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Apollo Tyres Limited, Chennai Plant

Abstract of Apollo Tyres Ltd. Chennai Plant Presentation

1. Outline of the Organization

1.1 Background of Indian Tyre Industry

Tyre is an essential part of mobility business and its growth is linked to the growth of automotive industry, which in turn is linked to the economic growth of the country or region.

Evolution of Indian tyre industry can be broadly divided into 3 phases as explained below:

Phase-1: Pre-Independence (1936-1947): During this period only Dunlop (UK) had the manufacturing plant in India along with two other trading companies viz. Goodyear and Indian Tyre & Rubber (ITR).

Phase-2: Post-independence – Regulated Economy (1947-1991): After independence in 1947, India adopted a concept of regulated economy, wherein license from Government was made mandatory to start or expand a business. Foreign companies' equities were restricted to a maximum of 40% and imports were highly taxed to protect Indian Industry. This resulted in lack of growth and competition. During this period Goodyear started their own manufacturing in India and few Indian tyre companies viz; MRF, Premier Tyres & CEAT started operations in early 1960s with technical collaboration of foreign companies. Apollo (ATL) and JK tyres started operations in late 70's. During this period rate of GDP growth was in the range of 3- 4%.

Phase -3: Market Liberalization era (1992 onwards): From the year 1992 onwards, Indian Government deregulated the economy, allowing foreign companies to start operations with 100% equity. Major Tyre manufacturing multinational companies (MNCs), like Bridgestone Tyres (JAPAN), Michelin Tyres (France), Continental Tyres (Germany) & Yokohama Tyres (JAPAN) established their manufacturing facility in India during this period. With improving infrastructure in India, the migration of tyre technology from bias to radial also started during this time. Rate of growth in GDP improved to 6 - 7% thereafter.

1.2 Apollo Tyres Ltd (ATL)

(1) Company Profile

ATL is one of the leading public limited tyre manufacturing company in India. The present chairman of ATL is Mr. Onkar Singh Kanwar (The founder's Son). ATL started its tyre business in 1977, with a single manufacturing plant at Perambra, Kerala with a Production capacity of 40 MT/Day. Today ATL is the biggest Indian multinational automobile tyre manufacturing company with a turnover of US$ 2.81 billion (FY22). Presently ATL has five tyre manufacturing plants in India (Perambra & Kalamassery in Kerala, Limda-Gujarat, Chennai-Tamilnadu and Chinnapandur-Andhra Pradesh) and two in Europe (one each in Netherlands and Hungary). ATL has a capacity now to manufacture more than 2300 MT/day of different varieties of automobile tyres and has sales offices in more than 100 countries across the Globe. Even though ATL was a late entrant into Indian tyre industry and in spite of the presence of world's top multinational tyre manufactures, ATL reached a leadership position in India through its organic and inorganic growth strategies. Presently ATL is the market leader in TBR & PCR tyres in India and has a significant position in all other categories (TBB, LCV and Agri). Among the five existing Indian plants, Chennai plant (APTC-Deming Prize winner) contributes around 40% of the revenue of the organization (APMEA).

(2) Vision and Values (Till FY22, please refer section 2 for more details)

① Vision: The vision of ATL is :***"To be a Premier Tyre company with diversified and multinational presence"*** by-

- Building Leadership in India
- Premiumization in Europe
- Exploring strategically attractive markets like North America
- Pursuing inorganic growth options

② Values

ATL is guided by its values known as "The Apollo Way" which include the values – Customer first, Business Ethics, Care for Society, Empowerment, One Family and Communicate openly.

(3) Our Pride Products

ATL is the first to introduce new technologies and innovative products mentioned in Table 1.1 into Indian market as per customer requirements which helped ATL to become the preferred brand in the Indian tyre market.

Table 1.1 : ATL's Pride Products

Year	India's First –Few amongst many
2001	First Farm Radial tyre for Agriculture sector – Farm King
2006	First range of Ultra-high performance V & W speed rated PCR tyres – Alnac & Aspire
2011	First heavy loading & high mileage TBR tyre – Endurace LD
2013	All steel super single tyre in truck & bus radial segment
2014	All steel 17.5" (LTR) size tyre
2015	First 1,00,000 Km passenger car radial tyre – Amazer 4G Life
2016	First high endurance OHT tyre (off road application) – Y-Lon
2019	First zero degree steel belted motor cycle radial tyre. – ALPHA H1

(4) Product Range

In line with ATL's vision of being a diversified company with multinational presence, ATL has developed the capability to design and manufacture different type of automotive pneumatic tyres. Over the years, the organization grew and expanded its footprint across different geographies with its wide product range. ATL sells its products under 2 key brands viz. Apollo and Vredestein across the globe and has multinational presence. ATL's product variety covers range

of categories such as PCR, TBR, LTR, Farm/OHT, LCV/SCV, OTR, TBB, 2/3 wheeler and Bicycle.Out of these various categories, APTC produces PCR and TBR tyres.

(5) Research & Development (R&D) facilities

In order to compete with new technologies of multinational companies and to cater the ever changing customer requirement, ATL has two full-fledged R&D centers. One is situated in Chennai, India (R&D–Asia) and the other one at Enschede in Netherlands (R&D- Europe). Over 400 engineers in these R&D centers are developing products and technology to cater the global market & customer requirements. R&D activities include Material science, Simulations technology, Design & Engineering, Process development and testing.

(6) Competitors

Table 1.2 : ATL's competitors

Company type / Market type	Indian company	Multinational company
Indian Market	MRF, JK, CEAT, Birla, etc.	Michelin, Bridgestone, Good Year, Continental, Yokohama and Maxxis
Global Market	MRF,JK,CEAT	Bridgestone, Michelin, Continental, Good Year, Pirelli, Yokohama, Sumitomo, Maxxis,Kumho , HanKook etc.

(7) Organization Structure

ATL has administratively divided its operations into two regions viz. **APMEA** (Asia Pacific, Middle East, and Africa) and **EA** (Europe & Americas). Both regions are headed by the respective Presidents(Refer Figure 1.1). APTC is a part of APMEA region. APTC is headed by unit head who is directly reporting to the president of APMEA (Refer Figure 1.2).

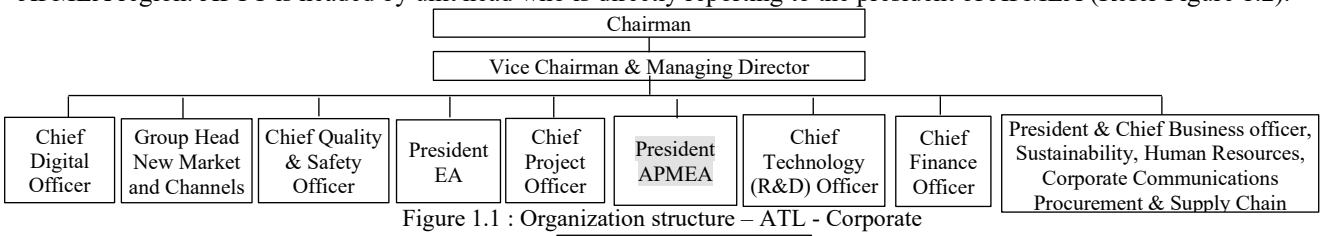

Figure 1.1 : Organization structure – ATL - Corporate

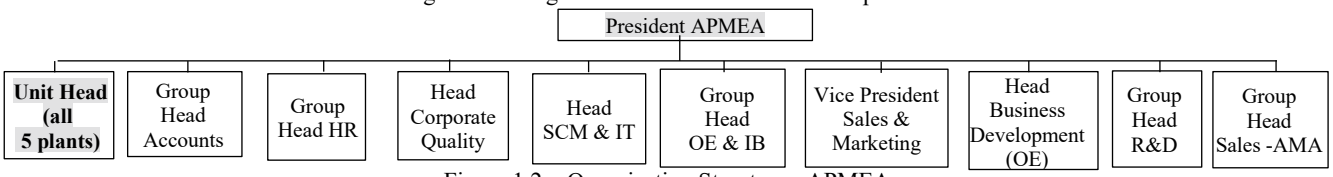

Figure 1.2 : Organization Structure - APMEA

1.3 Chennai Plant (APTC):

(1) Plant profile

As ATL grew in volume and spread its market into different geographies, ATL recognized the need for an additional manufacturing facility that can produce high performance products, with consistent high quality, to meet demanding requirements of world's leading automobile MNCs and also at competitive price to meet growing requirement of radial tyres in India. ATL management decided to set up a new facility, exclusive for TBR & PCR. Chennai was chosen as the site, as it was one of the leading automobile hubs in India where many multinational automobile companies like Ford and Hyundai had established their manufacturing facilities. Daimler Benz & Renault- Nissan was in the process of establishing their manufacturing facilities in close vicinity. Toyota had their plant in Bangalore about 250 Km. away. Further Chennai is the only one amongst the four automobile hubs in India that has a Sea Port. This would enable export of tyres and import of key raw materials. Conceived in FY08, APTC started commercial production in a short time by FY10 and rapidly increased production in consonance with the market requirements as can be seen in the Figure 1.3. APTC was built in various stages wrt to capacity enhancement in PCR & TBR. The initial capacity of PCR was 8 K tyres/day which was increased to 16K tyres/day in FY14. The initial capacity of TBR was 6K tyres/day which was enhanced to 12 K/day in FY19. With this, APTC became the biggest tyre plant in India with a total capacity of 850 MT/day. APTC is one of the advanced manufacturing facilities in India with automated product handling and is capable to make high quality products at optimal cost to compete with MNCs operating in India and to meet export demands. APTC is the only plant where ATL was producing TBR tyres (720 MT/Day) till FY21 in India which cater to the whole ASEAN market. Andhra Pradesh plant (new plant) has also started producing TBR tyres in FY21. Other than ASEAN market, APTC also supplies tyres to European and North American markets. Its innovative and lean layout makes this plant one of the most efficient and productive tyre plants in India.

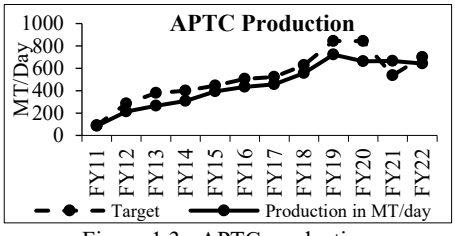

Figure 1.3 : APTC production

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(2) Organization structure

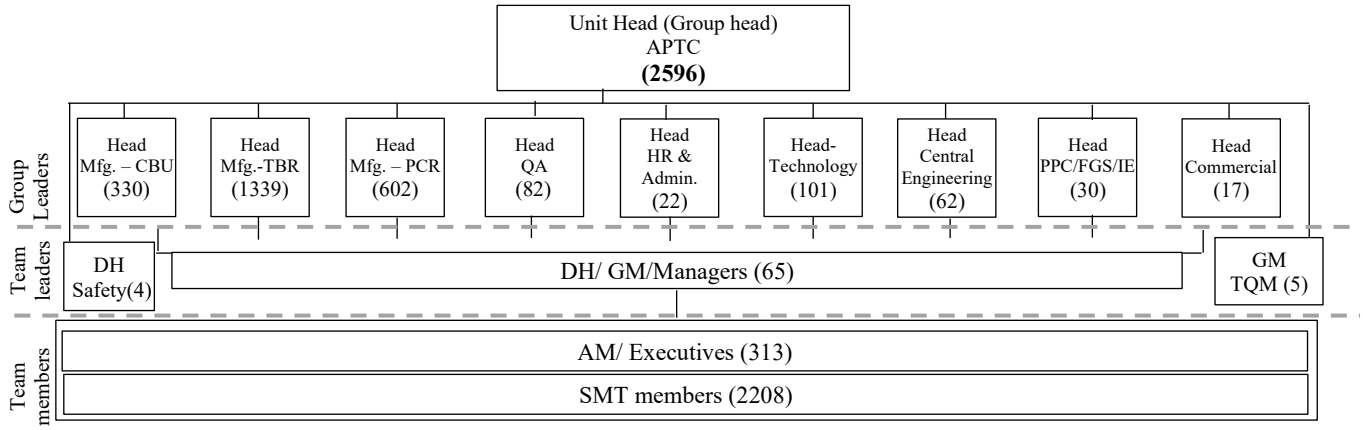

Figure 1.4 : Organization structure- APTC along with employee strength

APTC is headed by unit head supported by various department heads (9 Nos.). Other than manufacturing department heads, all other heads are having dotted line reporting to respective heads of APMEA region situated at Head office. As on 01st Mar'22 , APTC has 4,461 employees which includes 2,596 regular employees (shown above in Figure 1.4) and 1,865 outsourced employees.

[SMT Members: Team members who are working on machines in shop floor are called SMT members. Based on their employment contract term with APTC, they can be APTC on roll employees or NEEM Trainee or Apprenticeship trainees.]

(3) Relationship between departments in APMEA region and APTC

The normal operation of APTC includes manufacturing of different types of TBR & PCR tyres as per requirement of SCM. The market requirements by sales & marketing functions from across the globe are fed to SCM, who consolidates and allocates to different plants as per capacity and capability of each plant. The tyres are produced as per technical specification provided by R&D and are warehoused. These tyres are distributed to various markets by SCM. In ATL, raw material procurement is centralized and is handled by corporate RM purchase. Another major function of APTC is to support R&D in new product development, based on the customer's requirement captured through marketing and customer service. Prototype tyres are built in the plant for testing and various analysis.

(4) Customers

APTC is supplying its products directly to automobile manufacturers (Refer Figure 1.5) as well as to the replacement market. In TBR around 28% of production is supplied to OEMs, 52% to replacement and 20% to export (Based on FY22 Data). Whereas in PCR 32% to OEM, 40% to replacement market and 28% to export (based on FY22 Data). Other than domestic OEMs, APTC were also supplying PCR tyres to few OEM plants in Europe (Ford & Volkswagen) which is a matter of pride for the plant. Vehicles produced by OEMs in India fitted with tyres manufactured in APTC are getting exported to other countries. The replacement segment customers are reached out through a strong sales network comprising 6200 retail dealers in India.

Figure 1.5 : TBR & PCR OEM customers

(5) Products

APTC is capable to produce PCR tyres in the range of 12" to 18" and in TBR from 16" to 24.5". Presently APTC is producing more than 152 different PCR SKUs and more than 94 TBR SKUs per month. APTC is also capable to produce silica compound tyres for PCR up to a speed rating of "W" and high demanding tubeless tyres (22.5") in TBR. (Refer Figure 1.6)

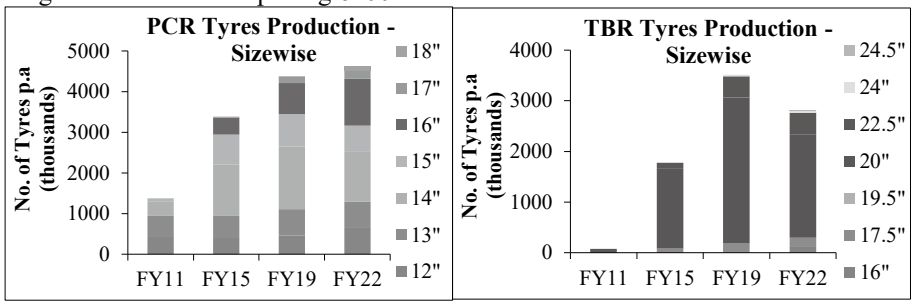

Figure 1.6 : Various tyre sizes in PCR and TBR category along with their production (YOY)

(6) Manufacturing process

Brief description about the tyre manufacturing process is given below & shown in Figure 1.7**:**

- **Mixing** is a process of mixing rubber, carbon black and chemicals to produce the compound for the subsequent processes. Mixing is carried out in various stages as per the requirement of specific compound.

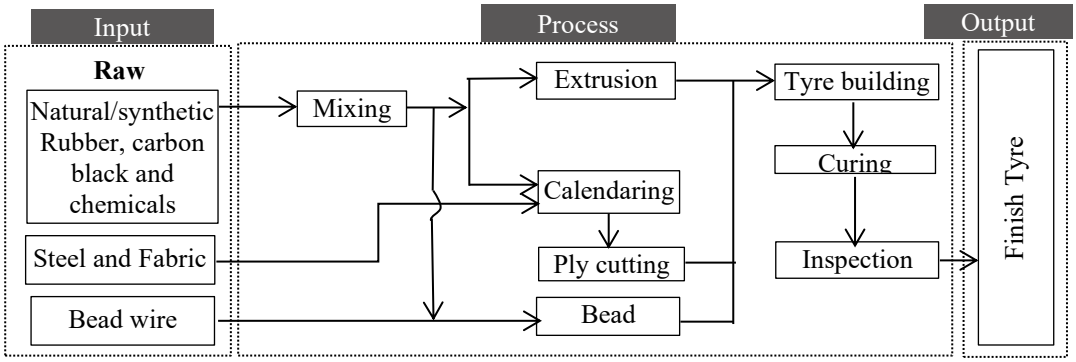

Figure 1.7 : Tyre manufacturing process flow @APTC

- **Extrusion** is the process by which compound is extruded into various profiles & dimensions, according to the requirement of components such as tread, sidewall, bead cushion etc.
- **Calendaring** is the Process to coat steel cords and fabric with compound to make body ply and breaker belt of tyre. Output of this process is called calendared material.
- **Ply Cutting** is the process of cutting the calendared material into required angle and dimension (Width & Length) as per the requirement of the next process i.e., tyre building.
- **Bead winding** is a process of rubberizing high tensile bronze coated steel wire into wound coils of required diameter and thickness.
- **Tyre building** is the most important step in the tyre manufacturing process wherein all the pre prepared components are precisely assembled to form a green tyre. All the components are being prepared inhouse.
- **Curing** is the process of vulcanization of green tyre under high pressure and temperature in specified mould.
- **Inspection** includes various processes like visual inspection, run out inspection, uniformity inspection, X – Ray inspection etc. to prevent the defect outflow to the customer.

