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THE VOYAGE FROM QUALITY TO TOTAL QUALITY MANAGEMENT

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ABSTRACT

The purpose of this paper is to trace the evolution of quality in the field of industry, especially its trajectory of growth from an abstract idea to a fully-developed action plan. Through the diachronic approach that examines the four industrial revolutions, the author reaches a clear definition of TQM and then applies the diachronic and synchronic approach in order to understand the process whereby selected prize-winning industries implement it. The findings reach the clear conclusion that innovation and quality are the hallmarks of TQM and indicate the signposts established by these organizations. The implications drawn by the author would be tough to ignore for any organization interested in achieving quality across the board. For the practical field of industry and its daily struggle, the study clearly suggests some ways and means of implementing TQM holistically. The paper also transmits a strong message for any community interested in quality by clearly outlining ways and means of achieving it. Experts and stakeholders from industry will find a lot of meaningful data in this study as will managers who are searching for solutions to the dilemma of TQM.

Keywords: Total Quality Management, Deming, Innovation, Improvement, Innovation

Introduction

Quality is an integral part of human society. The manufacturing sector ideally, should spell quality. The evolution of quality has been a crucial part of industrial growth. Today, quality has become a way of life in every field. The term 'quality' means differently for different people. According to experts, quality is fitness for use. It is the 'conformance to specifications'. If the product meets the needs of the customer and fulfils expectations, it is of good quality. The desire for improvement in quality services harks back to the time when prices were based on the quality of the products. The history of

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modem quality assurance spans over two centuries as well as several cultures, continents and major historical events.

The Early History of Quality

The First Industrial Revolution (1760 - 1820) saw the introduction of new manufacturing process. During this period, the manufacturing processes shifted from hand production to machine production. Process innovation led to change in the manufacturing process by introducing new chemical and iron production systems. Since this revolution began in Great Britain, most of the innovators were British.

The Second Industrial Revolution (1870- 1914) is also called the Technological revolution. This period was a period of Product innovation. The introduction of the railway network, telegraph and new products for electric power generation and transmission were the highlights of this era. In this era, the manufacturing industry shifted to 'moving line' and mass production technology. In the 1920s and the 1930s, the concept of evaluating manufacturing processes to promote product quality entered the American system. Statisticians in Germany and America applied statistical methods for analyzing and controlling quality variations in the product manufacturing process. In 1924, Walter A. Shewhart of Bell Telephone Laboratories developed a statistical chart for the control of product variables in manufacturing, an innovative milestone that is considered to be the beginning of an approach to quality known as Statistical Quality Control (SQC). When Shewhart later wrote a handbook called Statistical Method from the Viewpoint of Quality Control in 1939, it gained recognition from both statisticians and engineers. Working alongside Shewhart and contributing to his ideas in the 1920s were H.F. Dodge and H.G. Romig, both of Bell Telephone Laboratories, who developed the area of acceptance sampling as a substitute for full product quality inspection (Blinder. A, 2010).

According to Kolb,K.Rachel & Hoover,L.Marcy,(2012),During World War II (1939-1945), the concept of Quality Management emerged in order to take care of the emerging need for high quantity in military products with very stringent quality standards. To institutionalize the concept of quality management, the American Society for Quality Control was formed (ASQC). Gradually, the inspection department became the department of Quality Engineering (QE) or Quality Assurance (QA). These departments started working on process compliance to ensure in-built quality. Four factors were identified which could lead to in-built quality, as follows:

1. Man
2. Machine

3. Method
4. Material

The Technology / process department started laying down production processes on the basis of these four parameters. The focus of QE/QA shifted from inspection of products to the auditing of the manufacturing process. The technical experts believed that if the process is laid down correctly and is followed as planned, without any short cuts, the quality of the product will automatically remain within the designed parameters.

The different individuals and movements associated with the evolution of quality as a desirable goal have shaped the current state of quality management and quality engineering and demonstrated the difference that a quality-driven approach can make in delivering a successful product.

The Third Industrial Revolution saw innovation in information and communication technology. During this era, internet services were launched. More emphasis was laid on the generation of energy and renewable sources of energy. 3D printing using Nylon or plastic based material was introduced (Bhatt Ashish, 2017).

The Fourth Industrial Revolution has taken the manufacturing world by storm. Entrepreneurs, multinational companies, corporate houses and start ups are adopting new technology to improve their products. The newly innovated digital technology is taking root in all type of business. Technological breakthroughs have taken place in robotics, Artificial Intelligence, nano-technology and bio technology. According to Michael Dell, Founder of Dell Inc. 'the next Trillion dollars will be earned with data-for our customers and our industries'(BhattAshish, 2017)..

