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デミング賞
受賞報告講演要旨

Ashok Leyland Limited, Hosur Unit II



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1 Organizational profile:

1.1 Ashok Leyland (AL):

AL started in 1948 as Ashok Motors, to assemble cars in collaboration with Austin Motor Company, England. Ashok Motors became Ashok Leyland in 1954 with the equity participation of Leyland Motors, UK and started manufacturing Commercial Vehicles (CV) in India. Over the period of time, the company has become one of the key participants in, and drivers of India's economic growth. In 1987 Ashok Leyland was acquired jointly by Hinduja Group and IVECO. Hinduja Group is a transnational conglomerate with turnover of more than USD 25 Billion, presence across 100 countries and investments in Automotive, Information Technology, Media, Financial services, Oil & Gas, Power, Real Estate and Healthcare. Hinduja group and IVECO decided to part ways in 2007, following which Ashok Leyland has become an independent company manufacturing Commercial Vehicles. In 2010, AL entered into Light Commercial Vehicles (LCV) to become a full range player in the CV market.

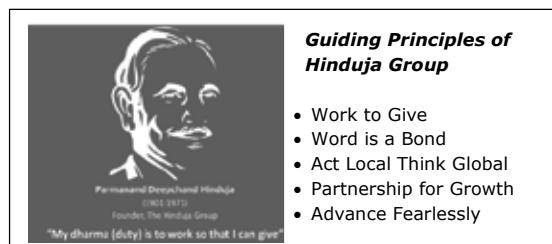


Figure 1.1 : Hinduja Guiding Principle's

(1) Our Source of Pride:

AL today is the second largest manufacturer of Medium and Heavy Commercial Vehicles (M&HCV, >7.5 Ton) in India. Globally AL is the fourth largest manufacturer of buses (>8 meters) and twelfth largest manufacturer of M&HCV Trucks (2016). The company achieved annual revenues of USD 2.8 billion in FY16 and the export business footprint exceeds across 50 countries. In addition, the company has the track record of being continually profitable throughout its 68 years of existence.

Ashok Leyland vehicles transport almost 70 million people to their destinations every day and move 10.5 million tons of goods every day in India. The company is one of the largest bus OEMs in the Middle East, with over 60% market share in several countries. Ashok Leyland has consistently pioneered the introduction of new technologies and innovative products into its markets is illustrated in Table 1.1

Table 1.1: Technologies pioneered by AL

Year	India's First	Year	India's First
1967	First Indian made double decker- "Titan Bus"	2005	India's first auto company to receive British Standard 7799 certification - ISMS
1969	Power steering introduction	2010	India's first Hybrid CNG Plug in Bus
1976	Viking-First Bus with alternator	2012	3718- India's first 37-tonne 5 axle haulage truck
1978	Cheetah- India's first rear engine bus	2012	World's first full flat, single step, front engine city bus
1980	Taurus-India's first multi-axle truck	2013	Neptune engine - electronic fuel efficient Engine with CRS
1982	India's first articulated bus-"Vestibule Bus"	2015	Zero Emission Electric Bus
1997	India's first CNG Bus launched	2016	India's first Electric Bus named Circuit
2002	India's first hybrid electric vehicle	2016	Roll over compliance School bus named Sunshine

(2) The Capabilities:

Ashok Leyland is a fully independent manufacturer with the ability to design, develop, manufacture and market all ranges of commercial vehicles and continuously upgrade its capability to meet customer needs.

① Manufacturing capability:

AL vehicles are powered by any of our four engines platforms, the H-Series, Neptune- series, P-15 and ZD30 series which are well accepted by the Customers. Gearboxes are manufactured under license from ZF (world's leading gear box manufacturer). AL also has the capability to design and manufacture application based specialty vehicles and power solutions.

Trucks	Bus	Light Vehicles	Specialty Vehicles	Power Solutions
				
Long Haul, Mining, Construction and Distribution Trucks	City, Suburban, Inter City, School, Staff and Special Buses	Short Distance Light Material transfer (last mile connectivity)	Special Logistics Vehicles	Power Generator sets, Marine and Harvester Engines

Figure 1.2: Ashok Leyland Product Portfolio

② Validation capability:

To develop these vehicles, the company has a full-fledged technical center near Chennai, India that is capable of independent end-to-end product development with advance CAE and simulation facilities. It is also equipped with testing facilities, which includes six poster chassis dynamometer, crash testing and test tracks.



Figure 1.3 : Ashok Leyland - Technical Centre

Summary of Ashok Leyland, Hosur Unit II Presentation



The products thus developed are produced in 6 manufacturing plants spread across India and are strategically located (Ennore, Hosur1, Hosur2, Bhandara, Alwar & Pant Nagar); in addition, it has an overseas plant at Ras-Al-Khaimah (RAK) in the Middle East. Plans are in place for establishment of satellite assembly plants as part of global expansion. These current facilities have a combined assembly capacity of 160,000 vehicles (M&HCV) and 66,000 vehicles (LCV), besides capabilities in engine machining & assembly, gearbox machining & assembly, axle & frame manufacturing, cabin stamping, welding, painting and trimming.



Figure 1.4: Manufacturing foot print

Table 1.2: Plant wise Manufacturing capabilities

Cab Press, Weld, Paint & Trim	Aggregates				Vehicle Assy.	Plant
	Axle Assy.	Gear Box Assy.	Engine Assy.	FSM MFG		
✓	✓			✓	✓	Hosur-2
-	✓	✓	✓	-	✓	Ennore
-	✓			-	-	Hosur-1
-	-	✓	-	-	✓	Bhandara
-	-	-	-	-	✓	Alwar
✓	✓	✓	✓	✓	✓	Pantnagar
-	-	-	-	-	✓	RAK



Figure 1.5 : ALH2 plant view

(3) Customers:

Ashok Leyland operates in India, Sri Lanka, Bangladesh, Middle East and Sub-Saharan Africa, with a small presence in Russia and UK. Across these markets, Ashok Leyland's products are primarily used for commercial activities. Our trucks are used for transportation of goods, mining, construction, special purpose (firefighting, cement mixer etc.) activities whereas buses are used for transportation of passengers within & outside city. Our customers comprise large fleet operators, individual small fleet operators, individual vehicle owners, entrepreneurs, government controlled state transport undertakings, municipal corporations and other government bodies.

The company reaches out to its customer through 2619 customer touch points (M&HCV and LCV) covering length and breadth of the Indian Sub-continent & 138 touch points established in international market.

(4) Market size and growth rate:

The global industry volumes for M&HCV Trucks (>7.5 T GVW) is estimated to grow from ~2.77 million in FY12 to ~3.88 million by 2020, i.e. an annual growth rate of 5%. The market for medium and heavy duty buses was much smaller, at ~388,000 units in FY13. It is estimated to grow to ~538,000 units by 2020.

The Indian market for medium and heavy commercial vehicles industry has been recovering from a deep recession. Total industry volumes dropped to a five-year low of 208,000 units of vehicles in FY14, from which it recovered to 247,000 units of vehicles in FY15. Total Industry Volumes had further grown to reach 318,000 units in FY16 and was expected to remain flat during FY17.

Ashok Leyland achieved a market share of 31.2% in Medium and Heavy Commercial vehicles in India (its dominant market) in FY16. This further grew to 32% in FY17. This represents the highest ever market share achieved by the company in the past six years. The company also enjoys significant market share in the segments that it competes in and grew from 17th position to 12th position in trucks globally & from 6th position to 4th position in bus globally (from CY09 to CY16 respectively).

(5) Ashok Leyland Vision:

Ashok Leyland has decided to remain an independent OEM. To do so, Ashok Leyland needs to grow its scale substantially, to achieve economies of scale across development and production. To focus the organization towards growing scale, Ashok Leyland has defined its vision as follows:

To be in the **Global Top 10** in M&HCV trucks (> 7.5T GVW) & **Global Top 5** in M&HCV Buses (8m and above) in volume terms.

The Indian commercial vehicle business environment has become extremely competitive with the entry of several global players. While the market is expected to grow, installed capacities are expected to grow faster and reach over 1.5 times the expected demand. Hence, to achieve the above scale, Ashok Leyland needs not only just defend its market share in an increasingly competitive domestic market, but also grow its volumes internationally.

AL long term strategy is to focus on "low cost and "budget" truck segments both in domestic and targeted regional markets. Given this, Ashok Leyland has set its objectives to not just hold its current market share in

Summary of Ashok Leyland, Hosur Unit II Presentation



India, but to grow its international sales volumes to 1/3rd of its overall volumes, in its targeted markets of SAARC, Middle East, Africa, CIS, ASEAN and Latin America.

These goals will be achieved primarily through the introduction of budget truck platforms that not only compete successfully with new entrants in India, but also enable the company penetrate international markets.

1.2 Ashok Leyland - Hosur Unit II (ALH2):

Ashok Leyland, Hosur Unit 2 was established in 1994, with assembly facilities and one of the largest press facilities in India for frame side members. The plant spreads over 946,964 sq. m of which 184,750 sq. m is built-up and the balance is rich in greenery with more than thirty-four thousand trees.

ALH2 is producing a very wide range of products in truck business, including specialty vehicles. The only plant among AL and competitors to produce vehicles of all segments in a single plant.

Based on the vehicle tonnage (Gross Vehicle Weight – GVW), the segments are classified by AL as given in Table 1.3.

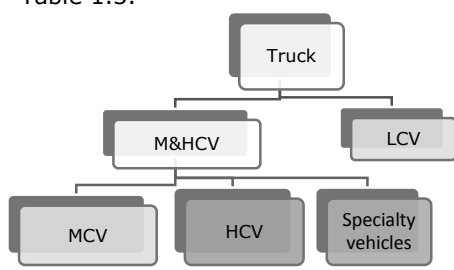


Chart 1.1 : ALH2 presence in segment

Table 1.3 ALH2 vehicle Segment and Range (current classification)

#	Segment	Sub-segment	Range (GVW)
1	Light Commercial Vehicles (LCV)	Light Commercial Vehicles (LCV)	2.5 to 7.5 Ton
2	Medium & Heavy Commercial Vehicles (M&HCV)	Medium Commercial Vehicles (MCV)	>7.5 to 12 ton
		Heavy Commercial Vehicles (HCV)	>12 to 49 ton
		Specialty vehicles	Various

Table 1.4 History of Vehicle production at ALH2

Vehicle Type	1994	1997	1998	2011	2017
ICV (currently MCV)		→	→	→	→
Specialty vehicles	X		→	→	→
HCV	X	X		→	→
LCV	X	X	X		→

(1) M&HCV business:

ALH2 started its production in FY94 under the license from IVECO FORD TRUCK with an investment of Rs. 2650 million. It was first set up to produce fully built Intermediate Commercial Vehicles (7.5 to 15 ton) with factory fitted cabin. Initial capacity of ALH2 was 9600 numbers per annum in single shift basis. From FY'97, ALH2 started producing specialty vehicles leveraging the factory built cabins for the applications like firefighting, logistics and recovery. FY98 onwards ALH2 started catering to M&HCV models (16 to 49 ton).

Over a period of last 10 years, more variants in M&HCV has been added in various segments. New cabin facilities were added in 2008 for higher tonnage vehicles in tipper, tractor and haulage applications. From 2012, higher tonnage haulages with multi axles were also added. Hence the varieties of vehicles in ALH2 has grown from 205 to 518 cumulatively from FY14 to FY17 along with production volume increasing from 13,700 nos. to 31,600 nos. in the same period.



Figure 1.6 : M&HCV truck



Figure 1.7 : Specialty vehicle

(2) LCV business:

The cyclical nature of M&HCV business made Ashok Leyland to rethink its strategy to better insulate itself from the vagaries of recession. Towards this the Company started to diversify its business by focusing more on "Power Solution Business", "After Market" and "LCV Business". Later these businesses really did handhold the company during the recessions in 2009 and 2011. The major contributor for this outright success was LCV Business and became a game changer in Indian LCV Market.

Ashok Leyland and Nissan Motor Company came together as a Joint Venture (JV) in 2007 to capture the growing Light Commercial Vehicle market in India

by jointly leveraging their mutual strengths. In the year 2011, JV successfully launched DOST, a sub 2.5 tonner vehicle which found its way to a variety of applications from city material mover to Ambulances and Garbage Dumpers. ALH2 was chosen as the right location for contract manufacturing of LCV for this JV. This decision was driven mainly by a) the versatility and skill level of the ALH2 team b) the availability of highly flexible lines and c) the availability of a panel pressing and painting shop, which was critical for LCV production. Later in



Figure 1.8 : LCV vehicle

Summary of Ashok Leyland, Hosur Unit II Presentation



Nov'16, Ashok Leyland acquired the entire stake of Nissan Motors from the JV and became independent in Design, Development and Manufacturing of LCV Vehicles. With renewed rigor and courage, ALH2 started foray into newer sectors, and started production of "Mitr" mini buses and "Partner" LCV trucks.

(3) Customer for ALH2:

For ALH2, Marketing is the Customer. The Customer-Supplier relationship is shown in Table 1.5

Table 1.5: Customers – M&HCV and LCV vehicles

Supplier	Inputs	Process	Outputs	Customers
Bought out material suppliers	MPS plan	Aggregates and Vehicle assembly	Assembled vehicle meeting Customer requirements in terms of quality and delivery	<ul style="list-style-type: none"> Global Trucks (M& HCV) Sales & Marketing-LCV
	Production plan			
	Materials/ child parts			
	Skilled manpower			
	Machine			
	Standards (Technical/ work)			

(4) Salient Features:

- Strategic location closer to three southern states and western part of India.
- Capable of producing all range and types of vehicles in a single facility
- Facility for fully built trucks
- Factory fitted cabin vehicles to cater to domestic and export markets

(5) Products & Aggregates:

ALH2 is a manufacturing plant with the capacity to assemble over 50,000 (M&HCV) and 65000 (LCV) vehicles annually. It can manufacture a full portfolio of trucks with rated load capacities from 2.5T GVW to 49T GVW, engine power from 58 to 230 hp, six kinds of cabins and front end structures, four engine families and fully built ready to use vehicles. It also has the capability to assemble bus chassis. Currently, ALH2 has produced more than 100 models and more than 700 variants in 8 platforms progressively so far. The list of products and aggregates manufacturable at ALH2 are shown below (Table 1.6).

Table 1.6 Products and aggregates manufactured at ALH2

Product and Aggregates:		
Chassis assembly	Cab	Frame Side Member
	Front Axle	Rear Axle

(6) Business Impact:

ALH2 is one of the largest plant of Ashok Leyland. The turnover of this plant is 0.80 Billion USD/ Rs 51.9 Billion (24% of Ashok Leyland turn over) in FY'17. The LCV volumes started contributing to 50% of entire Vehicle Volumes within 2 years from the start of JV and ALH2 volume contribution is 27% out of total AL M&HCV volume. The Hosur plant's competitiveness and proximity to south & west markets has played a key role in Ashok Leyland's transformation in the past few years. This has enabled Ashok Leyland to compete effectively in these markets and improve market share.

