Productivity methodologies, tools, and techniques

Total productive maintenance: A productivity management tool—Dr. S.K. Chakravorty

Total productive maintenance (TPM) is a practical knowledge-based management tool for attaining world-class manufacturing standards with high productivity, profitability, and customer satisfaction. It aims at maintaining the optimal condition of physical assets with zero breakdowns, zero defects, zero accidents, and zero losses. It emphasizes company-wide employee participation in achieving continual improvement in the management of physical assets, leading to perfection in plant performance. This approach demands cultural change in the organization and encourages teamwork.

TPM strives at increasing an operator's value-added time by eliminating six big losses, which reduce labor and equipment productivity and create waste. These losses are: equipment breakdowns; set-ups and adjustments; idling and minor stoppages; reduced speed; reduced yields; and scrap generation. The first two losses are "down-time losses" and used to evaluate "availability (*A*)." The third and fourth losses are "speed losses" and used to determine "performance efficiency (*P*)." The fifth and sixth are "quality rate (*Q*)" losses. When *A* is the ratio of net operating time over loading time, net operating time = loading time – breakdown and set-up. Loading time = planned production time – breaks – planned maintenance time. *P* is the ratio of actual production achieved over production quantity expected to be produced in a given time. *Q* is the ratio of the number of good products over the total number of products produced during a given period of time.

Based on the evaluation of the above losses, overall equipment effectiveness (OEE) is determined. OEE indicates the scope of productivity improvement available in a process. Assuming that a process involves 8 hours of loading time, 1 hour each for breakdown and set-up time, among 500 parts produced by a machine with a rated capacity of 100 parts/hour, 50 parts will be rejected and 50 parts recycled. Then the value of *A* is 75%, *P* is 83%, *Q* is 80%, and OEE is only 50% (OEE = $A \times P \times Q$). Thus productivity can be doubled in the above process by eliminating the losses, as shown in the Figure.

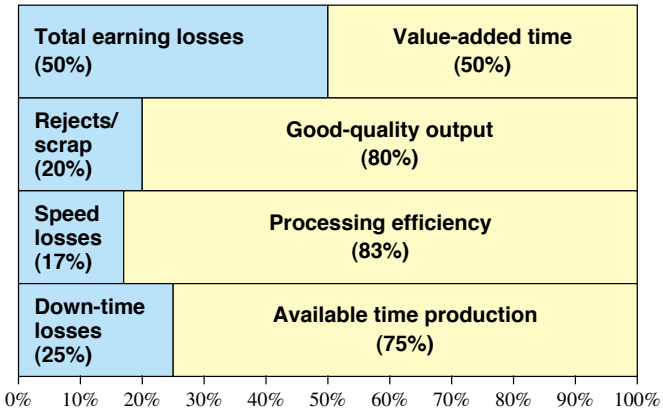

Figure. Effectogram.

TPM implementation involves eight fundamental development activities: focused improvement designed to minimize targeted losses by cross-functional teams; autonomous maintenance by involving operators in asset care; planned maintenance by designing adequate preventive and predictive maintenance plans; education and training by designing equipment-related skill development programs; early management of equipment that is easy to maintain; quality maintenance ensuring defect-free production; involving support divisions by streamlining information flow; and ensuring safety and environmental management through asset care. TPM has been implemented successfully in different industries worldwide. Benefits have been achieved in the form of greater productivity, improved quality, reduced costs, improved delivery, greater safety and environmental integrity, and improved employee morale. Some 120 manufacturing organizations in India have implemented TPM.

As an example, the 14 major benefits achieved by implementing TPM in Birla Tyres Ltd., can be summarized: 1) total production increased by 30%; 2) operating profits by 96%; 3) value-added productivity by 10%; 4) OEE by 20–30% in different plants; 5) equipment failure frequency/month was reduced from 1425 to 80 times; 6) scrap as a percentage of raw material decreased by 37%; 7) customer complaints fell to zero; 8) manufacturing cost per ton of production was reduced by 3%; 9) specific power consumption decreased by 13%; 10) maintenance cost was reduced by 22%; 11) administrative expenses fell by 14%; 12) raw material inventory dropped by 37%; 13) work in progress was reduced by 17%; and 14) the accident rate decreased to nearly zero. In addition, about 3,500 suggestions have been received and implemented per year, and more than 551 kaizen activities have been undertaken annually. These results show that TPM implementation can transform organizations culturally, provide a competitive edge by focusing on all types of cost and waste reduction, and can be used as a productivity management tool.

Contributed by Dr. S.K. Chakravorty, Deputy Director General of the National Productivity Council, India. Dr. Chakravorty holds a PhD in Production Engineering and has published extensively and been invited to address numerous national and international seminars on TPM/industrial maintenance topics. Dr. Chakravorty conducts frequent consultancy and training assignments in TPM and related areas.

To provide easy reference to productivity-related terms including methodologies, tools, and techniques, the APO developed the p-Glossary, available on its website (www.apo-tokyo.org).