

Quality and productivity linking methodologies for industries using SPSS

(Statistical Package for Social Sciences)

S.P. Untawale

Assistant Professor & Webmaster
Y.C. College of Engineering
Hingna Road, Wanadongri
Nagpur 441 110
untawale@gmail.com

S.S. Akant

Assistant Professor
Y.C. College of Engineering
Hingna Road, Wanadongri
Nagpur 441 110
ssakant@ycce.edu

Abstract

Worldwide competition and the pace of technological innovation simply will not permit distraction from industries' primary tasks of producing quality products at competitive prices. The profitability, productivity and market share of Indian firms have been adversely affected by many factors, including raw material price increases, a failure to understand customers and markets, incentives, quality procedure implementation and poor use of capital. In the present conditions of global business, most organizations have identified the competitive priorities, such as; cost, quality, dependability, flexibility and innovativeness. These priorities can be considered to be embedded in Total Quality Management (TQM) and Total Productivity Management (TPM).

Productivity and quality are intimately linked. An effective way to improve productivity is through total quality improvement, which must be a comprehensive

effort carefully linked to the strategic planning process. This study examines the factors responsible for providing a major enhancement to the organization by improving its quality and hence productivity.

The objective of this study is to determine how productivity and quality can be integrated and how to formulate a model for this interrelation. The data analysis and conclusions were sought using the factor analysis concept of SPSS (Statistical Package for the Social Sciences). About hundred people connected with quality and productivity was given a questionnaire on 90 parameters with respect to quality and productivity. The subjects felt that improving machines and equipment, strategic planning of resources, involvement and participation of people for monitoring, continuous quality improvement, performance improvement and quality procedure implementation would best increase both productivity and quality. The results showed that it is possible to devise measures, which increase both productivity and quality.

Keywords: *SPSS*, productivity; quality; resource planning; process orientation; quality performance improvement and monitoring; quality procedure implementation.

1. Introduction:

Possibility to integrate quality and productivity are of increasing topical interest in quality management. There are at least two reasons for this interest. First of all, there is a tendency nowadays to shift the responsibility of quality from a separate quality control department to the production line. As production managers and supervisors are mainly motivated by production goals, quality must be integrated into these goals, quality must be integrated into these goals to maintain their motivation. Secondly, not only do bad quality products make the moral loss of the

production people, but also economic losses. Company management could therefore use quality management to reduce costs.

Productivity and Quality

One source of confusion in sorting out best practices in organizational improvement is that very similar activities and initiatives carry a variety of names, depending on whether the major theme is quality, productivity, customer satisfaction, excellence, competitiveness or something else.

Quality, for example, can be defined in a number of ways. Older definitions emphasize fidelity to a set of final product or service standards or specifications worked out by the organization in the past with some reference to the customer's interest. More recent definitions feature the customer's complete satisfaction, excitement, or delight with the final product or service. The most recent definitions accept the need for complete customer satisfaction, but also recognize that the organization itself needs to design, install and operate high quality internal systems that allow customer satisfaction to occur, and the organization must operate in a strategic context that is satisfactory to all stakeholders, not just customers.

Productivity starts from a definition that relates an amount of *physical* output to its related labor input. More recent work has recognized that other inputs (capital, materials, energy, business services) are appropriately the subject of productivity analysis, and that output, especially in support groups or service-providers, may not be clearly physical. Productivity improvement requires balanced attention to the behavioral and managerial systems, in addition to the technical configuration. Output should not be counted unless it is “good” output. Thus we find quite a convergence between organizational productivity improvement and organizational

process quality improvement. Both are aimed at the customer's interest in better (including lower cost) products and services and are achieved through balanced systems improvement (FIG-1).