Like the revolutions that preceded it, the Fourth Industrial Revolution has the potential to raise global income levels and improve the quality oflife for populations around the world. To date, those who have gained the most from it have been consumers able to afford and access the digital world; technology has made possible new products and services that increase the efficiency and pleasure of our personal lives. Ordering a cab, booking a flight, buying a product, watching a film, or playing a game any of these can now be done remotely. The revised demands of the consumer mean more hard work for the producer. Offering all these services seamlessly makes its own demands on the assurance of continued and consistent quality levels. The need of the hour is not piecemeal implementation but holistic application of Total Quality Management across the board (Bhatt, Ashish, 2017).

Review of Literature

Total Quality Management (TQM)

Kujala, Jaakko and Paul Lillrank, (2004) emphasis that Total Quality Management is a fundamental shift from the earlier Quality Control methodology. While Quality control is the compliance of the process and predefined parameters, TQM calls for Quality Engineering. TQM is an organization-wide technique that creates an environment in which high quality products and services are delivered to the customers.It is a management technique to achieve long term success through customer delight.

Kujala, Jaakko and Paul Lillrank, (2004) further state that Quality Management is promoted more effectively and efficiently by implementing TQM activities within the business operation as concrete tools. The objective of TQM is to improve the performance of the organization through continuous improvement, customer focus and total participation. TQM incorporates three elements; one, Philosophy (Point of view), Promotion (Approach) and Method (Tool). It is a philosophy of total integration of the business to achieve the required result. The goal is to achieve greater efficiency and effectiveness, lower operating cost and increased market share. Deming Edward (2002) stated that the approach ofTQM should be based on Fourteen Points on Quality Management, a core concept while implementing total quality management.

Mr. Deming's 14 Points are as follows:

I. Create consistency of purpose for improving products and services.

II. Adopt the new philosophy

III. Cease dependence on inspection to achieve quality

IV. End the practice of awarding business on price alone, instead, minimize total cost by working with a single supplier.

V. Improve constantly and forever every process for planning, production and service.

VI. Institute training on the job.

VII. Adopt and institute leadership

VIII. Drive out fear

IX. Break down barriers between staff areas

X. Eliminate slogans, exhortations and targets for the workforce

XI. Eliminate numerical quotas for the workforce and numerical goals for management.

XII. Remove barriers that rob people of pride of workmanship, and eliminate the annual rating or merit system.

XIII. Institute a vigorous program of education and self-improvement for everyone.

XIV. Put everybody in the company to work for accomplishing the transformation

Tools help to identify, analyze and assess qualitative and quantitative data that is relevant to the business. Though providing a definition of the concept of TQM is not simple, researchers have suggested their own definition according to their belief, view and experience. Although there is no universally accepted definition, there have been attempts to arrive at a description of total quality management.

The International organization for standardization (ISO) defines TQM as "A management approach of an organization centered on quality, based on the participation of all its members and aiming at long term success through customer satisfaction and benefits to all members of the organization and society".

Expected Outcome through Implementation ofTQM

Through implementation of TQM activities, a number of benefits can be obtained leading to improvement in corporate performance. Some of them are:

- Strong corporate constitution
- New Product development/ Creation of additional value
- Quality improvement/ Prevention of problems
- Productivity enhancement/ Cost reduction/ Shorter Delivery
- Capability enhancement
- Efficient Human resource development

Evolution of Total Quality Management: TQM timeline & History of TQM

1920s	First seeds of Quality management planted as Principles of Scientific Management. New approach of Production management introduced wherein emphasis was on improvement in productivity through time and motion studies
1930s [	Methods for Statistical analysis and control developed
1950s	Dr. Deming taught the concept of TQM to Japanese companies by implementing Statistical analysis and Control Dr. Crosby promoted the concept of Zero Defect for improving quality
1960s [	Quality management system became a part of Quality Movement
Today	TQM is the name of the philosophy of a broad and systematic approach to manage organizational quality Quality standards such as ISO 9000 series and quality award programmes such as Deming prize and Malcolm Baldridge Nationa 1 Quality award specify principles and processes that comprise TQM. Holistic application of Total Quality Management across the board is the need of the hour

(Adapted: History of Total Quality Management published by the American Society of Quality)

The Impact ofTQM

According to ruSE (2017), once TQM takes over a business, it moves at a rapid pace and speedily disrupts old, well-entrenched procedures. The implementation of TQM in real time can be observed from the outside but is rather tough to predict or understand from the inside. Even for the industry movers and shakers who implement it, the experience of disruption and movement can get the best of all preparation and orientation. Indeed, across all industries, there is clear evidence that the TQM technology and reform that underpin the Fourth Industrial Revolution are having a major impact on business.

