Pareto Analysis of World-class Quality (WCQ) Level in an Automobile Manufacturing Plant

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Abstract

World-class Quality (WCQ) is an art to lead a way of life with positive attitude and a philosophy. Attainment of WCQ demands continuous efforts for delivering products and services that are free from defects and can cause enthusiasm for the customer. Adoption of modern lean thinking towards quality excellence at all levels lead to the concept of WCQ. The laxity in process which is legitimized and is virtually rampant everywhere should not be prejudiced, instead must be heeded to by incorporating Quality Values into daily practise of Short Lead time and Built-in Quality ultimately to achieve WCQ. In this study, the quality practices in Tata Marcopolo Motors Limited (TMML), Dharwad, India, has been analyzed by examining the core requirements and the actually possessed qualities towards assessment of its WCQ level. Established techniques of analysis such as the X-bar, P-Chart, Pareto Tool and Sandler's A-Test have been used. Control charts prove that changes in Simple Process Flow, Temporary Material Storage and Supply Chain Management (SCM) is requisite but Sandler's A-Test approves that the variables of Principles of Short Lead Time is not distant from achieving the Level 2 of World Class Quality. The Pareto Tool affirms that major non-conformance variable is Operation Control Verification among the principles of Built-In-Quality. Chi-Square analyzes that the probability of achieving is the Level 2 of World Class Quality is more than 50 per cent which is hypothetically true.

Keywords: *Pareto Tool, Performance, Supply Chain Management (SCM), World-class Quality (WCQ).*

Introduction

Quality is required for following purposes:

1. Becoming potentate in this competitive market.
2. Satisfying the increasing customer expectations.
3. Sustaining market leadership for longer period.
4. Attaining business excellence by thriving for quality practise daily.

Fifty of the world's most admired companies were listed by Fortune 2010 along with some explanations as to how they made it to the list. The top-10 in the list are: Amazon, Apple, Berkshire Hathway, Coca-Cola, Johnson and Johnson, Goldman Sachs, Google, Procter and Gamble, Toyota Motors and Wal-Mart. Effectively, those companies from diverse industry sectors often exemplify the performance standards and become the benchmarks for others to follow to seek customer enthusiasm. Everyone needs to get customer enthusiasm because it assures that performance excellence is attractive means to earn customer's loyalty. As it is customer-oriented organization one needs to produce attractive attributes with high quality products at competitive cost (Berman, 2014; Greenberg, 2015).

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Figure 1: World-class Quality (WCQ)



Table 1: WCQ Goals and Principles

GOALS	PRINCIPLES
Safety (Safe Work)	Standardization
People (Organizational Development)	People Involvement
Quality (Attractive Product)	Built -In –Quality
Delivery (Uptime/Volume)	Short Lead Time
Cost (Good Value)	Continuous Improvement for Competitive pricing

technologies and driving the culture among the different stakeholders to address the complex challenges which include expanding networks for Global Customer's preferences which indulges the need for Short and Effective Lead Time Cycles embedded with continuous improvement, visibility and the reliability of the value chain.

For this purpose, the approach should get rid of too rigidity, bureaucratic, variations, non-productive activities, hierarchic etc. to escalate to the level of a World-class Quality (WCQ) brand. The swivel mechanism for short lead time and Built-in Quality (BIQ) of WCQ has to be texturized (see Figure 1 and Tables 1 and 2) (Cliff Notes, n.d.; Insresearch.com, n.d.).

Background of the Company under Study

Tata Motors Limited is among the largest private corporations in India and is a leader in the field of automotive vehicle manufacturing in terms of assets and revenues. It has a Joint Venture (JV) with Marcopolo S. A., a Brazil-based leading company that has entered the Indian market. Marcopolo S. A. is an automobile company founded in 1949 in the city of Caxias do Sul, manufacturing a whole range of coaches with manufacturing facilities in Argentina, Colombia, Mexico and Portugal in addition to Brazil and a technology transfer arrangement with China. Marcopolo manufactures microbuses, inter-city buses and touring coaches, and produces more than half of the bus bodies in the country and exports its products to over 60 countries.