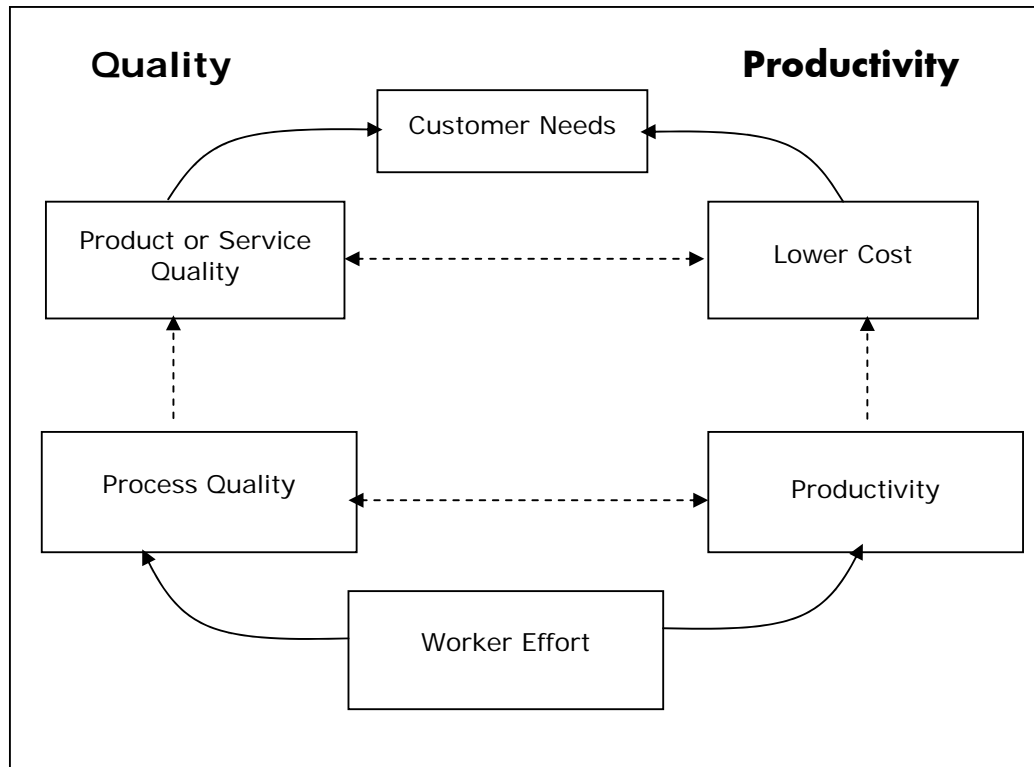


FIG-1

Quality environment

The quality specialist concentrates on the interface between customer needs and product or service quality, but in order to improve quality, is forced to deal with the process quality through providing better tools, training and motivation to the workers. The productivity specialist starts on process productivity for its own sake

but soon finds that the lower cost of the improved process satisfies another important customer need. And, of course, the way to make process improvement is through the worker. Thus there is convergence to a simple four-step integrated process. Workers effort leads to process quality and productivity improvement that allows the reliable creation of products and services that satisfy the customer. Productivity and quality are intimately linked. An effective way to improve productivity is through total quality improvement, which must be a comprehensive effort carefully linked to the strategic planning process. This study examines the factors responsible for providing a major enhancement to the organization by improving its quality and hence productivity. [1]

1.3 Total Quality/Productivity Management

In the present conditions of global business, most organizations have identified the competitive priorities, such as cost, quality, dependability, flexibility and innovativeness. These priorities can broadly be conceived as embedded in Total Quality Management (TQM) and Total Productivity Management (TPM). Whatsoever may be the plausible reasons, but the TQM and TPM has been viewed as two different ideologies in most organizations. [2]

Total Quality Management provides the most popular current example of a comprehensive improvement philosophy. Even this comes in different flavors and sizes, but the “total” In Total Quality Management has four fundamental definitions: horizontal, vertical, intellectual and strategic.

Horizontal means that the unit of analysis is the business process that cuts its way across the organization, starting with external suppliers, passing through operational and/or support groups of the organization, and ending with the final

customer.

Every person or subgroup making up part of the process has one or more immediate suppliers and one or more immediate customers, most of these being "internal" to the organization. Each supplier-customer interface should exhibit the care and attention normally associated with external contacts. Departmental membership is an organizational convenience but should not influence the effort put into a process.

Vertical total means that all levels of the organization have adopted the basic quality ethic and apply it in the processes they touch or otherwise influence. Quality is not the exclusive interest of production workers, or executives, or first-line supervisors. Problem-solving teams are often made from several organizational levels. There is a quality way to issue legal opinions and to advertise the products, just as there is a quality way to make and sell the products.