On the supply side, many industries are seeing the introduction ofnew technologies that create entirely new ways of serving existing needs and significantly disrupt existing industry value chains. Disruption

is also flowing from agile, innovative competitors who, thanks to access to global digital platforms for research, development, marketing, sales and distribution, can oust well-established incumbents faster than ever by improving the quality, speed or price at which value is delivered. Major shifts on the demand side are also taking place, such as growing transparency, consumer engagement and new patterns of consumer behavior. These factors force companies to adapt the way they design, market and deliver products and services. These factors bring along their own inbuilt demands; for example, new patterns of consumer behavior are dependent on the increasingly built upon access to mobile networks and data.

According to Prahalad,C.K. and Krishan, M S.(2008), a key trend is the development of technology-enabled platforms that combine both demand and supply to disrupt existing industry structures, such as those we see within the "sharing" or "on demand" economy. These technology platforms are rendered easy to use by the Smartphone and can convene people, assets and data thus creating entirely new ways of consuming goods and services in the process. In addition, they lower the barriers for businesses and individuals to create wealth, altering the personal and professional environment of workers. These new business platforms are rapidly multiplying into many new services, ranging from laundry to shopping, from chores to parking, from massage to travel. At the core of every such satisfactory implementation lies the philosophy ofTQM.

In the future, these developments will lead to a supply-side miracle, with long-term gains in efficiency and productivity. Transportation and communication costs will drop, logistics and global supply chains will become more effective and the cost of trade will diminish, all of which will open new markets and drive economic growth.

Innovation in the digital world has also changed customer requirement, which has in tum changed the way business is carried out. The major changes required to maintain quality, thus boosting the competetive spirit and driving growth in the manufacturing and service industry in India are:

1. Reducing time to market:

The present day consumer expects that the manufacturer should develop new products at a much faster rate and lower cost without compromising on quality. The impact of reduced new product development time can be used to define any actual field related problems and carry out any changes required in the basic design of the product in the early phase of testing. This allows the manufacturer to launch the fully tested product in the market at the right time,just when the market is demanding. Reduction in the time

to market leads to better chances of earning more revenue as the penetration of the product is more. The industry is utilizing latest engineering tools like Virtual reality, Artificial intelligence and 3D printing techniques to improve the product development cycle and meet customer / market requirements.

2. Enhancing manufacturing flexibility:

In the present buyers' market, customer needs vary from customer to customer. Since the Indian market is diversifying, requirements have become more complicated. The best example is the availability of different models and variants of automobiles available in the market. The availability is such that it meets the buying capacity, the driving comfort, safety requirements, luxury preference, color preference and seating capacity of each buyer. All these variants have been manufactured based on the feedback received from present and prospective buyers. Though requirements are varying, the market demands that the product is available at minimum price in the best quality. Thus, the industry needs to have an agile/ cellular manufacturing process based on a computer-integrated manufacturing system. To meet this scenario, the manufacturing industry is adopting flexible manufacturing processes so as to customize their product. The batch size for producing a product has become 'one'. Some of the features which can improve efficiency of adaptable/ flexible manufacturing processes are:

- A highly automated process with computerized monitoring of quality and productivity.
- Automated supply chain management system to coordinate with suppliers and sub suppliers to maximize efficiency at minimum cost
- Minimum change over time to reconfigure manufacturing process as per the requirement.
- Making manufacturing process readily scalable to meet market requirement without loss of productivity at minimum cost
- Ensuring availability ofinformation on real time basis.

Due to the liberalization of the economy and the entry of Multi National companies in India, the competition has become fiercer. Most Indian manufacturers have adopted new technology themselves or have collaborated with market experts to adopt the same. Due to less manufacturing cost in India as compared with some developed countries, Indian manufacturers have a leading edge over their competitors.

3. Improving quality of the product:

The Indian industry has realized that they need to ensure quality of the product/ services from the early

stages of introduction. If they are able to ensure quality, it will help them to keep the digital fac;ade of their business secure and robust. This will, in turn, improve the brand image of the product. As the customer requirement for the product has changed over a period of time, so has perception of the quality of the product. The closed loop quality system has been put in place with the use of digital technology. Luckily, with the introduction of digital technology, quality standards have improved through efficient business processes. However, too much emphasis on operational efficiency can lead to a reduction in quality standards. In reality, some companies compromise on quality standards in an effort to improve efficiency through non efficient use of resources, limited resources or untrained manpower. The government has introduced various checks on the performance of products, which the manufacturer is required to adhere to. This has led to further improvement in quality adherence.