Table 2: Principles of WCQ at Levels 1 and 2

WORLD CLASS QUALITY								
			Level 1			Level 2		
Sr	Principles (5)	Name	Absolutes	Core Requirements	Actions	Absolutes	Core Requirements	Actions
1	People Involvement	PI	8	40	219	8	4	30
2	Standardization	STD	4	31	109	4	4	28
3	Built In Quality	BIQ	5	41	153	5	14	76
4	Short Lead Time	SLT	9	125	156	9	2	11
5	Continuous Improvement	CI	7	58	129	7	4	24
	Total		33	295	766	33	28	169
WCQ Migration Strategy Level 1 acheivement criteria				Minimum 85 % Core Requirements are Green & No Red				

Rob Harrison demands the Best-fit Quality Management organization structure to foster a quality focused culture where the prime challenge is positioning the entire spectrum by proactively harmonize the processes by embracing appropriate

Tata Motors Limited in India is one of the largest private sector company and one of the leading business groups of companies where automotive vehicle manufacturing company too is leading in India in terms of revenues and assets. Tata Marcopolo

Motors Ltd. (TMML) is a JV between Tata Motors (which holds 51%) and Marcopolo S. A. (which holds 49%) to manufacture full-bodied buses and coaches, including varieties of 16-54 seater buses. The joint venture will also explore emerging opportunities in Bus Rapid Transit System (BRTS).

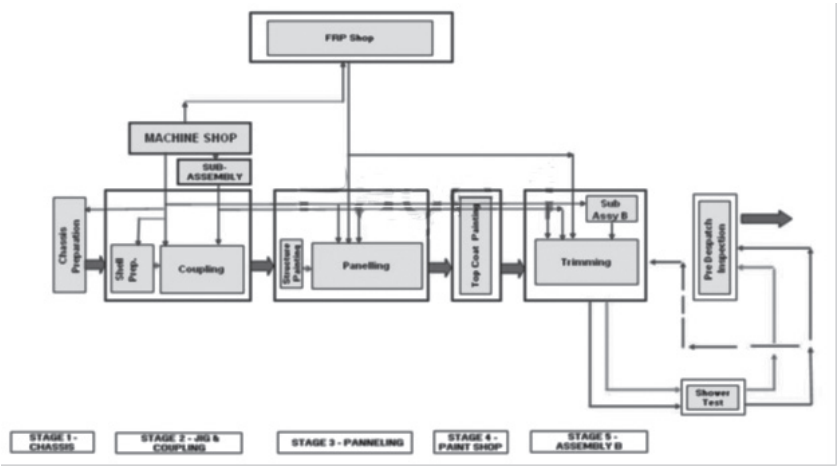
First manufacturing operation of TMML was set up in Lucknow in October 2007 and the second unit in Dharwad in May 2008 in Belur industrial area. The production tentatively started from May 2008 onwards with the investment of 450 Crores. This plant produce fully built buses on chassis. The plant assembles buses for domestic as well as foreign markets as per the specification of customers. At present the major customers of bus manufacturing unit are K.S.R.T.C, Bangalore, Delhi transport, Orissa state transport etc. Buses are also exported to Australia, Europe, South Africa, and Morocco.

The company TMML was manufacturing only Commercial Bus like school bus, passenger bus with different model with a capacity of 16-57 seaters with varied price till 2014. The company is set to manufacture luxurious buses to use for commercial purpose (passenger bus only) with semi-sleeper & sleeper bus with a/c & non a/c types with range of price, named star bus G2, starbus G7 luxury bus and articulated bus (road train). In Next 5 years the Production will be raised from 100 to 120 Buses per day by following Six-Sigma Process to reduce the Defects & Rejections and also increase the Company profit & sales. This Year the company is set to implement updated technologies in each and every field in the organization to reduce the mistakes and drive the company to make growth, to smoothen the each and every work.

Bus Manufacturing Process Flow

The First Stage consists of chassis, followed by coupling, paneling, paint shop and finally the assembly section. The flow of materials starts from the chassis stage and ends in the trimming stage where sub-assembly exists only for coupling and trimming sections. After assembling is over, the bus has go through shower test and finally from pre-dispatch inspection. Short lead from chassis preparation till the stage of assembly needs to inculcate the matrix of Six-Sigma with Total Quality Management (TQM) and Total Productive Maintenance for adherence of World-Class Quality.

Figure 2: Bus Manufacturing Process Flow at TMML Dharwad



Short Lead Time

Tata Marcopolo which started operations in 2008 is in the business of body building for more than seven years and has achieved great heights in its business. However, till date Tata Marcopolo has been operating on "PROJECT BASIS and the focus is on the complete operations on day-to-day basis. To achieve this objective of the company the people in the organization should learn to plan relevantly and know what part one needs to contribute.