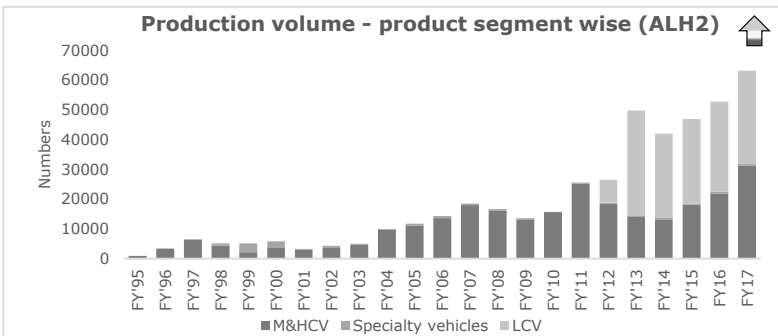


Chart 1.2 : Production Volume - segment wise

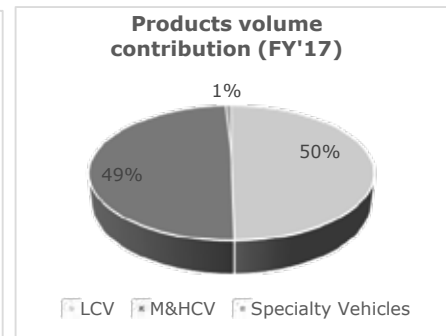


Chart 1.3 : Volume contribution of ALH2 products

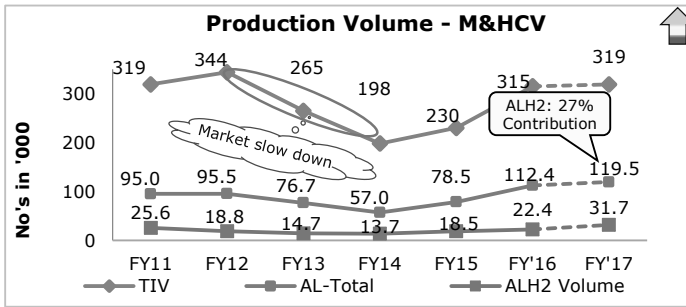


Chart 1.4 : Production Volume of ALH2

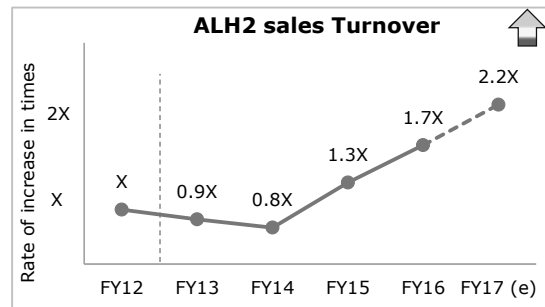


Chart 1.5 : ALH2 Turnover

2 Organization structure:

2.1 Ashok Leyland Organization Structure:

Ashok Leyland Limited is headed by the Managing Director (MD) who reports to the Chairman and the Board of Directors. The organization structure comprises of corporate functions and plants. Head Manufacturing & Project planning who is reporting to MD is responsible for all the manufacturing plants and Project planning. Head manufacturing of ALH2 reports to him. The organization structure of ALH2 is shown in Figure 2.1.

2.2 ALH2 Organization structure:

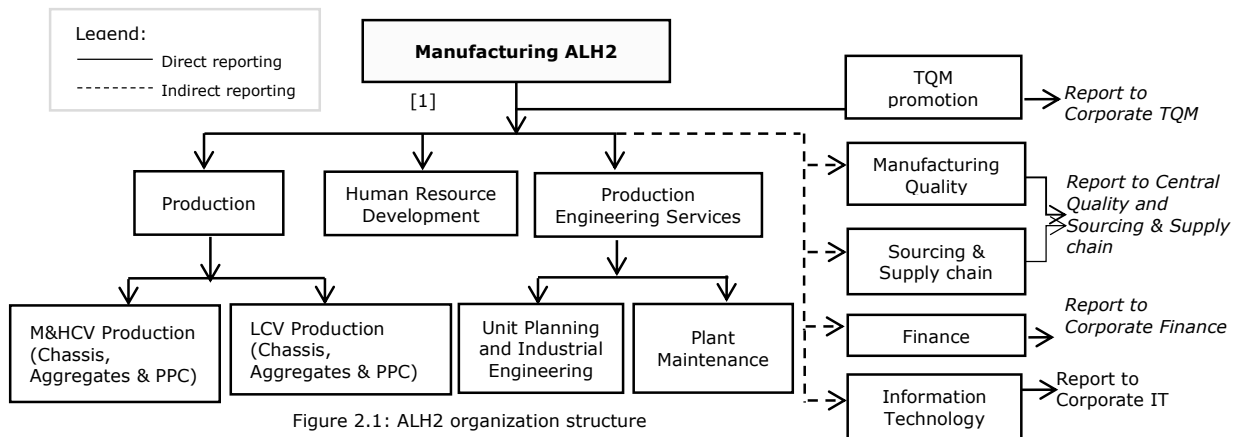


Figure 2.1: ALH2 organization structure

(1) Cross Functional Management:

In order to achieve the common goal of achieving the plant objectives and strategies, 5 cross functional teams were formed at ALH2. These Cross Functional Management teams were led by senior leadership in the Plant with members selected from various departments. The KPIs are deployed to respective level. These CFM's role was to set system and process to achieve strategic objectives derived from the plant Vision. The CFM objectives and focused activities are explained in section 5.1 to 5.5.

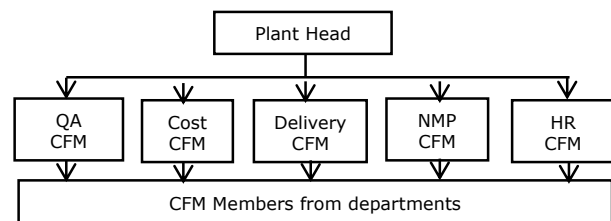


Figure 2.2: CFM structure of ALH2

3 Business objectives & Strategies:

3.1 Background:

ALH2 started its production in FY95 under the license from IVECO FORD TRUCK with an investment of Rs. 2650 million. It was first set up to produce fully built Intermediate Commercial Vehicles (7.5 to 15 Ton) with factory fitted cabin. Initial capacity of ALH2 was 9600 numbers per annum in single shift basis. From FY'97, ALH2 started producing specialty vehicles leveraging the factory built cabins. FY98 onwards ALH2 started catering to M&HCV models (16 to 49 ton).

In FY09, AL started LCV business (2.5 to 7.5T) in collaboration with Nissan Motor Company and from FY'12 onwards, ALH2 plant started LCV production by utilizing the existing plant, machineries and sharing the paint shop facilities. This posed newer challenges to the plant like 1) Painting processes; 2) Handling of increased number of variants in Weld shop; 3) Converting the existing ICV line for LCV and accommodating the ICV products in M&HCV chassis line

With the exit of Nissan from the LCV JV business during FY17, ALH2 will have to face more challenges with widening of LCV product range in coming years.

Summary of Ashok Leyland, Hosur Unit II Presentation



3.2 Business objectives (FY12 – 14):

Until FY14, KRAs were formulated at corporate level based on AL vision and deployed in terms of KPI's and targets. The corporate targets were deployed to ALH2 in the form of KPIs and these KPIs were further deployed to next levels. A gist of year on year KPIs and target given during that time are illustrated in Table 3.1.

Table 3.1: Business Objectives- Before Vision Formulation

#	Key performance Indicators	FY 12 Actual	FY 13 Plan	FY 14 Plan
1	Volume adherence (%)	79	90	95
2	0 MIS @ sales yard (DPV)	2.4	0.8	0.4
3	DMP – cabbed vehicle functional (Score)	313	220	175
4	MQMI (%)	87.1	90	95
33	Man Engagement Time (MET) %	63	85	85
34	Production Over Head (Rs/HECU)	X	0.95X	0.67X
35	Improve Labor productivity (HECU/100 man days)	2.53	2.71	3.07

This process had some weakness which is given in Table 3.2.

Table 3.2: Weakness and points to improve

Year	Weakness	Points to Improve
FY12 to 14	<ul style="list-style-type: none"> Too many KPIs; difficult to manage and control 	<ul style="list-style-type: none"> KPI prioritized and split into daily management and policy management items
FY15	<ul style="list-style-type: none"> Lack of clarity on the role of ALH2 to achieve AL vision 	<ul style="list-style-type: none"> Formation of ALH2 Vision based on AL top management directives Establish Strategic objectives linking with Vision and Strategies

3.3 Formulation of ALH2 Vision:

Based on the Company vision, top management directives, study of implications and internal situational analysis, ALH2 formulated its Plant Vision during Dec'14. ALH2 vision was framed as "To be a **Flexible** plant with **Wide Product Range** aiming towards **Operational Excellence**". The strategic objectives and strategies were formulated based on this Vision. The meaning of key vision elements is summarized in Table 3.3.

Table 3.3: Meaning of vision elements

Vision	Vision elements	Meaning
To be a Flexible Plant with a Wide Product Range aiming towards Operational Excellence	Flexible plant	Capacity to produce multi variants of small batch size to meet order requirements on time
	Wide Product Range	Capability to produce most models of the organization (the only plant in AL to have to do so)
	Operational Excellence	a) ALH2 vehicle quality must compete with that from any other modern plant, as seen by Customers b) Customers must get on-time delivery despite wide variety, low volume and fluctuating demand c) ALH2 must show cost competitiveness through low depreciation cost and comparable maintenance costs (despite old plant) and relentless cost improvement activities, although labour cost is higher d) Also it is necessary to upgrade ability and competence of permanent and temporary employees.

3.4 System to realize Vision:

Based on the inputs from the Deming prize committee, the gap in existing system was addressed by improving the process in a structured way. The schematic diagram of ALH2's improved system is shown in Figure 3.1.

3.5 Business Objectives and Strategies (FY15 ~ FY20):

The Strategic objectives have been revisited and the long term strategic objectives and annual objectives were evolved to realize ALH2 Vision which is shown in Table 3.4. Alignment with the ALH2 vision is thus ensured. Strategies were formulated by analyzing the environment and past data.

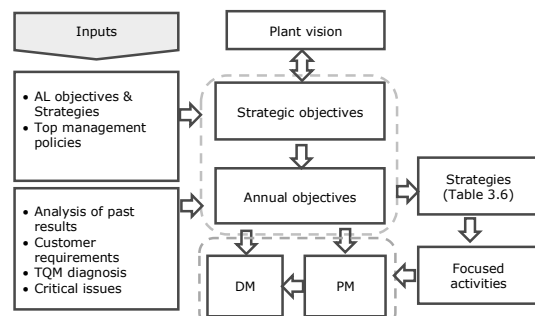


Figure 3.1: Schematic diagram of realizing vision

Table 3.4 Strategic objectives

#	Key Words	Strategic Objectives	Key performance Indices	FY 14 Actual	FY 15 Plan	FY16 Plan	FY 17 Plan	FY18 Plan	FY20 Plan
1	Flexibility	1.1) Capacity to deliver small batches (n)	1.1.1) Service level – M&HCV, n≤10 (%)	88	90	XX	-	-	-
			1.1.2) Incomplete deliveries, - M&HCV n≤10 (%)	Scope changed from FY'16 →		12 (Base)	8	5	1
2	Wide Product Range	2.1) Capability to produce new models	2.1.1) Readiness (Numbers)	started from FY'17 →		99 (Base)	101	114	147

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		2.2) Early stabilization of new models	2.2.1) Stabilization ratio (Ratio)	Started from FY'17 →		1.0 (Base)	0.5	0.4	0.2	
3	Operational Excellence	3.1) Competitive Quality levels	3.1.1) "0" MIS at sales yard – M&HCV (DPV)	0.4	0.3 @	0.2	0.2	0.2 @	0.2	
			3.1.2) "3" MIS – labour claims – M&HCV (FPV)	started from FY'16 →		0.95	0.67	0.5	0.3	
			3.1.3) AVES score (Score)	31.8	22	21	20	19	18	
		3.2) Cost competitiveness	3.2.1) Conversion cost (Rs/HECU) (in `000)	106.3	106.7	99.4	106.3	95.7	91.9	
		3.3) On-time delivery	3.3.1) Monthly service level – M&HCV (%)	89.3	95	XX	-	-	-	
			Weekly service level – M&HCV (%)	Scope changed from FY'16 →		85	90	95	XX	
			3.3.2) Monthly service level – LCV (%)	90	95	XX	-	-	-	
		3.4) Employee participation	3.4.1) Total Employee Involvement (TEI) (%)	Weekly service level - LCV (%)	Scope changed from FY'16 →		80	90	95	XX
				99.8	100	XX	-	-	-	
				Scope changed from FY'16 →		70	80 @	85	95 @	

XX – Scope/ frame work changed @ – scope revision

3.6 Alignment of ALH2 Vision with AL Vision:

ALH2 is one of the key players to help AL to achieve top 10 position in Truck segment. The relation between AL Vision and ALH2 Vision depicted in Table 3.5, which shows the importance of ALH2 towards achieving Company Vision. The effects of TQM implementation are given in section 6.

Table 3.5: Relationship between AL vision and ALH2 vision

AL Vision	ALH2 Vision elements		
	Wide product range	Flexibility	Operational Excellence
Global top 10 in Trucks	⊙	⊙	⊙
Global top 5 in Buses	Δ	Δ	Δ

⊙ Strong relationship ○ Moderate relationship Δ Weak relationship

The annual objectives are managed through Cross Functional Management (CFM) teams. These CFM formulate strategies (Table 3.6) and focused activities to achieve the objectives. The various focused activities implemented by CFM are explained in sections 5.1 to 5.5.

Table 3.6: Objectives & Strategies

#	Vision elements	Strategic Objectives	ALH2 Strategies	CFM	CFM theme	CFM strategies	Focused activities
1	Flexibility	Capacity to deliver small batches	Transformation initiatives	Delivery	Meeting small and bulk volume requirements	<ul style="list-style-type: none"> Enhance Model mix flexibility Supply chain flexibility 	Section 5.5
2	Wide Product Range	Capability to produce new models	Infrastructure creation & capability development	NMP	Making ALH2 ready for producing new models and achieving early stabilization	<ul style="list-style-type: none"> Leverage technology to enhance plant readiness 	Section 5.2
		Early stabilization of new models	Control at upstream: Establish early stage controls	NMP		<ul style="list-style-type: none"> Early stage involvement System introduction of ST strategy for effectiveness 	
3	Operational Excellence	Competitive Quality levels	Improvement in Quality and Reliability	Quality Assurance	Producing Quality products and satisfying the customers	<ul style="list-style-type: none"> Developing system for defect flow out and recurrence prevention People development Supplier capability building 	Section 5.1
		Cost competitiveness	Develop IT enabled cost management system	Cost	Overcoming the cost disadvantage due to wide range and flexibility while maintaining old plant	<ul style="list-style-type: none"> "Essential" and "Muda" reduction 	Section 5.3
		On time delivery	Augmentation of Capacity and efficiency	Delivery	Meeting small and bulk volume requirements	<ul style="list-style-type: none"> Capacity enhancement Efficiency improvement 	Section 5.5
		Employee participation	Establish Role, responsibility and Individual work	HRM	Enhancing the skill & competency as well as enhancing employee participation	<ul style="list-style-type: none"> Promote improvement activities, reward and recognition 	Section 5.4

Thus the unique vision and strategies of ALH2, when realized, will make ALH2 a vital part of the achievement of the vision of the company.



4 TQM promotion:

4.1 Need for TQM:

ALH2 is set to play an important role in Organization's vision through Flexibility, Wide product range and Operational excellence. To reach operational excellence, ALH2 need to excel in Quality, Cost and Delivery. Though ALH2 was achieving its production targets, being a two-decade old legacy plant, it had challenges of achieving company's overall requirements in terms of producing all ranges of vehicles with fluctuating volumes and order quantities. Also relocation of two batches of permanent manpower from ALH1 between FY10 and FY14 to ALH2 led to further increase in conversion cost. As a part of AL strategy in FY12, LCV range of vehicles was added in to ALH2's product portfolio. Thus the challenges became multifold in meeting the delivery and operational efficiencies along with sustaining the quality levels. Hence the most appropriate way to manage the complexities in a structured way was to adopt TQM.

4.2 TQM Framework of ALH2

AL developed its model for TQM in 2012. ALH2 started practicing daily management from FY13 to resolve abnormalities and critical issues based on factual data. However, the TQM diagnosis by Deming Prize committee in FY16 has given specific guidance to improve alignment of ALH2's vision statement and framework based on the issues and challenges faced by ALH2. Accordingly, the frame work was revised and changes incorporated (Figure 4.1).