(7) Technical capabilities

Tyre is a highly versatile engineering product used on vehicles to facilitate mobility of people and goods with safety and comfort at desirable speeds. Hence, design and manufacturing of tyres, becomes very complex and critical to safety, durability, comfort and performance. APTC is one of the most modern tyre plants in India with the latest technology and advanced machineries. Silica based tyres are the latest technical advancement in the highly demanding passenger segment. APTC is the largest producer of silica based tyres in India catering to the need of OEM customers like Toyota, Renault Nissan, Volkswagen, and Ford besides exports to Europe.

(8) Recognitions and Awards for APTC:

Table 1.4 Recognitions and awards for APTC

Year	Recognition & Awards	Remarks
2022	"TN Green Champion Award for the year 2021	-
2021	Best Environment Promotion Supplier - Chennai Region by *Toyota Kirloskar Motors (TKM)*	Won the environmental award among ~43 suppliers of TKM in the region. (Won 2nd time in last three years)
2021	• 4 Star rating for best EHS practices by CII CII National award for water management	-
2020	• "Zero PPM" award by Toyota	APTC is consistently achieving zero ppm for Toyota from start of supply (FY16)
2019	• Best Performance award by *Renault Nissan Mitsubishi*	-
2018	• Excellence in Customer Delight from *Hyundai*	-
2017	• **Award for "Zero PPM" by achieving "Zero Defect Supplies'' by Toyota, Japan (Presented by the President of TMC)**	***Only two suppliers invited by Toyota, Japan, ATL was one of them –Proud moment***
	• Quality Performance Award of 2016-17 from *Volkswagen*	*ATL is the only tyre manufacturer won this award despite having other competitors*
2016	• Best New Supplier Award by *Toyota*	*ATL is the only supplier to receive the award*

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2. Business goals and Strategies

2.1 MTP FY05 – FY11: "Passion In Motion (PIM)":

In FY05, ATL developed its first Mid Term Plan (MTP) "Passion in Motion" (PIM) with a vision of "Becoming a 2 billion USD company by FY11" (Revenue in FY05 was 0.61 billion USD). As part of the organic growth strategy, ATL Management decided to set up a new manufacturing facility, exclusively for TBR & PCR tyres in Chennai and started production by the year 2010.

2.2 MTP FY12 – FY16: "AGILE" (Apollo Growth Innovation Leadership Excellence):

Having achieved US $ 2 billion target through its MTP FY05-FY11 and with two international brands in its fold, ATL developed its second MTP called "AGILE", with a vision to become "*A significant player in the Global tyre industry and brand of choice, providing customer delight and continuously enhancing stake holder value".* In line with this vision, APMEA also formulated its vision as ***"To be rated as best Indian tyre company by all stakeholders".***

(1) APMEA-Challenges:

- **TBR Market share:** After the starting of APTC plant in FY10, ATL became the market leader in India for TBR tyres by end of FY12. At the same time, TBR market was rapidly increasing due to expanding market size as well as conversion of TBB to TBR (18% to 36% FY12 to FY16). During this period, the challenge for ATL was to sustain the leadership position of TBR and to move further ahead by increasing the gap with other competitors.
- **PCR Market share:** Even though ATL achieved market leadership in TBR, could not gain the leadership position in PCR market.
- **Profit Margin:** Operating profit margin was declining from FY10 due to highly competitive market and increase in rubber prices in India.

(2) APMEA -Strategies:

To get the organization ready for competing with multinational tyre companies and to meet multinational automobile manufactures' (OEM) expectations by supplying tyres with No.1 quality, top management decided to follow TQM approach

- **TBR Market share:** As APTC was the only plant producing TBR tyres, faster ramp up of TBR production to installed capacity of 6000 tyres/day at APTC
- **PCR Market share:** 1) Increase share of business to OEM customers with improved tyres to create pull in the replacement market 2) Design and develop new tyres for replacement market to replace existing products which will give better performance in terms of durability (mileage) & fuel efficiency 3) Develop & manufacture tyres for higher segment cars that will provide more value addition and brand visibility
- **Profit Margin:** Reduction of manufacturing conversion cost

(3) APTC Objectives and Strategies:

APMEA strategies were deployed to APTC as objectives, for which APTC level strategies were formulated. Refer Table 2.1.

Table 2.1 : APTC MTP FY12-FY16 – Objectives & Strategies (Truncated version)

APMEA Objective	APTC Objectives	Managing Points	APTC Strategies	Status
To improve the market share of TBR	To become the preferred choice of customer	1.TBR complaint @ Field-ppm	• Establishing QMS • Monitoring & Improving CTQ Parameters through DWM and strengthening of standards	X
		2.TBR complaints @ customer (OEM) -ppm	• Establishment of PDI system	X
	Production Ramp- up to meet market demand	3.Schedule Adherence – SKU wise for TBR (Delivery compliance) (%)	• Change production planning from Push to Pull • Implementation of PIBS to support production planning • Implementation of replenishment model at warehouse	O
		4.Production per day in Nos.- TBR	• Process redesign • Capacity enhancement by debottlenecking	O*

Legends : "O": Target achieved, "X": Target not achieved, "O*" : Target not achieved due to low demand

(4) Remaining Problems @ APTC:

1) Increasing trend of TBR field complaints ,2) TBR OEM customer complaints not met the target and, 3) Target of conversion cost has not met

2.3 MTP FY17-FY22: "Passion in Motion 2.0 (PIM 2.0)":

(1) APMEA

① **Vision:** In continuation to its MTP FY12-FY16 and its ambition to become a significant global player, ATL formulated the third MTP called "Passion in Motion 2.0 (PIM 2.0)" with revised vision "***To be a premier tyre company with a diversified and multinational presence***". In line with this vision, APMEA region also formulated its vision as ***"Building Leadership in India".***

② Reflections (from the MTP FY12-FY16) and Current Opportunities:

In MTP FY12-FY16 period, revenue growth achieved by APMEA was at CAGR of 9.44% over 5 years which was better than major competitor who was @ 8.1%. Though operating profit margins improved from 9.49% to 18.68% but ATL could not achieve leadership position neither in operating profit margin nor in PCR market share in APEMA region (Refer Figure 2.1)

Tyre market in India and APMEA region was expected to grow at a rapid rate providing opportunity for ATL-APMEA region to grow as planned and reach the leadership position in PCR and sustain the leadership position in TBR. To be number one in both product categories, it was identified 1) to improve the rate of growth & share in current market, 2) to enter new markets, 3) to meet more stringent product specifications of OEMs, and 4) to enter into premium products segment.

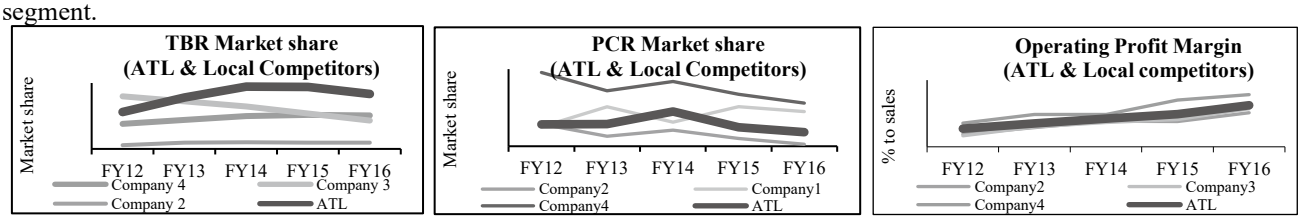

Figure 2.1 : Market share of TBR, PCR and Operating Profit margin

③ Objectives:

In line with ATL's vision, APMEA region set the objectives to target domestic market share of more than 30% for TBR (Baseline FY16- 23%) & more than 22% for PCR by FY21 (Baseline FY16- 11.8%) and to be leader in operating profit margins. To realize this vision, objectives were set using Policy Management approach.

(2) APTC:

① Vision:

Observing the enhanced adoption of TQM in APTC, the ATL top management decided to further strengthen TQM activities in APTC as a means to achieve the goal of supplying tyres with No.1 quality. Based on APMEA vision, **APTC defined its vision as *"To deliver quality products at lowest cost using engaged employees by the safest way."***

APTC developed its MTP FY17-FY22 in line with APMEA by evaluating past performance, listening to the voice of the customer, assessing competitor plans and other challenges emerging from the changes in external environment. APTC used variety of methods like PESTLE, Customer Value Management (CVM), and SWOT to develop the MTP. Some of the details are given as follows.

② Reflections (from the MTP FY12-FY16) and Current Opportunities:

APTC could ramp up the production as per market requirements contributing to the APMEA revenue while producing increased number of SKUs. Effective implementation of DWM including standardization made a significant contribution in smoothening of plant operations. OEM Customer complaints reduced by more than 50% as per plan due to standardization, improvement of inspection process and inspector skills. Schedule adherence improved to 96% against target of 95%. In spite of all these efforts, few objectives could not meet the target and were carry forwarded to MTP FY17-FY22. (Refer Table 2.2)

TBR Business:

- **Field complaints:** It was analysed that increase in field complaints is mainly due to the use of TBR tyre for super heavy load segment. These family of tyres were developed for the normal load application segment whereas it was found out that it is being used for super heavy load application also. Though this product of ATL could survive compared to competitor's products but resulted in increase of field complaints. With the aim of supplying tyres with No.1 quality, field complaint reduction was again taken as an objective in MTP FY17-FY22 (Refer MP no. 1 in Table 2.2)
- **OEM Customer complaints:** At the end of MTP FY12-FY16, TBR customer complaints at OEM had reduced significantly but could not meet the target. The pending issues were related to packing and tubes. Objective of OEM Customer complaint reduction was taken in MTP FY17-FY22 (Refer MP no. 2 in Table 2.2)
- **Ticket adherence:** Considering the potential growth of TBR tyre market during MTP FY17-FY22, the company decided to increase the installed capacity of APTC TBR plant. Quick ramp-up was also needed to produce the increased quantity of tyres based on market requirement. Along with steep increase in numbers, additional challenge of complexity to produce more number of SKUs was also necessitated due to expanding markets. Hence this became the challenge and taken as objective in MTP FY17-FY22 (Refer MP no.3 in Table 2.2)
- **TBR Productivity**: During MTP FY12-FY16, conversion cost target was not met. Personnel cost is one of the significant factors which contributes around 30% of total conversion cost. Reduction in personnel cost is achieved through productivity improvement, which was taken as one of the objectives in MTP FY17-FY22. During MTP FY17-FY22, ATL decided to enhance APTC's TBR capacity from 6K tyres/day to 12K tyres/day. This was also an opportunity for APTC to do the process redesign, layout changes and debottlenecking of various TBR processes, which also supported the objective of TBR productivity. (Refer MP no. 4 in Table 2.2)

PCR Business:

- **New Product Industrialization (NPI):** To meet the increasing requirement from the market (Replacement, OE & Export), it was necessary to industrialize more number of SKUs. In FY16, out of 72 SKUs industrialized, only 53 SKUs could meet the targeted lead time which was only 73.6 % of total. Remaining 19 SKUs could not achieve the targeted lead time due to increased iterations. APTC took this as a challenge and set the objective to improve the same in MTP FY17-FY22. (Refer MP no. 5 in Table 2.2)
- **OEM Warehouse yield:** In MTP FY12-FY16, one of the strategies was to increase the OEM business to enhance PCR market share. Tyres conforming to OEM specification (measured in terms of warehouse yield) can only be sold to OEMs. In FY16, the warehouse yield of OEM tyres was 85%. Therefore, improving product quality conforming to meet OEM Specification was taken as an objective in MTP FY17-FY22. (Refer MP no. 6 in Table 2.2)

Common to TBR & PCR:

- **Conversion Cost:** Targets of direct and indirect conversion cost were not met during MTP FY12-FY16 due to the delay in implementation of identified strategies such as development of alternate power sources, energy saving projects and productivity improvement projects. This was also taken as objective in MTP FY17-FY22 (Refer MP no. 7 in Table 2.2)
- **Skill development:** ATL set up a green field plant in Hungary in the year FY16 and work for the next green field plant in Andhra Pradesh commenced in the year 2019. During start-up of these plants, more than 25% of critical skilled manpower requirement were met from APTC and its vacancies were filled with lateral recruitment and freshers from engineering institutions. A sudden influx of large number of new members posed challenges of safety, skill & competency at various levels in APTC. Considering the situation, Skill development was taken another important objective in MTP FY17-FY22-FY16. (Refer MP no.8 in Table 2.2)
- **Employee Engagement:** Till FY16, people were actively participating in plant QCC activities and at external forums also. A significant drop in the participation has been observed from 15.9 % in FY16 to 8 % till FY18. To improve the situation of employee engagement, this was also taken as objective in MTP FY17-FY22. (Refer MP no.9 in Table 2.2)
- **Employee Safety:** Safety performance of the plant is measured by "Lost time Injury Frequency Rate (LTIFR). With various safety systems introduced, LTIFR was reduced from 2.1 in FY12 to 0.61 in FY16. However, LTIFR target of 0.5 was not met in FY16. To eliminate the accidents from the plant, LTIFR was taken as objective in MTP FY17-FY22. (Refer MP no. 10 &11 in Table 2.2)
- **Corporate social responsibility:** The company and its employees take pride in exhibiting its responsibility towards the society and environment, through many CSR projects. APTC also works closely with automobile manufactures to reduce the fuel consumption by minimizing rolling resistance of tyres, which in turn reduces CO2 emissions as well as reduces consumption of precious fossil fuel and is working hand-in-hand with various organizations to mitigate evil effects of end of Life of the product. To keep continuous focus on this initiative, this was taken as objective in MTP FY17-FY22. (Refer MP no. 12 in Table 2.2)

b3) Objectives and strategies:

Table 2.2 : APTC MTP FY17-FY22

APMEA Objectives		APTC Objectives	Managing points (UOM)	APTC Strategies	Challenging / Basebuilding Strategy
TBR	To improve the Market share of TBR	To become the preferred choice of customer	1. TBR Complaint @ Field – 6-month exposure (ppm)	Defect prevention through – • Application of vertical evaluation & QA Matrix • Process stability & capability improvement • Application of QC story methodology • Standardization of high impact parameters	**Breakthrough reduction in TBR field complaints through BQiP**
			2. TBR Complaints @ Customer (OEM)	• Strengthening of Quality gates	Management of Quality Assurance
		To produce as per SCM requirement	3. Schedule Adherence – SKU wise for TBR (Delivery compliance)	Reduce the losses in Tyre building through- • TBR Component standardization (Complexity reduction) • Cycle time and setup changeover time reduction • Enhancement of Component inventory management	Delivery Management
	Lead by Operating Profit Margin	Improve the efficiency	4. Productivity – TBR (Kg/Manhr.)	• Improving the efficiency of existing processes through application of lean tools • Optimization of Manpower through work Standardization	**Breakthrough Improvement in TBR productivity through TPS**

PCR	To improve the Market share of PCR	Timely Industrialization of New product	5. SKU wise- NPI lead time –PCR (% of NPI on time)	• Improvement of trial planning process • Reduction of iterations by strengthening design standards	New Product Industrialization
		Improve the efficiency	6. PCR OEM Warehouse yield – (%)	• Prioritization of high contributor SKU and improving their yield through application of QC story Methodology	**To improve product quality in consonance with narrowing OEM (PCR) specifications**
Common for TBR and PCR	Lead by Operating Profit Margin	Reduction of conversion cost	7. Direct Conversion cost (Rs/Kg)	• Power procurement cost reduction through enhancement of alternate power sources • Specific power consumption reduction • Scrap reduction through QC story projects	Cost Management
	Develop people capability and motivation	Enhancement of functional Skill	8. Skill up gradation of SMTs (%)	Skill & capability building process enhancement through • Reducing Lead time of Skill Development • Enhanced Capability development process for employees (Non-SMT members)	Human Resource Management
		Enhancement of Employee Involvement	9. Involvement of people in QCC (%)	• Increase in frequency of the QCC refresher training • Capability building training for facilitators • Increase in number of facilitators from QA, Tech, and Engineering department to support manufacturing Bus	
		Enhancement of safety practices	10. LTIFR –Plant (Index) 11. LTISR –Plant (Index)	• Enhancement of Safety standards • Enhancement of Risk Management system • Enhancement of BBS observation system and Safety Education & Training	Creation of Safe Work Culture
		Creating the environment and social sustainability	12. CSR Initiatives	• Environmental and social need assessment and initiation of CSR Projects	Care for Environment and Society

Note : Challenging strategies are in bold font in above table and base building strategies are in normal font.
Activities related to all above mentioned objectives are described in section 4. The effects of these objectives are exhibited in section 5.

Due to COVID-19 pandemic, the Government of India declared country wide lock down on March 24, 2020 and lasted few months. The lockdown relaxation for industries was announced by the Apr'20 end and APTC commenced operations from first week of May'20 in a phased manner.During re-starting of the plant, APTC faced with multiple issues like non-availability of manpower, operating by fulfilling all Government prescribed guidelines, logistics, fear among employees to attend duty etc. APTC developed new strategies to mitigate hardship to its employees, safeguard assets of the plant, meet emergency customer requirement and contribute to the needs of society in the vicinity of the plant. It was decided that APTC will use its learning from TQM application and meet these challenges. In this context, additional strategies were planned and implemented as follows while keeping alignment with the plant's vision.

- COVID-19 testing, contact tracing, monitoring and follow up of suspected cases and doing tie-ups with local hospital for admitting employees. All prescribed protocols were followed inside plant.
- Distribution of immunity boosting medicines, ration kit, PPEs and sanitizers along with counselling sessions to boost the morale of employees. 100% employees were double vaccinated by 17th Dec 2021.

All above mentioned strategies helped APTC to manage its operation during this tough time and supply necessary tyres to the customers.In addition to the above, APTC also initiated CSR activities to overcome challenges for society during pandemic. Some of the activities are distributing reusable cloth masks made by rural women to employees, their families and neighboring village members, providing ration kits to needy families in neighboring villages and contributing 20 Mn INR to Chief Minister's disaster relief fund.