Movement of materials or products of the right quantity with the right equipment to the right location at the right time, using the shortest route at the lowest cost for both the customer and the supplier is defined as short lead time. There is a desired reduction in time from the time anorderisplaced by a final customer and the delivery of the product to the customer's destination and receipt of payment. The core objective for the same involves managing flow of Inventory for compiling

the Pull System and Kanban system, Implementation of Strategy of Kaizen for improving material storage and Total Quality Management to control the handling of inventory of materials in the right way at all the time for efficiency and quick execution to reduce the non-value added activity as it too incurs cost, for continuous flow of productivity to hail customer loyalty. Customers usually can wait for few days only but if frequency of delay to deliver increases, customer changes mind to switch to the other product when the switching cost of substitute is competitive enough (see Figure 2).

In a nutshell Short Lead Time strategies are:

1. First In First Out (FIFO)
2. Pull System
3. Simple Flow
4. Lean Materials Management
5. Kaizen with Total Quality Management
6. Total Productive Maintenance
7. Six Sigma
8. 5 S namely SEIRI (Organization), SEITON (Neatness), SEISO (Cleaning), SEIKETSU (Standardization) and SHITSUKE (Discipline) need to be inculcated during process.

Absolutes of Principles of Short Lead Time as per WCQ Guidelines

There are nine absolutes for which core requirement actions are performed:

1) Simple Process Flow

A process incorporates a mechanism of 5's namely Sort, Set in Order, Shine, Standardize, and Sustain for constant drive to attain a simple sequential process flow of material sketched out to be easily visible for Continuous improvement process and Effective Lean Management, Prevention costs of spoilage, spillages, omission etc. of crucial parts, and study of ergonomics in action for empty containers and inventories too for optimizing cost.

2) Small Lot Packaging

Determining, assigning or designing the appropriate standard quantity and flexible load configuration Containers (e.g. container/ trollies) for carrying more parts per load and Standard containers of various types and sizes for multiple delivery in least time per shift is requisite. Design accurate and user-friendly packaging and labeling for proper alignment of inventory for occupying less space and less time in material handling. Precautionary packing to be provided by supplier, wherever possible brought parts in sets, kitting or sequencing system. Audit system to monitor with cautions against any possible violations.

3) Fixed period ordering system and Level vehicle order schedule

Order scheduling process meets the customers demand by incorporating Material Requirement Planning (MRP) for accurate scheduling and Economic Quantity Cost (EQC) as per the Supplier wise and Part wise schedule quantity as per Share of Business (SOB) criteria limits which allows pre-determined, fixed period for ordering of Parts, to eliminate the wastes of overproduction, over-processing, inventory, and waiting while managing the flow of material through the pipeline. Kanban system and Just-In-Time (JIT) is crucial to avoid unnecessary cost of carrying and Management system for documentation of obsolete parts for tracking and monitoring the shipment failures to tailor off the stoppage of production.

4) Controlled External Transportation

Established pipeline for logistics with established controls that are managed by a lead logistics provider to provide a minimal freight handling and Just-in-Time (JIT) delivery for less movement within limited space. 5 Rs, namely, Refuse, Reduce, Reuse, Recycle, Recover etc., aids in accurate planning.

5) Scheduled Shipping / Receiving

Receiving and shipping dock activities support reduction of overall lead time to level and standardize shipping/receiving activities and resource requirements as per customer's conformance. Leveling of deliveries to minimize Congestion for Efficiency Improvement, Safety Improvements, and facilitate Continuous Improvement & Cost Savings.

6) Temporary Material Storage

A single point of database, Plan For Every Part (PFEP), organized with wide varieties of classification which can be assessed by different users where Parts is approved by the Quality Department along with primary and secondary storage areas with well-defined norms. Safety (safe stacking heights) and inventory control (min/max, overflow) are ensured on the shop floor for managing exceptions (min and max violations, out of stock conditions, overflow, etc.).

7) Internal Pull Delivery

Replenishment system is timely, in the right quantity and to the right location free of damage and in the best possible type of presentation to team members trained in the Pull system. PERT analysis is used to reduce Redo activity and CPT analysis is used to minimize the in-process bottlenecks, repetitions, replications, etc. during production to eliminate the discrepancies.