An intellectual total means that the thoughts and models that drive the improvement process have been derived from and reflect the best managerial, behavioral and technical thinking. It is easy to spot imbalance as executives describe their organization's efforts. It is easy to talk about "empowering" workers, for example, but if the organizational structure is still designed for control of job processes, there won't be much voluntary redesign by the work force. Process control statistics will be of little use if no one understands them.

Finally the subject of the improvement effort must be that which is strategically important to the organization. Improvement efforts can start out with pilots or "practice" initiatives, but ultimately there must be a linkage between the main subject matter of the various improvement teams and the priority need of the

organization as identified in the strategic planning exercises. That is where the Quality Circles of the late 1970's and early 1980's fell short of the original expectation. They were generally established within single departments and chose their improvement issues from the immediate neighborhood rather than being prefocused on issues (typically cutting across departments) that were of high priority to the organization.

What all Total Quality Management (or, for that matter, Total Productivity Management) efforts have underlying principles as continuous improvement, management-by-fact, and "every work station a control point." The intent is that each worker at each level takes upon himself/herself to do the work right the first time, never pass on bad work, and strive to make improvements in the work processes based on data they receive (or generate themselves) concerning "their" processes.

The objective of the present study was to determine personnel opinions of measures, which, on one hand, increase productivity and, on the other hand, improve quality; the personnel were questioned in connection with the investigation of quality parameters in their workplace. The problem of how productivity and quality can be integrated was also given detailed attention. The differences between different groups were also examined. Finally, the general factors behind the presented measures were analysed with a factor analysis.

Every organization makes an attempt to strive for excellence, such a mission to attain excellence in the long run requires creation of value through profit, growth and survival. The value is always linked to the bottom line performance measures like consistent performance, price/cost leadership,

flexibility, responsiveness, differentiation etc. The strategic thrusts that may be needed to achieve bottom line results in the competitive environment have to be imparted through total quality and total productivity management. It is already established that quality is an important determinant of profitability; high quality and high return on investment usually go together, quality and market share are related, a strategy of quality and productivity improvement usually leads to increased value, high quality and high productive performers usually win the race in the competition. [3]

2. Methodology

The objective of this study is to determine how productivity and quality can be integrated and how to formulate a model for this interrelation. About hundred people connected with quality and productivity was given a questionnaire on 90 parameters with respect to quality and productivity. The data was reduced for investigating interdependences using the technique of factor analysis. This analysis means the study of interrelationships among variables in an effort to find a new set of variables, fewer in number than the original set of variables, which express that which is common among the original variables. This technique attempts to simplify complex and diverse relationships that exist among a set of observed variables by uncovering common dimensions or factors that link together the seemingly unrelated variables, and consequently provides insight into the underlying structure of the data.

2.1. About SPSS (Statistical Package for the Social Sciences)

SPSS (Statistical Package for the Social Sciences) is a data management and analysis product produced by SPSS, Inc. in Chicago, Illinois. Among its features are modules for statistical data analysis, including descriptive statistics such as plots, frequencies, charts, and lists, as well as sophisticated inferential and multivariate statistical procedures like analysis of variance (ANOVA), factor analysis, cluster analysis, and categorical data analysis. SPSS is particularly well suited to survey research, though by no means is it limited to just this topic of exploration.

SPSS is a modular product. That is, it requires the Base System module to run, but you may wish to use other modules (typically Advanced Statistics and Professional Statistics) to carry out specific analyses not supported by the Base product.