Our house of TQM has the intent on the top, which is creating a win-win for all stakeholders. AL's corporate tag line "Aapki Jeet Hamari Jeet" is framed keeping the customer's interest as paramount. It denotes that "your victory is our victory". This mean our aim is to make the customer successful and that is the only way we can be successful. Leadership creates the vision and strategy for the businesses, and the values that we abide by. The ultimate aim is to realize AL Vision. ALH2 vision is aligned to achieve this goal.

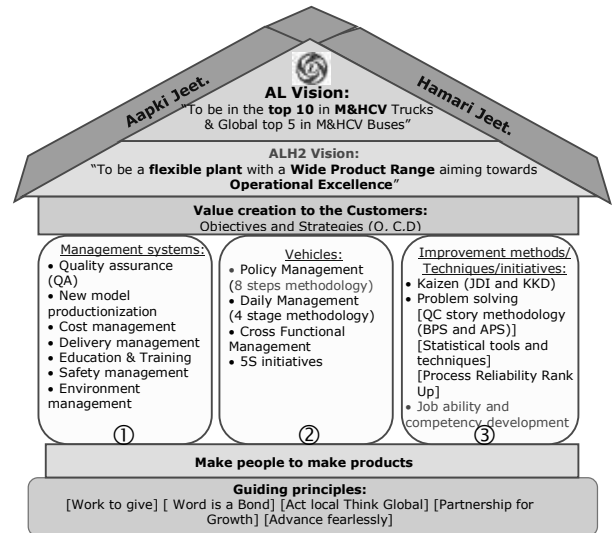


Figure 4.1: ALH2 TQM Framework

The Beam below the roof represents the "way we manage". ALH2 vision can be realized through objectives and strategies that create value to all stakeholders in terms of QCD. This is supported by three major pillars.

Pillar 1 represents the Management systems which are put in place to effectively and efficiently manage the QCDSM Objectives and strategies. These cover Quality Assurance, New model productionization, Cost, Delivery, Education and training, Safety and Environmental Management.

Pillar 2 represents TQM Vehicles. ALH2, in order to realize its vision uses vehicles like Daily management (DM) and Policy Management (PM) to align the efforts of the entire organization. ALH2 believes that its organizational capability lies in the ability to improve, maintain and transform itself to reach heights and sustain in the changing world. Big improvements and transformation are dealt through PM (Breakthrough) while the maintenance and small improvements are handled through DM. DM and PM bring in stability to operations, and manage large scale improvement, ably supported by Cross Function Management.

Pillar 3 represents Improvement methods/ techniques/ initiatives which help to resolve the problems and achieve tasks identified through DM and PM. Kaizen (JDI/KKD) and Small Group Activity (SGA) are for Total Employee Involvement (TEI), while QC Story approach is to enhance the problem solving capabilities of managers.

The foundation of this whole TQM house is built on Human development. **People development (Hitozukuri)** is very important in ALH2 TQM initiative, as it makes people ready to face the challenges of constantly developing technical skills and improved ability to solve the problems. Job ability and competency of working and managing associates are important in **making right products (Monozukuri)**. This helps employees to use their expertise and knowledge to give suggestions and carry out Kaizens in their work areas. Human development helps to align & achieve the common goals of ALH2. The job ability and competency development of ALH2 is explained in Human Resource Management section (section 5.4).

4.3 TQM Diagnosis

ALH2 underwent External TQM diagnosis from the Deming prize committee in Aug'15. Major areas of improvement exhibited in Diagnosis report led to major systemic changes at ALH2.

In order to address major critical issues of plants, exhaustive top management diagnosis system (Management Process Evaluation) was developed and practiced from FY16. This diagnosis covers 7 evaluation category like 1) Understanding of superordinate policies and vision, 2) Exercising of leadership, 3) Planning and deployment of annual policies, 4) HRD and work place activation, 5) Business/operational process management, 6) Information sharing, analysis and utilization and 7) Activity results. This enabled plant to develop policies for FY17.



4.4 Daily Management

(1) Background

ALH2 follows a DM framework which covers all aspects of DM in 4 stages as shown in Table 4.1.

Table 4.1: Illustrations of Daily Management Stages

Stage-1	Stage-2	Stage-3	Stage-4
<ul style="list-style-type: none"> Process Mapping, Organization Role & Responsibility for all (KPI Table) Standardization (PFMEA, Control plan, SOP/WIS) 	<ul style="list-style-type: none"> Review Mechanism - Monitoring of KPIs Identification of abnormalities & deviations (Daily Monitoring and identification of abnormality by barbaric limit) 	<ul style="list-style-type: none"> Correction/CA as appropriate Revision of standards as appropriate Stability Vs. Capability Matrix – KPI improvement 	<ul style="list-style-type: none"> Horizontal deployment as applicable Knowledge sharing of shining ideas (DM Success stories)

(2) DM in Phase 1 (Establishment & Improvement): Daily Management is in practice at ALH2 since FY13 with the objective to establish proper management over key performance indicators of Quality, Cost, Delivery, Safety and Morale. Internal DM trainers were developed to initiate this activity in model areas and after gaining success in these areas, this has been disseminated across the plant by providing training to all managers. The abnormalities are addressed as and when it occurred and in case of chronic issues, the analysis and action is done at the end of every month. The guiding approach of ALH2's DM system is to attain stability first and simultaneously progress towards capability. The four stage approach for DM implementation which starts from role identification and KPI finalization is being followed. Once the practice started yielding results, the plant started widespread implementation of the system throughout the plant, including all non-manufacturing areas. Also to enhance the capability of the people to implement DM, regular training programs were conducted.

① Alignment through Management System Charts:

Once DM started gaining momentum, then the major challenge was to establish alignment across the departments and to eliminate overlapping & missing responsibilities. In-order to overcome these challenges "Management System Charts "(MSCs) were introduced across the plant in a phased manner. The business or operational processes were identified in ALH2 and MSC was prepared for each of these processes including CFM processes with clear objectives. It explains the sequential activities to be carried out by each member with clear Roles & Responsibilities and has references to the standards. These MSC's have two types of KPI's namely; Result KPI and Effect KPI. These KPIs are monitored as Daily Management items. In order to review the effectiveness of Quality Management System, Management review is carried out periodically. This has resulted in further refinement of roles and responsibilities aligning to business processes.

② Review Mechanism (Stability vs. Capability):

DM practice was spread across the organization and the entire organization was connected through KPIs. The health of the organization was nothing but the performance of these KPIs. A management analysis & review system was established to understand the performance of the KPIs in-terms of two major criteria (Stability & Capability). All the KPIs were reviewed based on this 2 x 2 matrix on a monthly frequency & the KPIs were categorized into 4 quadrants as shown in Table 4.2. This analysis was also useful for the management to identify management issues that has to be acted upon to improve the performance of the plant. With the help of DM implementation, ALH2 has increased DM KPI achievement ratio (number of KPIs in Q4) from 17% (FY15) to 82% (FY17) which is shown in Chart 4.1. Few irrelevant KPIs from FY15 were identified and dropped subsequently.

Table 4.2: Stability Capability Matrix

2X2 matrix		Stability	
		Not OK	OK
Capability	Not OK	Q1 (Many abnormalities & target not met)	Q2 (No abnormality; but target not met)
	OK	Q3 (Abnormalities not eliminated; but met the target)	Q4 (No abnormalities and met the target)

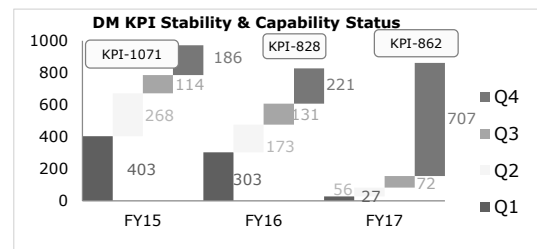


Chart 4.1: DM KPI stability and capability Status

(3) DM in Phase 2 (Expanding the Horizon):

DM system was further improved based on the comments of the TQM Diagnosis report. The framework of DM system was further fine-tuned based on the collective experience and practice. An exhaustive guideline on DM in the form of Management System Chart was prepared. Based on the improved system, trainings were conducted throughout the organization. Also the next batch of DM trainers called TQM Leads were also developed. The major improvements in the Daily Management System in this phase are introduction of 4 Quadrant Analysis & Abnormality reports.

① Abnormality Reports:

During the KPI monitoring, the abnormalities captured were addressed through JDIs & KKDs. This approach yielded results in initial phase to resolve the low hanging issues. However, some of the true causes were not directly in the control of the KPI owner as they were related to other functions/departments. Hence there came a requirement to handle such abnormalities. Abnormality reports were thus introduced for effective

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communication to the concerned departments. The analysis portion was made more specific by the use of abnormality reports which helps in the resolution of abnormalities through CFT approach.

② 4 Quadrant analysis:

To enable management visualize and decide on the progress of DM KPIs, 4 quadrant analysis was introduced to compare the KPIs' migration over a period of time from one quadrant to other as follows:

1. Stagnant KPIs – those KPIs that remains to be in same quadrant (either 1st, 2nd or 3rd Quadrant)
2. Worsening KPIs – those KPIs that falls back from a better quadrant to worse one.
3. Improving KPIs – those KPIs that migrates from a quadrant to another better quadrant.
4. Achieved KPIs – those KPIs that have achieved both stability and capability and are in 4th quadrant.

This analysis in-turn enables the management to take decisions to enable the KPIs achieve stability and capability. Also it is evident that all KPIs in stagnant category and Worsening category are to be given utmost attention and be improved.

(4) Daily Management - Major System and its improvement:

Table 4.3 Table for Major System Improvement

#	Pre-TQM Before FY12	Establishment & Improvement (FY13 ~ FY15)	Expanding the Horizon (FY16 onwards)	
			Pre-TQM diagnosis	Post TQM diagnosis
1	<ul style="list-style-type: none"> • No structured Daily management Practice was available. 	<ul style="list-style-type: none"> • Systematic implementation of DM • Training on DM by consultant • 4 stage Implementation of DM • AL Wide DM Trainers program launched in 2013 	<ul style="list-style-type: none"> • MSCs introduced. • Management summarization of DM KPIs through 2 x 2 matrix was introduced. 	<ul style="list-style-type: none"> • MSC for DM prepared • The guidebook on "AL approach to Daily Management" introduced and training given to all • MSC concept introduced for all the Business process and Effects & Result KPIs identified. • Existing formats revisited and new system introduced – 4 Quadrant analysis, etc.,

4.5 Policy Management

(1) Background:

① **Pre TQM:** ALH2 followed KRA deployment process until FY14 for planning the yearly business and other operational targets. The deployment was done based on the traditional method of functional KRA and targets being deployed to plant as a Corporate Planning (CP) metric.

② **Establishment & Improvement:** To align the effort of all employees towards the company goal, ALH2 developed a procedure for policy setting based on 8 steps methodology. Based on 1) Factors important to the company's performance; 2) Priority issues and; 3) Efforts required. The Break-Through objectives are identified aligned to the Vision. Policy Deployment process was adopted as a tool for managing business in FY16 and deployment of organization's vision and strategy up to department head levels. Training cum workshop was conducted to impart the knowledge about the process. Six Blitz policies were identified in FY16, monitored, reviewed and actions initiated to achieve the policies identified.

③ **Expanding the Horizon phase:** During the TQM diagnosis of ALH2, there were gaps identified by the Deming prize examiners in PM. For example, there is no clear basis for plan, PDCA demonstration - review of previous year is not taken in to consideration, target not realized and Top management diagnosis is missing. Hence in order to address the gap, the entire PM system was revisited considering the comments and inputs given by Deming prize examiners. The bottom up approach also strengthened as issues arriving from various sources are also considered as inputs for prioritizing the items for policy direction.

Table 4.4: Illustrations of Policy management stages

Stage-1 Setting	Stage-2 Deployment	Stage-3 Implementation	Stage-4 Review
<ul style="list-style-type: none"> • Previous year analysis • Critical issues from various sources • Critical issues for the period • Evolving Annual policies 	<ul style="list-style-type: none"> • Policy deployment • Budget planning • Resource allocation 	<ul style="list-style-type: none"> • Implementation of means & projects • Monitoring of results • Gap analysis • Countermeasures 	<ul style="list-style-type: none"> • Review of policy items • Policy review • Top management diagnosis • Period end review • Student model analysis

(2) Policy Setting FY17:

Policy Management process: The policy cycle begins in the month of April in a Financial Year. Various inputs are considered for arriving annual policies given in Table 4.5.

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Table 4.5 Inputs for Policy Management process

Inputs till FY16	Inputs (Current Process)
<ul style="list-style-type: none"> External Environment Corporate Issues 	<ul style="list-style-type: none"> Critical issues to address strategic objectives Top Management diagnosis TQM diagnosis by DEMING PRIZE COMMITTEE Department critical issues (Unresolved DM issues) Status of previous year policies Super ordinate policies (Upper policies)

Based on prioritized critical issues and the year's Strategic objectives & Policies are developed. These policies are deployed to the HODs/CFM and based on it, goals and means are deployed as projects. For each of the policy identified, target was set based on the analysis of previous year issues. Strategies identified for the issues were also deployed as projects.

The breakthrough improvements are done through QC story approach and others by daily management improvements. The summary of the projects identified for FY17 and implemented status are listed in Table 4.6.

Table 4.6 Improvement summary

#	Item	Total
1	QC story	52
2	KKD	17
3	Poka-Yoke	4

(3) Policy Review System

The progress of policies is reviewed by the upper level managers on a regular basis. Gap analysis are discussed and countermeasures are taken. Plant level and department reviews are done and further reviews are extended to deep thorough review of Problem solving & Task achieving themes. Plant level reviews are carried out in Policy rooms by plant head. Policy directions are reviewed half yearly and guidelines & directions are provided and in some cases even policies are revised, where required. The issues arising from the reviews have not only helped to improve achievement level, but also the policy management system.

(4) Results of Policy Management at ALH2

To understand status of policy implementation, KPI attainment ratio was calculated using the student model. This analysis considers not only the achievement of the objectives but also whether goals and means identified to achieve the objectives have been fully implemented. The gist of the results of the policy objectives of FY17 is given in Table 4.8. The policies implemented in FY17 are all explained in the CFM sections (section 5.1 to 5.5).

Table 4.7: Student model analysis

2X2 Matrix		Goals	
		Implemented	Partially/ not implemented
Objectives	Achieved	A	B
	Partially/ not achieved	C	D

Table 4.8 Status of policy objectives (FY17)

#	Policy Objective (FY17)	KPI	Target	Actual	Goal	Target	Actual	Student model
1	Capacity enhancement to meet future volume	Volume	35000	31759	Model mix flexibility	62 %	62%	A
					Cycle time reduction in chassis line	11.6 min	8.8 min	
2	Improve straight pass (LCV)	Straight pass %	84	82	Straight pass DEOL	65%	58%	B
					Straight pass shower	40%	32%	
3	Improve Labor productivity	LECU / 100 man days	3.01	2.95	Manning vs actual	90%	90%	A
					Line balancing	85%	85%	
					Contract productivity	0.9%	0.91%	

(5) Policy Management - Major System and its improvement:

Table 4.9 Table for Major System Improvement

#	Pre-TQM Before FY12	Establishment & Improvement (FY13 ~ FY15)	Expanding the Horizon (FY16 onwards)	
			Pre-TQM diagnosis	Post TQM diagnosis
1	<ul style="list-style-type: none"> Traditional Goal Deployment methodology was followed to deploy CP Metrics. AL Company Vision formulated. 	<ul style="list-style-type: none"> Introduction of PM Training on PM by consultant Vision formulated for plants. Formulation of Blitz policies 8 steps methodology for policy management was introduced. Introduction of Policy Management FY16 X matrix 	<ul style="list-style-type: none"> Training by internal faculty covering all HODs. 	<ul style="list-style-type: none"> MSC for Policy Management prepared Manual for PM prepared covering all the stages Policy evolved based on various sources including previous year analysis Systematic target setting System introduced for Top management TQM diagnosis Systematic policy deployment System introduced for Year-end policy review Student model analysis introduced

4.6 Cross Functional Management

Explained in section 2.2 (1) and 5.1 to 5.5.