8) Level Vehicle Order Schedule

Level Vehicle Order Schedule is important because it is base for calculation of material requirement (Direct and Indirect), engine requirement, manpower requirement, and logistic arrangement for MASOP operations as per sub-assembly requirements.

9) Supply Chain Management

An open line of communication between plant and supplier base, would promote timely feedback visibility that allows effective problem solving and continuous improvement system. Responsible persons and timing are defined for each Plan For Every Part (PFEP) element to ensure compliances. Elements include line side presentation, part packaging, internal delivery, storage, transportation method, receiving, logistics and sourcing etc. System of measuring key performance criteria (e.g. on-time delivery, cost reduction, cube utilization etc.) and monitoring all suppliers delivery performance is vital. Training and awareness to new and poor performing suppliers is vital.

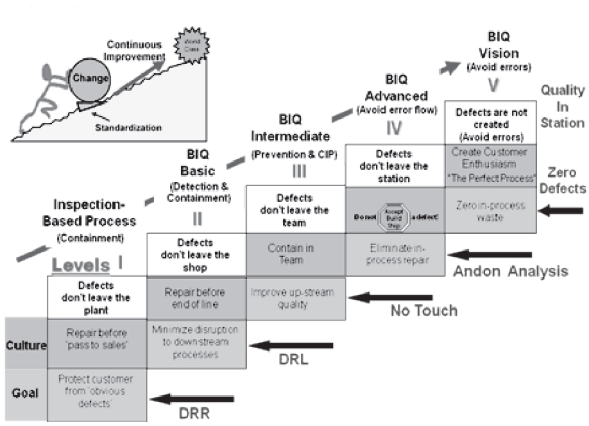
Literature Review

Built-in Quality (BIQ) as per World-class Quality (WCQ)

There are 5 levels in the World-class Quality (WCQ) and currently Tata Marcopolo is still working for Level 1. Tata Motors is working for Level 3, and Toyota had already reached Level 3. None of any company in the business sector had reached 5th level of WCQ in India (see Figure 3).

1. This is the method by which quality is built into the manufacturing process itself with the intension of not building or accepting the defects during the process.
2. Defects are prevented to provide defect-free product to the customers.
3. Counter-measurements by implementing the improvement in Quality Indicators to prevent the reoccurrences.
4. Minimal Process Variations through robust control with improved communication

Figure 3: Levels of BIQ as per WCQ



throughout till the supply chain.

Absolutes of Principles of BIQ

1. Product Quality Standard
2. Manufacturing Process Validation
3. In-process Control and Verification
4. Quality Feedback /Feed forward
5. Quality Management System

1) Product Quality Standards

Appraisal cost like inputs of engineering requirements, design requirements, process requirements etc. and outputs should be in standard format of user-friendly and any changes should be developed to be maintained in QMS for customers enthusiasm.

2) Manufacturing Process Validation

Prevention-focused process, i. e. the manufacturing process to exceed the customer's expectations by application of error proofing after product is evaluated starting with design reviews and also during pre-production builds. Risk analysis (e.g. PFMEA) during operations and its planning indulges standardized work development and develops problem solving during process control are validated for pruning of defectives in the system.

3) In-Process Control & Verification

Building standardized work for containment of abnormalities likely to emerge within the system and prevention system to control process variations for cyclic and non-cyclic jobs are supported through a TPM plan. QCOS system for close monitoring of List of equipment, parameters effecting quality, process capability and key process equipment control for its conformity towards quality. Error proofing system

like Poka-Yoke, Andon, FPS system and Systematic problem solving – for Effective Quality checks and its implementation should not be heuristic but escalate the production of zero-defects.

4) Quality Feedback/Feed Forward

The standardized communication and pathway endeavors the conformance between customers and suppliers through standardized communication pathways to ensure that quality product reaches to those who need it.

5) Quality System/Control Management

Quality standards and its practices like Just-in-Time (JIT), Just-in-Sequence, procedures, and organizational structure to manage the quality system define and regulate the intended operations of the quality activities. Following are the actions recommended as per WCQ:

Strategic Quality plan – WCQ roadmap, 5 principles, 54 QP's, 33 absolutes, 295 core requirements, 750+ action points integration of WCQ requirements with current system & practices.