India's Story

The year 1999 was an important landmark in the economic history oflndia. Sharma,Pankaj,(2017) says that the Indian Government declared the New Economic Policy (NEP), emphasizing liberation, privatization and globalization. Some of the objectives behind the launching ofNEP were:-

1. Plunge Indian Economy into the arena of globalization and give it a new thrust in market orientation.
2. Move towards higher economic growth rate and build sufficient foreign exchange reserves.
3. Permit the international flow of goods, services, capital, human resource and technology without restrictions

Hence, the equity participation of foreign investors was raised from 40% to 100%, barring some sectors. Consequent to this major change in economic policy, the Indian industry went through the following changes:-

1. Signed Technical and financial collaboration with foreign industries.
2. Setup of wholly owned subsidies by MNC's
3. Adopted management philosophies of successful foreign companies.

A large number of Indian companies either collaborated with or adopted the policies of Japanese organizations. While promoting exports, the companies realized that the Quality of Products and services decide their fate. While improving the quality by adopting new tools and techniques, the industry also focused on improving their brand image. This encouraged the companies to strive for winning Quality Awards. Quality awards have thus become a status symbol for many companies. There

has been a many fold increase in these awards worldwide, based on methodology, type of industry, size of industry. TQM has been adopted by most of the companies as a catalyst to achieve results. Winning quality awards has become a certificate for maintaining the quality of their products and services. Though a number of such awards have penetrated into the business environment, only a few have been able to retain their stamp of prestige. The Deming prize is one of them.

JUSE (2017) declared the following Indian organizations as the winners of the Deming prize and Deming Grand prize (formerly known as the Japan Quality Medal) in the last decade:

Deming Certification/ Prize

- 2008 - Tata Steel Limited
- 2010 - National Engineering Industries
- 2011 - Sanden Vikas (India) Limited
- 2012 - Mahindra & Mahindra (FES) Swaraj Division
- 2013-RSB Transmission India Ltd.
- 2014- Mahindra & Mahindra Powerol Business
- 2016-AshokLeylandLtd(Pantnagar)
- 2017-AshokLeylandHouserUnit-II
- 2017 - CEAT India Ltd.

Deming Grand Prize

- 2012-Tata Steel Limited
- 2013-RaneBrakeLiningLtd.
- 2015- National Engineering Industries Ltd.

Research Methodology

The study of some organizations who have won the Deming certification in the last five years has concluded that these organizations adopted TQM methodology with special emphasis on innovation. The methodology resulted in overall business improvement.

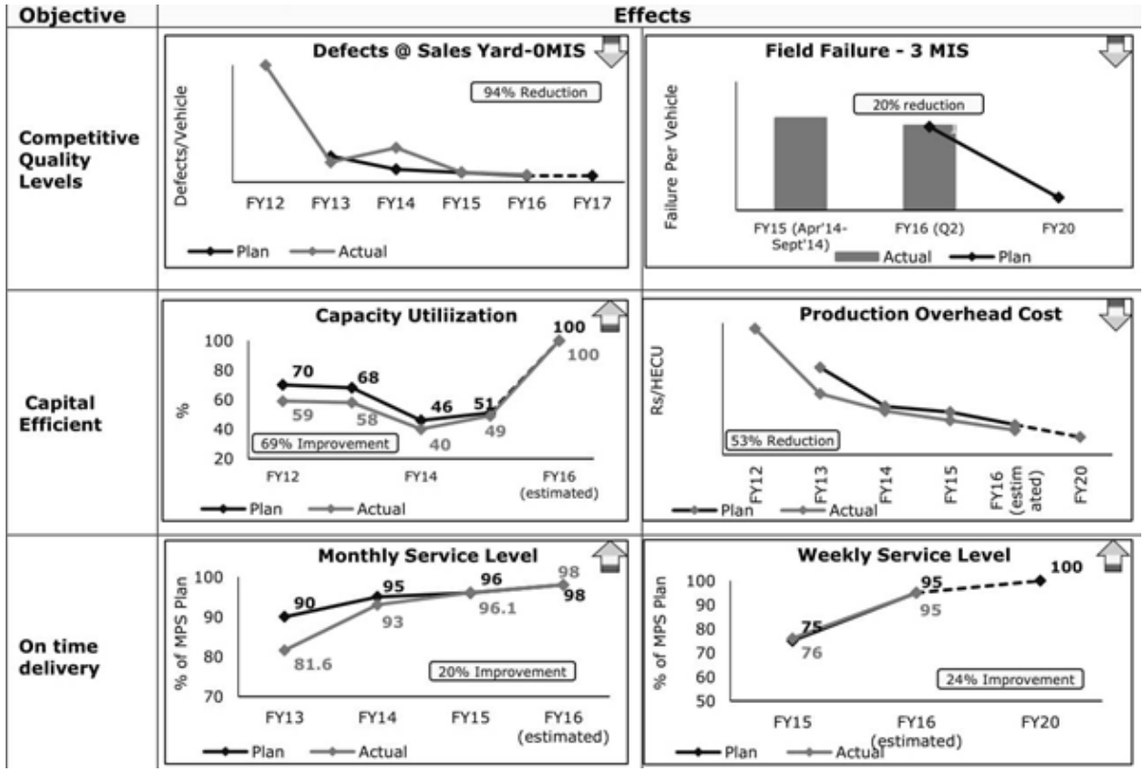
The organizations in which the study was conducted and the results obtained are briefly analyzed here. The data has been collected from the website of JUSE (Union of Japanese Scientists and Engineers: Organization which awards the Deming Prize) and websites of the winning organisations