4.7 Improvement methods/ Techniques/ Initiatives:

(1) Problem solving:

ALH2 emphasizes improvement activities involving all front line employees to create a sense of belongingness and achievement. During the pre-TQM phase, it was observed that:

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a) Involvement of employees across departments is not uniform; b) There was no systematic monitoring to track department-wise performance; c) The reward and recognition system needed improvement
 d) Knowledge of employees on 7-QC tools was low

Accordingly, a system of involving all the front-line employees under the banner of small group activity (SGA) teams has been institutionalized across the company. Employees were trained on basic 7 QC tools and Suggestion scheme (SS) has been formed.

To institutionalize problem solving and task achieving methodology at ALH2 the following were done:

- a) An **IT enabled** system for managing Improvement projects was designed and implemented
- b) Education & Training was provided to improve problem solving skills of employees
- d) Six sigma Green belts and problem solving experts were developed.

(2) Deployment of TQM Initiatives through "Mission Gemba" People participation:

To deploy all TQM initiatives with 100% involvement of all employee, "Mission Gemba" has been started in 2005. The objective of Mission Gemba was to drive frontline attitudinal change and improve work culture to achieve significant business performance improvement. Mission Gemba is based on ISER (Information, Skill, Empowerment, and Reward & Recognition) concept. Various TQM initiatives such as 5S, Quality, Cost, Safety, Go green, Inventory, Critical machines, EEI and Agility have been promoted through Mission Gemba. The participation is through Suggestions scheme, SGA and CFT.

① Problem solving process through QC Story:

For further enhancement of analytical capability of managers & supervisors, Basic Problem Solving (BPS) and Advanced Problem Solving (APS) techniques with QC story approach was introduced in the plant. Managers and supervisors, who have selected the projects for resolution, undergo 2 days training for BPS and 6 days intensive training on APS in two phases. Total 228 Managers have been trained as of FY17 (Covers 68% of the executives). Review by champion, project sponsors, plant head and subject expert is being done. Majority of the SGA projects are completed following BPS techniques; complex problems are resolved using APS methodology. Chart 4.2 shows the improving trend of the total improvement projects completion. Chart 4.4 shows the trend of the increase in QC story projects. Recently ALH2 introduced the Task achieving methodology and measures implementation also in addition to problem solving. Going a step ahead, "Deep Dive" project have been started for big problem which is existing across organization in nature and heavy in impact. These initiatives have helped ALH2 in achieving the TEI in improvement activities.

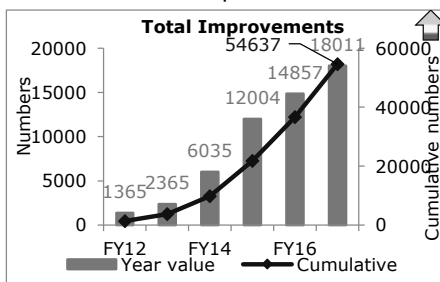


Chart 4.2 Total Improvements

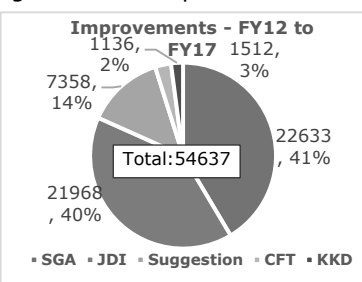


Chart 4.3 Improvement type distribution

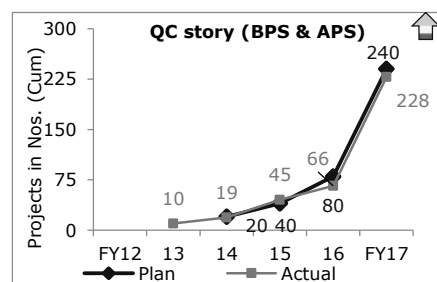


Chart 4.4 QC story projects

(3) Internal / External Competition

With the objective to promote improvements, teams are encouraged to participate both in internal and external convention. Plant level convention "Mini Improve" and organization level convention "Improve" have been started at ALH2 since FY03. All SGA teams first participate in plant level and then go for AL level convention. In FY16, total 50 teams participated in plant level and 10 teams participated at AL level. Top 3 teams were sent to National level (CII, QCFI, etc.) and international level.

4.8 Education & Training:

Education and Training is vital part of human resource development and it is the backbone of the overall development of the company. It is an important function for the alignment of individual growth with the organizational business plans to develop a work force proficient in knowledge, skill & competence. Training is being continuously imparted to all permanent and temporary employees in ALH2. Trainers, both internal and external, are identified based on their competency. External trainers include TQM consultants. ALH2 is handling wide variety of products, the product requirements & quality expectation is varying product to product. This requires a high degree of skill to perform the operations. Hence ALH2 developed a unique system of "**Job ability development**" for associates and role based "**competency development**" for executives. The job ability and competency development are explained in section 5.4. With active management support and participation, several TQM training programs have been designed and are organized for the various level of employees.



4.9 TQM promotional activities:

(1) TQM Promotion Organization:

Since the inception of TQM, Corporate TQM and Plant TQM cell was supporting the plant in TQM education and promotion. Steering committee was formed in FY13 headed by the plant head, supported by department heads and the department heads are supported by the department coordinators. Plant TQM cell is supported by the Corporate TQM. The role of TQM organization is given in Table 4.10.

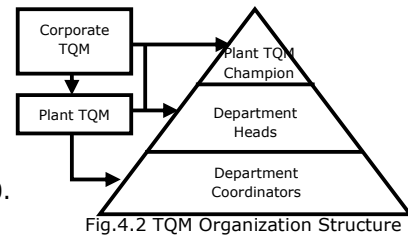


Table 4.10 Role of TQM organization

TQM secretariat (Corporate)	TQM champion	TQM cell (Plant)	Department Heads	Department coordinators
<ul style="list-style-type: none"> • Planning & research • Allocate resources & budgets • Capture customer & stakeholder's expectations • Formulate implementation strategies • Liasoning with JUSE and TQM sensei • Development of systems 	<ul style="list-style-type: none"> • Mentoring & driving plant level TQM 	<ul style="list-style-type: none"> • Training and coaching the team on TQM implementation • Development of standards & system specific to plant 	<ul style="list-style-type: none"> • Scheduling actions, reviewing & timely course corrections 	<ul style="list-style-type: none"> • Facilitating & progress monitoring

(2) Visits to Deming prize winning companies: In order to learn and apply the best TQM practices, visits of Employees to **Deming prize and Deming Grand Prize winning companies** such as Denso, GC Corporation, Wabco, TVS Motors, Rane, RSB & SGC and guest lectures by top management of Deming prize winning companies had been arranged in FY15 and FY16 for top management leaders and TQM leads.

(3) TQM Leads development: To promote the TQM culture across the plant, DM trainer and TQM leads programs were conducted and representatives from each department/ functions trained by TQM Sensei on various aspects of TQM like PM, DM and Kaizen approach. Upon successful completion, they were certified as "TQM Leads". These Leads play the role of front-runner cum facilitator for TQM initiatives in their processes. As of FY17 there are 11 TQM leads and 15 DM trainers developed in ALH2. This has helped the departments address DM and PM issues systematically thereby improving the DM attainment ratio to 82%.

4.10 TQM Maturity Index:

To gauge the progress of TQM initiatives a maturity index has been established and monitored under 4 categories such as TQM Basic, TQM way, TQM culture and Deming prize activities. These 4 categories cover various items such as policy management, daily management, cross functional management, problem solving, training and development and Deming Prize activities etc., Monthly PDCA of TQM activity is rotated based on TQM maturity index. The TQM maturity index has been improved from 2.7 (FY15) to 4.0 (FY17) in 1 to 5 scale.

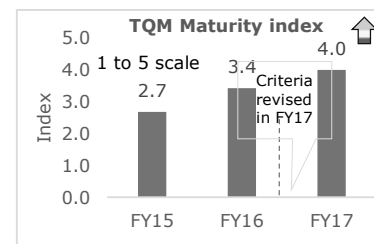


Chart 4.5: TQM maturity index

5 Major management challenges, strategies & progress of TQM initiatives

5.1 Quality Assurance:

(1) Background:

ALH2 Quality Assurance System started with Intermediate Commercial Vehicles (ICV) in the year FY94, and expanded with legacy AL models of Medium & Heavy Commercial Vehicles (M&HCV) manufactured in other units in FY98. Subsequently in FY11, AL-Nissan Joint Venture (JV) for contract manufacturing of Light Commercial Vehicles (LCV) started with inputs of AVES (Alliance Vehicle Evaluation Standards) & Quality Gates, which were subsequently adopted in M&HCV also. The overall Quality Assurance System of ALH2 is focusing on Quality related aspects of New products, Incoming Parts, Inprocess, Outgoing Products, and Field Quality to meet the Customer requirements.

With the company's growing needs as per the vision, ALH2 requires a high degree of **Flexibility** to handle **Wide Range of products** aiming towards **Operational Excellence**, in spite of being a two decades old plant. Hence Quality Assurance CFM addresses the requirements to meet the objective of achieving **"Competitive Quality Levels"**. With increase in the number of variants produced in each models & platforms and high expectations on quality levels, led to increased complexity of manufacturing, resulting in more defect generation & outflow.

(2) Detailed explanation of focused activities – Examples:

① Improvements in Outgoing Quality:

Introduction of Process Reliability Rank Up methodology to reduce In-process defects

- PRRU methodology introduced, 12 CFT's identified and training provided on PRRU methodology.
- All defects modes were consolidated and mapped

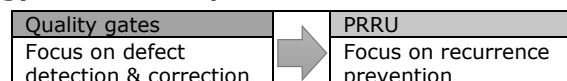


Figure 5.1.1 – Approach for in-process

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- Based on the existing process controls (PFMEA, Control plan and WIS) occurrence & flow out controls were evaluated and general assessment rank (A, B, C, D, E, F) was given for each defect mode and target ranks identified based on kaizen plan with the target 50% of reduction of defects in one of the high volume models
- 170 defect types were resolved through PRRU approach in lift axle model (Chart 5.1.1).

Table 5.1.1: M & HCV Chassis Line 3 Process control Rank (Lift Axle models):

Before		Occurrence			
		①	②	③	④
Flow out	<1>	A	A	A	B
	<2>	A	B	C (1)	D
	<3>	A	C	D (125)	E (1)
	<4>	B	D	E (39)	F (4)

After		Occurrence			
		①	②	③	④
Flow out	<1>	A	A	A	B
	<2>	A	B (1)	C (0)	D
	<3>	A	C (125)	D (1)	E (0)
	<4>	B	D(39)	E (4)	F (0)

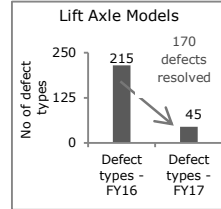


Chart 5.1.1 - Defect reduction in lift axle

Table 5.1.2 - Kaizen category

Kaizen category	Nos.
1 Standardization	126
2 Process Kaizen	35
3 Tool	9
TOTAL	170

Introduction of Human Error Prevention Techniques(HEP):

In PRRU network sheet, the in-process defects against each operation & upstream defects were mapped and the current control rankings were mapped. From the process defects, the defects attributed to Human errors were stratified and kaizen planning done to eliminate Human errors (Table 5.1.3). To reduce Human error, HEP techniques were introduced along with Process reliability rank up (PRRU) methodology.

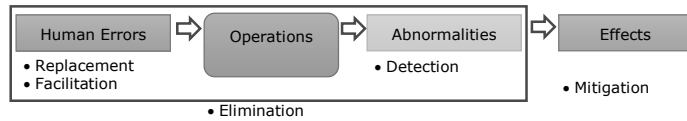


Figure 5.1.2 - HEP methodology

Table 5.1.3 - HEP actions

Problem	Cause	Action	Results
Process issues related to human errors	Inadequate process control	<ul style="list-style-type: none"> 63 team members were trained for HEP techniques Framework has been created for implementation of HEP techniques based on learnings, Cumulative 369 Poka-yoke improvements initiated, due to this PDI defects reduced from 107 to 18 defects as shown in the Chart 5.1.2 	

Chart 5.1.2 - Poka Yoke vs Defects reduction

Sustenance of these improvements are monitored through periodic process audits.

② Improvements in Incoming Quality:

Supplier initiatives - System improvements for Surface protection & dimensional issues

During FY'12, the incoming rejection was very high (7196 ppm). The major contributors were Aesthetics, Dimensional, Welding and Casting defects. In order to reduce the incoming rejections, various initiatives like Painting & handling improvements drive, 100S, Weldone and Castright were taken to address the management and technical issues at supplier end over the period of time. The typical example of key initiatives (Painting & handling and 100S) taken and the results are summarized in Table 5.1.4.

Table 5.1.4: Supplier improvement initiatives

Problem	Cause	Initiative	Actions	Results
Surface protection Issues contributed to 57% of Overall rejections (FY 12)	Process design / product design on surface treatment specification not adequate	Painting & Handling Improvements drive: (FY13) (25 Part families in 2 Phases)	<ul style="list-style-type: none"> Process improvement for Salt spray resistance with suppliers, Powder coater's Assessment & improvements, Zinc rich primers & sealant introduction, etc. Packing standards revised to reduce handling defects through Painting & Handling sign off Development of surface protection guidelines/inspection standard 	
Dimensional Issues contribute to 40% of Overall rejections (FY 14)	Inadequate defect flow control at supplier end	100S initiative: (FY15) PPM > 100 Suppliers, identified for improvement	<ul style="list-style-type: none"> Quality Gates concept introduced at supplier end to control defect flow out at PDI stage Quality Gate Manual was created & training imparted to all the identified Suppliers. Checklist was created to evaluate Q gate effectiveness & monitoring done on a regular basis to ensure the effectiveness 	

Chart 5.1.3 - Surface protection defects

Chart 5.1.4 - Dimensional issues

③ Improvements in-process quality (Occurrence Prevention Control):

In FY 15 straight pass was taken as one of the objective to improve in-process Quality. Analysis, showed that process defects were high in order to reduce occurrence, PFMEA, SPC and Poka-Yoke were used. Defects attributed to skill were addressed through Job ability development and HEP as in Table 5.1.5.