Dr. Dawei Lu specifies that Quality Management System (QMS) should be effective and continuous improvement process which compromises of building internal system and external system to meet the quality standards. Simple process should be standardized to neutralize the chances of defect. The Managing Director of MC Fire Protection, Mike Chilman, explains that compliance with ISO 9001 brings in professionalism intrinsically and extrinsically to maintain the elite standards. Ron Branning focused on resolution of significant quality issues that are to be controlled through a robust quality risk program which serve as a proactive method for managing risk throughout the product lifecycle. A properly designed and executed quality system would boast to commercialization of product more quickly. This means rigid processing system at zero defect would reduce the work during inspection or trial run tests. Richard J. Schonberger follow-up the nine Japanese techniques for trade-offs of four competitive priorities namely: cost, quality, service and transparency (Sokovic et al., 2006). His emphasis on World-class Manufacturing (WCM) may be chronicled as the third major event that follows standards methods and time espoused by Guru of Scientific Management and Modern theory of Management. Peter Stonebreaker and Keong Leong presented a hierarchy of 5-levels that initiated from visionary Business and Operations strategy and later structure the organization Design/Human resources, Technology & Performance. For this, we need orientation of information system, effective operational management towards the quality to be prospected towards the customers delight for achieving the World-Class Quality. R.Anthony Inman stressed that the focus is on implying the transformational leadership strategy to work beyond the conventional methodology to broom into World Class Quality which is the committed action plan from the Top executives. The Siemens policy for World Class Quality is "Implementations of the mandatory elements of Quality Management and continuous improvement through integrated components of Business Process. Elevating Strategic relevance Charles McKinney informs to implementation of Matured Process Excellence Organizations enjoy or achieve credibility and success by executing a flexible performance improvement methodology for executing top priorities which are proactive, employing the best tools, selecting the best projects and leveraging organizational momentum above critical factors for success (Midor, 2012). Ultimately leverage in proactiveness with zero defect is vital.

Objectives of the Study

1. To identify the variables hampering the efficiency of Short Lead Time.
2. To identify the causes for non-conformance of performance of Short Lead Time.
3. To recommend the strategy for Built-In-Quality on the basis of analysis of control chart.

Research Methodology

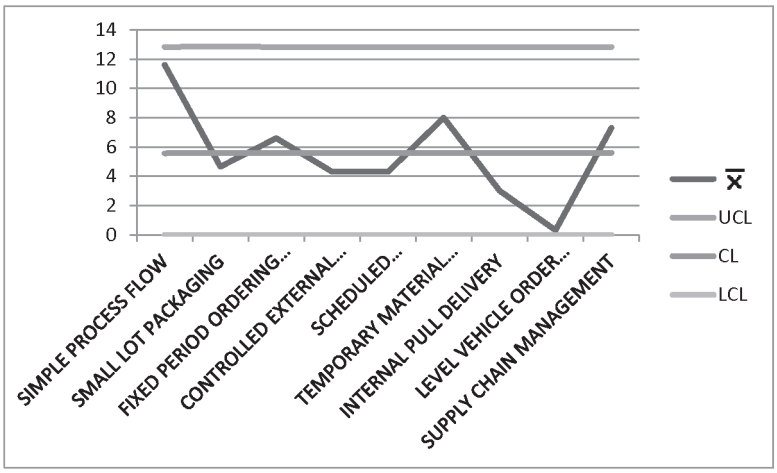
Benchmarking exercise has been used between these 5 principles of World-class Quality (WCQ) and actual preached in organization. The absolute core requirements are the well-defined variables under each principle of Short Lead Time and Built-In-Quality and these core requirements are the standards with rules and guidelines of actions which are recorded and compared with the benchmark. These core requirements are practised than counted as actual action performed. This study involves the analysis of two principles of World Class Quality namely Short Lead Time and Built-In-Quality. The study is about analysis of impact of variables of Short Lead Time by using X-control Chart and P-Value to attain World Class Quality and also analysis of causes of Non-Conformance for Built-In-Quality by using Pareto tool. The objective of research has been hypothetically tested by using Sandler's A-Test method where Upper Central Line is considered as central line. Similarly Chi-Square test is between the UCL value and deviation from Mean value of X is treated as Expected and Observed values respectively (see Table 3).