2.5 MTP FY23-FY26:

(1) At ATL:

In the mid of FY22, ATL has worked out its new MTP FY23-FY26 with new vision: "Driving Progress, together" with an Objective of reaching a revenue of US$ 5 billion by FY26.

(2) At APMEA:

Vision: Extending our leadership in India and reflect significantly in APMEA

(3) At APTC:

Vision : Deliver value to customers by building a "High Productive-High Performing Plant", utilizing TQM framework and digitalization while focusing on Safety, Sustainability & ROCE.Business objectives and strategies are defined to achieve this Vision and are being implemented.

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3. TQM Promotion

3.1 Background for TQM initiation and its need

As part of ATL's MTP FY12-FY16, the top management decided to follow TQM approach to get the organization ready for competing with multinational tyre companies interms of supplying tyres with No. 1 quality and meeting customer expectations, especially the multinational automobile manufacturers. Based on internal assessment of systems & QA practices prevailing in the organization, top management decided to introduce TQM for entire APMEA in FY12. Even though TQM was introduced whole across APMEA, the adoption and progress of TQM in APTC was more, as it was a new & young plant. This also helped APTC to make products of international quality and at optimum cost to meet business goals. In FY18, after recognizing the progress of TQM and its success in manufacturing high performance products by APTC for APMEA and European markets, the top management decided to challenge Deming Prize for APTC. The purpose of going for Deming prize was to evaluate APTC's TQM maturity level and learn further from comprehensive process of Deming examination. History of TQM promotion at APTC is depicted in Table 3.1.

Table 3.1 : History of TQM Promotion @ APTC

Period→	TQM Introduction & Development: (MTP FY12-FY16)	TQM sustenance and developing organizational capability: (MTP FY17-FY22)
APMEA Vision	To be rated as best Indian tyre company by all stakeholders	Building Leadership in India
APTC Objectives	Ramp up production to meet market demand and become the preferred choice of customer along with reduction in conversion cost.	To become the preferred choice of customer, timely industrialization of new products, efficiency improvement, enhancement of functional skills, reduction of conversion cost, Enhancement of safety practices etc.
TQM Objectives	Establishment of TQM practices to ensure process sustenance and reduction of defectives in the market	Enhance process capabilities to offer better experience to customer and employees
TQM Initiatives	• DWM in Manufacturing area • Policy Management • Problem solving QC story • QC Circle • QM & HSE systems • Functional Trainings • Suggestion Scheme • Basic trainings on 5S and Safety	• Defect outflow control • Task achieving QC story in addition to Problem solving QC Story • Advanced QA tools such as Vertical Evaluation, QA matrix & Stability Capability matrix • Cross functional management • Lean • DWM in non-manufacturing areas • People capability development

Note: TQM initiatives of MTP FY12 -FY16 are still being continued.

3.2 Framework for TQM Implementation

(1) TQM Promotion Organization

To promote and practice TQM methodologies and to thereby inculcate the customer oriented & fact based approach among the workforce across the plant, TQM secretariat was formed for centralized coordination. A Steering committee was also formed, chaired by unit head and supported by functional heads. In all Business unit/functions, TQM coordinators were identified to implement the TQM activities in their respective areas under the guidance of Business unit/functional team leaders in coordination with TQM Secretariat.

(2) House of TQM

After studying various TQM models, APTC has introduced its customized house of TQM which got strengthened further with the inputs from Dr. Noriaki Kano. This house of TQM represents the thought process of APTC where organizational core values, Product technology, application of information technology and involvement of employees are considered as the foundation. Various principles (such as PDCA rotation, process approach etc.), Vehicles (such as policy management and daily work management etc.), and various Techniques (Such as QC story, Lean methodology etc.) are helping APTC to achieve its business objectives which is in alignment to achieve customer satisfaction as per company's vision. Refer Figure 3.1. APTC has also prepared linkage matrix to apply the various TQM vehicles/Techniques in line with its business needs. Refer Table 3.2.

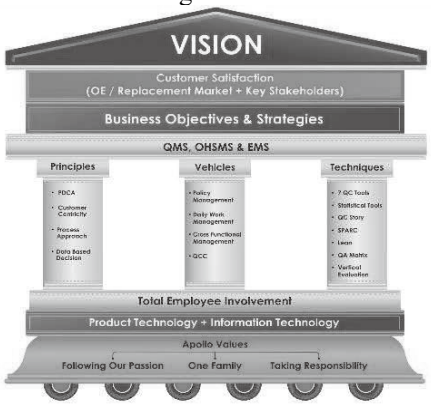

Figure 3.1 : House of TQM
(Our sincere thanks to Dr. N Kano for this house)
*Key stake holders – Employees, suppliers, investors & Society

Table 3.2 : Business Objectives vs. TQM Vehicles and techniques for MTP FY 17-FY22

APTC Objectives	Managing points (UOM)	APTC Challenging & Base building Strategies	TQM Vehicles & Techniques										
			PM	DWM	CFM	QCC	Problem solving QC story	TA QC Story	Stability Capability Matrix	Vertical evaluation	QA Matrix	Lean	ICT
To become the preferred choice of customer	TBR Complaint @ Field – 6 month exposure	Breakthrough reduction in TBR Field Complaints through BQiP	□	Δ	□		Δ		□	□	□		
	TBR Complaints @ Customer (OEM)	Management of Quality Assurance	□	□	□				□	□	□		
To produce as per SCM requirement	Schedule Adherence – SKU wise for TBR	Improve Schedule Adherence through Delivery Management	□	□	□			□					□
Improve the Efficiency	Productivity – TBR	Breakthrough improvement in TBR Productivity through TPS	□	Δ		□	Δ	□				□	
Timely industrialization of New products	SKU wise – NPI lead time – PCR	Management of New Product Industrialization	Δ	□	□								□
Improve the Efficiency	PCR OEM Warehouse yield	To improve product quality in consonance with narrowing OEM (PCR) specifications	□	□		Δ	□				□		□
Reduction of conversion cost	Direct Conversion cost	Management of Conversion Cost	□	Δ	□		□	□			□		
Enhancement of functional skill	Skill upgradation of SMTs	Building Employee Capability and Motivation through Human Resource Management	□	Δ	□								□
	Involvement of people in QCC												
Enhancement of safety practices	LTIFR – Plant	Creation of safe work culture		Δ	□	Δ				□			
	LTISR – Plant												
Creating the environment and social sustainability	CSR Initiatives	Care for Environment and Society		Δ	□								

Legend : □ - Strong relation , Δ - Moderate relation

(3) TQM Policy:

To introduce & deploy various TQM principles, vehicles & techniques to continuously improve the quality and thereby to meet the customer expectations proactively for improving business effects with the application of Information & Communication Technology (ICT) and fostering the improvement activities by engaging all the employees of organization.

(4) TQM Education & Awareness:

Though the various training program was in place from the inception of the plant to improve the knowledge and skill of people about various TQM initiatives such as PM, DWM etc., that was limited to only few selected category of people. To expand the application of TQM further, quality training program consists of general and specialized training was developed by HR department in FY18 to cover all the levels of the employees in a phased manner. Trainings on topics such as QC story , 7QC tools, QC circle, Advance QA tools (QA matrix, Vertical evaluation, 2X2 matrix) were conducted across various levels. Further to give exposure to senior leadership team on world class quality & thereby support our TQM journey, trainings such as EPQM program – AOTS, International Seminar on TQM conducted by JUSE and ISQ annual conference were provided.

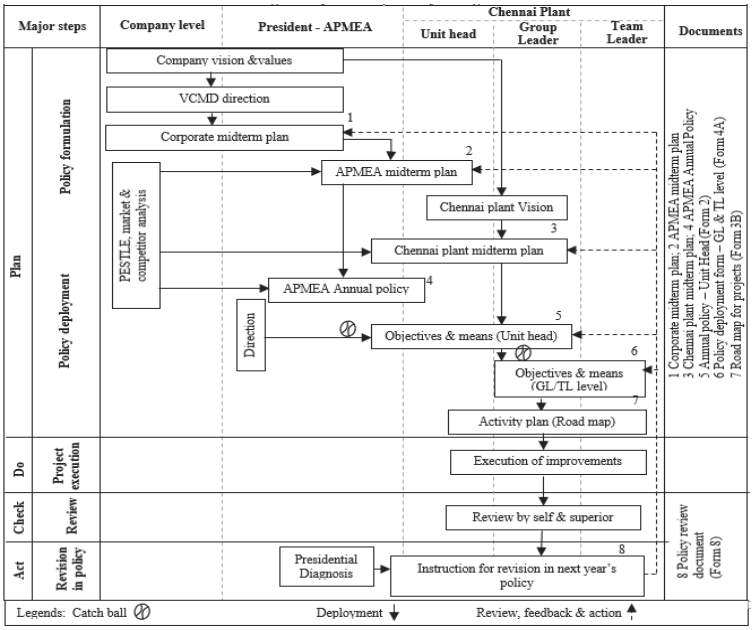

Figure 3.2 : Policy Management flow chart

3.3 TQM Vehicles

(1) Policy Management: The process of Policy management starts with the formulation of corporate mid-term plans followed by APMEA and APTC mid-term plans. Mid-term plans are getting reviewed every year and in line with the priority issues, annual policy is being prepared at APMEA president level. Policy management

exercise is being conducted every year before the start of financial year and is being attended by all stakeholders of business including heads of all APMEA functions and unit heads. Process of policy management is shown in the form of flow chart in Figure 3.2. APTC has introduced Policy Management process from FY12-13 by giving awareness to senior management and middle level management as a vehicle to drive and deploy corporate business objectives & strategies. After formulating APTC mid-term plan, annual objectives are prepared for unit head to set the priorities for that year. These annual objectives are deployed to the functional head and team leader levels. All the policy items are being reviewed monthly by unit head and by APMEA president quarterly and improvement are being made accordingly. From FY19 onwards, further improvement has been done in the Policy management process. Unlike previous years, now at the end of year unit head , Head level and team leader level policies attainment is being analysed with the help of "Four student model"(FSM) to further improve the effectiveness of policy management process. FSM evaluation is done annually to evaluate target achievement and strategy implementation. FSM analysis (refer Figure 3.3) shows clearly that policy attainment rate & no. of policy items in Student type A were increased at all levels year on year . This shows improvement in effectiveness of Policy management process. At the same time, total no. of policy items at Head level & team leader level were increased significantly year on year(refer Figure 3.3), which shows policy management approach is taking deep roots at APTC.

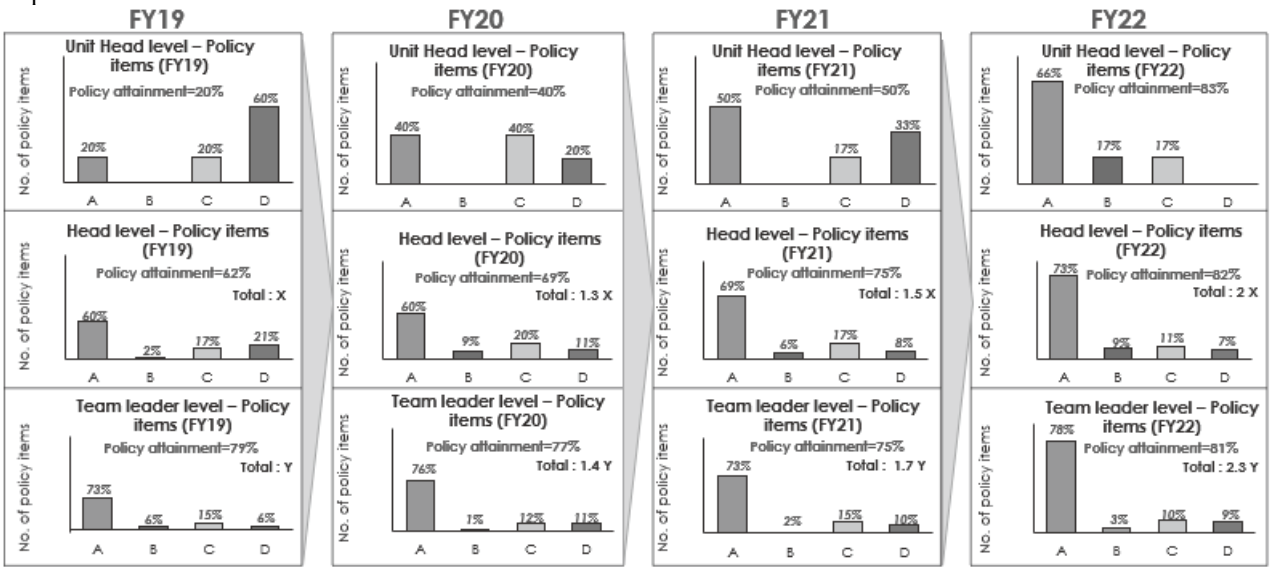

Figure 3.3 : Four student model evaluation trend (FY19-FY22)

(2) Daily Work Management: Daily work management in TQM way had been adopted by APTC in Year FY12 with the objective to have a regular control over key performance indicators (Managing/Checking points) related to quality, delivery, cost, safety & morale. The sustenance of Daily management had been reflected through the trends of MP/CP in each department. In each BU, there is a DWM centre where review of the MP/CP is taking place at defined frequency. In case of any abnormality, PDCA has been rotated and after identifying the root cause for abnormality, standardization of action being documented in appropriate standards, such as PFMEA, Procedures etc. To manage the daily work management activities at plant level, Stability Capability matrix was prepared from the start of FY19. Each SBU has identified the CTQ parameters and mapped them in stability capability matrix. Total 71 special characteristics and critical to quality characteristic has been mapped for stability and capability in FY22. Based on this matrix, prioritization of parameters is being done to make them stable and capable.

(3) Cross Functional Management: After getting stability in Daily Work Management process, to achieve cross functional objectives related to Q,C,D,S&M, APTC is using Cross Functional Management as a process from FY17 onwards. There are six Cross Functional Management Committees at APTC (refer Table 3.3) that meets quarterly to assess the progress and propose improvements from a plant- wide perspective. Each CFM is headed by the respective functional heads which is shown below. Strategies are prepared by these CFMs to meet business objectives.

Table 3.3 : CFM Relationship Matrix

CFM \ Function	HR	Mfg.	QA	PPC	Technology	Commercial	Engineering
Human Resource Management	¯^	¯	¯	¯	¯	¯	¯
Quality Assurance Management	Δ	¯	¯^	X	¯	X	¯
Cost Management	¯	¯	Δ	Δ	Δ	¯^	¯
New Product Industrialization	X	¯	¯	Δ	¯^	Δ	X
Delivery Management	¯	¯	¯	¯^	Δ	Δ	X
Safety	¯	¯	¯	¯	¯	¯	¯^

Legend: - ¯: Strong Relationship Δ: Moderate Relationship X: Weak relationship ^ : CFM leader

(4) Quality Control Circle (QCC)

To involve SMTs for identifying and resolving their work related abnormalities, arising out of daily work management and to continuously engage them in improvement initiatives by utilizing their innate knowledge, APTC had launched QCC initiative in FY11. Various system level improvements were done in the QCC initiative during FY20-FY22 which resulted in increase of QCC participation from 8% in FY18 to 78% in FY22. Total 797 improvement projects (Cumulatively) were done from FY11 to till FY22 by QC circles. Detailed explanation of PDCA rotation done in QCC initiative is explained in section 4.4.

3.4 TQM Techniques

Apart from the application of basic quality tools, SPC, Lean etc., APTC had given focus on advanced TQM tools to realize the business objectives, which are explained below.

(1) Problem solving through QC Story (A3 Sheet): Any problem identified through Gap analysis been addressed through two types of problem solving approach such as 1) Problem solving type QC Story methodology 2) Task achieving type QC story methodology.

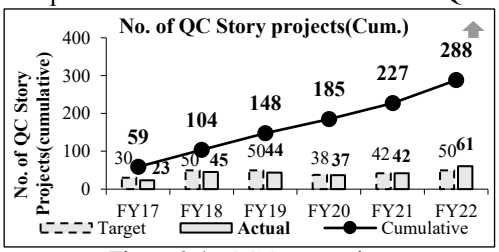

Figure 3.4 : QC Story projects

The projects will come from policy deployment process and cross functional management. Various trainings have been imparted to the concerned people for the usage of statistical tools and QC story approach in order to build their capabilities. Projects are identified through annual business plan like field complaints and any other chronic issues of department. A standardized template to execute the QC story projects has been prepared & utilized. Periodic reviews of these projects are being carried out by their superior, unit head and subject experts from TQMI. Number of projects completed through this approach is shown in Figure 3.4.

(2) Suggestion Scheme (SPARC): Suggestion scheme was introduced to encourage people involvement in small improvement activities. System level improvements were done in Suggestion scheme in FY20, FY21 & FY22 which led to increase of suggestion /employee / year from 4.14 in FY19 to 7.32 in FY22 and suggestion acceptance% from 5.5% in FY21 to 32% in FY22. Detailed explanation of PDCA rotation in Suggestion scheme is explained in section 4.4.

(3) QA matrix: APTC started the use of QA Matrix in FY14 with a simple relationship between product characteristics (in vertical axis) and process parameters (in horizontal axis). In FY18, it got strengthened by adding few additional rows of information such as source of data, standards and records w.r.t. to the process parameters etc., QA matrix is utilized as a tool for quick response to abnormality identified such as defects occurring in house or reported from field by reviewing its corresponding process parameters and related standards. The parameters identified through QA matrix are being reviewed in detail to identify the root cause related to the availability of standards, their adherence and adequacy. Based on the identified root cause/s, necessary countermeasures are being established. Currently the application of QA matrix is purely manual using excel sheets and is not a user friendly process as it has more than 500 rows and columns. To mitigate this a software is being developed to automate the QA matrix.

(4) Vertical evaluation : Vertical evaluation has been used in TBR & PCR SBUs to understand the quality level at various stages of process such as at customer end, ship out inspection end and in process end. The whole idea behind this evaluation is 1) to detect the defects at generation end and to prevent its flow out to customers and 2) prevention of occurrence of defects through BQiP.

