ISSN 2229-5518

Technical Audit – "A Throughfare of System Perfection"

Prof. S.B. Srivastava

Abstract: When the design parameter of any equipment is fixed, it indicates the beginning stage of any equipment and at this stage; it is not possible to find out the exact requirement which the equipment has to fulfill. For utility equipments, it can not be anticipated what will be the actual operating requirements. The engineering concept during commissioning of the equipment is well guided by the experts and their guidance is limited for only a short period. With the passage of time and change in environment, the operating condition of the equipment changes. At this stage, the performance of the equipment/industries shows a downward trend. Sometimes, the system, situations and circumstances of working change. It affects the operating condition of Industries or Institutions even incurring huge losses. Every work is followed by certain technicality and if the technicality is deviated, the out come will affect performance. This is the main reason behind the continuous analysis and methodical approach to improve performance and to reach towards system perfection. Technical Audit is a "tool" to create awareness, develop skills, integrate knowledge, upgrade technicality, increase profitability, productivity: improve working conditions and quality of life. Technical Audit delights Owners of industries and also the Customers.

Technical Audit is one of the most important *Improvement Tool* for big Industries and Multi National Companies. It is a well known fact that the improvement aspect always exists everywhere. Only there is the need to identify what should be that improvement. Small-small improvements are not the big things but all the small improvement together makes a heaven. Technical Audit is a systematic approach to study and identify the improvement for system perfection, productivity and profitability.

Index Terms: Technicality, Profitability, Efficiency, Consumption, Performance, Owner's delight, Standardisation, Idle Spindle, Data, Technical Audit.

Abbreviations: AICTE – All India council of Technical education, ESP – Electro-static precipitators, DM – Demineral, ETP – Effulient treatment plant, DG – Diesel Generator, NDT – Non destrictive testing, RH – Relative humidity, ETME – Emerging trend in mechanical engineering, MMM – Madan Mohan Malviya, DC – direct current, et al – and others

---

INTRODUCTION

Technical Audit is one of the audits where the facts are searched; facts are studied; facts are indicated and suggested. It is not a fault finding Audit. When any Institution / Industry / Enterprise are launched, the situations, circumstances and conditions are different. With the passage of time all these situations, circumstances and conditions are altered. In the starting of any unit, certain practices are stared which are economical at that time but after the some periods, the same practice becomes uneconomical and a burden on the employer. The burning example of this fact is that at the starting of Grasim Nagada (a chemical factory), a system was formed that every employee will be given some liters of milk free of cost when he will come on duty. Since at the starting time the TOTAL OPERATION was on a small scale but after the passage of time the capacity was enhanced to a manifold extent, the number of employees has also increased to a manifold extent. The new plant chemical division has also opened side by side. Now all the employees are demanding for milk and multi millions are expended as the cost of milk. Similarly, for cement plants, earlier the wet process manufacturing was feasible but due to technological development the feasibility of wet process cement units became outdated. The units which have not adopted dry process are now closed. Technical audit gives the right suggestions at right point, at right time for thoroughfare to system perfection and increase profitability.

In technical Audit the technicality of every system, equipment, process, stores and inventories, spare parts, administration, commercial activities and each inputs are studied with out any prejudices. During the study the areas where the improvement is possible is highlighted.

Literature Survey:

Survey of the research literature indicates that either the research have been directed out on General Auditing Principles or procedures and not on the Effectiveness of Quality Audit itself. This has also been confirmed by Rajendran and Devadasan (2005). The only exception is Health and Milne (2002) and Franka Piskar (2006) who have given some contribution to Value Added Quality Audit.

The contribution of Zutshi and Sohal, (2002) represent the practical experience of eight prominent auditors with respect to adoption of EMS/ISO 14001 (a quality system) by Australian Organizations. The issues and benefits relating to the quality auditing processes are discussed. The aims of research by Terziovski et al (2002) were to examine the role of non financial auditors and the audit process with respect to the existing ISO 9000 Quality Standards. They concluded that conformance auditing has a role in the early stage of quality system implementation.