Varimax rotation of the factor analysis of the measures							
Item	Factor *						
	I	II	III	IV	V	VI	VI
FACTOR I: Process Orientation (including SPC), Strategic Planning of Resources							
Knowing the overall mission of the organization increases Quality	0.817	-0.086	0.062	-0.415	-0.136	0.045	0.040
Quality improvement may be achieved with recognition of technological changes	0.661	-0.251	-0.296	-0.303	0.151	0.196	0.433
Quality is also improved by regular review of work produced	0.885	-0.008	-0.010	0.159	-0.066	0.210	0.301
Continuous improvement in work will increase Quality	0.771	-0.275	-0.071	-0.367	0.083	-0.091	0.193
Resource utilization by the people in the work unit keeping the quality emphasis leads to improvement in quality.	0.840	-0.028	-0.149	-0.272	0.082	-0.260	-0.054
Timely delivery of materials and supplies, as ordered increases Productivity	0.781	0.052	0.422	-0.257	0.053	0.062	0.043
Monitoring complaints about product/services/work increases Productivity	0.612	-0.239	0.125	0.489	-0.092	0.435	-0.250

Monitoring complaints about product/services/work increases Quality	0.773	-0.099	0.179	-0.007	-0.239	0.496	0.122
For setting organizational improvement priorities, evaluating the change in the business strategy increases Productivity than quality	0.788	-0.364	0.123	-0.079	-0.309	-0.118	-0.060
Adequately training organizational members to use the equipment they have increases Productivity	0.779	-0.055	0.229	-0.235	-0.105	0.060	-0.378
Prior to purchasing an equipment, planning for the procedure and identifying the user, increases Productivity	0.821	-0.158	-0.008	-0.335	-0.139	-0.217	0.089
Organizations finances monitoring increases Quality	0.721	-0.168	0.091	0.234	-0.193	0.280	0.226
Comparison of performance data with goals, standards, or objectives of the organization improves Quality	0.804	0.136	0.095	-0.206	-0.375	-0.161	0.191
Increasing responsibility to efficient workers will increase quality than productivity	0.687	-0.308	0.457	-0.192	0.350	0.114	-0.043
Use of statistical process control charts or graphs to track data over time in an organization increases Productivity	0.863	-0.298	0.105	-0.078	-0.231	-0.114	-0.101
FACTOR II: Good quality improvement practices/Organizational improvement policies							
Planning in advance might improve Productivity along with quality	0.032	0.593	-0.263	-0.097	0.002	0.507	-0.349
The structure of the organization makes it easy to focus on Quality	0.121	0.632	-0.196	0.482	0.153	-0.074	-0.278
Timely delivery of materials and supplies, as ordered increases Quality	0.241	0.734	0.260	0.298	0.110	-0.152	0.167
Recognition is more significant in improving quality than productivity	-0.329	0.698	-0.089	-0.028	0.295	-0.327	0.010
Paying fairly for the work done increases Productivity	-0.051	0.593	0.504	0.001	0.012	0.201	0.318
The use of surveys of some/all members of the organization in order to determine whether improvements in quality are needed increases Productivity	-0.061	0.551	-0.346	0.010	-3.180	0.380	-0.322
Acceptance of quality performance improvement by all of the organizational members increase Productivity	0.426	-0.563	-0.549	0.230	0.021	0.100	-0.144
For organizational improvement priorities, instituting training programs increases Productivity	0.128	0.792	-0.483	0.014	-0.019	0.149	-0.100
Organizations finances monitoring increases Productivity	0.181	0.834	0.211	0.181	-0.270	0.051	-0.013

FACTOR III: Quality performance improvement/Planning for new technology, effective communication & timely output							
Regular review of the quality of work produced increases Productivity	0.388	-0.207	-0.732	0.139	0.283	-0.253	0.108
Quality and productivity policy helps in increasing Quality	-0.047	0.164	-0.715	0.355	0.413	0.135	-0.064
Effective communication channels between departments in the organization leads to improved productivity	0.495	0.380	0.620	0.058	0.089	0.327	0.056
Effective communication channels between departments in the organization leads to improved quality	0.225	0.359	0.632	0.132	0.092	0.456	0.060
Accountability of people for success/failure improves Productivity	0.266	0.224	-0.550	0.282	0.357	0.277	-0.184
Acceptance of quality performance improvement by senior management and middle management increases Productivity	0.216	0.305	-0.534	0.131	0.349	0.445	-0.005
Acquiring recent technological improvements (equipment, materials) increases Productivity	-0.018	0.528	0.713	-0.047	0.162	0.252	-0.001
Formal submission of good ideas by organizational members through a suggestion system will improve Productivity	0.291	-0.506	-0.524	0.020	0.106	0.169	0.131
FACTOR IV: Continuous quality improvement & monitoring concerns/Communication, utilization & understanding of quality							
Planning ahead for technological changes (such as new development in computer software) may improve Productivity	0.454	0.190	0.021	-0.632	0.338	-0.182	0.289
Keeping concern for the need for quality will increase Productivity	0.278	0.478	-0.273	0.529	0.297	0.239	-0.350
Necessity of awareness about quality will increase the overall quality	-0.217	0.605	-0.173	0.618	0.072	0.342	-0.091
Giving top priority to continuous improvement of work will increase Productivity	0.543	-0.001	-0.135	0.600	0.031	0.265	0.383
Right tools, equipment, and materials in work unit to get the job done increases Productivity	0.582	0.038	-0.233	0.529	0.409	0.081	-0.185
Monitoring of Quality improvement concerns at least on a quarterly basis increases Productivity	0.249	-0.011	-0.283	0.712	0.340	0.408	0.017
FACTOR V: Involvement & participation of people for monitoring							