3.5 Improvement in processes through application of ICT

ICT is extensively used to support business processes in APTC and always keep abreast with the latest development. Various ICT initiatives were implemented out of which some are summarized below:

- Maintwiz (FY17) : Localised ERP system for maintenance activities. Resulted in Elimination of manual work order generation in TBR automation
- Track and Trace (FY17): Implemented in CBU & PCR for traceability of materials & components. Elimination of manual traceability and ease in traceability
- Online Uniformity /OE yield for PCR (FY20): Real time monitoring and analysis of OE yield to trigger upstream process for controlling causes. OE Yield improvement from 94% to 96%
- Online OEE data capturing for mixers (FY20 & FY21) : Real time data capturing of OEE related losses and Online monitoring of machine wise OEE, related components and losses. Resulted in OEE improvement (TBR Belt cutter machine KC4 from 42% to 47%) and reduction of 2 manhours /day (data entry)
- Online SPC and capability analysis in pilot areas (FY21 & FY22) : Real time monitoring of tread weight through control chart
- Digitalization of PM & DWM -4E tool (FY22) : Deployment of PD/DWM, real time data capturing, monitoring & improvement

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4. Base Building Strategies
4.1 Management of Quality Assurance

(1) Background:

After inception in 2010, rapid market expansion of PCR and TBR tyres in India helped APTC to gain substantial market share with the addition of new markets and customer base. APTC faced a major challenge of increasing customer complaints from both OEM and replacement market. Driving improvements in the processes and QA systems through adoption of TQM was the critical need to attain the company's mid-term strategy of becoming a market leader in both PCR and TBR by supplying No. 1 quality tyres. To address this issue of increasing complaints from customers,QA function was restructured in FY15 and strengthened with 4 verticals – Customer interfacing, Quality auditing, Quality engineering and QMS with a specific responsibility to improve customer quality indicators. With this new structure of QA function, focused activities were initiated to strengthen quality gates and drive quality improvements in processes, which helped in making improvements in few of the customer quality indicators. The following major issues pending as on FY16 were considered for MTP FY17-FY22:

- High zero km complaints from replacement market in TBR
- High TBR & PCR complaints at OEM
- Increasing TBR complaints at field

Based on the systemic issues, key focus activities were identified to strengthen Quality gates and prevention of defect generation, which is explained in this section.

Exhibit 4.1.1 : Vertical Evaluation of TBR Zero Km complaints

Process	Trend between FY11-FY16	Pareto Analysis – FY16
In process Rejection - GT	Green Tyre Rejection @ Tyre Building	Green tyre Rejection FY 16
Final Inspection Rejection	Visual Inspection Rejection	Visual Inspection Rejection FY16
Customer Complaint	Zero Km Complaint at Customer	Zero Km Complaint FY16

(2) Major progress of Focus Activities:

① Control on defective product outflow from Visual Inspection

a. Vertical evaluation of Zero KM complaints as on FY16

During FY15, focus was given to improve inspection by introducing inspector qualification by MSA (Measurement system analysis).To attain the goal of 6 ppm by FY22 in TBR zero km complaints, it was necessary to strengthen the quality gates to prevent defect outflow. Vertical evaluation was utilized for analysis of zero km complaints (refer Table 4.1.1) to identify opportunities for strengthen the quality gates. This evaluation helped us to build strategies for enhancing quality gates and identifying improvement projects for defect reduction in process, which is explained below.

b. Development of Visual inspection standards

Inspector acceptance score (no. of inspectors qualified) in MSA was 76% in FY16; 24% of inspectors were in conditionally acceptable level. Also, inspector agreement score against standard was lower than 90% indicating the gap in understanding of the inspection standards. Inspection standards were in written form with statements and numbers! Team developed visual standards for inspection to create clarity and uniformity in understanding between all inspectors. In FY17, visual inspection standard has been developed, released to utilize for training of inspectors along with master samples. This helped in improving the Inspector acceptance score in MSA to 82% in FY17 from 76% in FY16 (refer Figure 4.1.1).

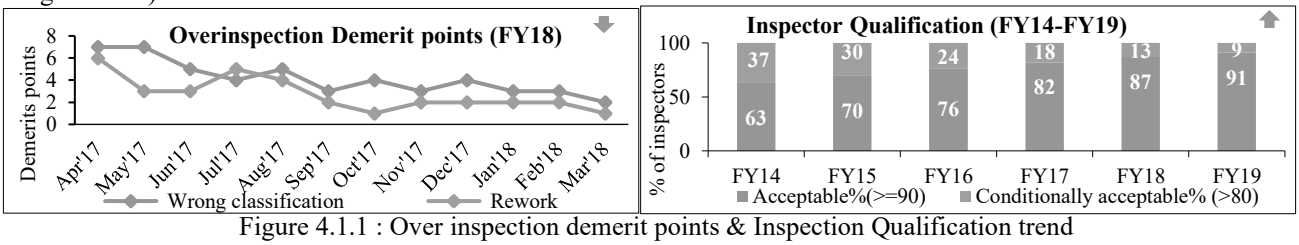

Figure 4.1.1 : Over inspection demerit points & Inspection Qualification trend

c. Establishing inspection effectiveness measurement system (FY18)

Further to increase the inspector acceptance score, over inspection system was introduced, in which, tyres from the storage are picked up randomly and inspected to identify visual defects. This information was used to give quick feedback to inspectors, and this helped in creating awareness on inspection leaks quickly, rather than waiting for complaints. With this process, MSA score of inspectors improved to 91% in FY19 (refer Figure 4.1.1).

② Strengthen finished tyres dispatch process to OEMs by introducing Quality gates

During the initial years before restructuring the QA organization in FY15, no system was existing for ensuring customer specific requirements before dispatch. This was resulting in repeated issues from different OEMs in PCR and TBR. QA team focused on developing the OE specific Pre-dispatch inspection standards to ensure, each customer specific requirements are met. This has resulted in reduction of OEM complaints by more than 50% by FY16. Pending issues at FY16 were related to packing and after inspection activities, which were addressed through standardization and system introduction.

a. Developing standards for TTF (Tyre, Tube, Flap) packing process

During FY16, APTC had received repeated complaints from TBR OEMs on TTF packing. It was observed that, no visual standards were established for TTF packing for OEMs and inflation of tubes was not standardized. QA team focused on developing visual standards for TTF packing process in line with OEM requirements and also establishing standardized air inflation system. This has resulted in reducing OEM complaints related to TTF packing to Zero in TBR during FY19 as shown in Figure 4.1.2. To ensure these results are sustained, a new process of "Customer complaint sustenance verification" process has been established.

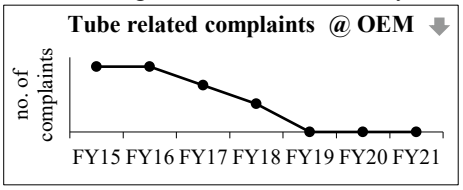

Figure 4.1.2 : TBR Tube related complaints

③ Prevention of defect generation

While we started progressing on improving the inspection system and dispatch processes to prevent defect outflow, internal defects started increasing. Towards prevention of defect generation, process audit has been established during FY16 and is utilized to identify gaps in SOPs and abnormalities in processes. Following key systems are introduced to improve abnormality management and defect prevention.

a. Standardization using A, B, C classification of abnormalities in process and product audit

Auditing system has been standardized to ensure abnormalities noticed are addressed systematically. Quality auditors carryout process audit to check the adherence to standards and specifications. Observed deviations are evaluated and classified for absence, inadequacy or non-adherence of the standard. A process was put in place to classify the observations into A, B and C classes as shown in the Figure 4.1.3. Quality engineers improve or develop standards for B or C type deviations in manufacturing with the support of other relevant functional members. QMS team helps in inclusion of standards in to QMS system.

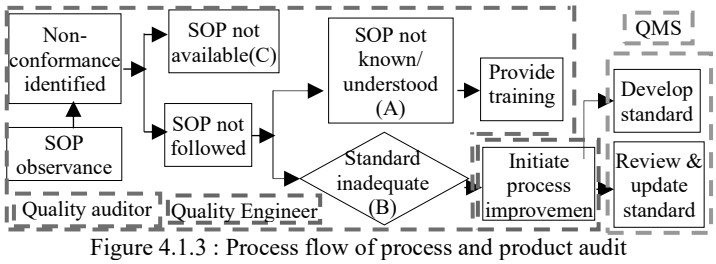

Figure 4.1.3 : Process flow of process and product audit

b. Process Stability and Capability improvement of Critical to quality parameters

For reducing the field complaints in TBR, focus was given to improve the CTQ parameters through BQiP approach. Based on this learning, monitoring of CTQs with the help of 2x2 matrix has been established during FY19 in PCR plant also. Monitoring of process stability and improving of capability is being carried out to build quality in processes. Inclusion of new parameters into monitoring is being done on annual basis to enhance process controls in manufacturing. (Figure 4.1.4).

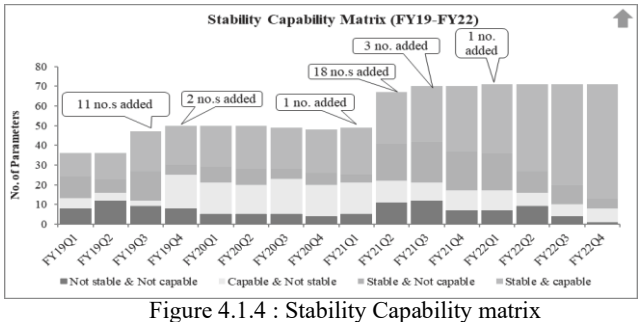

Figure 4.1.4 : Stability Capability matrix

c. Development of QA matrix and Standardization of high impact parameters/ problem solving

To facilitate abnormality management and standardization activities QA matrix has been established for both TBR & PCR product lines. Improvement opportunities are identified with vertical evaluation approach and QA matrix is utilized to identify high impact parameters related to defects and customer complaints. Assessment of non-standardized parameters and standardization is carried out with the help of cross functional teams to establish standards in manufacturing. This approach has helped in reducing internal defects as well as customer complaints.

d. Development of Video standards based on Criticality and Complexity of manufacturing processes.

During COVID19 pandemic lockdown period, unavailablity of manpower in manufacturing was a major concern for the plant. More than 20% manufacturing team members were recruited newly to meet the demand. Training these new recruitees for complex processes was a challenge, as SOPs were in written form. QA CFM established a process for enhancing the SOPs to video forms for manufacturing processes, especially, complex processes. Criticallity and complexity matrix (CC Matrix) is developed for prioritising the manufacturing processes for which video SOPs should be developed (refer Table 4.1.2). This approach is in progress to develop video standards covering all critical and complex processes.

Table 4.1.2 : CC matrix

Criticality	High	15	**16**	**14**
	Medium	1	12	**7**
	Low		1	1
CC matrix		Low	Medium	High
		Complexity		

4.2 Management of New Product Industrialization

(1) Background:

During the start-up of APTC, SKUs which were already in regular production in ATL's Limda plant were transferred and industrialized at APTC with the help of specification that was used in Limda plant. Within a short span of time it became very clear that to meet the increasing requirement from the market – OEM (Domestic/Export) & Replacement (Domestic/ Export) more number of SKUs need to be industrialized within a specified time period. (Refer Figure 4.2.1).

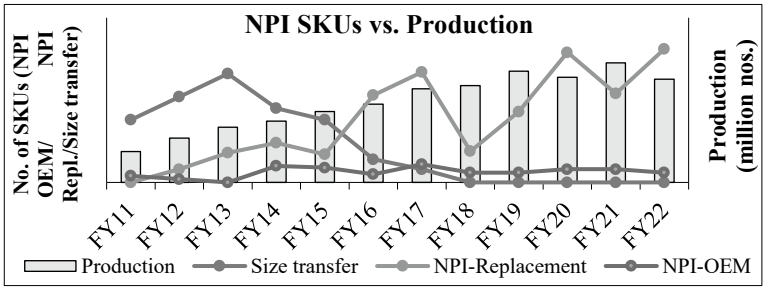

Figure 4.2.1 : NPI SKUs vs Production

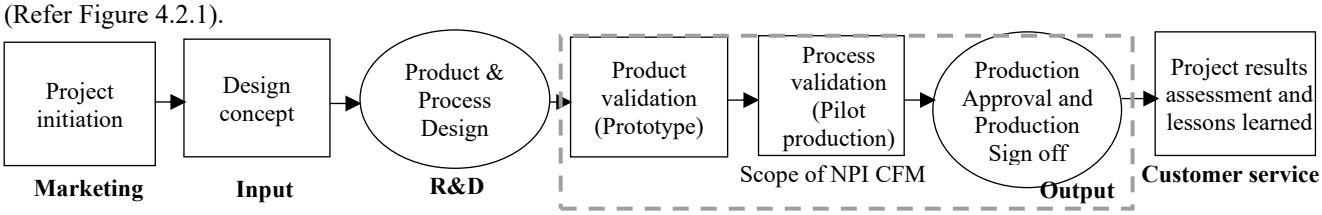

Figure 4.2.2 : Process for NPD & Scope of NPI

NPI CFM drives the industrialization of new products in APTC from product validation (prototype) stage to production sign off (refer Figure 4.2.2).NPI CFM constitutes of Plant Technology, QA, Manufacturing, PPC, Engineering, RMS, FGS & purchase (departments within APTC), R&D, & SCM (departments outside APTC).

During MTP FY17 – FY22, % of NPI on time was a key objective for the plant which got deployed to NPI CFM. Products which are industrialized (production sign off completed) within targeted lead time with desired quality and cost are called "On time NPI". Below mentioned factors are considered for signoff with stakeholders.

Quality related : Warehouse yield
Quality related : Meet all product certification (regulatory) requirements
Cost related : Scrap% of new products industrialized
Delivery related: NPI plan adherence

In line with MTP FY17-FY22 objective of meeting % on time NPI, NPI CFM objective was to industrialize new products by signing off within 7 weeks meeting QCD targets. NPI SKUs introduced during FY17-FY19 for new OEM models were with more stringent specifications and demanded more focus during Industrialization. From FY20 onwards, the classification of NPI products has been changed to Special (OE products with Silica tread cap compound and stringent uniformity specification) and Regular (replacement products with less manufacturing complexity) NPI SKUs. Based on the systemic issues of not meeting QCD targets of NPI , improving first time right of design was identified as the challenge and focus activities were identified for the same.

(2) Major Progress of Focus Activities:

① Build capabilities to industrialize new products meeting QCD targets within stipulated lead time:

a. Improving first time right of design process

a.1) Improvement of Gate system by including feedback mechanism:

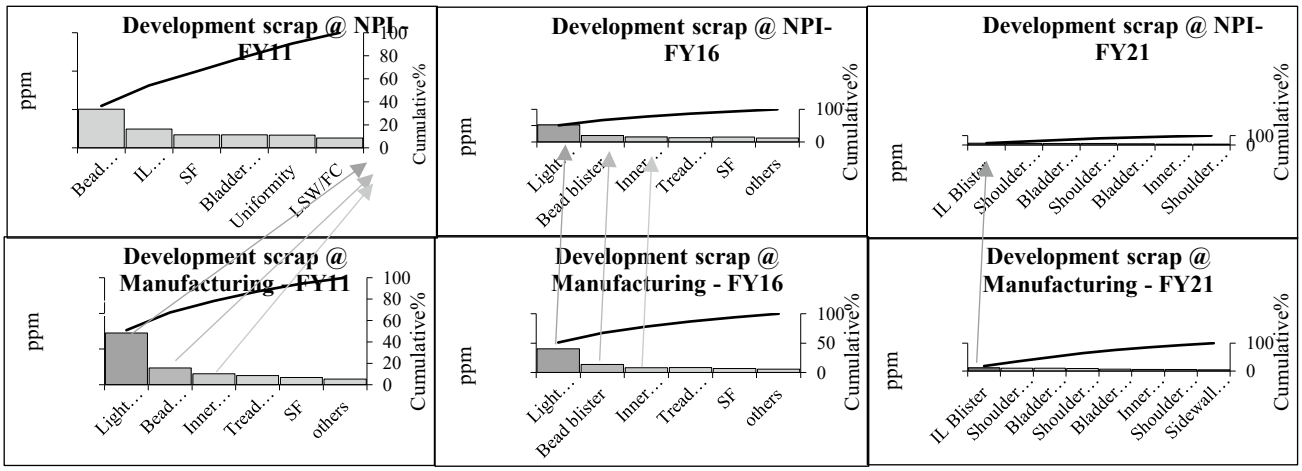

Figure 4.2.3 : Vertical evaluation of Development scrap

Inference of Figure 4.2.3 – FY11 : New defects observed in manufacturing stage were the defects which could not detect during NPI implies the weakness of gate review system during industrialization process. To overcome the same, Quality

gates were introduced at NPI sign off stage as explained in Figure 4.2.4. Since Quality gates effectiveness was improved, more defects were detected at NPI stage (Refer Figure 4.2.3 – FY16) which led to challenge of high development scrap resulted in not meeting the targeted lead time. After analysis, it was found that there were defects which should have been identified in the early stages of NPI process. To overcome this issue, stage gate review system was introduced during FY16 (refer Figure 4.2.4- highlighted with green colour) to clearly identify the root cause of defects in each stage of NPI process. Still the no. of iterations was high in FY18 due to lack of communication about lessons learnt to R&D. This has reduced further by introducing feedback mechanism with R&D (refer Figure 4.2.4 - highlighted with purple colour) after each gate review as well as capturing the lessons learnt in design standards (refer activity "A" in Figure 4.2.4). Thus, the rotation of PDCA after each gate review in all phase of development helped in reducing the development scrap (refer Figure 4.2.5) which resulted in lead time reduction in FY22. Systematic review, feedback and standardization activities (refer Figure 4.2.4) in NPI sign off process has helped in maintaining zero customer complaints related to new products.

