Manpower Optimization using Time Study Analysis

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ABSTRACT

Time studies seek to determine how much time it takes a qualified worker to complete an individual task at a predefined performance level. A time study, when done correctly, can help managers and business owners see how efficiently and effectively work is done on a production floor. The goal of a time study is to determine the average time it takes a worker with reasonable skill and ability to complete a specific task, estimate labor costs, and instill time management in employees. This paper discusses a method for analyzing idle time in various jobs by implementing kaizens on the shop floor and incorporating parameters such as working hours per shift and inspection lists to calculate the efficiency of people working in various departments in the industry.

Keywords: - *Time Study, Kaizens, Quality Assurance, Idle time, Assembly Line, Manpower Requirement*

Introduction

Quality assurance (**QA**) is a way of preventing mistakes and defects in manufactured products and avoiding problems when delivering products or services to customers; which ISO 9000 defines as "part of quality management focused on providing confidence that quality requirements will be fulfilled". This defect prevention in quality assurance differs subtly from defect detection and rejection in quality control and has been referred to as a *shift left* since it focuses on quality earlier in the process (i.e., to the left of a linear process diagram reading left to right).

The terms "quality assurance" and "quality control" are often used interchangeably to refer to ways of ensuring the quality of a service or product. For instance, the term "assurance" is often used as follows: *Implementation of inspection and structured testing as a measure of quality assurance in a television set software project at Philips Semiconductors is described.* The term "control", however, is used to describe the fifth phase of the Define, Measure, Analyse, Improve, Control (DMAIC) model. DMAIC is a data-driven quality strategy used to *improve* processes.

Quality assurance comprises administrative and procedural activities implemented in a quality system so that requirements and goals for a product, service, or activity will be fulfilled. It is the systematic measurement, comparison with a standard, monitoring of processes, and an associated feedback loop that confers error prevention. This can be contrasted with quality control, which is focused on process output.

Quality assurance includes two principles: "Fit for purpose" (the product should be suitable for the intended purpose); and "right first time" (mistakes should be eliminated). QA includes management of the quality of raw materials, assemblies, products and components, services related to production, and management, production, and inspection processes. The two principles also manifest before the background of developing (engineering) a novel technical product: The task of engineering is to make it work once, while the task of quality assurance is to make it work all the time.

Historically, defining what suitable product or service quality means has been a more difficult process, determined in many ways, from the subjective user-based approach that contains "the different weights that individuals normally

attach to quality characteristics," to the value-based approach which finds consumers linking quality to price and making overall conclusions of quality based on such a relationship.

Literature Review

1. World-Class Quality

"Achieving & excelling the world's benchmark levels to manufacture and deliver the best quality products to all the Customers."

Objectives of WCQ:

- To meet Customer Satisfaction and Delight.
- To achieve Market Leadership.
- To make the products Durable & long-lasting.
- To make the products valuable for money spent.
- To manufacture the products as per drawing, specifications & standards.
- To emphasize on attractive colors, shapes, aesthetics, packing, etc.
- To ensure the product is completely free from defects.
- To ensure that the product requires minimum repair and less maintenance.
- To provide innovative & easy to use solutions.

WCQ Culture:

- Quality to be built into the process
- Built In Quality to be made DNA of the Organization
- Involve all People to strive for Quality Excellence
- Prompt Actions for all abnormalities
- Quality Culture building training for all the employees & Suppliers.

Q-CULTURE

Q-uality Services
C-ustomer focus
U-sing feedback
L-inking partners
T-eamworking
U-biquitous Technology
R-esource optimization
E-nvironment-friendly practices

LEVELS OF WCQ:

World Class Quality is achieved by the step-wise implementation of 5 levels.