Taking feedback about the quality of work from customers increases Productivity	0.656	-0.247	0.032	-0.039	0.577	-0.201	0.245
Teamwork in the organization bring about an increase in Quality.	0.380	-0.036	0.242	0.142	0.723	0.303	-0.093
Analysis of data concerning goal/objective accomplishments, in order to determine whether improvements in quality are needed increases Productivity	0.054	0.381	0.113	-0.251	0.502	0.361	0.148
Mandatory procedures increases Quality	0.227	-0.176	-0.064	-0.102	0.631	-0.456	0.064
Holding people accountable for success/failure improves Quality	0.127	0.368	-0.054	0.344	0.646	0.351	0.282
Monitoring of Quality improvement concerns at least on a quarterly basis increases Quality	0.082	-0.251	-0.039	-0.047	0.713	0.610	0.015
Conducting customer surveys about product/services/work on regular basis increases Quality	0.022	-0.485	0.367	0.360	0.574	0.200	-0.021
Prior to purchasing an equipment, planning for the procedure and identifying the user, increases quality	-0.125	0.507	0.385	0.177	0.548	-0.108	0.006
FACTOR VI: Quality procedures implementation							
Paying fairly for the work done increases Quality	-0.145	0.263	0.140	-0.033	0.585	0.565	0.041
Keeping a tracking system in the organization for relevant quality information increases Quality	0.533	-0.256	0.253	0.242	0.245	0.593	-0.274
Reward to creative thinking in the organization increases Productivity than quality	0.392	-0.176	0.005	-0.495	0.240	0.576	0.153
FACTOR VII: Improvement in existing quality standards							
Increase in quality may be obtained by the quality of work feedbacks by customers	0.584	-0.438	0.131	0.106	0.151	-0.210	0.578
Proper organizational structure makes it easy to focus on Productivity	0.592	-0.095	0.112	0.134	0.200	0.035	0.718
Improving an already acceptable quality record increases Productivity than quality	-0.161	0.331	0.029	-0.103	0.063	0.317	0.680
* I = Process Orientation (including SPC), Strategic Planning of Resources; II = Good quality improvement practices/Organizational improvement policies; III = Quality performance improvement/Planning for new technology, effective communication & timely output; IV = Continuous quality improvement & monitoring concerns/Communication, utilization & understanding of quality; V = Involvement & participation of people for monitoring; VI = Quality procedures implementation; VII = Improvement in existing quality standards							

3. Key Results

The analysis concluded that improving machines and equipment, strategic planning of resources, involvement and participation of people for monitoring, continuous quality improvement, performance improvement and quality procedure implementation would best increase both productivity and quality. The results showed that it is possible to devise measures, which increase both productivity and quality. The study can be modeled as shown in the Fig. 2.



FIG-2

4. Discussions

Productivity and quality are intimately linked as shown in the Fig-2. An effective way to improve productivity is through total quality improvement, which must be a comprehensive effort carefully linked to the strategic planning process.