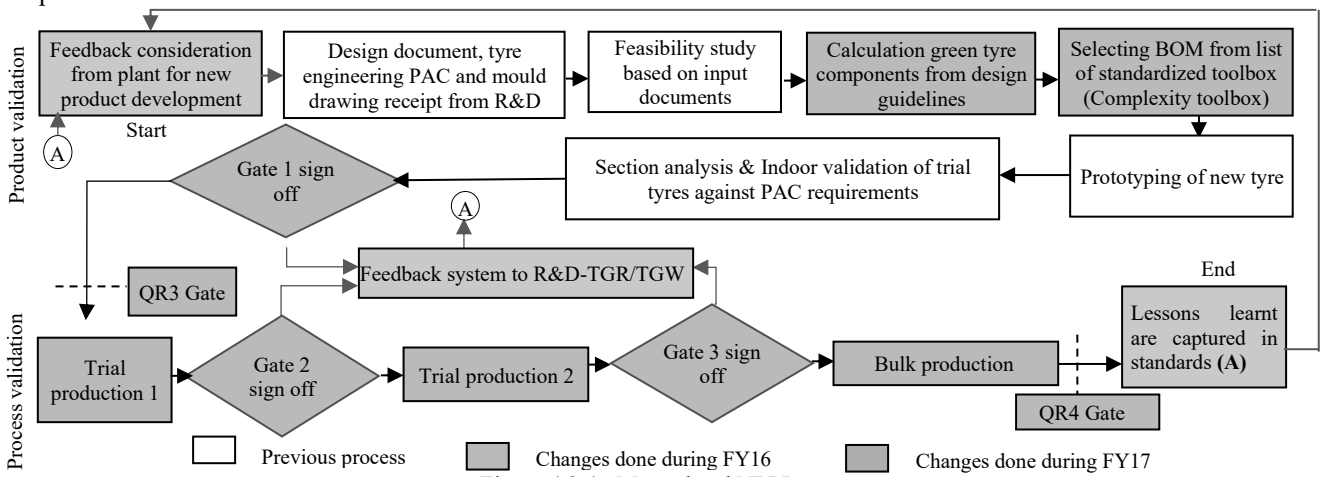

Figure 4.2.4 : Macro level NPI Process

a.2) Strengthening of design guidelines / WI through incorporation of learning:

Till FY16, green tyre design was being done based on individual project leader's experience. This led to higher defects leading to more number of iterations and higher lead time. To overcome this issue, team decided to capture the lessons learnt from each project through gate reviews after each stage and incorporate the learnings in the form of design guidelines / WI and to update / revise the same based on rotation of PDCA. E.g., Tread crack defects were found in one of the NPI product – Comtrac 2 All season. Based on analysis, it was found that tread ending was below the parting line leading to shoulder crack defect in cured tyre. A design standard was developed to standardize the tread ending for all products above the parting line in cured tyre and standardize the green tyre design. **Cumulatively 127 number of guideline standards / work instructions developed / updated from FY11 to FY22. This significantly reduced the development scrap from 1.1% (FY11) to 0.16% (FY22) which reduced number of iterations from 6 to 4. As a result of the same, NPI lead time was reduced.**

a.3) OEM warehouse yield improvement of new products:

Waveform & Vector separation analysis is done by plant technology to optimize process parameters which impact the tyre uniformity. Prior to FY17, these analysis were used to be done only during the trial production lot 2 based on feedbacks of trial production lot 1 which was consuming the time. After FY19, PDCA has been rotated by incorporating the mathematical analysis at proto stage (earlier stage in NPI process) itself with introduction of Waveform & Vector separation which has **resulted in meeting the targeted OEM warehouse yield of >85% during sign off stage itself.** During FY21, NPI CFM identified challenge of achieving OEM warehouse yield target of >90% at sign off stage and further improving the same to >95% within 6 months from sign off. To achieve the same, smaller trial lot was introduced before trial production lot 1 to validate the results of experimental design and optimizing the process parameters.This additional step led to achieving >90% at sign off stage. Additionally, new challenge was taken up to improve the OEM warehouse yield to more than 95% within 6 months of sign off through QC story methodology. This has led to achieving target of >95% within 6 months from signoff and thus enhancing the OEM warehouse yield of new products.

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4.3 Delivery Management

(1) Background

At ATL, the overall tyre demand is consolidated and allocated to various plants by SCM. APTC gets SKU wise demand for TBR & PCR every month. The objective of delivery management is to meet this allocated demand. This is measured as "SKU wise schedule adherence" on a monthly basis. It is calculated as percentage of number of SKUs adhered against the total number of SKUs planned. In addition to meeting this monthly demand from SCM, plant also ensures daily adherence of the delivery plan from OEM customers.This is measured as OTIF % (On Time In Full). Since FY14, APTC had achieved 100% OTIF for OEMs, the challenge for Delivery management CFM was to meet the SKU wise schedule adherence. Considering the potential growth of TBR tyre market during MTP FY17-FY22, ATL forecasted steep increase in TBR tyre requirement from APTC (refer Figure 4.3.1).

ATL decided to increase the installed daily capacity of APTC TBR plant from 6K to 12K. Delivery CFM worked with the stakeholders to ensure and align the speed of capacity ramp-up in line with volume projections. In addition to the volume increase, number of Tyre SKUs also increased by over 15% every year resulting in more in-house components on daily basis. Being the assembly area, tyre building was most impacted because of increased number of components (Input material). On the other hand, PCR demand was expected to be stable and hence not a priority issue compared to TBR (refer Figure 4.3.2). The challenge was meeting increased TBR demand and increased complexity in planning Tyre components & Green tyres. Delivery CFM focused on reduction of tyre building availability loss to increase output and subsequently reduction of green tyre shortage (NGT) in curing (setup & input material shortage).

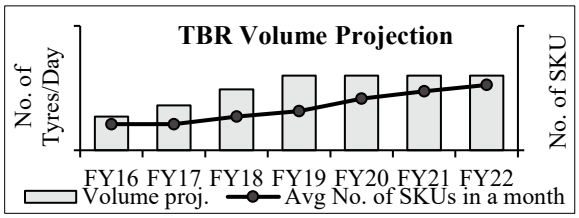

Figure 4.3.1 : TBR volume ramp up vs No. of SKU

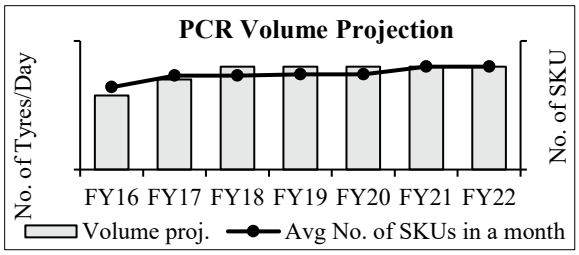

Figure 4.3.2 : PCR Volume ramp up vs No. of SKU

(2) Major progress of Focus activities:

In order to face the challenge of achieving schedule adherence with increased number of SKUs and demand, following activities were done during the period of FY17 to FY22.

① Focusing on customer centric delivery by improving the output of tyre building process:

a. Cycle time and set-up time (tooling &input material changeover) reduction in tyre Building:

In tyre building, set-up change over happens for the tooling and the input materials whenever a SKU is changed. The increased volume and SKUs of TBR resulted in increase of daily setup changes in tyre building, which in turn led to reduction in output. CFM worked to reduce change-over time in tyre building. Projects were identified to reduce the input material changeover time and tooling set-up time. Similarly, the cycle time of tyre building was also reduced by combining two process steps together. Three major projects were implemented for achieving this objective:

(i) Input Material changeover time reduction by 349 seconds for every setup in Tyre Building. (2 Tyres gain for every loading) - QCC project

(ii) Tyre building cycle time reduction by implementation of sidewall super assembly resulted in reduction of cycle time from by 18 Sec for highest running SKU of 20" tyres which is 70% of total volume.This has resulted in the daily capacity increase of 750 green tyres. – Task Achieving QC story approach

(iii) Change-over time reduction of drum (part of tooling) in tyre building by 30 min. (12 tyres gain for every change over) – Problem solving QC story approach

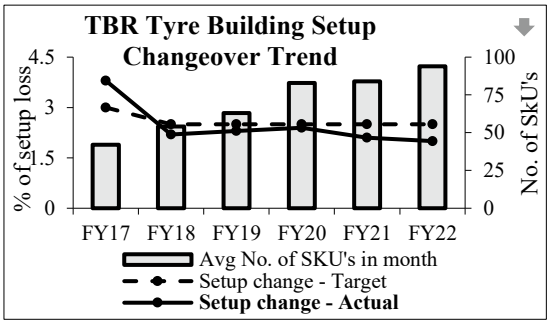

Figure 4.3.3 : TBM Setup change time

(i) Input Material change-over time reduction: Input material change-over time analysis shows the top three components contributing higher change-over time: 1. Steel chaffer, 2. Shoulder cushion and 3. Belt edge filler and 4. Sidewall. Projects were taken to reduce the change-over time of all these 3 components, which helped to maintain the setup change-over time below the target of 2.5% (refer Figure 4.3.3). Project no.1 for steel chaffer change-over time reduction is explained briefly below in Table 4.3.1.

Table 4.3.1 : Setup change reduction analysis and improvement

Problem	Root cause	Countermeasure	Time Saved	Before	After
High material change-over time for Steel chaffer in Tyre building.	Multiple manual steps for one cartridge changing.	Material handling equipment changed from **cartridge type to cassette type** which **reduced change-over time** & increased the **material holding capacity.**	Change-over **time saved per loading - 132 Sec**		

Similarly improvements were done in other components which lead to reduction of Input Material changeover time by 349 seconds. (refer Figure 4.3.4)

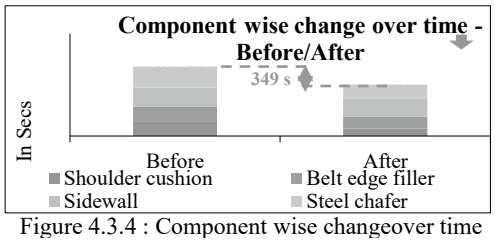

Figure 4.3.4 : Component wise changeover time

b. Enhancement of Component inventory management:

Daily production planning relies on the inventory accuracy of in-house components. Errors in inventory data will lead to faulty planning. The component inventory was captured in the planning software manually by operator resulting in time delay and data entry errors. The wrong system inventory led to frequent component shortages for green tyres. In order to overcome this issue, CFM introduced bar-code labelling of every production batch as a poka-yoke. This label is scanned for booking of stock whenever it is fed to next process which ensured on-time capture of data without any manual error. This system is implemented for all components of PCR and for critical components of TBR. Horizontal deployment in remaining TBR components will be planned in FY23 progressively. The PDCA cycle for improving the inventory management system is demonstrated in Figure 4.3.5 which helped to reduce component shortage loss in tyre building (refer Figure 4.3.6) and green tyre shortage loss in curing process (refer Figure 4.3.7).

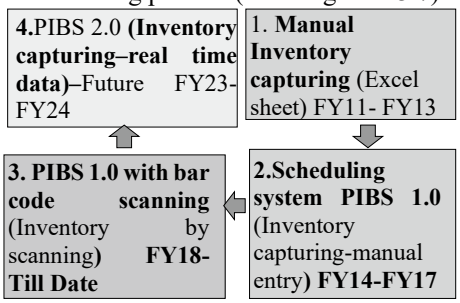

Figure 4.3.5 : Inventory management PDCA

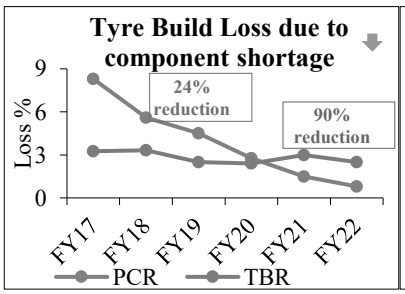

Figure 4.3.6 : Effects of component shortage

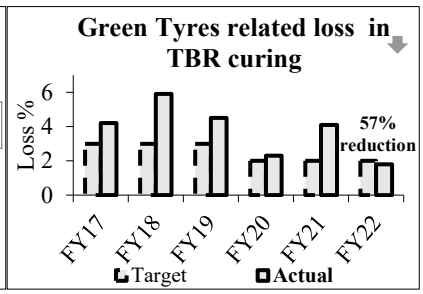

Figure 4.3.7 : Effects of Green tyre shortage

4.4 Human Resource Management

(1) Background:

APTC was established in 2010 with the intent to be a world class plant. Hardware was selected to make tyres of outstanding quality meeting current and future requirements of the customers at a cost that will generate good return on investment. It was planned for APTC to become a resource for supporting future expansions of Apollo Tyres for Radial Technology. For optimum utilization of such an investment in terms of achieving business goals, it was planned to manage the Human Resources through appropriate organization design and people processes. Accordingly, a flat three-layer organization structure was designed (Team member, Team Leader and Group Leader) to enhance agility, effective communication and to foster a culture of teamwork. This was prevalent for almost ten years. However, in employee satisfaction survey conducted in FY20, it was noted that employees had aspiration to get better designation, hence organization decided to introduce new grades in organization structure. These new grades are in-line with global Apollo organization structure. Additionally, to operate this plant with advanced manufacturing facilities, it was decided to hire only technically qualified Diploma Engineers as operating team members (instead of non–technical people like in conventional tyre industries). These Diploma Engineers were made responsible for PQCDSM deliverables of respective work centres called as Self-Managed Team (SMT) members. The internal customers of HR CFM are Top Management (strategy & policy) and all employees (services). The objective of HR CFM during MTP FY12-FY16 was to build skill level of employees in line with business requirements to produce consistent quality products in safe manner and to involve them in continual improvement activities. In MTP FY17–FY22, APTC planned to expand TBR plant capacity for which providing adequate new skilled manpower was a challenge.

(2) Objectives for MTP FY17:

- To enhance the employee capability to meet the requirements of TBR plant expansion
- To enhance the total employee involvement in continual improvement activities.

(3) Major progress of Focus Activities:

① Skill & capability building process enhancement:

The Skill development process focused on developing the Skills of SMT Members and trainees. Capability building process is for non- SMT members. Till FY17, for all newly joined SMT members, a structured 90 days induction program encompassing 30 days of classroom training and 60 days of OJT was devised to train them in safety, work processes and quality parameters. Entire syllabus was customized and training was delivered using in house resources. Skill assessment will be done by their respective department and skill matrix will be updated (Level 1 - Beginner, Level 2 – Semi Trained, Level 3 – Fully Trained and Level 4 – Expert). In FY18, government of India introduced a scheme called National Employability Enhancement Mission (which offers incentives) to give practical training to diploma engineering students and make them employable post completion of their fixed term OJT upto 3 years. In APTC, it was decided to induct up

to 30% of the shop floor crew from this pool of trainees to support TBR expansion. Due to this, number of trainees had gone up. Now, the challenge was to build skill of trainees on a regular basis in short period of time. To meet this requirement, skill development centre (SDC) was established, which is explained below.

a. Reducing Lead time of Skill Development:

In FY12, classroom training for the new joiners was more focussed towards instructor led training. To reduce the lead time of classroom training, SDC was equipped with more visuals like prototypes, process specific video SOPs, safety & quality inputs based on the job requirements through which training module was revised and duration was revised to 7 days of training from 30days. Post training, written exam is being conducted to ensure the effectiveness of the training. After 7 days of training in SDC, on the job training (OJT) is being imparted by respective BUs SMT members (Skill level – L4). Post OJT, skill assessment is conducted and skill matrix is updated. Number of trainees in skill level – L2 has improved from 92 in FY18 to 289 in FY22 (refer Figure 4.4.1).

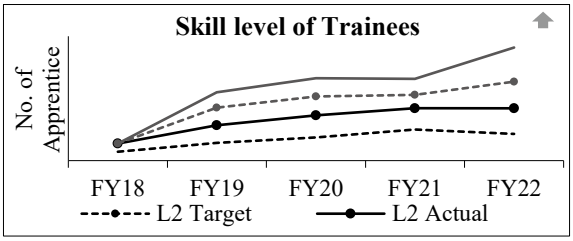

Figure 4.4.1 : Skill level of trainees

b. Enhanced Capability Improvement process for Non-SMT members

In the capability development process, capabilities of Non-SMT members, identified in line with MTP FY17 – FY22 were divided into two categories i.e. 1) Behavioral and 2) Functional. Behavioral trainings are common programs whereas functional trainings are department specific. Till FY19, training needs identification (TNI) was done through capability gap assessment of departments. As the TNI process was specific to the department, individual level analysis was not carried out, which was identified as a gap. In order to strengthen the capability development process, PDCA was rotated in FY20. Accordingly, individual wise capability gap identification & appropriate TNI were also identified for all Non-SMTs. Based on the TNI, categorization of training program in-terms of hierarchy & role was done. From the TNI, training was designed in consultation with internal & external experts, training calendar was prepared and training was imparted. Training effectiveness is being measured with 1. Immediate feedback, 2. Pre and post assessments, 3. Assessment on application of learning by their respective superiors. Refer Figure 4.4.2 for improved training process.

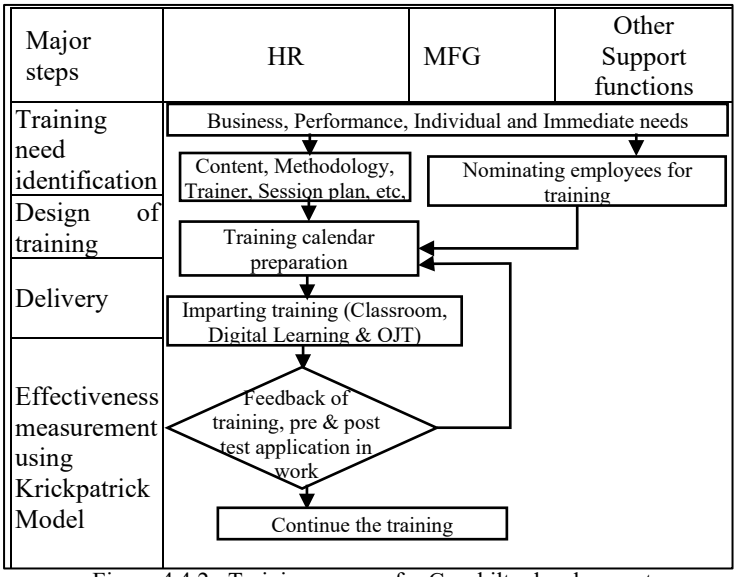

Figure 4.4.2 : Training process for Capabilty development

c. Training in the new normal (COVID 19 Pandemic period):

In FY21, because of the pandemic, employees were unable to attend physical trainings due to restrictions in travel and social distancing requirements. To tackle the challenge, entire training programs were moved to virtual / online platform and effectiveness were also captured using online evaluation process. However challenges were faced in participant attention and their engagement level. To overcome this, training modules have been broken down and delivered with lesser duration, video is ON at all times, sensitization of faculty about the engagement activities and included intermediate quizzes. This resulted in improved engagement level of participants. Based on the Competency Assessment of FY22, e-learning courses were mapped and assigned to respective employees to encourage the self-learning culture in the organization. This will result in improvement in competency level of employees which will be evaluated during FY23 competency assessment. This will be linked with the performance management score of individuals.