Table 5.1.5 System improvement for occurrence prevention

Existing system - Gap Analysis	System Improvements Initiated	Results
System improvement in Potential Failure Mode Effect Analysis (PFMEA) <ul style="list-style-type: none"> No structured feedback of actual failure modes to PFMEA. All potential process failure modes not addressed Despite coverage of failure modes in PFMEA, defects were recurring and Occurrence ranking was not fact based. 	<ul style="list-style-type: none"> Extensive training was imparted to 24 executives and 8 CFTs formed across for PFMEA System improvement Comprehensive way of identifying failure modes based on defect data bank in addition to potential causes. For each element of operation 16 types of human errors listed & possible effect on product is termed as failure mode Multiple inputs & fact based occurrence ranking Use of HEP for Detection & Prevention Controls 	131 Operations completed, which resulted in 131 Poka Yoke implementation in FY 17

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Early stage control through new model stabilization		
<ul style="list-style-type: none"> No comprehensive system to achieve early stabilization of new models considering QCD targets. 	<ul style="list-style-type: none"> To achieve the quicker stabilization of new models, stabilization index has been created consisting of a) Lead time b) Build quality issues and c) Cost. Introduced Stabilization-Time (ST) strategy to reduce losses. 	<ul style="list-style-type: none"> Stabilization ratio achieved as 0.43 (FY17) against the base of 1.0 (FY16)
Job Ability Development for Associates for defect reduction		
<ul style="list-style-type: none"> System lacks assessing skill level of permanent associates considering rejections, reworks & safety were not considered; more defects due to men 	<ul style="list-style-type: none"> New Framework Job Ability Standard (JAS) created for assessing skill on 9 parameters considering QCDSM JAS implemented in Cab Trim as pilot - 87 associates are assessed, further in Frame & Chassis Assembly and Cab Weld of M&HCV covering 668 permanent associates in FY 17 	<ul style="list-style-type: none"> DPV due to permanent associates reduced from 0.31 to 0 DPV in cabin trim area.
SPC Implementation for CTQ parameters		
<ul style="list-style-type: none"> Existing Framework was inadequate Being an assembly plant, usage of attribute Charts like U & P Charts for defects was not adequately applied. Barbaric control limits used for attribute parameters 	<ul style="list-style-type: none"> Framework created for SPC techniques Attribute type: 50 U - Chart for Defects monitoring in QG. Variable type-Monitoring of 6 CTQ parameters such as Clutch stand out, coating thickness, etc., thro' variable control Chart. Actions initiated against abnormalities and chronic issues. 	<p>Quality Gate DPV reduced from 8.7 (FY16) to 4.9 (FY 17) by using the application of attribute Charts in cab trim section</p>

(3) Effects:

<p>Reduce 0 MIS DPV @ sales yard (M&HCV)</p> <p>Chart 5.1.5: "0" MIS DPV at sales yard</p>	<p>Reduce AVES Score at sales yard (LCV)</p> <p>Chart 5.1.6: AVES score at sales</p>
<p>Incoming rejection ppm</p> <p>Chart 5.1.7: Incoming parts rejection ppm</p>	<p>Straight pass @ Firewall stage (M&HCV)</p> <p>Chart 5.1.8: Straight pass (M&HCV)</p>
<p>Straight pass @ Firewall stage - LCV</p> <p>Chart 5.1.9: Straight pass (LCV)</p>	<p>3 MIS</p> <p>Chart 5.1.10: 3 MIS overall failures</p>

5.2 New model productionization:

(1) Background:

ALH2 started production from 1994 to produce cargo range of (ICV) Intermediate Commercial Vehicles (7.5T to 15T). Later the plant facilities were modified to produce M&HCV (Medium & Heavy commercial vehicles) and LCV (Light commercial vehicles). In FY14, all the models produced in ALH1 were transferred to ALH2 and further multi axle vehicles (M&HCV) were added at ALH2 portfolio to cater market demand. This has resulted in considerable increase in new models and variants of M&HCV during FY14 to FY16. With this ALH2 has to cover wide range of products from 2.5T to 49T in 8 platforms.

Even though the number of models and variants are increasing year on year, the contribution of new models in overall volume is at 6% and in small order quantities. This posed a challenge to accommodate **wide range of vehicles and be flexible enough to handle small batches**. Further to the increase of new models and variants, the demand for M&HCV is also nearing to the capacity level. Hence it is very important for ALH2

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should have the **readiness to produce most of AL models and to quickly stabilize production of the new models.**

New model introduction was being carried out based on 3 months rolling plan of Master production scheduling (MPS). New model introduction process during pre-TQM period was being followed through various phases of GenMod process (New product development), which is shown in below Figure 5.2.1. In plant, the productionization process starts from only Phase 6.

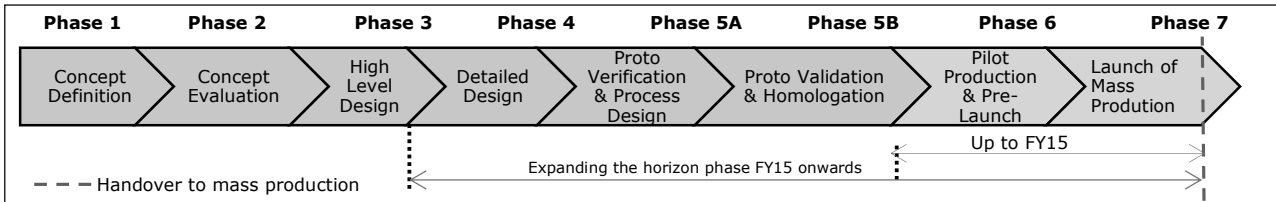


Figure 5.2.1 – Process of New Product Development with NMP Scope

In pre-TQM phase, the objective of new model introduction was mainly focusing on new product delivery time in line with the regular models delivery time (“Laydown” to “Pass to Sales (PTS)”). First production vehicle at unit was taken as a pilot vehicle and is signed off. After correction of the sign off points, the first 50 vehicles are monitored for product delivery time (Laydown to PTS). However, it was observed that defects and the delivery time was high. The following were major challenges faced.

- 1) High defects in Pilot vehicle and 2) New product delivery time high (Laydown to Pass to Sales)

Establishment and improvement phase (FY13-FY15):

During establishment and improvement phase, even though the product delivery lead time and Pilot vehicle defects were reduced with the help of focused activity of offline proto build, the new model lead time was still high because the rework at post off-track and quality gate issues (after pilot and before mass production) still existed. Hence it was necessary to focus on quality gate issues to reduce delivery time further. Based on the above quality gate issues & rework, a comprehensive system to measure quality, delivery and cost has been derived to **“achieve early stabilization of new models”**.

Considering the wide range and small batch quantity of new models a new objective has been derived as **readiness of plant to produce most of AL models**. For ALH2, Readiness is defined as “the plant is equipped to produce most of AL models”. The Figure 5.2.2 indicates how the readiness of models is being handled for existing as well as new platforms of vehicles.

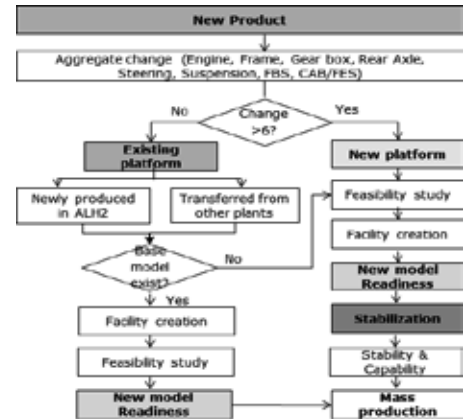


Figure 5.2.2 Process flow for model readiness

(2) Detailed explanation of focused activities – Examples:

① Introduction of ST (Stabilization - Time) ratio to achieve early stabilization.

In order to verify the quicker stabilization of new models, a stabilization index has been created covering a) Lead time b) Build quality issues and c) cost. Target for each of these parameters were set and monitored during new model productionization. A model will be considered as “stabilized” when all the 3 parameters reached the set target value of index 1. The Table 5.2.1 illustrates the stabilization index and criteria.

Table 5.2.1 – Criteria, Rating and target for stabilization index

#	Parameters	5	4	3	2	1
1	Observed defect at off-track (Q)	>100	75 ~ 100	51 ~ 75	26 ~ 50	≤25
2	Delivery time: In days (D) (LD to PTS)	>60	31 ~ 60	11 ~ 30	4 ~ 10	≤3
3	Cost: % over vehicle cost (C) (Inventory carrying cost + Rework cost till PTS)	>1%	0.5 ~ 0.1	0.3 ~ 0.5	<0.3	Target cost

ST (Stabilization - Time) ratio:

Stabilization ratio is calculated to understand the rate of improvement by comparing the stabilization index and number of vehicles to achieve the index value between new and base models.

Stabilization ratio = $(S_2 \times T_2) / (S_1 \times T_1)$; where S_2 = Stabilization index value of new model, S_1 = Stabilization index value of base model; T_2 = Number of vehicles taken to achieve the target Index value of 1 (new model) and T_1 = Number of vehicles taken to achieve the target Index value of 1 (base models)

The model (N2523) produced in FY16 was taken as a base model to compare with future new models. During FY’17, a new model (N 4019) was introduced and stabilization was monitored through ST ratio. Based on the issues faced during proto & pilot production of N2523 and two other similar base models, issues were consolidated in the form of ECR and MCR and proactively addressed in the Design mock up stage and the

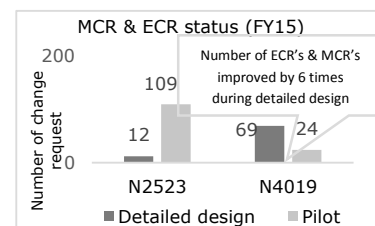


Chart 5.2.1 – MCR & ECR STATUS

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detailed design stage for N 4019. The above activity has helped in identifying 69 ECRs like wiring/air piping routing and clamping, accessibility issues, drawing errors and other issues. For wiring/air piping routing and clamping issues, inputs like sagging, length, strain, bend and fouling are given in product detailed design stage. Based on this input, product development has developed 3D modelling and released installation drawing to take care of these issues. With this the new model N4019 was stabilized in 27 vehicles compared to the base model of N2523 in 38 vehicles and stabilization ratio is 0.43.


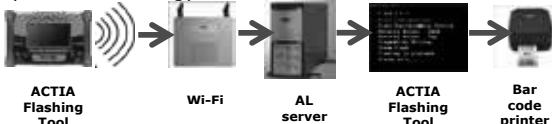
② Plant readiness for future product & process technology roadmap of the company:

AL evolved a product technology road map over the period of time based on the market analysis, Customer requirements, emerging trend, regulatory requirements, competitor analysis & benchmarking. Based on new model requirements, product and process technology inputs are received from product development & project planning. To meet these new model requirements, it is important to upgrade facilities and process. ALH2 evolved a process technology road map to adopt these changes and improve the capability for readiness for new models. This will help to reduce new model productionization lead time and capability to include a wide range models in ALH2.

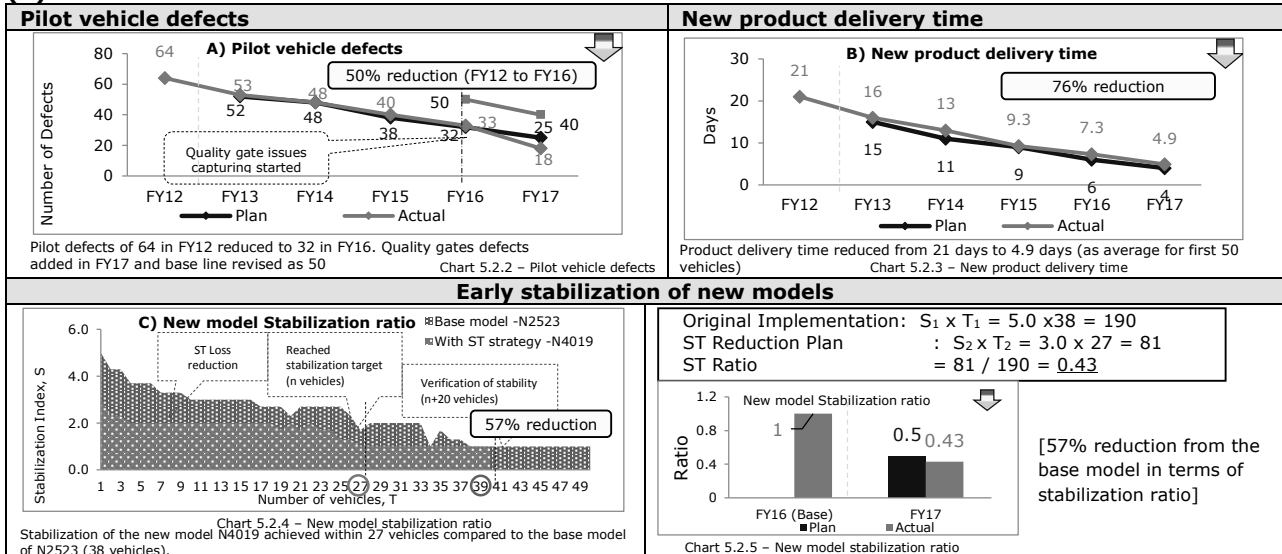
Technology development – WIFI ECU flashing technology (example):

One of the process technology implemented in ALH2 for product readiness is explained below.

Table 5.2.2: Technology development - Example

Product technology	Challenges	Process technology	Results
Until 2013, the ECU (Electronic Control Unit) only for Engine, data input through computer manually. Later 4 ECU's were introduced for Engine, Chassis, Cabin and Cluster electrical controls.	This require 4 data sets per vehicle. Correct data input to be fed to the 4 ECU's. Any wrong ECU data input will lead to failure. 	A new innovative on line WIFI enabled technology introduced for feeding correct data input to 4 ECU's. (Poka-Yoke). Multiple ECU can be handled through this process technology. 	• Elimination of wrong data input

(3) Effects:

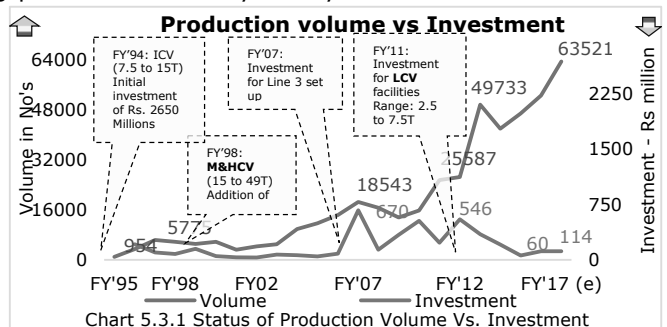


5.3 Cost Management:

(1) Background:

ALH2 is a 23 years old plant running with considerably depreciated assets, yet produces the widest range of vehicles with ever growing volumes and delivering products which fully satisfy the customer demands with flexibility on a continuous basis at low cost compared to other plants in AL Family.

Unlike other plants, this feature of ALH2 was evolved only by its steady and unrelenting efforts towards incremental improvements. For the last 10 years, ALH2 witnessed two economic slowdowns, price increases due double digit inflations and depreciation of currency in the economy. But the plant withstood all these economic difficulties with steady reduction in operating cost through prudent cost management initiatives. These cost management initiatives



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were tailor made, holistic in nature and were best suited to the ALH2 culture, which in turn helped to garner support from all functions in the plant towards operational excellence. Since inception, the only investment of significance has been during setting up LCV line. Other than that, all the other capacity enhancements, flexibility improvements and machine upgradations were done by the plant to bring more operational excellence in terms of operational cost. Currently, the capacity of M&HCV is 50000 per annum on 2 shift basis, which is 2.6 times the capacity which was laid down 23 years back. The key management challenges of ALH2 are given in Table 5.3.1

Table 5.3.1: Challenges faced

Environment	Challenges	CFM Theme	
<p>Old plant and older machines:</p> <ul style="list-style-type: none"> •Old machines were transferred from IVECO during plant commissioning •Constant upgradations of machines •Producing wide range products (2.5T to 49T) with varying work contents requires flexibility <p>Manpower costs:</p> <ul style="list-style-type: none"> •Permanent manpower transferred from ALH1 due to business consolidation (FY'10: 353, FY14: 499 persons) •Wage revision and welfare facilities to employees <p>Other operational costs:</p> <ul style="list-style-type: none"> •The economy was in inflationary phase-FY'05 to FY'14 •The Power cost was steadily increasing coupled with frequent power cuts, lesser wind power availability and less minimum demand quota given Tamil Nadu Electricity Board (TNEB) which compelled the plant to run Gen sets. •Tools, Consumables & Logistics were on an increasing trend due to price increases •Increased repair cost to ensure upkeep of aged machines and upgradations <p>Increase in direct material cost:</p> <p>Contribution of direct material costs per vehicle: 75 to 85% of total cost.</p>	<p>Chart 5.3.2 Equipment addition</p> <p>Chart 5.3.3 Manpower - Direct manpower</p>	<ul style="list-style-type: none"> •Maintaining the old plant (maintenance cost) •Cost competitive containing the manpower cost •Reducing plant operating cost •Reducing direct material cost 	<p>Overcoming the cost disadvantage due to wide range and flexibility & higher fixed manpower cost while maintaining old plant with lower maintenance and depreciation cost</p>

ALH2 plant's endeavor on Cost Management Initiatives (CMI) made the plant to get an edge when deciding on production models, as it delivers vehicles of any range at lowest cost living up to its Vision statement.