However, the effectiveness diminishes as the quality system matures. It has been observed by research results that 89% of the organizations firmly follow implementation of audit recommendations. Audit results, showing thrust on quality audit is recognized [Beecroft, (1996); Pivka and Ursi, (1999); Seddon, (2001); Heras et al., (2002); Magd and Curry, (2003); Fuentes et al., (2003); Pan, (2003); Piskar, (2003); Pivika, (2004);

Marki, (2005)], for their theoretical and empirical work. Bhatt et al. (2004) worked on quality and cost improvements in neo-

natal prescribing through clinical audit. By completing the audit cycle, improved therapeutic care has been achieved with more accurate drug monitoring target and reduced the drug cost. Similar findings have also been reported by Wickramasinghe and sharma (2005), Smith and Manna (2005), and Souillard et al. (2005). Oliverio Mary Ellen (2007) has given thrust to Audit Quality in U.K. Financial Report Counsel in Feb. 2007. S. Nagata et al, (2008), has given valuable information for improving Product quality through Audit System in April 2008..

Duraisamy, P. & James, Estelle & Lane, Julia & Jee-Peng Tan (1997). in their topic "Is there a quantity–quality tradeoff as enrollment increase, evidence from Tamil Nadu, India, have high lighted that increased enrollment of student requires increased resources and also it decreases the quality. Deolalikar, Anil & Hasan, Rana & Khan, Haider & Quibria, M.G., 1997, have pointed out in their research topic "Competiveness and human resource development" University Library of Munich, Germany, revised 1997, have the importance of human resource in quality education. David de la Croix & Matthias Doepke, 2007, in their topic "To segregate or to integrate- education, politics and democracy", said that it is the responsibility of Government to provide quality education to their citizen and resources for education should be managed by the Government. Alderman, suggest in their paper that the roll for private delivery of schooling services to poor households in developing countries is of importance if college maintains good resource. Puja Vasudeva Dutta, 2006, suggests about the gap between the wages of teachers and its effect on quality education. Monazza Aslam, 2003, finds in their research the difference in government and private education in Pakistan and quality. Geeta Kingdon & Francis Teal, 2004, points out that the performance of students is related with the wage of the teachers. Geeta Gandhi Kingdon, 1997, describes the condition of female education in India.

Srivastava, S.B., March 2009, "Technical Audit for Improvement of Educational Quality" (A case study of Indian Engineering colleges where Customer itself is the Input and Final Product), has given good thrust on Technical Audit. Srivastava, S.B., October 2009, "Quality and Profitability Improvement by Technical Audit" a case study of process plant published in "International Journal of Computer Science and Engineering", indicates the importance of Technical Audit in process plant.

Srivastava, S.B., October 2009,"Technical Audit to Improve Maintenance Effectiveness" Published in proceedings of National Conference, "Engineering Trend in Mechanical Engineering, ETME 2009 at MMM Engineering. College Gorakhpur, .sponsored by "AICTE", is one of the important eye openers for industry owners. Again Srivastava, S. B., January 2010, "Manpower Assessment of a Chemical Plant" by Technical Audit – a case study, published in International Journal of "Engineering, Science and Technology" indicating the importance of technical Audit.

.

The present work aims at giving more value to the Technical Audit which will result in the profitability of the organizations e.g. audit of equipment effectiveness, system effectiveness, process effectiveness, method audit etc for reaching a step forward towards Zero defect in product quality. A case study of a Chemical Industry is presented below for the same purpose

Method of Technical Audit:

In Technical Audit, first the study of plant, process, equipments, systems, manpower, material, cost, inventory etc. are studied for which the suitable formats are designed and requested with unit head to arrange the data as required in formats. There are basically five areas for technical audit. These areas-

- Pertaining to process engineering.
- Pertaining to mechanical engineering.
- Pertaining to electrical and instrumentation engineering
- Pertaining to plant safety, environment protection and security
- Pertaining to stores, inventories, purchases, consumption pattern, penalties, personnel, administration, sales and marketing.