② Revamping of suggestion system

Till FY16, each BU was equipped with suggestion coordinators who will collect and evaluate the suggestions. Central suggestion committee shortlists the suggestions for implementation based on feasibility and priority. Suggestion /employee / year target was fixed at 8 but participation of employees was gradually decreasing during FY16-FY19. Hence in FY20 it was decided to revamp suggestion scheme. Brainstorming sessions were conducted by involving various stakeholders such as shop floor members, suggestion evaluators and manufacturing heads and the gaps in the process were identified and appropriate countermeasures were implemented to revamp the suggestion scheme.

Table 4.4.1 : Suggestion scheme process improvements

Focus Area	Causes	Countermeasure
Participation	• Low Awareness about the scheme • Trainees were not included in scheme	• Re-launch of suggestion scheme as SPARC • Trainees were included in the scheme

Evaluation	• Less number of Evaluators(10 Evaluators) • Evaluation process was difficult • Capability of the evaluators was inadequate	• Number of evaluators are increased (45 Evaluators) • Evaluation process simplified (Scoring method simplified) • Suitable trainings(2 Nos) conducted for evaluators
Implementation	• Tracking of implementation was not available • No exclusive team for implementation	• Implementation tracker developed and reviewed weekly • Separate technical team appointed for implementation
Rewards & Recognition	• Reward in kind was not satisfactory • Rewarding was not done on timely manner	• Monetary reward coupon system introduced • Quartely reward distribution introduced

As part of revamping the process, SMT members were involved in various competitions like Naming contest, Logo designing. As a result, in the month of May'19 the team came up with a new name for the suggestion scheme called SPARC (**S**uggest **P**articipate **A**nalyse **R**esonate **C**elebrate). The revised process was standardized. Suggestions received has been improved from 4.14 in FY19 to 33 in FY20. However, participation in suggestion scheme declined again in Q1 of FY21 as employees were unable to use the existing paper & pen method considering the global pandemic scenario. To overcome this challenge, e-SPARC, an online tool to capture the employee's suggestions was launched in Jun'20. Simultaneously, evaluation and tracking were also made online. This method was useful in getting suggestions and easy for processing to next level without compromising the pandemic protocols. As a result of this countermeasure, suggestion / employee / year improved from 1.86 in Q1 of FY21 to 10.21 in Q2 and 10.60 in Q3. While doing the evaluation of received suggestions, the feedback from evaluators was that there were duplicate and not feasible suggestions. During the analysis of this situation, it has been found that R & R scheme was based on the number of suggestions rather than focusing on quality of suggestions. R & R system was revamped to bring focus on quality of suggestion. In order to evaluate the effectiveness of revised R & R system, suggestion acceptance% was added as a new metric and the same was improved by adopting QC story methodology. The suggestion acceptance % started increasing from 5.5% in FY21 to 23% in FY22. This improved the quality of suggestions and added value to the organization.

③ Promotion of QCC

APTC launched QCC initiative in FY11. Drop in participation in the QCC was observed from FY17. Lack of awareness in QCC was identified as one of the major causes through brainstorming. Training related to QCC methodology and usage of 7 QC tools were given by internal and external trainers. This helped to improve people involvement in QCC from 8.3% to 25.3 % against the target of 25% in FY19. However, in FY20, ambitious target of 50% was taken and against which only 38% was achieved. Major causes were identified, and actions taken as shown in Table 4.4.2 which resulted in improvement to 73% in FY21 and further to 78% in FY22. Also till FY19, performance of the QCC was monitored as number of completed projects. Total 430 improvement projects (cumulatively) were done from FY11 to FY19 by QC circles. With this, individual QCC performance was not evident and hence, from FY20 onwards performance was monitored as project completion rate, which is calculated as no. of projects completed per circle per year. In FY20 project completion rate was 0.32 and improved to 0.56 in FY21. The major factor for the low completion rate is due to gap in capability of facilitators for the newly formed circles. Trainings were planned to these facilitators and project completion rate improved to 1.02 in FY22.

Table 4.4.2 Summary of analysis and actions for QCC

Categories	Action Taken
Rewards	R & R policy released for QCC members and facilitators
Attendance	Weekly QCC attendance dashboard introduced
Training programs	Internal QCC trainings to cover all members (18 programs)
Project completion rate	Capability building training for facilitators (3 programs)
QCC Facilitators in Mfg.	Added 31 facilitators from QA, Tech, Engineering

4.5 Management of Conversion cost

(1) Background:

APTC is one of the cost centres of ATL, which contributes around 40% (FY22) to APMEA revenue and 33% (FY22) to APMEA operating profit margin. Manufacturing cost is a significant cost driver for ATL operations. Manufacturing cost has two components viz., Raw material cost and Conversion cost. APTC is responsible only for conversion cost (Raw material procurement is handled by Corporate Purchase department). Improvement in cost at APTC is driven through Cost CFM. Elements of manufacturing cost and conversion cost are explained in Figure 4.5.1.

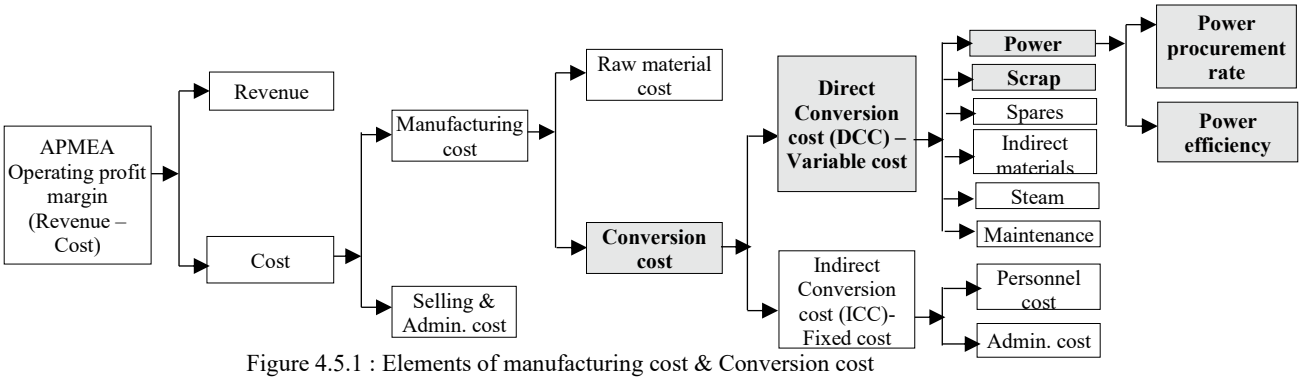

Figure 4.5.1 : Elements of manufacturing cost & Conversion cost

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Conversion Cost Management in APTC is carried out in three steps as mentioned below:

Cost Budgeting: APTC budget is finalized in line with APMEA mid term plan and annual budget. Cost targets for each of the cost elements are fixed based on the previous year best achieved levels of performance (which are the expenses required for managing operations). Plant cost target is further drilled down to SBU level (PCR , TBR & CBU) and further to BU level within each SBU.

Monitoring & Review: Cost elements are mapped to each BU and budget for each BU is assigned. Cost incurred by each BU against the allocated budget is monitored and reported. Gap analysis discussions happen at the respective DWM meetings with SBU Heads. The cost results are consolidated and published at the month end. Unit Head reviews SBU wise cost results on monthly basis.

Cost Improvement: Cost improvements are driven in terms of both (i) Expense reduction (ii) Loss reduction. Expense reduction is driven through Policy management (Breakthrough improvements are done through Task achieving QC story methodology) while Loss reduction is controlled through DWM.The progress of these improvements are monitored and reviewed by respective SBU Heads and Unit Head on a monthly basis. DCC contributes to 67% of Conversion cost (FY16) . Hence, this has been taken as objective for Cost management during MTP FY17-FY22. Based on pareto analysis of Direct conversion cost (FY16) , power cost is the major contributor (45% contribution). Power cost has two elements : (i) Power procurement rate and (ii) Power efficiency. Focus activities were identified to reduce power procurement rate through alternate power sources (Task achieving QC story) and Efficiency improvement through QC story methodology.

(2) Major progress of Focus Activities:

① Power procurement rate reduction through alternate power sources

Initially during FY16, power sourced from TNEB (government owned power source) was more than 80% of total requirement. Due to steep increase in power rate by the state government in FY16, and to meet increasing power requirement to support capacity ramp up, Cost management CFM took a challenge to identify alternate power sources to reduce power procurement rate.

Task Achieving QC story approach for Power procurement rate reduction:

Step 1: Understanding Organization's Policy: In line with the MTP FY17-FY22 objective – Reduction of Conversion cost , Power procurement rate reduction has been identified as the strategy to manage DCC.

Step 2: Setup the Task: After preparation of project charter and constituting the cross functional team, target for power procurement rate was arrived (**INR7.27 / KwH in FY16 to INR6.49 / KwH)** by considering the FY22 target of DCC (INR 14.93 / Kg). Broad objective of this project is to reduce the power rate significantly.

Step 3: Develop the Methods to perform the Task: Cross functional team brainstormed and identified the alternate methods which were further based on selection criteria as explained in Table 4.5.1.Optimum power procurement from each source was arrived at based on the power procurement rate (d) and maximum possible power which can be procured / generated (b) from each of the method which in turn was arrived based on the limitations (a) in power procurement.

Table 4.5.1 : Evaluation of alternate methods and selection of best method (Truncated version)

Possible Methods	Limitation (a)	Max. possible power which can be procured / generated (Million KwH) (b)	Optimum power procurement/ generation (Million KwH) (c)	Selection criteria					Decision (i)
				Power generation / procurement rate (INR/KwH) (d)	Investment (Million/MW) (e)	Payback (yrs) (f)	Sustainability (g)	Feasibility (h)	
Solar - BOOT model	Roof top capacity	24	24	4.5	No Investment		High	Medium	Selected
Thermal (In-house)	Steam availability	360	360	4.8	50	2	Medium	High	Selected
Power trading	Fluctuating rates	800	NA	10.0	No Investment		Medium	Low	Not selected

Step 4: Explore Successful Scenarios: The various possible scenarios against the selected methods were shortlisted based on evaluation criteria for implementation (refer Table 4.5.2).Risk associated with each selected scenario has also identified along with its mitigation plan and proposal presented to management for their approval.

Table 4.5.2 : Exploring implementation scenarios (Truncated version)

Selected methods	Implementation Scenarios	Implementation risk	Feasibility	Decision
Thermal (In house)	Fully condensing	Additional investment in boiler for process steam requirement	Low	Not selected
	Cogen –Extraction and condensing	-	High	Selected
	Cogen-back pressure	Power generated will be restricted according to process steam requirement	Low	Not selected

Step 5 : Implementation of Scenario: Selected scenarios were implemented as per plan. During implementation, variations in power rate was observed against the initial assumptions made due to seasonal availability of wind power , change of procurement rate of Group captive sources etc., Process of power procurement has been established to evaluate the share of business to various alternatives/ necessity of new alternative based on Production volume (monthly ticket), power demand, seasonal fluctuation and power availability from different power sources on monthly basis. (refer Figure 4.5.2). In line with this strategy only, the entire roof top of APTC was used for installing solar panel. The current roof top solar capacity of APTC is 12MW which

generates 17 Mn. Units/yr. *APTC roof top is the second largest roof top solar in India and one of the largest in Asia. Toyota Kirsloskar Motors appreciated this efforts and awarded APTC as* "*Best environment Promotion Supplier Chennai Region" which is a matter of pride.*

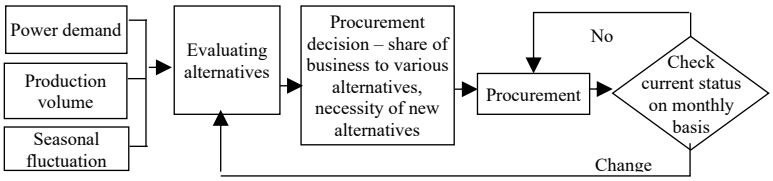

Figure 4.5.2 : System of Adaptive control in DWM for power procurement

Step 6 : Confirm the effects: Power procurement rate was reduced from INR7.27/ KwH in FY16 to **INR 6.31 KwH by FY21** as a result of continuous rotation of PDCA through increase in the share of alternate power in the overall energy mix (refer Figure 4.5.3).

Step 7 : Transfer to DWM: Standards were created for the implemented scenarios and SDCA approach was followed to sustain the achieved results. Further to this, power procurement cost has been reduced through managing power procurement share from various sources.

Step 8 : Future Plan: APTC is working on increasing renewable energy sourcing further to >50% of total requirement by FY26 through offsite solar (40 Mn units) in FY23 , wind (additional 50 Mn Units) by FY24

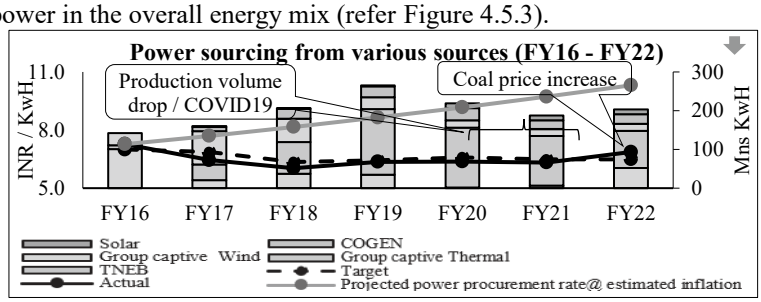

Figure 4.5.3 : Power sourcing from various sources and power rate

② Efficiency improvement through QC story methodology:

Power cost consists of two factors – namely power rate and power efficiency. Power generation efficiency improvement in Cogen through QC story methodology has been completed. Projects such as reduction of auxiliary power consumption of Cogen, reduction of in house power generation cost of Cogen and reduction of live steam consumption of cogen boiler de-aerator has resulted in power generation cost INR4.6/KwH in FY19 to INR 4.00/KwH by FY21.

4.6 Creation of Safe Work Culture

(1) Background:

APTC is committed to maintain safe and healthy environment at workplace in line with company's safety principle "Safety First – Always, In All ways". APTC has established safety management systems in FY12. To implement the safety practices across the APTC plant, an integrated safety organization structure (Refer Figure 4.6.1) was implemented in FY12 with an understanding that safety is everyone's responsibility. Safety performance of the APTC is measured by "Lost Time Injury Frequency Rate" (LTIFR) and "Lost time Injury Severity Rate" (LTISR). LTIFR is the ratio of no. of lost time injuries (LTI-Injury that results in loss of one day or more from work) to the total man hours worked, multiplied by 1 million. Similarly, LTISR is the ratio of total man days lost to total man hours worked multiplied by 1 million. Injuries occurring inside the plant are considered to calculate the safety performance. To reach the final goal of Zero LTI, equal focus is given to all LTIs to eliminate similar incidents. Prioritization of LTIs based on man days lost (severity) is not done since the final goal is to achieve Zero LTI. Since inception no fatal incident happened in APTC and safety indicators of LTIFR and LTISR is also improving year on year. Considering the LTIFR baseline 0.61 in FY16, challenge for the plant is to achieve its MTP FY17-FY22 LTIFR target of 0.2 by FY22 whereas global industrial benchmark is 0.25. Based on pareto analysis of LTI, inadequate standard , inadequate risk control and non-adherence to standard are identified as the system level issues. Following are the focus activities to overcome these issues.

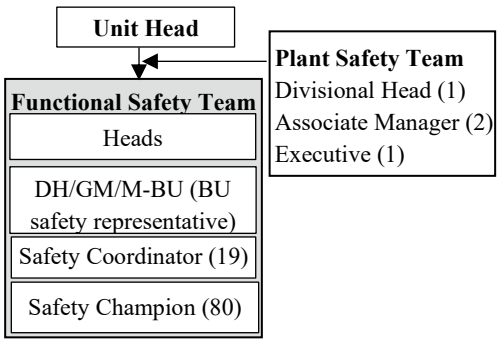

Figure 4.6.1: Integrated Safety Organization

- Strengthening of safety standards related to Powered Industrial Truck (PIT) operation, new machines, manufacturing process and non routine acitivities
- Review and strengthening of Hazard identification and risk management system.
- Enhancement of Behavior Based Safety (BBS) observation system and Safety Education & Training

(2) Major Progress of Focus Activities:

① Strengthening of safety standards related to PIT operation, new machines, manufacturing process and non routine acitivities

In FY16, there was total 6 nos of LTIs. After analysis of each LTI, it was found that 4 out of 6 are due to inadequate standards. Out of these 4, 3 were related to PIT operation alone. Through analysis, cause was identified as inadequate system of training for tow truck & BOPT. Training and licensing system for tow truck and BOPT operators established by including tow truck and BOPT operation in critical activity standard. This resulted in zero LTIs related to this cause.