(2) Detailed explanation of focused activities – examples:

① Reduction of energy procurement cost by optimizing the energy mix:

During FY'12, the power requirement of ALH2 was met from Tamil Nadu Electricity Board (TNEB), wind power and generator set. As there was a restriction for TNEB supply, the usage of generator was high. The price of generator unit was 3 times higher than TNEB. This led to increase in power. Hence cost CFM adopted a strategy of diversifying the sources of procurement and through this the DG share has come down by 62%. Various sources of power identified and the mix is optimized year on year based on the cost/unit of the power source at that point of time and the availability. The various sources identified and energy mix optimized is given in Table 5.3.2

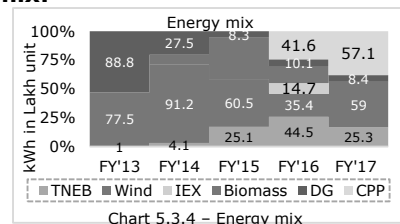


Table 5.3.2 Reduction of energy procurement cost

Year	Energy mix (%)						Problem	Cause	Actions taken	Effects
	T	W	I	B	D	C				
FY13	1	46			53		DG usage high	Restriction for TNEB power & wind power	Alternate source identified - Biomass	<p>Chart 5.3.5 – Power cost</p>
FY14	3	68		9	20		DG usage still high	Non-availability of TNEB power & limited usage of bio mass	Procurement on Bio-mass increased & TNEB power situation improved	
FY15	17	41		35	6		-	-	-	
FY16	26	20	9	15	6	24	Bio mass become unstable	Government restriction on bio-mass	Captive power plant (CPP) & short term procurement from online trading IEX	
FY17	17	39			5	38	IEX cost increased	Fluctuating cost by IEX	Roof top solar introduction	

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② Consumable cost reduction through optimization, negotiation, alternate sourcing & technology upgradations:

The consumable cost was classified in 2 categories i.e. Essential and Muda. The top contributors for consumable cost were identified and improvement projects were implemented to reduce Muda. The actions initiated on the major contributors. The consumable cost has come down through various improvement projects implemented on "MUDA elimination", "Incidental cost reduction" and "Essential cost reduction".

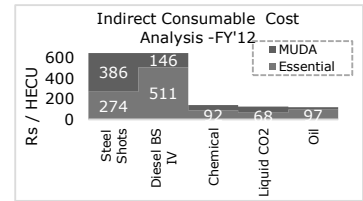


Chart 5.3.6 – Indirect consumable

Consumable cost reduction – Typical example CO₂ gas consumption:

CO₂ gas is being used in M&HCV weld section as a consumable. During FY'13, the CO₂ consumable cost was high. Hence in order to reduce the CO₂ consumption, daily Management approach was used. CO₂ consumption was taken as a DM KPI and monitored. The abnormalities were captured on daily basis, causes analyzed and actions initiated. The improvements were done in 3 phases. The daily management practices helped to achieve the process stable and capable over the period. The DM success story is given in below Table 5.3.3.

Table 5.3.3 DM Success story – CO₂ Consumption reduction

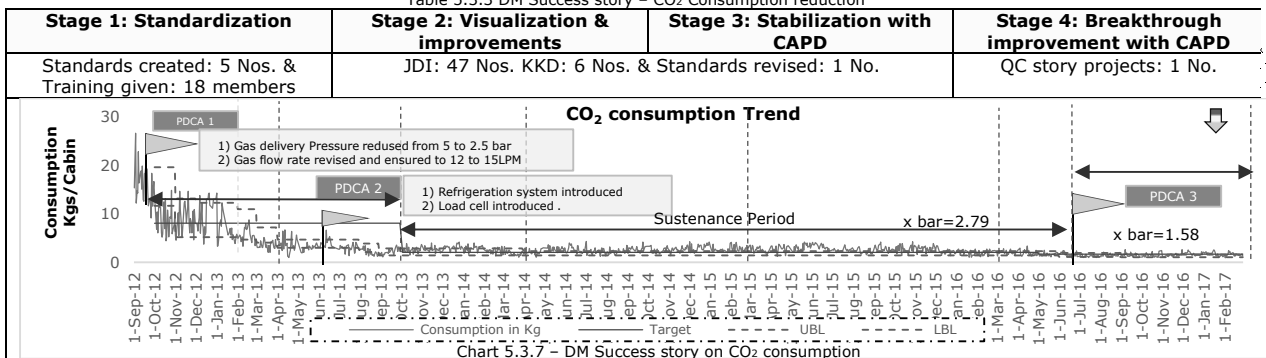


Chart 5.3.7 – DM Success story on CO₂ consumption

③ IT enabled Cost Management Initiative (CMI):

Till FY16, cost data for ALH2 was monitored manually at an overall level. Actions were initiated when related KPI trend were abnormal. This required systematic approach was required to handle huge data effectively. Also during TQM diagnosis, one of the comments given by examiners was that "essential" cost to be reduced after reducing the "Muda". Hence in order to address this issue, IT enabled cost management system (CMI) evolved at ALH2 through SAP system to monitor the cost drivers like Power, Tools and Consumables etc. Per unit cost norms is derived from well-established source such as OEM or Unit planning. Permissible cost for a specific resource is, norms of that resource multiplied by number of units produced. Actual cost is the expense recorded in system for producing that many units. Difference between actual cost and permissible (essential) cost is non-essential (MUDA). Implementation of this system was a major activity for ALH2 as it involved updating 10 million records related to various processes carried out. Implementation of this IT enabled system has helped ALH2 identify MUDA department wise, line wise, part number wise which in turn helped us to take theme specific projects for better cost management and control.

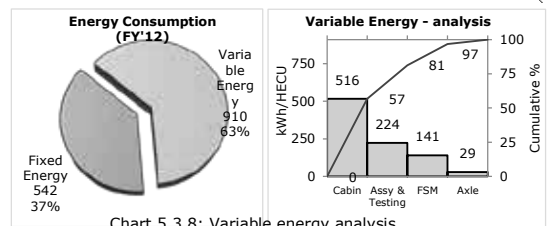
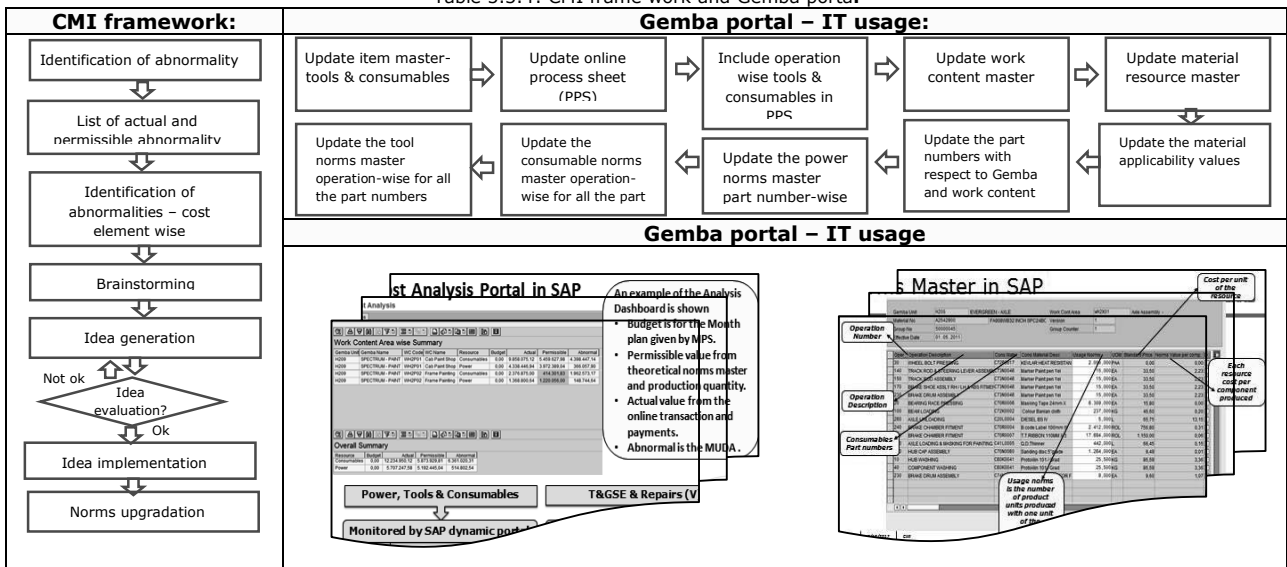


Chart 5.3.8: Variable energy analysis

Table 5.3.4: CMI frame work and Gemba portal



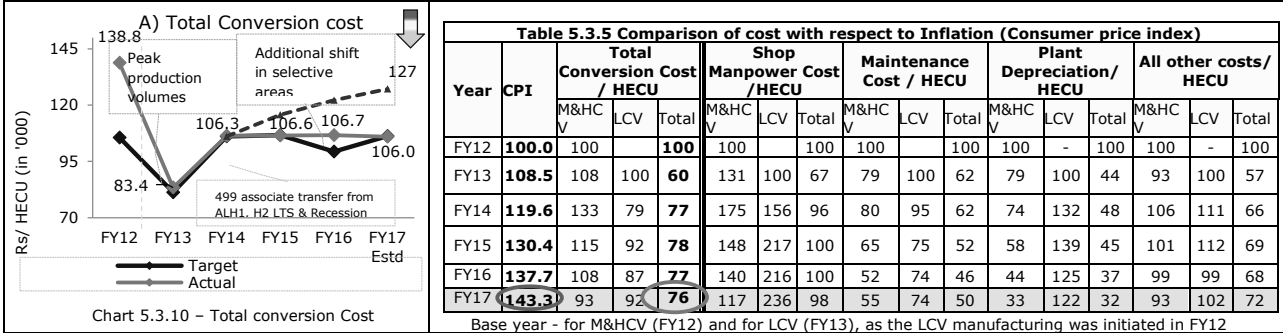
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Overview of improvements: (FY12 to 17)					Kaizens and Cost savings:	
Cost Category	System Improvement	Technology improvement	MUDA /Others	Savings in Rs. Crore		Chart 5.3.9 – Kaizens vs cost
Power	12	44	40	12.4		
Consumable	14	5	12	1.84		
Tools	16	1	12	0.60		
R&MV	19	41	47	5.45		

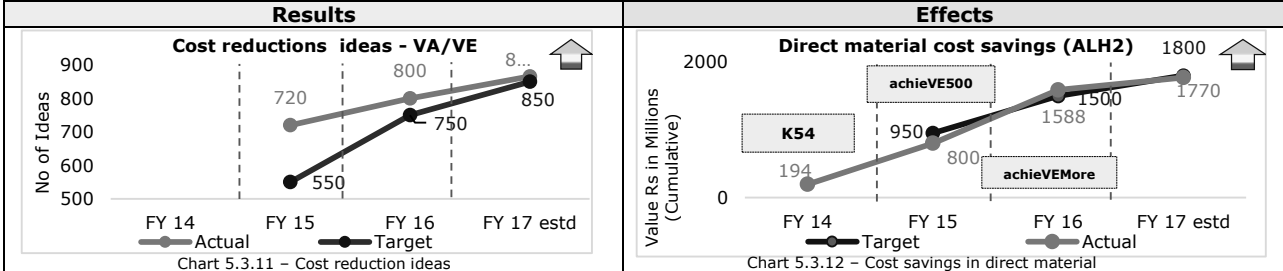
(3) Effects:

Reduce Total conversion cost



The consumer price index (CPI) increased from 100 (FY12) to 143.3 (FY17) whereas the total conversion cost index has reduced to 76 from the base year (FY12 - 100) in spite of Consumer Price Index (CPI) has gone up. ALH2 could reduce the conversion cost considerably in spite of old machines, increased man power cost & inflation rate (Consumer price Index) due to Cost Management Initiatives.

Achieve cost savings in direct material cost



5.4 Human Resource Management:

(1) Back Ground:

ALH2 plant, commenced in 1994, was designed to manufacture fully built vehicles. From 1995 onwards Hosur became a full-fledged industrial belt, thereby increasing the demand for skilled workmen. Thus it became the need of time for local industries to enhance technical knowledge and skill of local youth to make them "Ready to Hire". To fulfill business need & to provide skilled people back to society, ALH2 in collaboration with state government came out with a scheme in 1996. This scheme was named as "SEEU" Scheme for promoting Education and Employability for Underprivileged Students. This scheme started with the training in trade of fitter, welder, painter and Mechanic Motor Vehicle.

Later in FY12, Company entered in LCV production and manpower requirement went up drastically. By this time, many industries building up their operations which led to **shortage of manpower**.

The number of variants and volumes produced are increasing year on year (Chart 5.4.1). To produce high volumes, with flexibility to accommodate larger varieties in smaller batches became the critical challenge for ALH2. To handle this challenge, **capability development of all employees** became significant need. Hence, ALH2 decided to focus on "Making people to make products" with thrust on improving build quality.

In FY06, **Mission Gemba**, an employee engagement initiative was launched to engage employees in improvements. Through Suggestions Scheme and Small Group Activities, AL H2 achieved 100% people participation in FY13. As we matured, we decided to revisit the computation methodology and to widen the scope.

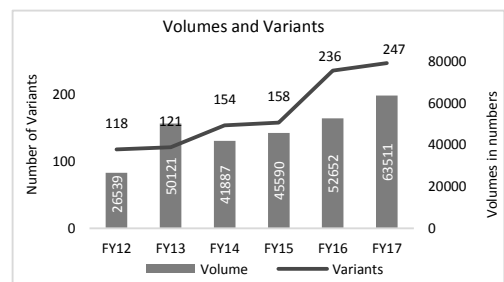


Chart 5.4.1 – Growth of Volume and Variants



(2) Detailed explanation of focused activities – Examples:

① **Trust building and Muri reduction program:** With the initiation of TQM, Plant started “Trust building” initiatives to make ALH2 a great place to work having productive and happy manpower. Following initiatives were taken to build trust across all levels of hierarchy.

- Employment to needy family members of associates
- Family engagement through (Felicitation of students, Personality development and Career guidance etc.)
- Performance based proactive incentive schemes
- TQM training program for permanent associates
- Improve work place safety

② **Muri Reduction through Effort and Ergonomic Index (EEI) initiative:** Muri reduction program has been started under EEI pillar of Gemba for making work easier involving all employees. EEI methodology focus on reduction of Efforts (Walking, Bending, Grasping, Placing, Process itself) and Ergonomic (Fatigue) reduction. It helps personnel to reduce adverse impact of Muri i.e. pain, illness, low morale, frustration and irritation. Till now, ALH2 has completed 3242 projects. One of the examples is given below in Table no. 5.4.1.

EEI Projects Progress		Bell Crank Level Lifting & Mounting	
Muri (EEI) Reduction Projects		Before EEI 4327	After EEI 2186
<p>Chart 5.4.2 EEI reduction</p>			<ul style="list-style-type: none"> - 50% EEI Reduction - One Man - No Bending - No Lifting

Above initiatives helped ALH2 in productivity enhancement from 2.53/LECU/100 Man-days (FY12) to 3.32 LECU/100 Man-days (FY16).

③ **Revamping SEEUS program:** SEEUS program was continuing to develop “Ready to hire” people but success rate was low at 58% in Pre TQM phase. ALH2 along with institute of management brainstormed on cause and taken countermeasures like additional revision classes, upgradation in equipment & tools, enhanced infrastructure and Soft skill training. Time to time, syllabus of each branch was revised and improved.



④ **Hands-on training for SEEUS Students:** In order to make students ready for the industrial environment, skill training is given for 30 days through “Skill Up” program. This program focuses on industrial work along with Safety, 5S, knowledge on ALH2 products & processes, Cognitive, Dexterity, Assembly operations, understanding of 2nd generation WIS etc. Till now, total 354 students are hired by ALH2 and other companies after getting certification from SEEUS. Dearth of Painters and Welders has been reduced through this scheme. Above activities, contributed significantly to the success rate of SEEUS which increased from 58% (FY12) to 96% (FY16).