Data Collection and analysis

Ashok Leyland Pantnagar (ALP)

Ashok Leyland was established in 1948 to assemble cars; started manufacturing Commercial Vehicles (CV).It manufactures trucks with l0Ton GVW (Gross Vehicle Weight) to 49 Ton CVW. It also manufactures Engines from 120H.P to 230H.P capacities. With total capability to manufacture 50000 trucks, it rolls out its products in 349 variants. After studying various TQM models, ALP developed its own model ofTQM. This framework represented their own TQM philosophy that integrates principles, methods, systems and tools for improving their performance, using innovation as the base for change. During the pre TQM phase, the major focus was to set up the TQM promotion organization, identify the goals for improvement which were based on corporate vision and strategic goals.

Innovations in Process and Technological set up resulted in the following advantages



Reduction in defect rates:

The rejection cost/ vehicle, came down from Rs 5064 (FY 13) to Rs 954/Vehicle (FYI 6). 1. e. reduction byover75%.

Improvement in Productivity:

Capacity utilization was 59% in FY12. Implementation of TQM and other measures taken by the organization resulted in increase in the capacity utilization to 100% in FY 16. Rough machining capacity of the Engine block increased from 28000 units to 36000 units per year after the bottlenecks were removed.

Improvement in Business performance:

ALP's market share in the Eastern and Northern market improved from 46% in FY12 and to 48.3% in FY15.

New product development

Avehicle named 'BOSS' was introduced on a new vehicle platform with 132 variants based on different wheel bases, color and load body sizes.

CEAT

CEAT manufactures a wide range of Radials and Bias tyres for both commercial and passenger vehicle segments.

CEAT introduced Quality Based Management (QBM) in FY 09. QBM approach was based on product and process innovation for capability

Strengthening the internal process controls: Process Failure Mode and Effect Analysis manual, Control plan and Work Instructions were developed. Special controls were put in place in the form of SPC, Poke yoke and Inspection.

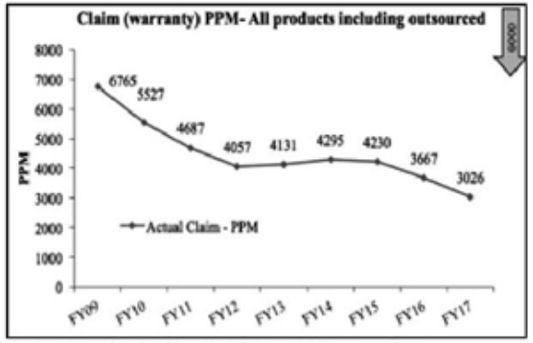


Fig 1: Steady decline in Claim PPM over the years

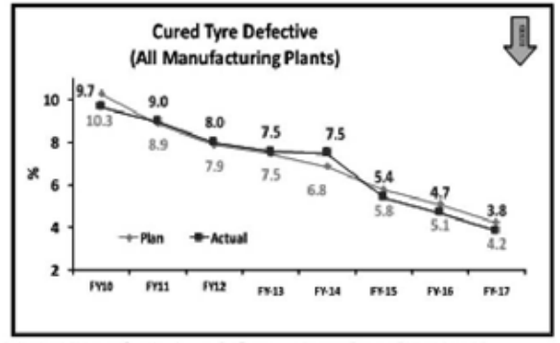


Fig 2: Manufacturing defect rate reduced to 3.8%

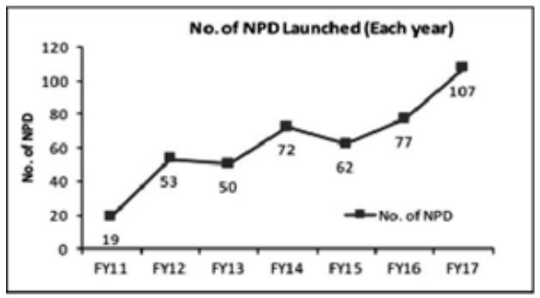


Fig 3: 400+ New SKUs launched in the last 5 Years



Fig 4: Steady improvement in profit since QBM

Improvement in quality was measured by warranty claim data, It got reduced from 4057 PPM to 3667 between FY12 and FY16. Similarly, the 'Quality system audit score' increased from 68 to 80 during FY14 and FYI 7, i.e., the qualityoftheproductimprovedby 23%.

