safety as a business objective can assist an organization in achieving long-term benefit of operational sustainability.

Krause [34] reported that a positive change in safety spills over & affects the entire organization - from productivity & quality to morale & culture.

B.F. Muniz et. al. [41] carried out their work on occupational accidents & safety management in Spanish firms. They concluded that accidents have adverse effect on both productivity & quality. Their findings show that safety management has a positive influence on safety performance, competitiveness performance & economic financial performance. On one hand Occupational accidents deteriorates a company's name while on the other hand the decreases the internal working climate. A good occupational safety management can have a positive effect not only on accident rates but also on competitiveness variables and financial performance.

George Berg & Richard Dutmer [6] studied the relationship between Quality, Safety & Productivity in construction companies. They concluded that construction productivity can be improved & projects made more profitable if the installation quality is increased & jobsites are safer.

### **3. RESEARCH GAP:**

The interrelationship correlating Quality, productivity & Safety improvement affecting the operational & financial performance is a gap which needs to be bridged using real life data collection & analysis, thereby analyzing the effect on the overall performance of organization.

Further the relationship between Quality, Productivity & Safety is to be investigated & a method has to be proposed to serve as a decision support to management.

The purpose of this research is to quantify & combine three critical performance measures into one global index.

#### **4. CONCLUSION :**

A thorough literature review reveals that a considerable work has been done to establish the relationship between various performance measures like Quality, Reliability, Productivity, Flexibility, Safety, Risk, Organizational climate, Operating performance & Ergonomics in various industries like oil industries, roofing industries, construction industries etc. The factors which correlate these parameters in concern with the Indian manufacturing industries are yet to be identified.

Driving profitability & sustainable competitive edge requires a broader, more strategic approach to managing the relationship between various parameters like Quality, Productivity, Safety, Cost, Risk, Reliability, Flexibility etc. Determining the priorities is the need of the hour. The research work aims to uncover some of the relationship hitherto unidentified.

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