Different formats are designed for collecting the data of different areas. These formats may relate with the following-

- Air compressors performance data
- Water softening plant performance data
- Cooling tower performance data
- Refrigeration plant performance data
- DM plant performance data
- Humidification plant performance data
- Data on DG set operations
- Details of compressed air dryers
- Performance data of pollution control equipments
- Consumptions of bearings
- Stores inventory analysis
- Life value analysis of high value items
- Consumption of lubricants
- Repeated job order on workshop
- Analysis of major and repeated breakdowns
- Capacitor check sheet
- Plant lighting data
- Data for motor sizing
- Data on transformer oil
- Transformer loading data
- Generator performance monitoring sheet
- Safety performance data
- Recruitment data
- Training and development data
- EPF, Gratuity payment records and absenteeism, labor turnover records etc
- Performance of sales and marketing management

All the data are studied one by one keeping the aim where improvement is possible and the unit can achieve savings in terms of cost, quality, system perfection and easiness in operation. It is also studied where capacity enhancement is possible with the same resources or with a small investment.

Scope of Technical Audit: The scope of technical audit is related with process, mechanical, electrical, instrumentation engineering and management. Some of the important point of technical audit is as under-

Process Engineering Performances:

- Performance / thermal efficiency of thermic oil heater, boiler and auxiliaries, blowdown heat recovery, ash disposal, performance of ESP, coal receipt and consumption with respect to the moisture and ash content.
- Treatment of raw water, circulating cooling water, DM water and boiler feed water, water conservation, performance of softeners, chillers and ETP, consumption of chemicals.
- Handling and storage of raw materials, inventory of raw materials and finished goods.
- Performance of DG sets, thermal efficiency, specific consumption of fuel and lubricants, capacity utilization, spare parts consumptions, use of additives and filtration systems.
- Performance and maintenance of cooling towers, specific energy consumption of cooling towers and corrosion rate.
- Review of efficiency of common equipments like pumps, compressors, fans, blowers and heat exchangers.
- Specific coal consumption in kiln, burner problems, life of refractory lining.
- Recovery, recycling, handling storage and disposal of waste products/toxic/hazardous materials.
- Defects observed in fabrics, man hours consumed in mending.

Mechanical Engineering Performances

- Study of mechanical break downs (both affecting and not affecting the production), preventive action taken by the units, suggestion to prevent the breakdowns.
- Lubricants storage and consumptions, conservation measures, reclamation of used oils, variety reduction.
- Stores inventory levels, consumption of high value items, stock checking, material receipt, inspection and issue procedures, surplus and non moving items, rejection rate of material received, stock out positions, specially indented items lying unused.
- Review of material handling methods, maintenance of material handling equipments.
- Review of ware housing of raw materials and finished goods, packing cost.
- Activities carried out in mines bench marking, crusher operation and breakdowns analysis, Diesel and oil consumptions, working of shovels, dumpers, loaders etc., performance of crushers.
- Workshop facilities availability, machine utilization, pending work orders.
- Documentations (manuals/catalogues) record keeping and procedures.

Electrical Engineering Performances:

- Maintenance, operation and breakdown studies of electrical equipments (both affecting and not affecting the production), check lists, cost of spares consumed, safety work permit systems.
- Electrical tripping/outage analysis protection system, selection and testing of relays.
- Power distribution system, average and peak time charges, specific energy consumption, checking of bus bar sizing, switch gear coordination.
- Maintenance of stationary batteries, DC (direct current) supply for emergency and auxiliary oil pumps.
- Power factor improvements, working of capacitors, energy loss in capacitors.
- Motor burning and loading analysis, motor winding procedures, NDT facilities.
- Transformers and breakers, make rating, loading, protections, breakdowns and action taken, oil quantity and quality analysis, die-electric strength.
- Study of variable speed drive, details of make, type and control provided installation details, problem experienced and overall performance.
- Review of plant lighting, ventilation and cooling system.

Instrumentation and Control Performance:

- Analysis of tripping caused due to instrumentation faults, Functioning and tuning of auto loops, checking of protection interlocks.
- Review of maintenance practices and schedule of periodic checks for instruments and control systems, study of instrument breakdowns, (both affecting the production and not affecting the production) and suggestion to minimize the same, cost of spares consumed.
- Analysis of condition monitoring and NDT carried by the units, maintenance records and data for future reference.
- Evaluation of process safety controls provided for critical and hazardous services, Check whether any control are by- passed, and effect on operation.