Table 3: Analysis of Variables of Short Lead Time by using Control Charts

VARIABLES	$\bar{x}$	UCL	CL	LCL	$\bar{R}$	PUCL	PCL	PLCL
SIMPLE PROCESS FLOW	35	42.34	16.8	0	10	37.04	0.168	0
SMALL LOT PACKAGING	14	42.34	16.8	0	9	37.04	0.168	0
FIXED PERIOD ORDERING SYSTEM	20	42.34	16.8	0	9	37.04	0.168	0
CONTROLLED EXTERNAL TRANSPORTATION	13	42.34	16.8	0	6	37.04	0.168	0
SCHEDULED SHIPPING/RECEIVING	13	42.34	16.8	0	7	37.04	0.168	0
TEMPORARY MATERIAL STORAGE	24	42.34	16.8	0	11	37.04	0.168	0
INTERNAL PULL DELIVERY	9	42.34	16.8	0	2	37.04	0.168	0
LEVEL VEHICLE ORDER SCHEDULING	1	42.34	16.8	0	1	37.04	0.168	0
SUPPLY CHAIN MANAGEMENT	22	42.34	16.8	0	10	37.04	0.168	0
TOTAL	151							
	16.78				7.2			
P-BAR	0.168							
Q-BAR	0.832	A	1.02					
PQ/n	12.29	R	7.2					

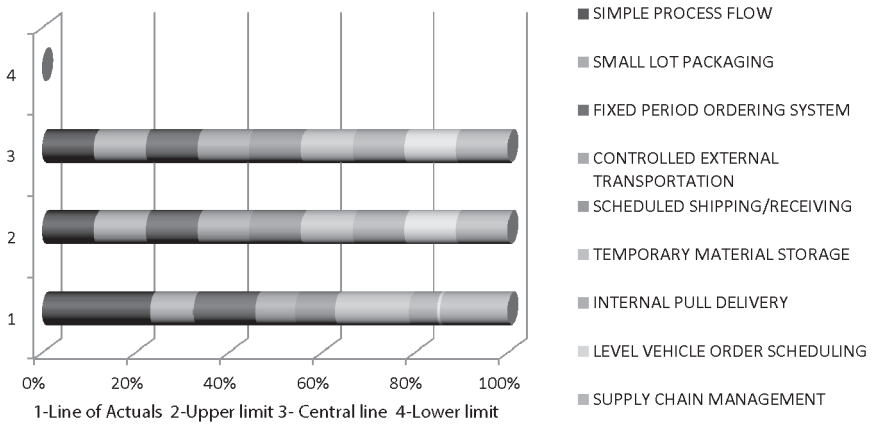
Source: Author's Analysis

Figure 4: Illustration of Variables of Short Lead Time by using the X-bar Control Chart



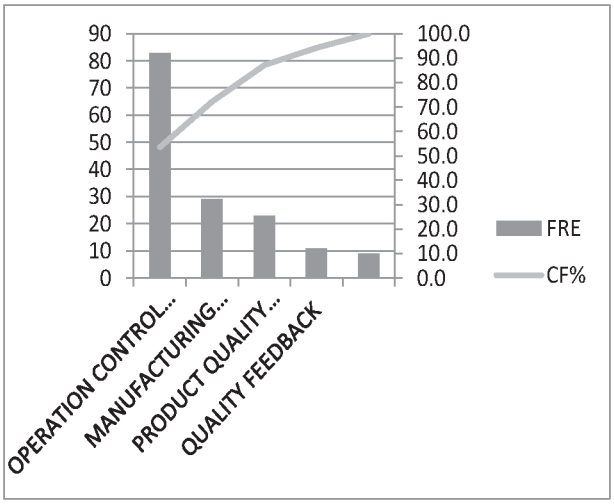
Source: Author's Analysis

Figure 5: Illustration of Variables of Short Lead Time by using P-Value



Source: Author's Analysis

Table 4: Analysis of Variables of Causes of Non-conformance of WCQ



Source: Author's Analysis

Figure 6: Pareto Tool Analysis of Causes of Non-conformance of WCQ

Quality procedures–CAUSES	FRE	CF%
OPERATION CONTROL VERIFICATIONt	83	53.5
MANUFACTURING RELATED VALIDATION	29	72.3
PRODUCT QUALITY STANDARDS	23	87.1
QUALITY FEEDBACK	11	94.2
QUALITY CONTROL SYSTEM	9	100.0