The factors responsible for improving both productivity and quality, deduced from the study starts from process orientation that involves strategic planning of available resources. This process orientation begins with understanding the overall mission of the organization and recognition of latest technological changes. The work produced must be regularly reviewed with a bend towards continuous improvement in the work procedure. Utilization of resources by the people working on the job keeping an aim to deliver the good in time leads to a perfect process. Monitoring complaints about the product and services and evaluating the change in the business strategy for improvement in process leads to an increase in productivity along with quality. The process orientation also involves imparting training to organizational members who are going to work on the existing equipment along with identifying people for working on newly procured equipment leads to improvement. A thorough comparison of the performance data with goals, standards or objectives of the organization making use of tools as statistical process control charts or graphs helps in process orientation in turn leading to quality and productivity improvement. The second factor identified is good quality improvement practices and organizational improvement policies adopted by the organization. This factor gains its standing by advance planning at all levels of the organizational structure, keeping in mind the timely delivery schedule as per the orders. This

factor is improved by paying adequately for the work done along with keeping a track of the quality improvement using the method of surveys. There must be awareness and acceptance of quality performance improvement priority throughout the organizational levels.

The third factor leading to simultaneous improvement in productivity with quality is the quality performance improvement. This factor can be broadly conceived as planning for new technology, effective communication and timely output technique. Taking regular review of quality of work produced, having a well-defined quality and productivity policy, keeping an effective communication channel between the departments and accountability of people for success as well as failures leads to quality performance improvement.

There must be an acceptance of quality performance improvement at senior and middle management level of the organization along with participation of organizational members by means of formal submission of good ideas in the form of suggestion system will improve the parameters.

The fourth factor deducted is continuous quality improvement and monitoring concerns. This factor involves planning ahead for technological changes, keeping concern for need of quality, giving top priority to continuous improvement of work; use of right tools, equipment, material for the job and monitoring the quality improvement concerns at least on a quarterly basis lead to improvement.

The fifth factor is the involvement and participation of people for monitoring. This factor activates by taking feedback about the quality of work from the customers, analysis of the data concerning objective accomplishments for determining the requirement of quality improvement, implementation of

mandatory procedures, measuring accountability, conducting customer surveys and planning for procedures prior to purchasing a new equipment.

These factors equally affect the productivity and quality.

The sixth factor is implementation of quality procedures. This factor involves the major parameters as fair payments for the work done, a tracking system in the organization for relevant quality information and rewards to creative thinking in the organization.

The seventh factor is improvement in existing quality standards, which may be obtained by the quality of work feedbacks by customers, proper organizational structure and improvement in already acceptable quality record.

Improvement flows from executive commitment, assessment, and improvement in team activity. Assessment is often done poorly but a thorough and objective assessment involving customer identification, benchmarking, and training needs analysis will provide the basis for major enhancement of an organization.

5. References

- [1] Carl G. Thor, 1992, Linking Productivity and Quality improvement, Productivity Journal Vol.33 No.1, p.p.10-14
- [2] Mohanty, R. P., Lakhe, R. R., 1994 "Understanding TQM", Journal of Production Planning & Control, Vol.5, No.5.
- [3] Garvin, D.A., 1984, "What does Product Quality Mean?" Sloan Management Review, Fall
- [4] Everett E. Adam, 1994, Alternate quality improvement practices and organization performance, Jr., Journal of Operations Management 12, 27-44

BIODATA OF SPEAKER

NAME: Sachin Untawale
DESIGNATION: Assistant Professor & Web Master, Dept. of Mechanical Engineering
ORGANIZATION: Yeshwantrao Chavan College of Engineering, Hingna Road, Wanadongri, Nagpur, INDIA
Tel: +91 (712) 2745415, +91 (7104) 237919, 236868
Fax: +91 (7104) 232376
Email: untawale@gmail.com
Mobile: +91 9423054164

FIELD(S) OF SPECIALIZATION:

- Quality & Productivity
- Computer Applications
- Database Management Systems

ACADEMIC QUALIFICATION(S):

- 1989 Bachelor of Engineering, SRKN Engg. College, Nagpur, India
- 1996 Master of Engineering, Visveswaraya National Institute of Technology, Nagpur, India
- M.I.E, The Institution of Engineers (India)
- Submitted Ph.D. thesis.

WORKING EXPERIENCE(S): 19 Years

- August 1989 till date working with Y.C. College of Engineering, Nagpur, India