The result of process innovation resulted in increase in production ofSKU / week by 42% in Bhandpur unitand27% atNasikunit. Calicut unit increased its productionfrom45.9K unit in Ql ofFY12 to 130K units in Q3 ofFYl 7.

With the introduction ofnew products, It increased its net sales from 44.4 in FYI 2 to 54.6 Billion INR in FY16, an increase of 22%.

Ashok Leyland Hosur Unit 2 (ALH2)

The Ashok Leyland Hosur unit 2 (ALH2) established in 1994 for manufacturing of Light Commercial vehicle (GVW 2.5 to 7.5 Ton Capacity), Medium commercial vehicle (>7.5 to 12 Ton), heavy Commercial vehicle(>12 to 49 Ton) and special vehicles. Ashok Leyland laid emphasis on innovation underTQM its TQMmodel in 2012.

Improvement Techniques through innovation were a part of their methodology:

1) Capacity to deliver smaller batches (n)

1.1) Service level – M&HCV, n≤10

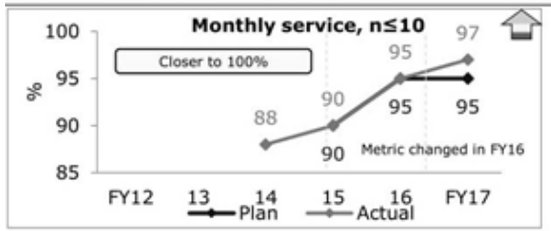


Chart 6.1 Service level, n≤ 10

1.1.2) Incomplete deliveries – M&HCV, n≤10

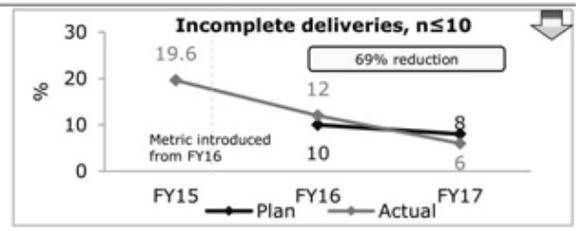


Chart 6.2 Incomplete deliveries, n≤ 10

2.1) Capability to produce new models

2.1.1) Readiness

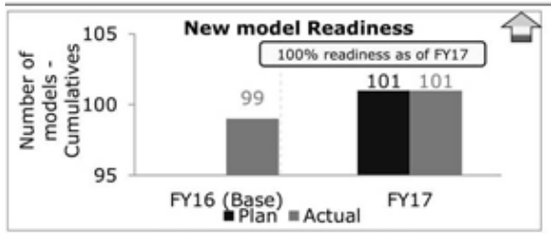


Chart 6.3 New model readiness

2.2) Early stabilization of new models

2.2.1) Stabilization ratio

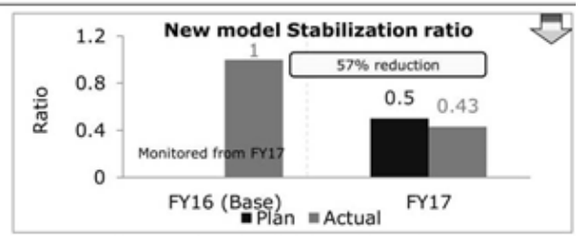


Chart 6.4 New model stabilization ratio

3.1) Competitive Quality levels

3.1.1) "0" MIS at sales yard (M&HCV)

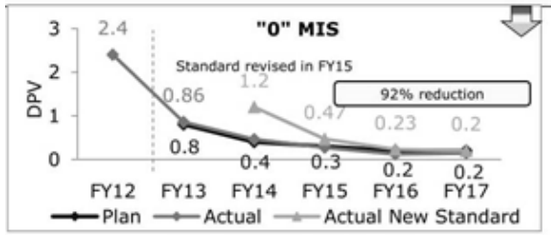


Chart 6.5 "0" month in service

3.1.2) "3" MIS - labor claims (M&HCV)