Source: Author's Analysis

Table 5: Calculation of Student's T Distribution as per X-Control Chart

VARIABLES	$\bar{X}$	$R = \bar{X} - X$	R^2	Central Line
SIMPLE PROCESS FLOW	35	18.2	332	16.8
SMALL LOT PACKAGING	14	-2.8	7.72	16.8
FIXED PERIOD ORDERING SYSTEM	20	1.2	1.42	16.8
CONTROLLED EXTERNAL TRANSPORTATION	13	-3.8	14.3	16.8
SCHEDULED SHIPPING/RECEIVING	13	13.0	169	16.8
TEMPORARY MATERIAL STORAGE	24	-7.8	60.5	16.8
INTERNAL PULL DELIVERY	9	-7.8	60.5	16.8
LEVEL VEHICLE ORDER SCHEDULING	1	-15.8	249	16.8
SUPPLY CHAIN MANAGEMENT	22	22.0	484	16.8
Total	151			
X	16.78			
TTEST	0.5			

Source: Author's Analysis

Analysis and Interpretation

From the above Figures 4 and 5, one can analyze that Simple Process Flow, Fixed-period Ordering Flow, Temporary Material storage and Supply Chain Management activities are hyper-active than practically required. This is impacting on the other activities namely Level Vehicle order Scheduling to greater extent, and even on Scheduled Shipping, Small Lot Packaging. Pareto Tool gives us the clear picture that Quality Control System is effective rather than the Operation system which indulges the Scheduling, Layout, Standards and its Validations. The causes according to the Pareto Tool as per Table 4 and Figure 6, indicates the maximum fault in the Operation Control verification and In-Process manufacturing related validation. The defectiveness in the system has to be chalked out for improving the efficiency by utilizing the Appraisal and Prevention Systems at the Setup time itself rather controlling at the end point of manufacturing in the form of inspections, obligation of quality standards, acting as per feedback etc.

Hypothesis Testing

H_o: *There is no much gap/deficit between the built-in quality and world-class quality if authentically managed.*

H_a: *There is much gap/deficit between the built-in quality and world-class quality if authentically managed.*

T-Test value = 0.5

Critical value at 5% and degree of freedom of 8 =1.860.

Hence we accept the Null Hypothesis clarifying that if they work on operations and its scheduling for enhancing efficiency would definitely create wonders (see Table 5).

H_o: *There is not much difficulty in achieving the Level 2 of Built-in Quality of World-class Quality if authentically managed.*

H_a: *There is much difficulty in achieving the Level 2 of Built-in Quality of World-class Quality if authentically managed.*

Table 6: Sandler's A-Test Results

VARIABLES	$\bar{x}$	UCL	F= X-UCL	F^2
SIMPLE PROCESS FLOW	35	42.34	-7.34	53.93
SMALL LOT PACKAGING	14	42.34	-28.34	803.4
FIXED PERIOD ORDERING SYSTEM	20	42.34	-22.34	499.3
CONTROLLED EXTERNAL TRANSPORTATION	13	42.34	-29.34	861.1
SCHEDULED SHIPPING/RECEIVING	13	42.34	-29.34	861.1
TEMPORARY MATERIAL STORAGE	24	42.34	-18.34	336.5
INTERNAL PULL DELIVERY	9	42.34	-33.34	1112
LEVEL VEHICLE ORDER SCHEDULING	1	42.34	-41.34	1709
SUPPLY CHAIN MANAGEMENT	22	42.34	-20.34	413.9
TOTAL	151		-230.10	6650

Source: Author's Analysis

A-Test value = 0.125609

Critical value @5% and degree of freedom of 8 = 0.278

Hence we accept the Null Hypothesis clarifying that if they work on Total Quality Management, Kanban, Just-In-Time, Operations Control System etc. would definitely aid to improve to promote to Level 2 of World-class Quality (see Table 6).