Safety and environment Performance:

- To review the safety audit report for compliance of recommendations and present status, safety appliances and fire fighting system provided implementation of safety work permit system.
- Preparation of emergency plant operation manuals, availability of general exit and escape routes, communication and first aid in case of emergency, emergency handling procedures.
- Handling, storage and testing of gas cylinders, statuary requirements by explosives and factory act.
- Measures taken to reduce noise levels.
- Furnace Oil/diesel and naphtha oil) storage and handling, fire hazards if any.

To justify the need for technical audit in Industries or organizations, an example of single point lesion is given below.

A single Point Study of Technical Audit:

This study was conducted at a reputed textile unit of Aditya Vikram Birla Group of Industries. In the industry there were 30 Ring Frame (the name of a machine which performs the spinning activities). All the ring frames were in operation and the production of yarn was continuous.

Production Problem: A technical audit team visited a reputed textile plant and found that incidence of "idle spindles" on ring frame was high. This resulted in lower production, even with 5% under booking by parts, the yarn shortage persisted.

Revenue loss was substantial as there are 30 ring frames in the unit and each ring frame is having 444 spindles. On full doff each spindle contains approximate 3600 yards of yarn per bobbins. It indicates that if a single spindle remains idle throughout one doff, say in case of 30s count, there will be a loss of 0.07 Kilograms of yarn per bobbins. This will fetch a revenue loss of Rs. 5000/- per annum.

Causes of Idle Spindles: Technical audit team identifies the following reasons /causes for idle spindle-

- Defective simplex roving
- Shortage of back stuff
- Bad working condition due to ambient relative humidification and temperature of the shed.
- Use of non – standard machine accessories e.g. spacers, aprons and ring travelers etc.
- Displacement of spindle tapes due to miss alignment and jamming of Jocky pulley.
- The design of machine creel in case of double roving feed for fancy yarns.
- Reluctance of piecers to restart idle spindles and fitters to attend the idle spindles, negligent working of tape – man.
- Fiber blends not suited to the system of spinning.

Cause and effect diagram and pareto chart for above problems are as under-

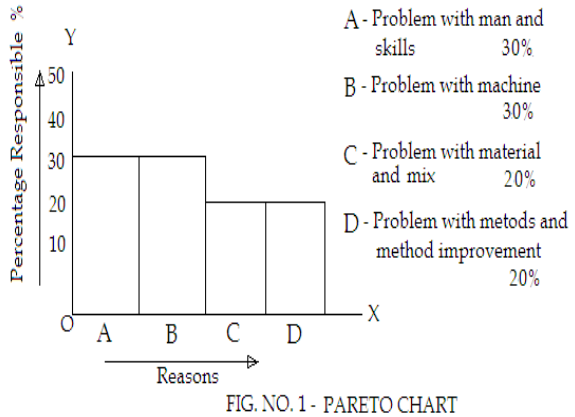

FIG. NO. 1 - PARETO CHART

The Pareto Chart shown in Fig. No. 1 shows that there is the problem regarding the method and method improvement and this problem is responsible 20%; there is the problem regarding the material and material mix i.e. different proportions of fibers are not being mixed properly or their proportion is not correct. This problem is also responsible 20%. Similarly the problem with machine is responsible 30% and the problem with manpower is responsible for 30%.

The other reasons for less production are as under-

a) Defective simplex roving
b) Shortage of back stuff
c) Bad working condition
d) Problem with accessories
e) Displacement of tape
f) Creel design problem
g) Problem with personnel
h) Blending problem of fiber

The above problems are illustrated with a cause effect diagram or fish bone diagram as shown in Fig. No. 2; where each cause of the problems is mentioned. This diagram is also called as "Ishikawa diagram" after the name of its inventor.

In this diagram different causes and its effect is described. The importance of cause is also studied. It is established by this diagram that which reason for the problem is more important and where more attention is to be paid to control the problem.