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After making the PIT related incidents zero, in FY17, APTC observed 3 new LTIs due to inadequate standard out of which 2 LTIs was related to use of new machines first time. Safety team has a process to assess the safety requirements for a new machine which is getting included along with the other machine specifications and shared with machine supplier. After the installation and before trial run of machine, safety team conducted audit to verify conformance to safety requirements and to identify additional hazards related to work area. In case of any additional hazards identified, project team is being informed about the same and do the required modifications. Analysis of these 2 LTIs revealed that new machines were operated without closing the safety audit observations because there was no close looping mechanism to cross verify the closure of safety findings. To make this process fool proof and closed loop, PDCA has been rotated by revisiting the process by adding 'safety signoff' step to use the machine. Now safety team is verifying the closure of all the safety related observations and then only permission of using the machine is being signed. This improvement has ensured the zero LTIs related to use of new machine. Remaining one LTI occurred in TBR tyre building during checking carcass drum. Process SOP for this activity was found inadequate and did not include adequate safety instructions. As an immediate action the SOP was improved. A key learning was derived during the review of this action. SOPs were getting updated only after incidents which is a reactive approach. As part of being proactive, in FY18 all other SOPs for manufacturing processes and non-manufacturing processes (routine operations) were revisited and safety instructions for each task were included by revising the SOP format. From FY19 onwards, SOPs were revised year on year based on incidents, HIRA updates and new SOPs were added as needed. Safety one point lessons (SOPL) were also created for key safety instructions and employees were trained on the same. Total number of standards revised year on year is mentioned below in Table 4.6.1.

Table 4.6.1 : Revision of Standards

Type of Standards \ Year	FY17	FY18	FY19	FY20	FY21	FY22
Manufacturing SOP revised	32	116	22	18	14	11
Maintenance SOP revised	27	89	71	194	57	39
New SOPLs prepared	243	115	134	92	60	42

During FY19, 3 LTIs were observed due to non-availability of standards while performing non-routine activities. (Non-routine work are jobs performed for first time or rarely). On analysis, it was found that standards were not developed for activities which are carried out for first time or occasionally. To take the action on such issue, mapping of non-routine activities was done and around 265 standards were created for identified non-routine activities. Safety work permit system is also extended to new non-routine jobs to conform the safety while working. During FY21, one LTI occurred during a major maintenance job. On analysis, it was found that SOP defines manual use of shaft for removal of screw and the manual handling guidelines to be followed for this activity. Despite this, due to lack of coordination between members during manual handling of shaft resulted in an LTI. Hence in order to eliminate manual handling risks, SOP was revised with use of puller for removal of screw. Standard instructions were developed for all screw removal activities in the plant. A survey was conducted to identify manual handling of heavy jobs in plant and mechanical handling aids are provided/planned to eliminate fall of material risk. Format for development of on the spot method statement is updated to include information about manual handling activity involved in the job and its safety control planned.

② Review and strengthening of Hazard identification and risk management system:

To identify the potential Hazard and risk associated with operations and activities, Hazard identification and risk assessment (HIRA) system is in place. HIRA assessment was carried for all operations and activities in the APTC during FY12 and the same is being reviewed every year. Safety risk score is arrived for all risks based on likelihood and consequence, and the risks are classified as high, medium and low. Based on the LTIs happened during FY12 to FY16, evaluation of the effectiveness of HIRA system was done as shown in Table 4.6.2. Above analysis revealed that all the LTIs happened, was mapped in the HIRA but the countermeasures were limited to administrative controls (least effective) and adequate engineering controls (more effective) were not established for the same. To establish this system, hierarchy of control concept was introduced in HIRA in FY17. Revised hierarchy of Controls introduced consist of elimination, substitution, engineering controls (most effective) and administrative controls and PPE (least effective). All activities in the plant was updated with revised hierarchy of controls. Risk reduction projects (RRPs) were taken to implement the most effective controls including safety poka yokes for high risks activities and reduce the risk level to medium or low. Effect of the revised HIRA also resulted in LTI reduction as shown in Table 4.6.3. An example of LTIs related to inadequate risk control and action taken is shown in Table 4.6.4.

Table 4.6.2 : LTI Vs HIRA -Before

Analysis of LTIs from FY12-FY16		Hazard/Risk identified in HIRA	
		Yes	No
LTI happened	Yes	**57**	0
	No	3946	---NA--

Table 4.6.3 : LTI Vs HIRA - After

Analysis of LTIs from FY17-FY22		Hazard/Risk identified in HIRA	
		Yes	No
LTI happened	Yes	**21**	0
	No	4925	---NA--

Table 4.6.4 : Example of risk reduction through engineering control

No. of LTI	LTI description	Safety Control	
		Before	After
2 LTI (FY18)	Hand injury in windup operation (2 LTIs)	Instruction in SOP to stay away from nip point. Warning sign at workplace. (Administrative control)	Implemented engineering controls such as Manual inching during initial passing, Liner speed < 5 mpm, Safety light curtain and Safety fence.

During FY18-FY22, 546 risk reduction projects were implemented. Few key risk reduction projects to strengthen the risk management in SBUs are briefed below in Table 4.6.5.

Table 4.6.5 : Key risk reduction projects in SBUs

Year	LTI	SBU	Key risk reduction project	Effect
FY18	2 no. LTI in windup operation	TBR	Implement engineering controls for windup operation	Zero LTI (Till FY22)
FY19	One LTI in mixer due to hit by forklift	CBU	Man machine separation for PIT operation in key areas	
FY20	One LTI in Bead Apex cutter during jam-up clearing	PCR	Safety light curtain (poka – yoke) to all Bead apex cutter area to prevent cutter operation when hand placed in danger zone	
FY21	One LTI in Twin Drum Apex	TBR	Safety guard extended and pneumatic safety valve (poka – yoke) implemented in zig zag cutter	
FY22	One LTI in ash conveying system, cogen boiler	CE	Safety poka yoke for energy isolation and restart	

③ Enhancement of BBS observation system and Safety Education & Training :

LTIs related to non-adherence of standards also were observed over the years in APTC. Non-adherence of standards is a behavioral aspect of human and hence to improve adherence to standards, BBS observation system was introduced in FY14. Gap analysis was carried out periodically and action taken to strengthen BBS observation system is explained in below table (refer Table 4.6.6).

Table 4.6.6 : Enhancement of BBS observation system

Status of FY14	Action taken	Status of FY16	Reason for Gap	Action taken	Status of FY18	Reason for Gap	Action taken	Status of FY22
9% Unsafe behavior (Non-adherence of standards)	Introducing BBS observation system	3.8% against the target of zero	BBS check sheet was with common points only	BBS check sheet revised from common points to hazard category based	2.1% against the target of zero	Process specific behavior not included in BBS form	BBS check sheet revised to capture Process specific behaviors	0.65% against the target of zero

Along with various systems established to prevent LTIs, right from its inception APTC is giving adequate focus on Safety Education and Training. 2 days extensive plant level safety induction training program is established for new joiners from FY12. Department wise safety induction training was introduced in FY16. In FY18, Safety skill development centre was upgraded with prototypes and Safety gyan labs was introduced with hazard models. Despite this, APTC encountered 4 LTIs to temporary employees (new trainees introduced in FY19). To understand the reason, APTC did the analysis and effective job specific safety training and assessment process was implemented. Due to this, zero LTI is achieved for new trainees since FY20.

Vertical evaluation approach for Safety:

Vertical evaluation approach is used for arriving at safety strategy using the Heinrich accident theory which relates LTI incidents, First aid & minor incidents (reactive) to risks identified through Haziner & BBS (proactive). Factors contributing to risks, related to major LTI , First aid & minor incidents are identified and actions are taken for these. This proactive approach resulted in reduction of at risk behaviour by 55% (from FY19 to FY22) , reduction of First aid & minor incidents from 68% (from FY19 to FY22) and LTIFR reduction by 73% (from FY19-FY22) – refer Figure 4.6.2.

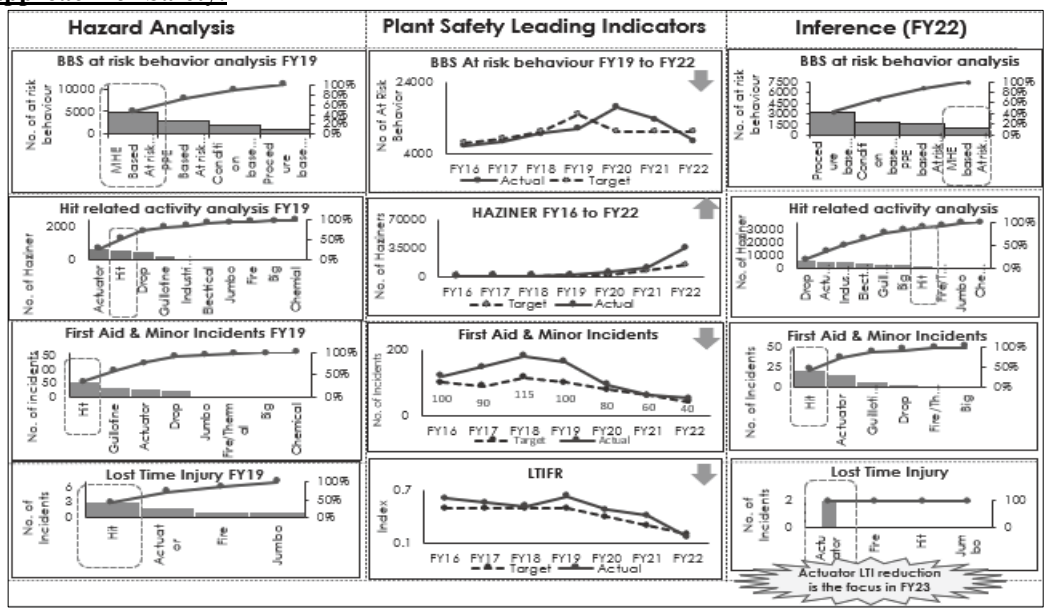

Figure 4.6.2 : Vertical evaluation – Safety (FY16-FY22)

Incidents happening outside plant: APTC has also started monitoring and acting upon road transport safety incidents to employees occurring outside plant from FY18. Actions such as introduction of 3-point contact retractable seat belts in all company buses, road safety audio messages before commencement of journey, receiving feedback from passengers on safety during travel and creating awareness about road safety rules, guidelines for safe bike ride etc., were implemented and being followed.

4.7 Care for Environment and Society

(1) Background:

At ATL, Corporate Social Responsibility (CSR) is embedded in the long term business strategy to ensure that business priorities co-exist with social needs & environmental sustenance in order to drive holistic development of communities and the eco system. CSR objective is to contribute to the nation's growth and development, mitigate the effects on environment and uplift the rural communities in the neighboring villages. To implement CSR initiatives, every year 2% of ATL's profit is allocated as budget.

APTC is situated in a hybrid environment with industries and villages in and around the facility. In FY07, in order to establish APTC plant, potential environmental impact assessment was conducted. CO2 emissions and discharge of waste water was found as major potential contributors to impact environment adversely. This potential threat was taken care during the design stage of APTC itself and robust systems were built with possible countermeasures such as recycling of processed water through Effluent Treatment Plant (ETP), through Ultra Filtration (UF) & Reverse Osmosis. Plant is designed in such a way that all the processed water is going to effluent treatment plant and getting filtered. This water is reused for internal purposes viz., sanitation, horticulture and certain amount for the process again. Similarly, a well-planned system was also established to control emissions. Over and above these measures, APTC has also invested in creation of renewable energy and installed a rooftop solar of 12 MW which is second biggest in India. APTC does not limit only to the compliance of statutory requirements. As per organization's philosophy of care for society, APTC has taken various initiatives to conserve environment and payback to the society by uplifting the neighboring communities through various CSR initiatives. Process flow for doing CSR activities is described below in Figure 4.7.1.

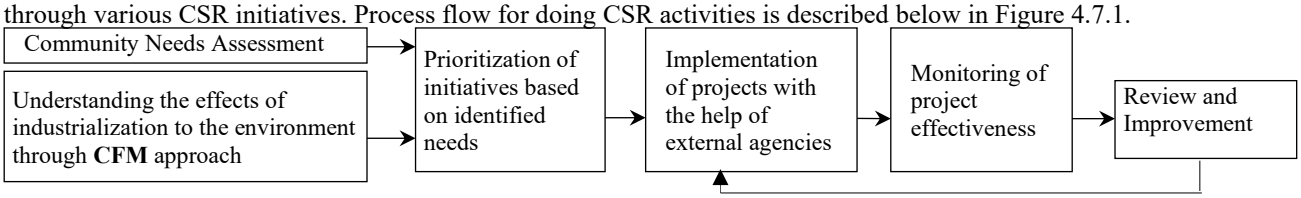

Figure 4.7.1 : Integrated approach to CSR activities

(2) Description of CSR Activities:

Community assessment was conducted in FY12 to identify their needs through questionnaire, interviews and focus group discussion method. Area of 5 km radius wherein there are 10 villages around the plant was considered as neighboring community to do CSR projects. After becoming stable in terms of production in FY15, APTC has conducted a biodiversity assessment with the help of external agency to understand its actual impact on environment. Based on the assessments outcome, prioritization of issues has been done and 4 key themes have been decided to work upon in consultation and coordination with corporate CSR team. Identified themes were 1) Waste Management & Sanitation, 2) Biodiversity Conservation and Climate Change Mitigation, 3) Other Local initiatives, and 4) Livelihood and Skill. Various long term projects (Period of projects may vary from 3 years to 10 years) have been identified based on these themes and project implementation has been done with the help of external agencies. Below is the summary of the projects.

① Waste Management & Sanitation

- Clean My Village - Community Solid Waste Management waste collection, segregation at source, conversion of waste to wealth. 90% of families segregate waste at source and 70% of it is recycled and up cycled.
- Open Defecation & Bad hygiene - Construction of individual toilet cum bathing facility and awareness generation. Open defecation reduced from 75% to 5% and families not having toilet facility reduced from 68% to 8%

② Biodiversity Conservation and Climate Change Mitigation

- Pond Eco Conservation - 6 water bodies were restored and are maintained
- Offsetting carbon emissions of APTC through Tree Farming and Carbon Sequestration. Plantation of 0.35 Mn teak & sandal trees and maintenance for 10 years. 323 farmers earn, short term income from inter cropping and a long term income after 15 years. Sequestered 25,000 tonnes of CO2

③ Livelihood & Skill : Computer Literacy Project resulted in increase of access to computer usage (59% to 100%)

④ Other Local initiatives on need basis : Purified RO drinking water facility for community members in the villages. TDS level reduced (800ppm to 100ppm) which is suitable for drinking, benefitting 4500 villagers.

Overall community members from 10 villages (18,000+ members) are benefitted out of the above projects. Effectiveness of all the projects is being monitored regularly and corrective actions are being taken in case of any abnormalities found.

5. Challenging Strategy

Apart from the above explained Base building strategies , APTC also implemented below mentioned challenging strategies as a part of the MTP FY17-FY22.

5.1 Breakthrough reduction in TBR Field Complaints through BQiP

TBR field complaints were in increasing trend during FY12 – FY16 and peaked during FY16. Being the market leader in TBR, it was a critical business need to reduce TBR field complaints to retain the brand image, as well as sustain market leadership in TBR and hence identified as major challenge in MTP FY17-FY22. To supply tyres with No.1 quality , advance TQM tools were adopted. Based on vertical evaluation , it is identified that Belt bulge which was the major contributor was observed only after usage at field and found cannot be detected at plant. Inorder to prevent defect generation , BQiP - Build Quality in Process approach was adopted. CTQs related to Belt bulge were identified from QA matrix. Based on Stability Capability matrix, 6 out of the 14 CTQs were not stable and not capable. Stability was improved by taking actions on abnormalities and standardization. Capability was improved through QC story methodology. This led to reduction of field complaints related to belt bulge in FY19 H1. However another defect -ply bulge @ shoulder increased during this period. Body ply stretch was identified as the internal failure cause for ply bulge. Actions were taken for controlling defect outflow to customer by strengthening inspection standards which resulted in increase of internal rejection. BQiP approach was adopted then for reducing the defect generation through standardization of high impact parameters in QA matrix related to body ply stretch. As a result of the same and continuation of improvements in stability & capability of CTQ parameters , field complaints related to Belt bulge reduced by 77% , field complaints related to Ply bulge reduced by 43% and overall TBR complaints @ Field reduced by 72% from FY16 to FY22.

5.2 To improve product quality in consonance with narrowing OEM (PCR) specifications

Quality conformance to OEM specifications is measured in terms of conformance to visual and uniformity specifications. OEM warehouse yield is the measure of tyres conforming to OEM specifications. OEM warehouse yield was 84.7% during FY16, because of which APTC must produce 15.3% extra conforming tyres to meet 100% OEM demand. Hence improving PCR OEM warehouse yield was identified as one of the major challenge for MTP FY17-FY22. Top contributing SKU's in pareto of non-conforming SKUs were taken for OEM warehouse yield improvement through QC story methodology. Waveform analysis and QA matrix were used to identify the significant parameters for low yield. Vector separation study was used to optimize the component placement angle which was one of the significant cause. Actions taken were standardized as part of design guidelines. Every year top contributing SKUs were selected similarly and improved through QC story methodology. This resulted in improvement in OEM warehouse yield by 15%.

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6. Overall Effects

APTC has introduced TQM as a vehicle in line with its envisaged vision and for building organizational capabilities. Along with the growth of the Indian economy, APTC has also expanded its business and sales, with sales of 13.29 billion rupees (approximately 21.3 billion yen) at the time of TQM adpoption in 2012, and sales of 55.97 billion rupees (approximately 89.6 billion yen) in FY22, an increase of approximately 4.2 times. Following exhibits show the effects of the objectives defined during MTP FY17-FY22.