H_o: *They do not have to concentrate more than 50% for variables of Short Lead Time to achieve the Built-in Quality for World-class Quality.*

H_a: *They have to concentrate more than 50% for variables of Short Lead Time to achieve the Built-in Quality for World-class Quality.*

Table 7: Chi-square (X^2)Test Results

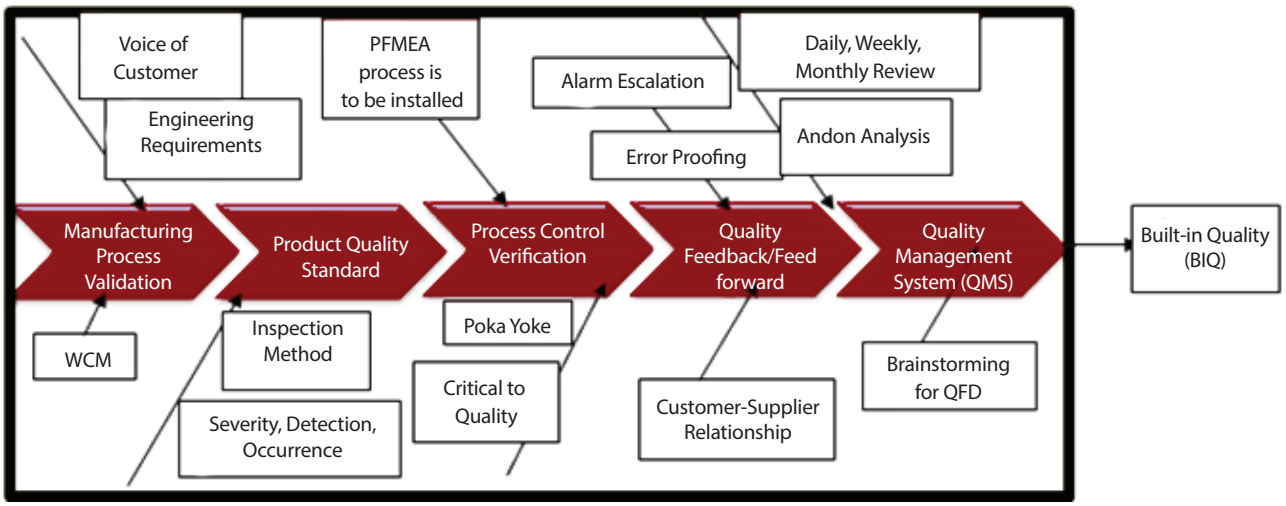
VARIABLES	$\bar{x}$ -x	UCL
SIMPLE PROCESS FLOW	35	42.34
SMALL LOT PACKAGING	14	42.34
FIXED PERIOD ORDERING SYSTEM	20	42.34
CONTROLLED EXTERNAL TRANSPORTATION	13	42.34
SCHEDULED SHIPPING/RECEIVING	13	42.34
TEMPORARY MATERIAL STORAGE	24	42.34
INTERNAL PULL DELIVERY	9	42.34
LEVEL VEHICLE ORDER SCHEDULING	1	42.34
SUPPLY CHAIN MANAGEMENT	22	42.34
Chi-square value	6.60726	

Source: Author's Analysis

Chi-square (X^2)Test value = 6.60726 at degrees of freedom (df) of 8.

As per the table Critical Value of Chi-square, the probability under H_o at dof of 8, the calculated value is greater than 50% of critical value of 7.344. Hence we accept the Null Hypothesis indicating that achievement is more than half-way and they have to target the next half by using relevant and reliable strategies as mentioned in the suggestions (see Table 7).

Figure 7: Fishbone Diagram inculcating Short Lead Time for BIQ for acquiring WCQ



Source: Author's Analysis

Conclusion

The company has to follow all the nine absolutes, principles along with its sub-requirements of packaging standards, internal delivery of materials, storage, logistics, transportation methods etc., so that they can conform towards the quality of the product which should be delivered to the customer with zero defects. For the same cause Inventory levels to be defined part-wise in each shop and to be displayed at each locations and these levels need to be monitored periodically for smooth and efficient handling of inventory and its delivery in time. Optimum storage location to enhance the lead time while performing and Material Requirements Planning (MRP) for accurate scheduling, documenting inventories, scrap disposal process needs accountability and rigidity its management to meet the objective. Responsible persons and timing are to be defined for each Plan for Every Part (PFEP) element is crucial. In a nutshell, there are barriers in implementation of WCQ practices which are inhibited like poor planning, no proper accountability, ledearship, poor utilization of resources etc., need to be tackled. The implementation of WCQ practices in an organization leads to better competitive advantage as it basically includes various tool. Techniques and methodologies such as TQM, total productive maintenance, JIT, supply chain management and six sigma along with the 5 main principles of WCQ (see Figure 7).

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