⑤ **“Road to School” Initiative:** As SEEUS enrolled students were from poor and rural background, they were found lacking in basic primary education which was affecting the input quality of SEEUS program. To improve the Quality of incoming students in to SEEUS, ALH2 started focusing on basic primary education through a holistic development mission called ‘Road to School’, a unique initiative of its kind, 72 Government Schools from remote parts of Krishnagiri district were adopted under this mission. After detailed diagnosis of the existing system, an unique methodology was designed focusing on providing individual attention for slow learners, additional coaching and transportation arrangement. This facilitated significant improvement in the scores of the identified students (1515 nos from 72 schools). This initiative is not only supporting the society, but also helping in realization of our Prime Minister’s vision of Skill India (New India through Skill upliftment).



⑥ Process specific skill enhancement for permanent associates:

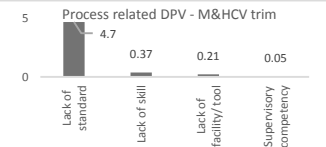
During pre TQM, as the business need for skill based training was limited (low volumes, models/variants), training for permanent associates was provided mainly on Gemba initiatives and critical processes. In FY13, Traditional Skill Mapping system was introduced and “On-the-Job-Training” was provided using work standards. In the meantime, volatility in the market is increased and various stranger models & variants are introduced. In FY15, a need was felt to go more process specific hence process specific / station specific skill sets were identified by Managers and training identification became more focused to the process requirements. Till FY15, total 1649 associates were covered in these changed skill sets. This process helped in raising people skill level and defect reduction of man generated defects from 1.2 DPV (FY12) to 0.47 DPV in (FY15).

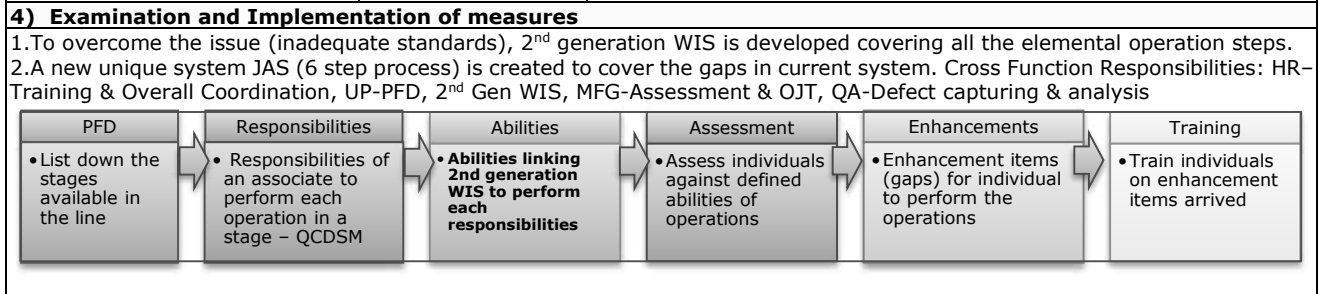
⑦ **Job Ability Standard (JAS):** Even after “process specific skill” mapping system implementation, human generated defects (“0” MIS) were stagnant at 0.47 (considerably high). To reduce it further, a unique process to develop the ability among permanent associates on QCDSM parameters connecting with 2nd generation WIS. JAS is introduced in FY17 as a tool to assess the ability of an individual on his work area. JAS is implemented in M&HCV Cab Trim as a pilot, wherein 82 associates are assessed and defects produced by them are analyzed.

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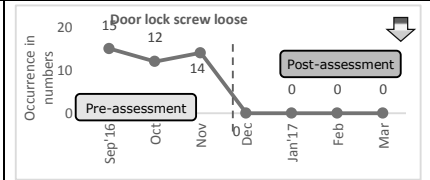
Table 5.4.2 : Job ability standard - Application case

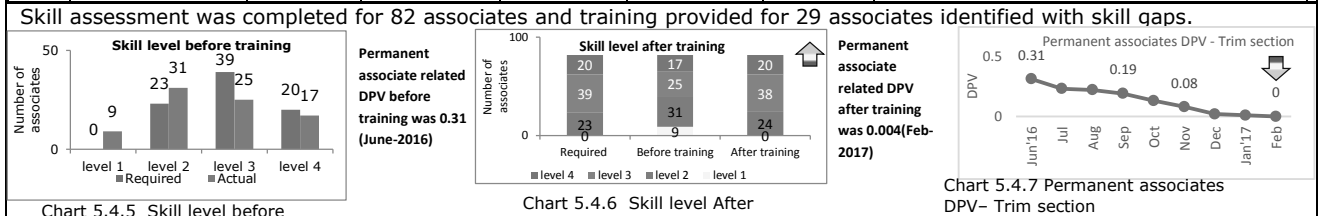
<p>1.Problem definition</p> <p>Defects generated from trim process is 5.33 DPV in Cab Trim line quality gate. <small>Data period: FY16</small></p>  <p>Chart 5.4.3 Defect contributor</p>	<p>2. Grasping current situation</p> <p>Inadequate standard and lack of skill contributed to 95%(5.07 DPV) of total process defects in cab trim.</p> <p>Observation:1) Work instruction sheets (WIS) is not describing the elemental operation steps. Hence, WIS is not comprehensive. 2) The current system evaluates only common skills not supported by data but based on supervisor knowledge and experience. Also, 99% associates (Total 82 associates) of Cab trim, met their skill requirement (L3 & L4); still, Defects are generated >> Skill assessment system not adequate. Current skill: L1-Beginner, L2-can read & do, L3-can do independently, L4- can teach</p> <p>3) Establish target: 50% reduction in M&HCV cab trim line quality gate DPV</p>
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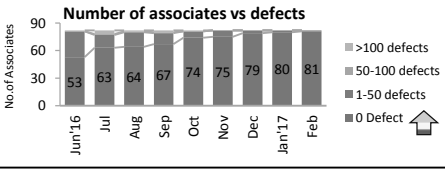
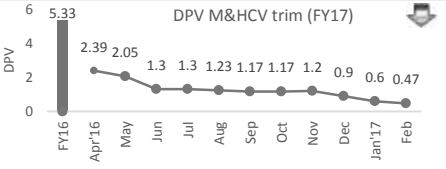


Example of one Associate (M&HCV Cab Trim assembly)

Name: M. Saravanakumar, 62923 Operation 0340 - ASSY OF DOOR LOCK, DOOR PAD & STRAPPING KEY

Level	Required Skill	Actual Skill	Defect Details	Gap	Training details	New Skill	Defect Trend
L1	Can work under guidance		Door lock screw loose Sep'16 - 15 Oct'16 - 12 Nov'16 - 14	Operator not aware of the door lock screw tightening sequence	2nd generation WIS-tightening sequence education by supervisor		 <p>Chart 5.4.4 Door lock defect trend</p>
L2	Can work independently						
L3	Can troubleshoot						
L4	Can teach						



<p>5.Confirmation of effects</p> <p>The number of associates generating "0"defects has significantly increased after Job ability standard implementation.</p>  <p>Chart 5.4.8 No.of Associates vs defects</p>	<p>6.Standardization</p> <p>JAS completed for 650 associates out of 1636 & ALH2 has drawn a roadmap to complete JAS for all permanent associates by FY18.</p> <ul style="list-style-type: none"> SOP for Job ability standard was developed. Management system Chart was developed.  <p>Chart 5.4.9 DPV - M&HCV Trim</p>
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8) Managers & Supervisors competency enhancement system:

Position Based Competency enhancement: Pre TQM, Supervisors' training need was coming through annual performance appraisals where supervisor' used to choose their training need from available menu on yearly basis. To handle the wide product range and to improve the rapport with associates, a new process based competency enhancement system has been launched in FY15. Assessment made for all Supervisors and Managers (365) till FY16.

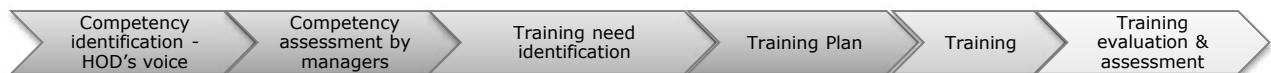


Figure 5.4.1 - Process based competency process

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Role Based Competency enhancement: In spite of high training need fulfillment, these trainings were not enough to improve their performance in QCDSM at Gemba. Hence, role & responsibility based competency system has been started in FY17. Process of same is given below in Figure no. 5.4.2.



Figure 5.4.2: Role based competency development process

Leveraging Daily Management system, Roles & Responsibilities are identified for each supervisor to support their deliverables KPIs. Standards are revised/made to perform all responsibilities and activities related too. Assessment of supervisors are done based on required competencies (knowledge & experience). To establish the same, a pilot line, M&HCV Cab Trim was identified then planned for horizontal deployment in all manufacturing and manufacturing service areas (147 supervisors). Example of one supervisor is given below in Table 5.4.2.

Table 5.4.3 : Example of Supervisor's training

Name: Mr. Abdul Wajid. A		Department : Cab Trim				
Level	Required Competency	Actual Skill	Gap	Training details	New Skill	Results
L1	Knows 5S concepts		1. Unable to do audit using 5S check sheet. 2. Unable to identify and take action for 5S gaps and abnormalities.	Training given in Jan'17 on : 1. 5S audit using check sheet 2. 5S abnormalities & countermeasures		<p>Chart 5.4.10 Number of JDIs</p>
L2	Able to apply					
L3	Able to identify 5S gaps, analyze and take action					

This new system helped drastically in pilot lines and DM KPI Achievement ratio of supervisors increased from 45% to 90% (FY16).

9 Skill Up program for temporary associates / new comers



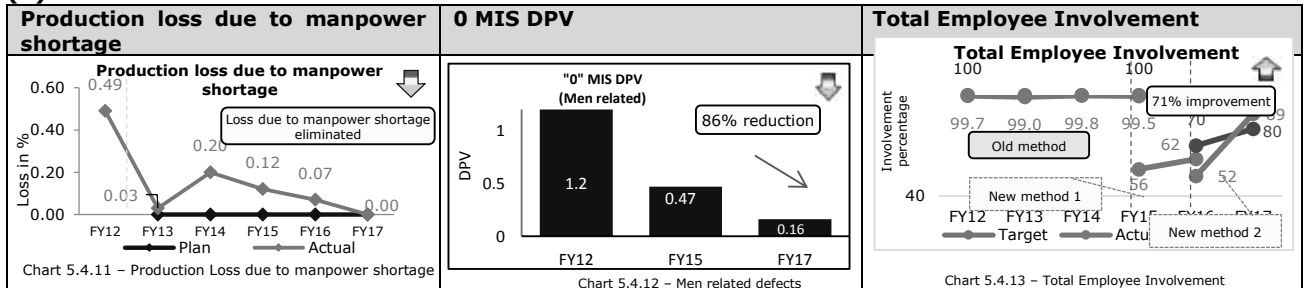
With regular upliftment in training methodology of permanent associates, significant reduction observed in their contribution in defects. Later in FY16, Human error data analyzed and found that temporary associates are still contributing more than 80% due to skill gap and turn over mechanism. Till FY14, ALH2 use to train temporary associates for 3 days at shop floor. With same, associate use to take long time to adapt to operational requirements leading to human error. To reduce temporary associate related human error, H2 established **Skill Development Center** in FY17 after benchmarking with similar Auto industries viz., TVS Motors, Toyota Motors, Yazaki Ltd, MSSL and AL Pantnagar. Glimpse of Skill Development Centre is shown in Figure. 5.4.3 .

Using this infrastructure, a 6 days training module has been designed covering Basic Safety, Product, Cognitive and Dexterity training. Real time simulation of major process i.e. Chassis Assy, Paint, Weld etc. created within Centre and all associates were trained in free environment. Only passed candidate are allowed to join shop floor. Till now, 1370 associates have been trained at "Skill Up" facility, evaluated and certified.



Figure 5.4.3 - Skill Development Center

(3) Effects:



5.5 Delivery Mangement:

(1) Background:

ALH2 was the first plant to produce ICV vehicles with cabin among all the AL plants in FY95. Volumes started ramping up with the introduction of M&HCV models from 950 vehicles in FY98 to 25000 plus by FY11. From FY12, production of LCV range of vehicles (<7.5 T GVW) started and progressively more specialty vehicles were added to the product range of ALH2. In the last 4 years ALH2 has become the plant producing the largest variety of products.

During the period FY12-14, the big slowdown in the economy threw newer challenges for AL to survive and sustain the market share. In FY13 out of the total orders given to ALH2, 40% of the orders were in batch sizes

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of 10 or less in a month. Hence it was necessary for the plant to be flexible enough to produce and supply every such order. Also the scenario continued thereafter and flexibility became key for ALH2 to produce high volume orders as well as lower volume variants with equal importance.

However, in LCV the initial ramp up was very high and the demand was more or less steady thereafter. Hence the delivery challenges were more towards in-house as well as supplier capacity enhancement.

Therefore delivery management CFM address the **flexibility** requirements of the plant to produce **wide variety** of orders irrespective of batch size to meet the objective of **'on-time delivery of orders irrespective of batch size'**. It also addresses capacity enhancement in ALH2 for the future volumes required to realize the company vision.

Delivery management process for M&HCV begins with (MPS)-Master Production Scheduling for the purpose of unit wise resource planning (Man, Machine, Material & Method) and month wise execution. Whereas in LCV the process begins with Market Planning and it directly is being communicated to ALH2 since there is no need of unit wise planning as ALH2 is the only plant producing LCV.

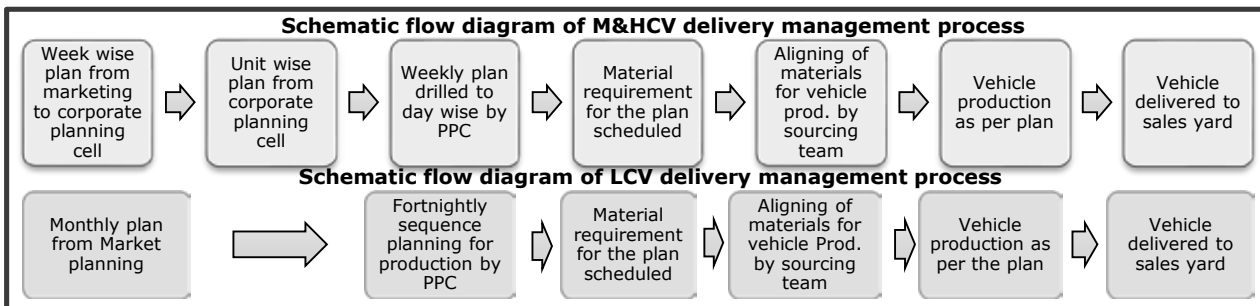


Figure 5.5.1: M&HCV and LCV delivery management process flow

From FY95, delivery performance was measured on a monthly volume basis. No specific focus was given on smaller orders. Volume ramped up year on year but the plant was not able to achieve targets.

① Delivery performance measurement:

Table 5.5.1 Operational definition of Delivery performance measurement

#	Year	Measurement System	Change in Metrics		Frequency
			From	To	
1	Till FY13	Only Quantity	-	*Volume adherence [Volume adherence = (Number of vehicles delivered/ Total vehicles planned) * 100]	Monthly
2	From FY14	Quantity-in-Time	Volume adherence	* Service level [Service level = (Number of vehicles delivered as per plan / Total vehicles planned)*100]	Monthly
	From FY15			* Service level of n≤10 (only M&HCV)	Monthly
3	From FY16	Quantity-in-Time	*Monthly service level	*Service level for runner models (M&HCV) * Service level (LCV)	Weekly
			*Monthly service level of n≤10 (only M&HCV)	*Incomplete delivery (ID) for n≤10 [ID= (Number of n≤10 orders not delivered in full / Total number of n≤10 orders)*100] (M&HCV)	Monthly

② Establishment and Improvement phase: Delivery performance of orders in small batches(n≤10)

In FY15 ALH2 formulated the vision of being a flexible plant considering the business requirement of servicing M&HCV orders of small batch size. Hence from FY15 a new metric **"service level for small batch variants (n≤10)"** was taken as the metric for **"Flexibility"**. In FY15, the target for service level of n≤10 was achieved through several focused activities.