Here, it can be seen in Fig. No. 2, that the most important problems are with the machine and materials itself. If these two problems are controlled, the problem will be sorted out by more than 75%.

The rest of the problem related with man and method can be controlled easily with proper coordination and training. The cause and effect diagram as shown in Fig. No. 2 shows that there is a major problem with blending of fibers and defective simplex roving. Also there is shortage of back stuff. The second major problem is with the machine itself. After analyzing the problem in detail, following suggestions were given by the technical audit team-

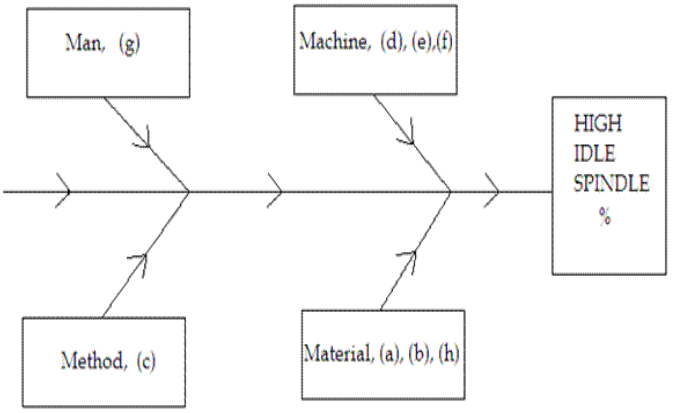

FIG. NO. 2 - CAUSE AND EFFECT DIAGRAM

- Prevent the production of defective simplex roving bobbins and control the sick roving spindles of simp-

lex machine.
- Whenever the back stuff shortage problem is faced, adopt the practice of cutting the rings.
- Ensure the timely replacement of accessories according to the spun count and use the standard accessories.
- Training to machine cleaner and tape man should be given properly for correct work practice to control the jamming of the jockey pulleys and tape displacement along with the related activities.
- For the production of fancy yarn, to feed double roving, the creeling system may be modified suitably to avoid idle spindles. It was observed that generally, the spindles remain idle due to non accommodation of required numbers of bobbins on the existing creel.
- Some suitable measures should be adopted for motivation of fitters, piecers and tape man so that they do their jobs more conscientiously.
- Standardizations of fiber blends should be done so that it should be suitable for cotton spinning system.

To implement all the suggestions at one time was difficult and for the implementation at one time major shutdown was to be taken. So it was decided to carry out the implementation of suggestions in phases. The implementation of suggestions have been taken in the following ways-

- Firstly the identifications of spindles. The quality of simplex roving was improved by controlling the sick roving spindles of all simplex machines.
- Working of air conditioning system thoroughly. The ambient RH and temperature controlled by installing the additional equipment for controlling RH and temperature.
- Ring Frame cutting or advance planning of spindle utilization started to utilize maximum number of ring frame spindles on all the machines.
- Standard accessories or spare parts e.g. spacers, synthetic aprons and ring travelers were procured and there use started.
- The suitable training schedule framed and on site training to cleaner, tape man and other related workmen have been given. It was told them practically that how to control the jamming of jocky pulleys, the displacement of tape and alignment of the equipment parts.
- One additional row of creeling pegs has been installed on either side of the ring frame as such to avoid bobbins to feed roving to all ring spindles for production of fancy yarn.
- Motivation plan to concerned employees and worker were framed and implemented. It was clearly told the role of each worker for betterment of the organization.
- Fiber blends e.g. tow cut polyester and flax etc. were taken off the product mix by the authorities due to their non suitability to be spun on cotton spinning system.