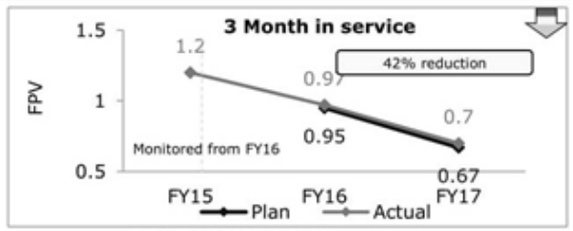


Chart 6.6 "3" months in service

Defect rate was measured as 'O' MIS at sales yard. This parameter showed an improvement by 71% in FYI 7 over FY15. A major reduction was seen in the rejection of incoming components. The Rejection came down to 297 PPM (FYI 7) from 7197 PPM (FYI 2).

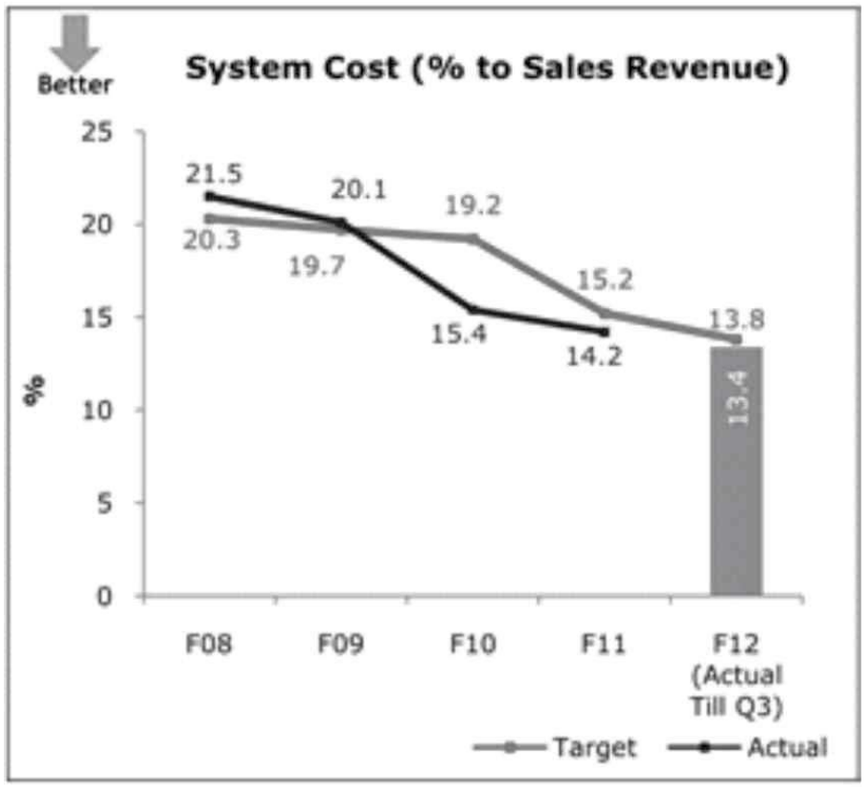
Production volume increased from 18.8K to 31.7K between FY12 and FYI 7. ALH2 increased its sales by 2.2 times during the period from FY12 to FY17. Similarly, EBIDTA increased by 16.3 times during this period. No. of models and their variants available to the customers increased from 118 (FY12) to 247(FY17)

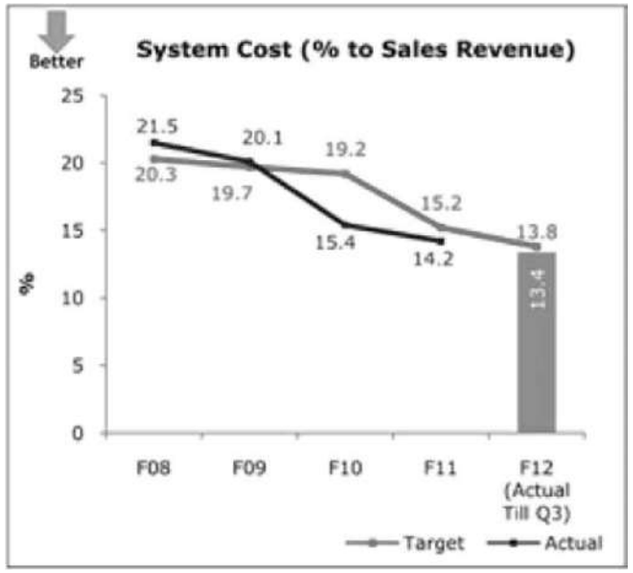
Mahindra & Mahindra- Swaraj Division

The Automotive and Farm Equipment sector (AFS) is one of the l O sectors of the Mahindra group. The Swaraj Division of M&M is an independent strategic business unit of AFS and is engaged in the manufacture of Tractors in the range of 21 H.P. to 72 H.P. The Swaraj Division adopted the TQM philosophy in FY07 with the aim at achieving overall excellence though innovation