Post-recession from FY16, the TIV started increasing. ALH2's volume was also ramping up, and the number of variants were also increasing. Subsequently the variants with n≤10 also increased. This increased the complexity in delivery management system and also it was necessary to not miss any order of small batch orders. Therefore "% of Incomplete deliveries" a measure of the proportion of orders of variants with n≤10 "not serviced fully as per the requirement" was considered for delivery performance. This is a stringent measure than service level.

(2) Detailed explanation of focused activities – Examples:

① Supplier Capacity enhancement to meet ALH2's requirement: (M&HCV)

Production loss due to material shortage was one of the major contributor for low delivery performance, moreover M&HCV production volume of ALH2 was expected to increase rapidly between FY14 & FY17. As the RPD was increasing, few major items like load body, G45 cabins, flitches, cross members etc., were found to have capacity constraints to meet ALH2's requirement. In order to review & identify the gap in supplier's capacity versus projected peak requirement, half yearly capacity review system has been introduced.

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Table 5.5.2 PDCA on Supplier capacity enhancement

Problem				Approach / Actions taken		Effects			
In FY16 around 73 part families which were identified as critical and categorized as follows:				12 actionable points with timelines and responsibilities were evolved for the Red & yellow category items and 11/12 Actions are completed.					
Capacity not meeting peak volume				Improvement	Cycle time reduction projects				
Capacity meeting peak volume but not buffer requirement					Quality issue resolution				
Capacity meeting peak volume & buffer requirement					Layout changes / process Improvement				
Domain	No. of part families			Investment	Sub-contracting				
Sheet metal	33	1	13		19			Tools / Fixtures modification	
Non metallic	12	0	4		8			Infrastructure up-gradation	
Proprietary	17	3	0	14	Man power enhancement				
Casting & forging	9	1	1	7	Additional shift operation				
Load body	2	0	1	1	Additional source development				
Total	73	5	19	49					

Chart 5.5.1: Supplier capacity status

This periodic evaluation has helped in proactively identifying gaps and improving the capacity to meet the increasing demand.

② Reduction of Lead time (From Laydown to Sales yard):

The lead time for delivering vehicle which is considered from laydown to sales yard was 6.7 days against the target of 6 days in FY12. This has a direct impact on the response time to service orders.

Table 5.5.3 Reduction of Lead time

Problem	Approach / Actions taken	Effects
<ul style="list-style-type: none"> Delay in rework at VTS after PDI inspection. (Inspection was done only at end of line – delay in feedback to respective stages) 	<ul style="list-style-type: none"> Quality gates were introduced in conveyor line to improve the detection at source and to reduce the rework at Vehicle Test Shop (VTS). 	
<ul style="list-style-type: none"> MUDA in Transport as the assembled chassis was moved to supplier for load & tipper body fitment (since the facility was not available in-house), after fitment of load body the chassis is brought again to ALH2 for inspection and pass to sales. 	<ul style="list-style-type: none"> Load body fitment facility was created in house by shifting CMVR activities to VTS & utilizing CMVR shed for Load body fitment. Some of the standard activities done at VTS shop were shifted to conveyor. Subsequently the capacity of load & tipper body mounting increased from 25 to 45 and 8 to 40 respectively. 	

Chart 5.5.2: M&HCV Lead time trend

③ In-house capacity improvement in cabin paint & trim shops:

Background:

Cabin paint shop is a facility shared by both M&HCV and LCV production. Initially cabin paint shop was producing only M&HCV cabins and in FY12 LCV production commenced. In the initial years LCV production volume was less but it increased rapidly. Paint shop was constrained in meeting the combined requirements of both M&HCV and LCV production.

Table 5.5.4 In-house capacity improvement in cabin paint line

Problem	Approach / Actions taken	Effects
High lead time in Pretreatment Electrode Deposition (PTED)	<ul style="list-style-type: none"> Improvement of Man Engagement Time (MET) to 510 minutes. Cycle time reduction through Muda elimination 	
MUDA of cabins waiting in robot painting line, since M&HCV cabin's work content is higher than LCV cabin.	<ul style="list-style-type: none"> Concept of Single & multi model painting was introduced. Single model: Only LCV cabins will be painted at a cycle time of 3.8 minutes Multi model: Combination of LCV, M&HCV cabin will be painted at a cycle time of 5 minutes 	

Chart 5.5.3: Paint shop capacity

④ Reduction of incomplete deliveries of n≤10 orders through policy management:

Background:

ALH2's volume requirement in small batch sized orders is increasing year over year, This in turn makes servicing the orders more complex. ALH2's vision element "Flexibility" focuses mainly on small batch sized orders, hence it becomes highly important to meet the small batch sized orders.

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Table 5.5.5 Reducing incomplete deliveries

Problem	Cause	Approach / Actions taken	Effects
• Non-Fulfillment of small batch sized orders.	• Volume adherence was not focusing specifically on small batch sized orders.	• A new metric "Incomplete Deliveries" was introduced and also been taken up as a policy for FY17 Incomplete Deliveries: The adherence will be in binary (i.e) either 0 or 1. 0 - Not supplied in full 1 - Supplied in full Goals, strategies and focused activities identified through past data analysis were deployed to the next level and CFM, wherever applicable.	• Incomplete Deliveries of M&HCV

Chart 5.5.4- Incomplete delivery M&HCV

(3) Effects:

Table 5.5.6 Effects & results

A. Increase M&HCV delivery performance	
<p>Service level - LCV</p> <p>Chart 5.5.5 - LCV delivery</p> <p>Inference: Weekly service level improved by 32%</p> <ul style="list-style-type: none"> - - - Changed from Volume adherence to Monthly service level - . - Changed from Monthly service level to weekly service 	<p>Service level - M&HCV</p> <p>Chart 5.5.6 - M&HCV delivery performance</p> <p>Inference: Monthly service level improved by 20% Weekly service level improved by 13%</p> <ul style="list-style-type: none"> - - - Changed from Volume adherence to Monthly service level - . - Changed from Monthly service level to weekly service level
C. Increase M&HCV delivery performance of small batch variants (n≤10)	
<p>M&HCV delivery performance of small batch variant (n≤10)</p> <p>Chart 5.5.7 - Service level for small batch</p> <p>Inference: Monthly service level of n≤10 variants improved by 8% and Incomplete deliveries reduced</p>	

6 Effects of TQM:

ALH2 leveraged TQM practices to achieve its vision of "To be a **Flexible** plant with a **Wide product range** aiming towards **Operational Excellence**".

The various strategies and focused activities implemented has helped ALH2 in realizing the strategic objectives in line with long term vision. The status of ALH2 long term strategic objectives and AL vision is summarized below.



6.1 Tangible:

Strategic objectives:

1) Capacity to deliver smaller batches (n)	
1.1) Service level – M&HCV, n≤10 <p>Chart 6.1 Service level, n ≤ 10</p>	1.1.2) Incomplete deliveries – M&HCV, n≤10 <p>Chart 6.2 Incomplete deliveries, n ≤ 10</p>
2.1) Capability to produce new models 2.1.1) Readiness <p>Chart 6.3 New model readiness</p>	2.2) Early stabilization of new models 2.2.1) Stabilization ratio <p>Chart 6.4 New model stabilization ratio</p>
3.1) Competitive Quality levels	
3.1.1) "0" MIS at sales yard (M&HCV) <p>Chart 6.5 "0" month in service</p>	3.1.2) "3" MIS - labor claims (M&HCV) <p>Chart 6.6 "3" months in service</p>
3.2) Cost competitiveness	
3.1.3) AVES score (LCV) <p>Chart 6.7 AVES score</p>	3.2.1) Total conversion cost <p>Chart 6.8 Conversion cost</p>

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3.3) On time delivery

3.3.1) Service level - M&HCV

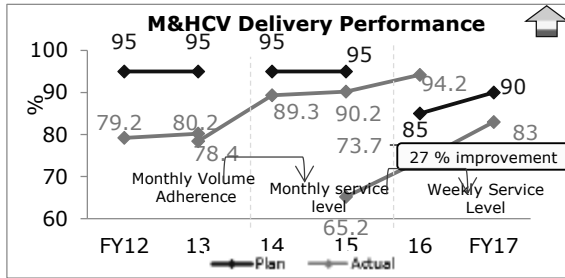


Chart 6.9 Service level (M&HCV)

3.3.2) Service level - LCV

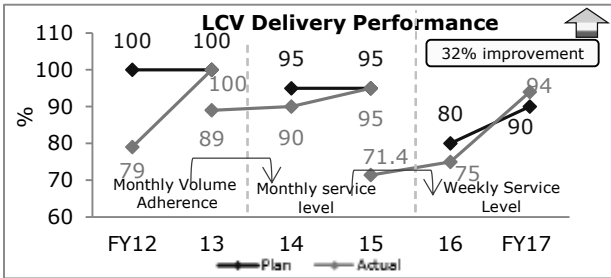


Chart 6.10 Service level (LCV)

3.4) Employee participation

3.4.1) Total Employee Involvement (TEI)

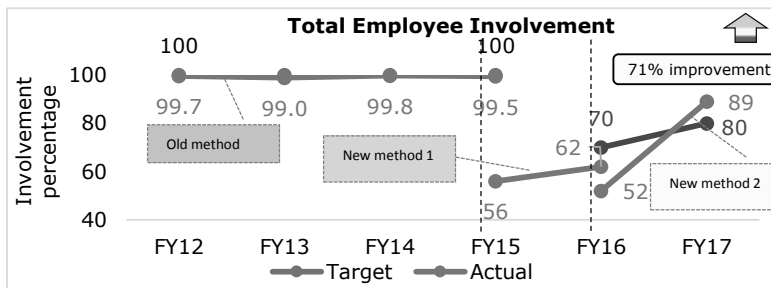


Chart 6.11 Total Employee Involvement

Criteria revised in FY15 & FY17
Scope expanded in FY17.

71% improvement from FY16 to FY17 (52% to 89%)

6.2 Intangible:

1. Improved motivational levels and participation exaggerated a 23 Years old plant to 1 Year young vibrant plant.
2. Have gained high level of confidence from the customers by improving the flexibility in delivery.
3. Openness to accept challenges by the plant buoyed confidence for further investments at ALH2 with the recent decision of running LCV business independent of Nissan.
4. Brand image improved in the Society due to the scale and level of CSR activities done in educating the underprivileged from remote areas for a brighter New-Gen.

Reference:

1) Overall Sales - ALH2

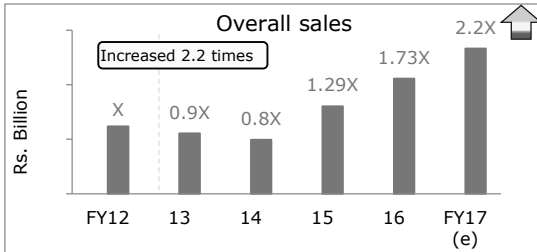


Chart 6.12 ALH2 sales

2) EBITDA - ALH2

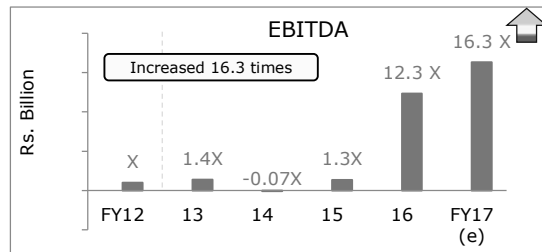


Chart 6.13 ALH2 EBITDA

6.3. Status of AL Vision

Global Ranking - Truck (M&HCV) - As of CY16 (Dec'2016)

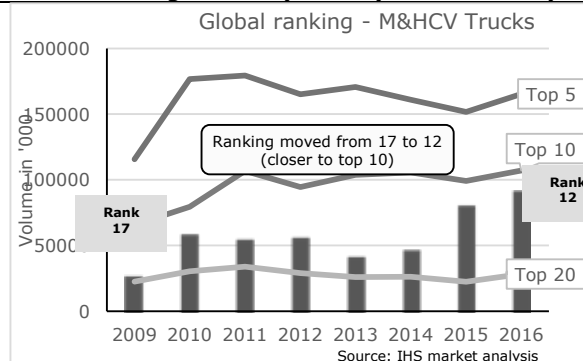


Chart 6.14 Global ranking M&HCV trucks

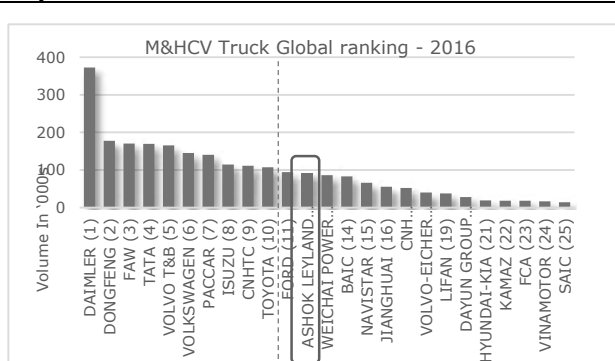


Chart 6.15 Global ranking of top 25 players

Inference: Volume gap reduced



7 Future plan:

Implementation of TQM gave ALH2, its right path towards its Vision. While implementing strategic objectives as per the timeline, ALH2 needed future plan which is well ahead of time and gives a clear edge compared to its competitors. This will give more benefits of business prosperity and reduce the effects of business cyclicality. Based on the learnings from TQM journey and remaining problems, future plan has been evolved to realize long term objectives.

7.1 Remaining problems:

To achieve the goals of the ALH2 vision, the following problems and gaps have been identified.

- Improving the Service level for bulk and smaller batches
- Improve Fit & Finish to international level (AVES & ALVES)
- Improve manufacturing reliability continuously (3 MIS)
- Raise operator and managerial ability levels much higher
- Raise ability to make much greater volume with minimal investment
- Drastically improve straight pass in Chassis assembly
- Digitalize manufacturing work
- Anticipated increase in conversion cost to be contained considering the investment in process and technology

7.2 Plan to realize Vision and Business Objectives

Table 7.1 : ALH2 Future Plan

Key Word	Objective	Plan (FY18 ~ FY20)
Flexibility	Capacity to deliver small batches (n)	<ul style="list-style-type: none"> • Enhance model mix flexibility between lines to 73% • Next phase of transformational initiatives to reduce delivery lead time
Wide Product Range	Capability to produce new models	<ul style="list-style-type: none"> • Develop capability for Modular Business Programs (MBP) in M&HCV • Productionization of Wave 1 and Wave 2 new LCV program • Increasing the speciality vehicles range • Leverage process technology for new model readiness
	Early stabilization of new models	<ul style="list-style-type: none"> • Refinement in process technology for early stabilization of new models
Operational Excellence	Competitive Quality levels	<ul style="list-style-type: none"> • Improve Fit & Finish of M&HCV vehicles to the global budget truck benchmark
	Cost competitiveness	<ul style="list-style-type: none"> • Continuous focus on Muda elimination and essential cost reduction through IT enabled Cost Management Initiative (CMI) • Leverage technology for norms upgradation • Focus of cost planning
	On time delivery	<ul style="list-style-type: none"> • Change scope from weekly service level to daily service level • "Make to Stock" (MTS) to "Make to Order" (MTO)
	Employee participation	<ul style="list-style-type: none"> • Expand the scope to all category of employees including temporary manpower • Expand Job ability development program for temporary work men

7.3 Future Plans for further strengthening TQM

ALH2 seeks to sustain the TQM journey in the future through:

- 1) Enhance the rigor of KAIZEN among all categories of Employee
- 2) Strengthening Annual Planning Process
- 3) Leveraging IT
- 4) Benchmarking
- 5) TQM in AL's plants and Key suppliers
- 6) Spread TQM