The objectives of the 5 levels are respectively:

- *Defects do not leave the plant.*
- *Defects do not leave the shop*
- *Defects do not leave the team.*
- *Defects do not leave the station.*
- *Defects are not created.*

The fifth level is obviously an ideal situation towards which every company must strive

Methodology

TIME STUDY:

Time study is a direct and continuous observation of a task, using a timekeeping device (e.g., decimal minute stopwatch, computer-assisted electronic stopwatch, and videotape camera) to record the time taken to accomplish a task and it is often used when:

- there are repetitive work cycles of short to long duration,
- wide variety of dissimilar work is performed, or
- process control elements constitute a part of the cycle.

The Industrial Engineering Terminology Standard defines time to study as "a work measurement technique consisting of careful time measurement of the task with a time measuring instrument, adjusted for any observed variance from normal effort or pace and to allow adequate time for such items as foreign elements, unavoidable or machine delays, rest to overcome fatigue, and personal needs."

The systems of **time and motion studies** are frequently assumed to be interchangeable terms, descriptive of equivalent theories. However, the underlying principles and the rationale for the establishment of each respective method are dissimilar, despite originating within the same school of thought.

The application of science to business problems, and the use of **time-study methods** in standard setting and the planning of work, was pioneered by Frederick Winslow Taylor. Taylor liaised with factory managers and from the success of these discussions wrote several papers proposing the use of wage-contingent performance standards based on scientific time study. At its most basic level time studies involved breaking down each job into component parts, timing each part, and rearranging the parts into the most efficient method of working. By counting and calculating, Taylor wanted to transform management, which was essentially an oral tradition, into a set of calculated and written techniques.

Description

*So, we followed the method of TIME STUDY and put together our observations to find out a comparative study between the existing manpower and the manpower required by the QUALITY ASSURANCE DEPARTMENT. This was done in the following steps***:**

Assessing the current workload and calculating the required headcount:

- Mapped work processes.
- Assessed work and time allocation.
- Arrived at the required headcount to handle current services.

Vehicle Assembly Line:

Area	Sub Area	Existing men per day	Shift	Current Production Level	Production Level	Men Proposed	Production Level	Men Proposed	Production Level
Veh Assy Line	Line-1	12	A+B		140	13	150	13	160
	Line-2	12	A+B		140	13	150	13	160
	Line-3	20	A+B	75+75	150	18	150	18	160
	Prima EOL	10	A+B	10+10	20	9			
Grand Total (Incl 12% abs.)		54				53		45	

The study was conducted for existing production levels and manpower was proposed for existing as well as other higher production levels.

Veh Assy Line 3

Area	Activity	Manpower A	Manpower B	Manpower C	OP1 min.	OP2 min.	Work content per veh in Minute	Production Level/ shift: 70 SMM	70 Req manpower		75 SMM	75 Req manpower		80 SMM	80 Req manpower	
Buy off gate	Mountings, Studs, Propellor Shaft, Front axles, Engine and Transmission Bolts, Exhaust brake, Lift axle fitment, Centre bearing mounting, Wheel Nut, Brake, Accelerator Horn (2 INSPE. veh per inspector)	2	2	0	5.8		6	408	1.0	1	438	1		467	1	
DRR-1/ Ok Sticker	First shot ok Data entry in SAP system after PDI GATE.	1	1	0			2	127	0.3	1		1			1	
EOL (End of Line)	NPI & Hold veh Inspection	2	2	0					2	2		2			2	
SAP Data Entry	Data Entry - (tyre nos., chesis no., battery type,tyre brand etc) (in office)	2	2	0			8	564	1.3	2		2			2	
GPS Activation	for Signa & Prima Models, Travel card bringing from EOL. (in Office)	1	1	0			2	145	0.3	1		1			1	
Torque Audit	Bearing Cap, Engine Top and Bottom, Central bearing cross Assembly, Propellor Shaft, Steering frame	2	2	0	3.3		3	228	0.5	1	244	1		260	1	
Total Net manpower per shift		10	10	0					8			7.6			7.7	
Manpower per shift (Roundup)									8			8			8	
A+B Shift Manpower (incl 12% abs)		20						18			18			18		