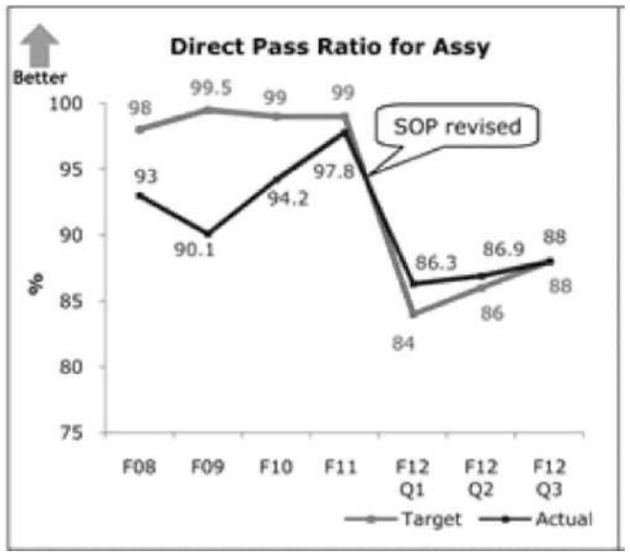
Productivity improvement was achieved through (i) Reduction in cycle time of various machining and assembly operations by innovating new processes and Manufacturing process re-engineering

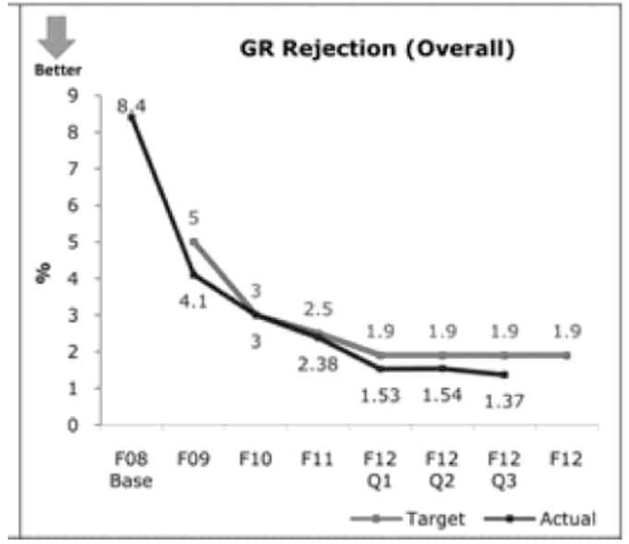
In addition, a new Product Development System, and various innovative cost management initiatives were introduced to achieve organizationalobjectives.





Improvement in defect ratio was calculated in three parameters. The first is rejection of components supplied by vendors. This rejection of suppliers' components reduced from 20000 PPM in FY11 to 2042 in FY16. Second, direct pass ratio improved from 50% in FY13 to 95.7%. Third was measurement of Field failures in 0-250 hrs of operation. This valve decreased from 5.95 RPH (FY11) to 3.03(FY16).





The implementation of these innovative measures resulted in reduction of manufacturing cost. It reduced from Rs. 5625/TractorinFY13 to Rs. 4865/TractorinFY16

Innovative thinking and customer requirement resulted in the introduction of 5 new Models of Tractors with various new features and reduction in specific fuel consumption.

Conclusion

The innovation in digital technology has led to increased expectations of the consumer. The Consumer has become the epicenter of business and the need is how well s/he is served. Physical products and services, moreover, can now be enhanced with digital capabilities that increase their value. New technologies make assets more durable and resilient, while data and analytics are transforming how they are maintained. A world of customer experiences, data-based services and asset performance requires new forms of collaboration, particularly given the speed at which innovation and disruption are taking place. The emergence of global platforms and other new business models, finally, means that talent, culture and organizational forms will have to be rethought. Overall, the shift from simple digitization or the Third Industrial Revolution to innovation that is based on combinations of technologies or the Fourth Industrial Revolution is forcing companies to re-engineer the way they do business.

The bottom line, however, is the same: quality is the fountain head of all growth and progress. As a philosophy, TQM is a wonderful leader and as a standard to maintain, it becomes a tough task master. When quality was just an abstract concept vaguely comprehended, it was easy to cut comers but difficult to survive tough competition. Today, when TQM is a rigorous but planned progression, implementation and achievement of quality often becomes a series of procedures to be implemented in letter and spirit.

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