After the implementation of the valid suggestions given by technical audit team, marked improvements in the ring frame production were observed. This has resulted the parta (profitability on sale/produce) under booking from 5% to 3% i.e. there is gain +2%. Also the attitudes of the workers have been changed. The detail of cost benefit analysis is as under-

The purta under booking due to idle spindles before technical audit : 5 %

After implementing the suggestion given by technical audit team, purta under booking : 3 %

Thus gain in total production : 2 %

Considering average production per day as 5500 Kilogram, gain in production : 110 Kgs

Taking the contribution rate per kilogram : Rs 26/- Kgs

Gain per day = 110 X 26 = Rs. 2860/-

Gain per month = 28600X 30 = Rs. 85800/- : Rs. 85000/-

The gain per annum = 85000 X 12 = Rs 1020000/-, Say = Rs. 1.02 millions per annum

The out come benefit from Technical Audit is Approximately Rs. 1 Million per annum

Conclusion:

Conclusion from his research papers comes out that Technical Audit will increase the Customer and Owner's DELIGHT and gives a NEW thrust to the organization. The success of Technical Audit depends up on the implementation of audit report and management's ability to adopt it. The Technical Audit assures the increased knowledge about the Product Quality and Profitability. The point wise conclusions are as under:

- The study clearly shows that the Technical Audit helps to improve the product quality and profitability of the organizations.
- The Technical Audit gives a thrust on management by considering one parameter at a time.
- It also compares the existing parameters with the best possible parameters or with the ideal parameters (If required the comparisons are also made with the recently developed parameters).
- The outcome of Technical Audit findings provides some suitable and favorable changes in the organization's workings which result in the improved product quality, profitability and utilization of equipments.
- Timely adoption of Technical Audit will benefit both, the customer and the producer.
- The effectiveness of the organization improves due to change in employees attitudes.

- Technical skill of people will increase as new ideas are given by technical audit.
- The reliability of the product quality will increase.
- The profitability of organization will increase and waste will be eliminated or reduced.
- The working environment will improve due to reduction of failures.
- Standardization of spares is possible by technical audit. Idle running of equipment will come down

Bibliography:

1. Bhatt, J., Nye, C. and K Kirkbride, V, (2004), Quality and Cost Improvement in Neonatal Prescribing through Clinical Audit, Training for quality, Vol. 4. No. 3, pp. 14 - 25
2. Duraisamy, P. & James, Estelle & Lane, Julia & Jee-Peng Tan, (1997). "Is there a quantity-quality tradeoff as enrollments increase? Evidence from Tamil Nadu, India," Policy Research Working Paper Series 1768.
3. Deolalikar, Anil & Hasan, Rana & Khan, Haider & Quibria, M.G., (1997). "Competiveness and Human Resource Development," MPRA Paper 2819, University Library of Munich, Germany, revised 1997.
4. David de la Croix & Matthias Doepke, (2007). "To Segregate or to Integrate: Education Politics and Democracy," Working Papers 60, ECINEQ, Society for the Study of Economic Inequality.
5. David de la Croix & Matthias Doepke, (2007). "To Segregate or to Integrate: Education Politics and Democracy," Working Papers 60, ECINEQ, Society for the Study of Economic Inequality.
6. Franka Piskar, (2006), Quality Audits and their Value Added, Int. J. Services and Standards, Vol. 2, No.1, pp. 69 – 83
7. Fuentes et al, (2003), ISO 9000 Based Quality Assurance Approaches and their Relationship with Strategic Analysis, Int. J. of Technology Management, Vol. 14, No. 2 / 4, pp. 277 – 286
8. 12. Geeta Kingdon & Francis Teal, (2004). "Does performance related pay for teachers improve student performance? Some evidence from India," Development and Comp Systems 0409009, EconWPA
9. Heath, P. and Milne, D. (2002), makes Quality Everyone's Business: A Case Study of Partnership in Primary Care, Int. J. of Service and Standards, Vol. 1, No. 2, pp. 193 – 205.
10. Heras, I., et. al, (2002), ISO 9000 Certification and Bottom Line; A Comparative Study of Profitability of Basque, Region Company, Int. J. of Service and Standards, Vol. 1, No. 3, pp. 358 – 378.
11. How to asses Technological Standards of a Company, Nov. (1991) Published in International Journal of Production Economics, by Elsemeir Science BV, pp 41-47.
12. Marki, M, (2005), Innovation Process and Quality Development, Managerial Auditing Journal, Vol. 18, No. 4, pp. 313 – 322.
13. Magd, H., and Curry, A., (2003), ISO 9000 and TQM; Are they complimentary or Contrary to Each Other. Int. J. of Innovation and Learning, Vol. 1, No. 1, pp. 36 – 44.
14. Matthias Doepke & David de la Croix, (2004). "To segregate or to integrate: education politics and democracy," 2004 Meeting Papers 390, Society for Economic Dynamics.
15. Oliverio, Mary Ellen, (2007), Promoting Audit Quality, U. K. Financial Report Counsel Discussion Papers, CPA Journal Feb. 2007
16. Pivika, M, (2004), ISO 9000 Value Added Auditing, Int. J. of Technology Management, Vol. 14,No. 2 / 4, pp. 277 – 286.
17. Piskar, F., (2003), The Influence of Quality Certification on Slovenian Companies and their Continuing Efforts in this Field, Indl. management and data system, Vol. 104, No. 7, pp. 558 – 566
18. Pan, J.N., (2003), A Comparative Study on Motivation and Experience with ISO 9000 and ISO 14000, New York, NY: McGraw – Hill.
19. Piviki, M, and Ursi, D., (1999), Slovenian Experience in ISO 9000 Certification Process, The Quality Management And Business Excellence, Vol. 15, No. 3, pp. 345 – 355.
20. Puja Vasudeva Dutta, (2004). "The Structure of Wages in India, 1983-1999," PRUS Working Papers 25, Poverty Research Unit at Sussex, University of Sussex
21. Rajendran, M. & Devadasan, S.R., (2005), Quality Audits; Their Status, Pprowess, and Future Focus, Quality Audits; Their Status, Prowess, and Future Focus.
22. Srivastava, S.B., (2009)"Technical Audit to Improve Maintenance Effectiveness" Published in proceedings of National Conference, "Engineering Trend in Mechanical Engineering, ETME 2009 (October 12-13), at MMM Engineering. College Gorakhpur, .sponsored by "AICTE" p.p. 209-213.
23. Souillard, M. et. Al, (2005), A Flexible Framework for Managing temporal Clinical Trial Data. Int. J. of Electronic Health Care, Vol. 1, No.4, pp. 413 – 426.
24. 36. Srivastava, S.B., February 21 & 22, (2003), "Energy Savings for Efficient Steam Utilization", Published at "International Seminar" Proceedings on "Energy Optimization in Process Industries" organized by Indian Institute Of Social Welfare and Business Management, Kolkata, p.p.150-163.
25. Srivastava,S.B., (2009)"Technical Audit for Improvement of Educational Quality" (A case study of Indian Engineering colleges where Customer itself is the Input and Final Product), published in National Journal, "CHEMENVIRO", Vol. (5),, March 2009, at Babu Banarsidas National Institute of Technology and Management, p.p. 8 -16.
26. Seddon, J., (2001), Quality Audit, After the Quality Audit, 2 nd. Edition, Milwaukee, WI, ASQ Quality Press.
27. S. Nagata, et al, April, (2008), Improving Product quality through Audit System, visited on July 3, 2008 at site, http://www.fujitsu.com/domloads/MAG/vol44-2/papers10pdf
28. Smith, A. D. and Manna, D.R, (2005), E – Recruitment of Patients for Clinical Trials, Int. J. of Educational Management, Vol. 18, No.4, pp. 266 – 279
29. Terziovski, M. et al, (2002), From Conformance to Performance and Continuous Improvement Using ISO 9000 Quality System Standards.
30. Wickramsinghe, N. & Sharma, S. K., (2005), Key Consideration for Ensuring High Quality, J. Management and Enterprise Development, Vol. 1, No. 3, pp. 208 – 217.
31. Zutsi, A. and Sohal, A.S., (2002), Env. Management System Auditing: Auditors Experience in Australia, Int. J of management and Enterprise Development, Vol. 1, Nos. 3/4 pp. 441-457.

Prof. S.B. Srivastava
Principal
College of Engineering and Technology,
Sitapur Sksha Sansthan, Sitapur, U.P., India.
Email: sb_srivastava1@rediff.com