PRIMA EOL

Area	Activity	Manpower A	Manpower B	Manpower C	OP1 min.	OP2 min.	Work content per veh	Production Level/ shift: 10 SMM	10 Req manp		12 SMM	12 Req manpow		15 SMM	15 Req manpowe	
Buy off gate	PDI inspection, All travel card points checked, Vehicle ready to roll out	2	2	0	30	30	60	600	1.4	2	720	2		900	2	
FITMENT	Bumper Fender fitment, All Electricals Checking, Top line Inspection	2	2	0	20	20	40	400	1.0	1	480	1		600	1	
OK INSPECTION	OK STICKER, DEFECT FEEDING, ROLL OUT ENTRY	1	1	0	10		10	100	1	1	120	1		150	1	
Total Net manpower per shift		5	5	0					4			3.7			4.6	
Manpower per shift (Roundup)									4			4			5	
A+B Shift Manpower (incl 12% abs)		10						9			9			11		

This shows the deployment of manpower on different jobs and a correlation between the number of people that are present and that should be present.

FRAME LINE:

Area	Sub Area	Existing men per day	Shift	Current Production Level	Production Level	Men Proposed	Production Level	Men Proposed	Production Level	Men Proposed	Production Level	Men Proposed
Frame	Line-1 (Incl abs.)	15	A+B+C	70+70+0	140	12	140	12	160	12		
	Line-2 (Incl abs.)	15	A+B+C	60+60+60	180	12	210	12	240	12		
	Line-3 (Incl abs.)	14	A+B	75+75	150	11	140	11	160	11		
	5000T Press	6	A+B+C	30+30+30	90	6						
	NPI Frame Insp Clearance	2	A			2						
Grand Total (Incl 12% abs.)		52				44		36		35		0

Frame Line 3

Area	Activity	Manpower A	Manpower B	Manpower C	OP1 min.	OP2 min.	Work content per veh in Minute
Frame Line 3	**Bend check** (length of frame, bending of frame, putting stickers, Documentation etc.)	2	2		3.7		4
	Hole and bolt check Riveted bolt, tightening of nuts and bolt, diameter of the holes etc.	2	2		3.7		4
	Hold area Torque Check, frame width check,Frame width, Torque of spring bracket, Wheel Nut torque check	2	2		5		5
	Rectification clearance	1	1		5		5
Total Net manpower per shift		7	7				
Manpower per shift (Roundup)		7					
A+B Shift Manpower		14					

Production Level/ shift								
60			70			80		
SMM	Req manpower		SMM	Req manpower		SMM	Req manpower	
221	0.5	2	258	0.6	2	295	0.7	2
220	0.5	1	257	0.6	1	293	0.7	1
300	0.7	1	350	1	1	400	1	1
300	0.7	1	350	1	1	400	1	1
	5			5			5	
	5			5			5	
10			10			10		
11			11			11		

TRIM LINE OR FITMENT LINE:

Area	Sub Area	Existing men per day	Shift	Current Production Level	Production Level	Men Proposed	Production Level	Men Proposed	Production Level	Men Proposed	Production Level	Men Proposed
Trim	HCFL	12	A+B	60+60	120	7	140	9	160	9	180	12
	LP	6	A+B	80+0	80	3	60	2	70	3	80	3
	SFC & Tilt	13	A+B	45+5	50	13	60	13	70	18	80	18
	Prima	13	A+B	50	50	10	60	12	70	12	80	13
Grand Total (Incl 12% abs.)		44				33		36		42		46