6.1 Tangible Effects

(1) Effects of APTC MTP FY17-FY22 Managing points

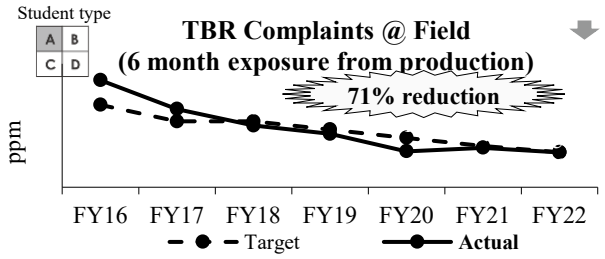


Figure 6.1 : TBR Complaints @ Field

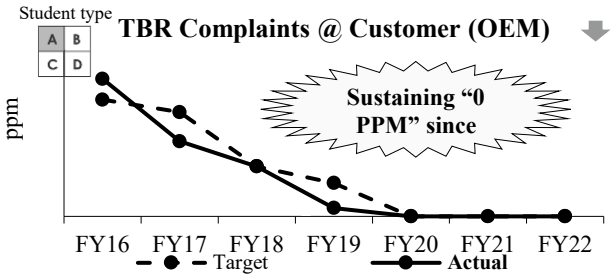


Figure 6.2 : TBR Complaints @ Customer (OEM)

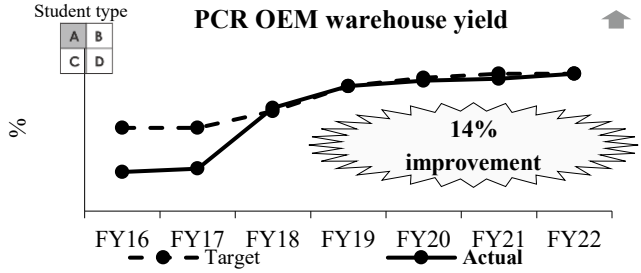


Figure 6.3 : PCR OEM Warehouse yield

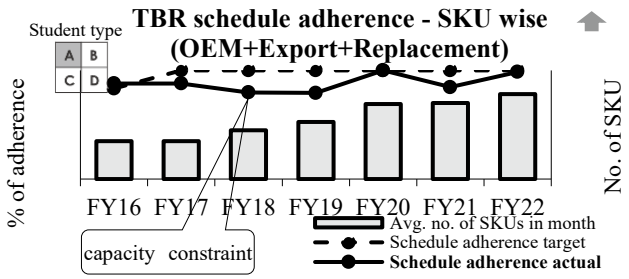
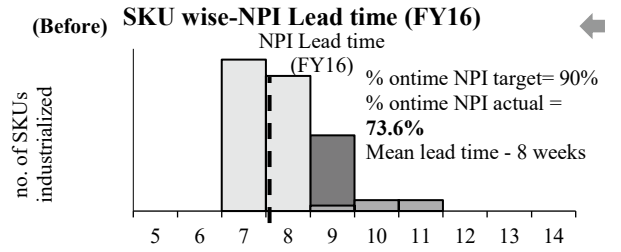


Figure 6.4 : TBR schedule adherence-SKU wise



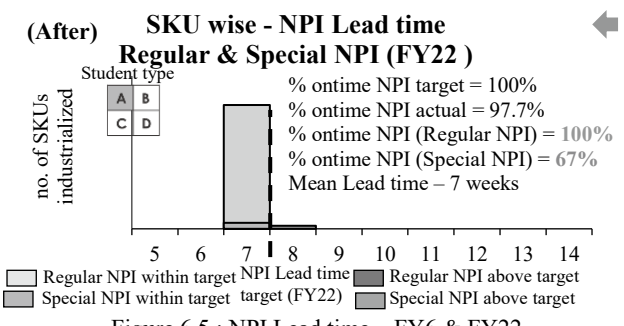


Figure 6.5 : NPI Lead time – FY6 & FY22

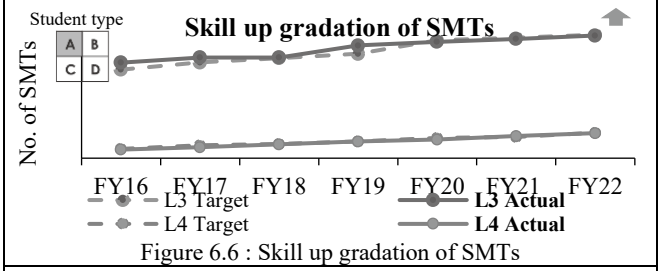


Figure 6.6 : Skill up gradation of SMTs

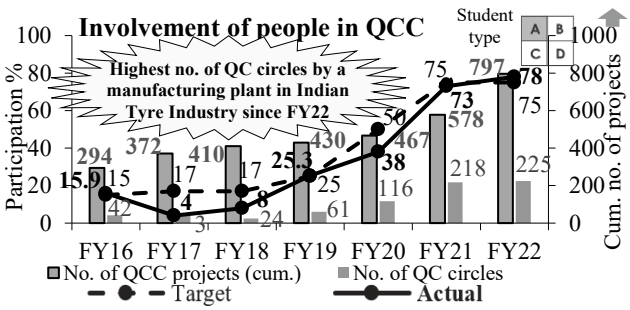


Figure 6.7 : Involvement of people in QCC

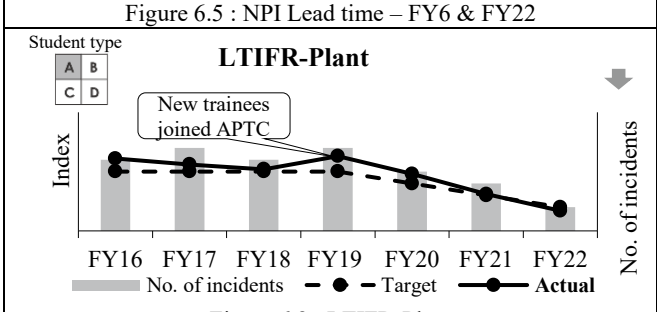


Figure 6.8 : LTIFR-Plant

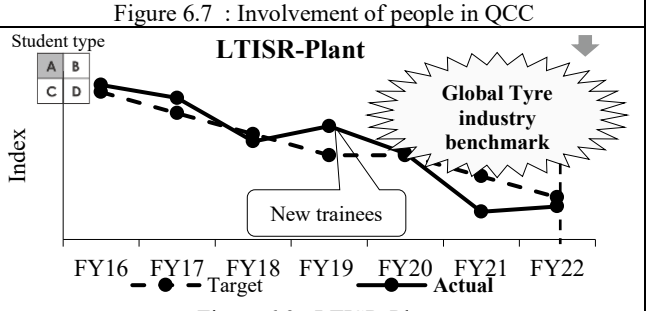


Figure 6.9 : LTISR-Plant

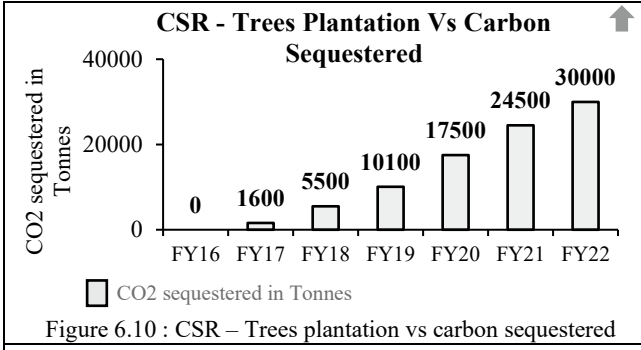


Figure 6.10 : CSR – Trees plantation vs carbon sequestered

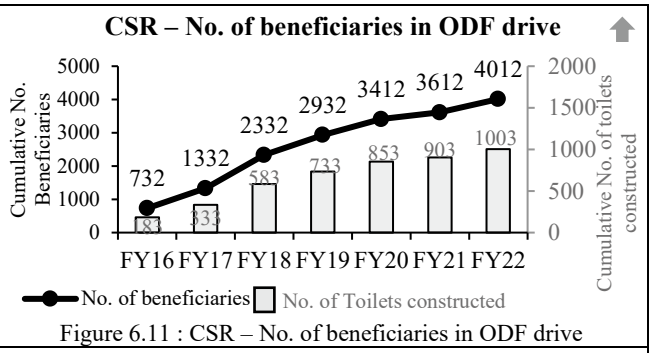


Figure 6.11 : CSR – No. of beneficiaries in ODF drive

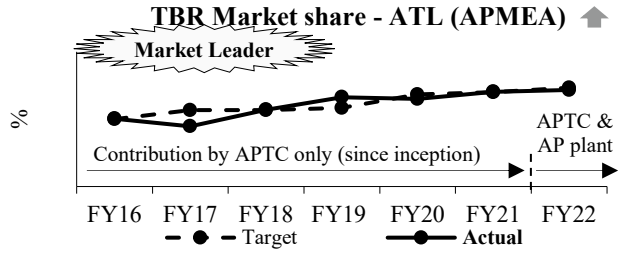


Figure 6.12 : TBR market share – ATL (APMEA)

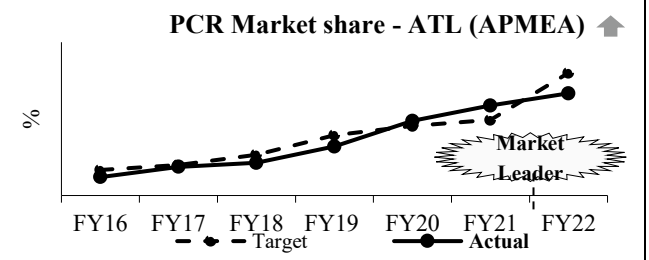


Figure 6.13 : PCR market share – ATL (APMEA)

6.2 Intangible Effects

- Customer (External & Internal) focus increased in all processes.
- Thinking became data driven and Problem Solving became structured
- Culture of Standardization, Daily Work Management & PDCA taken deep roots
- Structured Cross functional working between departments has enhanced
- Above mentioned tangible benefits helped APTC to won various awards and recognitions(Refer section 1.3 (8)).

7. Future plan

Considering the global tyre market scenario, ATL is planning to strengthen its multinational presence further. Recently, ATL has embarked into North American (NA) tyre market, which is a challenging market in terms of expectation from customers, market size, legal regulations etc. ATL also want to continue one of it's objective as sustaining dominant position in the APMEA markets. To support this growth, APTC plays a significant role (around 40% contribution by APTC to APMEA's revenue) and hence it is important to define its future goals in line with MTP FY23-FY26 ,which are mentioned below:

- Development of tyres to suit global tyre markets is very important and APTC is committed to complete all the NPIs as per the NPD plan of R&D in shortest feasible lead time.
- Sustain Zero PPM complaints at OEMs and be a benchmark for complaints at field within APMEA plants.
- To be a benchmark in internal rejection across tyre industry in India by using advanced TQM tools viz. BQiP, QA matrix, Stability - Capability matrix etc.
- To grab the first mover advantage by manufacturing advanced product like intelligent tyres in consonance with digital advancements (Tyres with RFID).
- To be a benchmark among Indian tyre companies by achieving lowest conversion cost to deliver enhanced value to all stakeholders.
- Enhancement of skill and competency of employees through (i) process-based skill assessment & multi skilling through job rotation for SMTs and (ii) level wise competency development courses for managerial team.
- To enhance the employee involvement in QC Circles from 78 % to 90% and focus on project completion rate.
- To enhance the safety standards in order to achieve Zero LTIFR and be a bench mark across the global tyre manufactures.
- Extensive usage of ICT for faster and data-based decision making to meet business objectives.

APTC will further enhance the use of advanced TQM tools to improve the effectiveness of various processes

- Four student model to evaluate and improve the effectiveness of policy management process, and
- Stability capability matrix to measure and improve the DWM status of plant.

It will also further strengthen the application of other tools like problem solving QC story, task achieving QC story, QA Matrix, Vertical evaluation etc.

APTC is also committed to support other ATL plants and other APMEA functions such as R&D, Sales & Marketing, and Customer Service etc. in their TQM journey and has a plan to challenge the Deming prize for whole APMEA in subsequent years. APTC wants to further enhance its TQM level and will challenge Grand Deming prize also in future.

8. Terminology Glossary

Table 8.1 : Terminology Glossary

Terminology	Explanation
12”	12” -*12 inch (tyre size)*
2x2 matrix	Stability capability matrix-*A matrix to access the status of various process/product parameters w.r.t. stability & Capability. It has 4 Quadrants.Quadrant-1 Not Stable, Not Capable, Quadrant 2- Not Stable, Capable, Quadrant 3- Stable, Not capable &, Quadrant 4- Stable & Capable*
4 Student model	*It is a method to evaluate the effectiveness of Policy deployment interms of target achievement and process*
4E tool	4E - Empowering Employees for Effectiveness and Efficiency, Tool for deployment of PD/DWM, real time data capturing, monitoring & improvement.
Admin.	Administration
Agri	Agriculture sector Tyres. Tyres that are used in tractors, farm equipment etc.
AM	Associate Manager
AOTS	The Association for overseas Technical Cooperation and Sustainable Partnerships
APMEA	Asia Pacific, Middle East & Africa
APTC	Apollo Tyres Chennai plant
ASEAN	Association of Southeast Asian Nations
ATL	Apollo Tyres Ltd.
BBS	Behavior Based Safety- *A system to identify the unsafe acts due to behavior of an employee*
BOM	Bill Of Materials
BOOT	Build Own Operate Transfer model for solar energy
BOPT	Battery Operated Pallet Truck
BQiP	Build Quality in Process
BU	Business Unit
CAGR	Compounded Annual Growth Rate
CBU	Common Business Unit- A *Strategic Business Unit of APTC where Mixing process is being carried out*
CC matrix	Criticality Complexity matrix
CE	Central Engineering
CFM	Cross Functional Management
CII	Confederation of Indian Industry
COGEN	Cogeneration-*Cogeneration of power is the process of producing electricity and heat simultaneously*
Complaints @ Field	*It is a type of complaint from the end user reported due to failure of tyre during usage. The failed tyres are collected at regional inspection centre for analysis by plant and R& D team*
Complaints @ OEM	*Defective tyres reached at customer end and officially reported by the OEM customer*
CTQ	Critical to Quality
Cum.	Cumulative
DCC	Direct Conversion Cost- *Cost incurred during the conversion of raw materials into finished goods*
DH	Divisional Head
EHS	Environment Health & Safety
EMS	Environmental Management System
EPQM	Executive Program on Quality Management
ERP	Enterprise Resource Planning
FSM	Four Student Model-*Method to evaluate Policy management effectiveness interms of target achievement & process.*
GL	Group Leader
GM	Group Manager
GT	Green Tyre
HIRA	Hazard Identification and Risk Assessment
HR	Human Resources
HSE	Health, Safety and Environment
ICT	Information and Communication Technology
ISQ	Indian Society for Quality
IT	Information Technology
Kg/Manhr	Kilogram/Man Hour **-** *Unit of Measure for Productivity*
LCV	Light Commercial vehicle
LCV/SCV	Light Commercial vehicle / Small Commercial Vehicle
LTI	Loss Time Injury
LTIFR	Lost Time Injury Frequency Rate - *ratio of number of lost time injuries (Injury that results in loss of one day or more from work) to the total man hours worked, multiplied by 1 million*
LTISR	Lost Time Injury Severity Rating - *ratio of total man days lost to total man hours worked multiplied by 1 million.*
M	Manager
MFG	Manufacturing
MNCs	Multi-National Companies

MT	Metric Tonne
MTP	Mid Term Plan
NEEM	National Employment Enhancement Mission - *Government scheme introduced for employment*
NPD	New Product Development
NPI	New Product Industrialization
ODF	Open Defecation Free
OE & IB	Original Equipment & Institutional Business
OE/ OEM	Original Equipment Manufacturer
OEE	Overall Equipment Effectiveness
OHSMS	Occupational Health and Safety Management System
OHT	Off Highway Tyre
OJT	On the Job Training
OTIF	On Time In Full
OTR	Off The Road
PAC	Product Acceptance Criteria
PCR	Passenger Car Radial
PDI	Pre Dispatch Inspection
PESTLE	Political, Economic, Social, Technological, Legal and Environmental
PFMEA	Process Failure Modes & Effects Analysis
PIBS	*An online Apollo specific production planning and inventory monitoring system.*
PIT	Powered Industrial Truck
PPC/FGS/IE	Production Planning & Control , Finished Goods Store and Industrial Engineering
PPE	Personal Protective Equipment
QA matrix	*A matrix to establish relationship between product and process characteristics.*
QCD	Quality Cost Delivery
QMS	Quality Management System
QR	Quality Review
R&R	Rewards & Recognition
RFID	Radio Frequency Identification
RO	Reverse Osmosis
ROCE	Return On Capital Employed
RRP	Risk Reduction Project
SCM	Supply Chain Management
SDC	Skill Development Centre
SKU	Stock Keeping Unit
SMT	Self Managed Team
SOP	Standard Operating Procedure
SOPL	Safety One Point Lesson
SPARC	Suggest Participate Analyze Resonate Celebrate – *Suggestion scheme at Apollo Tyres Chennai plant*
TA QC	Task Achieving QC story
TBB	Truck Bus Bias
TBR	Truck Bus Radial
TDS	Total Dissolved Solids
TGR/TGW	Things Gone Right / Things Gone Wrong
TL	Team Leader
TMC	Toyota Motor Corporation
TNEB	Tamil Nadu Electricity Board - *Power generation and Distribution Company owned by Tamil Nadu* Government
TNI	Training Need Identification
TPS	Toyota Production System
TQMI	TQM International private limited - *One of the TQM consulting and training agencies in India*
TTF	Tyre , Tube and Flap
VCMD	Vice Chairman & Managing Director
Vertical Evaluation	*Vertical Evaluation is an advanced Quality tool used to evaluate the quality level at various quality assurance stages together (Customer, ship out inspection & different in process stages at manufacturing) and take actions to control defect outflow to customer & prevent defect generation at process.*
Vector Separation	*Mathematical simulation study to find out the optimum setting of spotting of the components to achieve the best Uniformity value*
Waveform analysis	*It is the technique used to find out the high and low magnitude area by analyzing the wave pattern across the circumference of the tyre, measured through Uniformity machine.*
Zero KM complaints/ZKC	*Complaints received from dealer related to aesthetic or technical function of the tyres which are detected during or immediately after fitted on rims or mounted to vehicles, before the tyre is put into service.*