SFC + Tilt :Trim Line

Area	Activity	Manpower A-Shift	Manpower B-Shift	OP1 min.	OP2 min.	Work content per veh	Production Level/ shift 50 SMM	50 Req manpower		60 SMM	60 Req manpower		70 SMM	70 Req manpower		80 SMM	80 Req manpower	
PDI Gate	TILT: door lock, Hydraulic pipe, Brake pedal, Driver seat, Seat belt, dashboard, Head lamp, Steering, Grab Handle, SFC: Master Cylinder sub Assy and fitment, Door Fitment, rear View Mirror, Air filter , Windscreen fitment	3	2	7.2	NA	7	359	0.9	1	431	1.0	1.0	503	1.2	2.0	575	1.4	2.0
Shower	Testing	1	1	5	NA	5	260	0.6	1	312	0.7	1.0	364	0.9	1.0	416	1.0	1.0
Stage Inspection		2	0	7	6	13	650	1.5	2	780	1.9	2	910	2.2	3	1040	2.5	3
FAT Cab & Final		1	1						1			1.0		1	1		1	1
Inprocess Inspection		1	1						1			1.0		1	1		1	1
Total Net manpower per shift		8	5					6			6			8			8	
Manpower per shift (Roundup)								6			6			8			8	
A+B Shift Manpower		13						12			12			16			16	
A+B Shift Manpower (incl 12% absenteeism)		13						13.4			13.4			17.9			17.9	
A+B Shift Manpower (incl 12% absenteeism) -Roundup		13						13			13			18			18	

Prima:Trim Line

Area	Activity	Manpower A-Shift	Manpower B-Shift	OP1 min.	OP2 min.	Work content per veh	Production Level/ shift 50 SMM	50 Req manpower	60 SMM	60 Req manpower	70 SMM	70 Req manpower	80 SMM	80 Req manpower
In-process Audit	B Shift not operational	1	1					1		1		1		1
PDI Gate at Stn no 36	Rear Window fitment, Side window fitment, Dashboard, Electrical Checking, Mechanical Checking and Adjustment, Wiper Grill, Gromet, Instrument Cluster, Grab handle, Pedal Box, Driver seat Fitment, Fuse box	2	2			7	350	0.8	420	1.0	490	1.2	560	1.3
Total Net manpower per shift		3	3					2		2		2		2
Manpower per shift (Roundup)		3						4		4		4		5
A+B Shift Manpower		6						4		4		5		5
A+B Shift Manpower (incl 12% absenteeism)		6						5		5		5		6
A+B Shift Manpower (incl 12% absenteeism) -Roundup		6												

Prima:Trim Line

Area	Activity	Manpower A-Shift	Manpower B-Shift	OP1 min.	OP2 min.	Work content per veh	Production Level/ shift 50 SMM	50 Req manpower	60 SMM	60 Req manpower	70 SMM	70 Req manpower	80 SMM	80 Req manpower
PDI Gate at end of line (EOL)	Rear Window fitment, Side window fitment, Dashboard, Electrical Checking, Mechanical Checking and Adjustment, Wiper Grill, Gromet, Instrument Cluster, Grab handle, Pedal Box, Driver seat Fitment, Fuse box, Footstep Bracket, Air Filter fitment, Rear Casting, Front Casting	4	3			7	333	2	400	3	467	3	533	3
Total Net manpower per shift		4	3					2		3		3		3
Manpower per shift (Roundup)		4						4		6		6		6
A+B Shift Manpower		7						4		7		7		7
A+B Shift Manpower (incl 12% absenteeism)		7						5		7		7		7
A+B Shift Manpower (incl 12% absenteeism) -Roundup		7												

Grand Total (PDI Gate nos36 +EOL)	13	10	12	12	13

METROLOGY LAB:

METROLOGY										
Sl NO.	Area	existing manpower per shift			existing manpower per day	Proposed manpower per shift			Proposed manpower per day
		A	B	C		A	B	C	
1	ENGINE METROLOGY	9	3	0	12	8	3	0	11
2	TRANSMISSION METROLOGY	8	3	0	11	6	3	0	9
3	FRONT AXLE METROLOGY	2	2	0	4	2	2	0	4
4	REAR AXLE METROLOGY	2	2	0	4	2	2	0	4
5	PLANT I METROLOGY	2	2	0	4	2	2	0	4
6	PLANT III METROLOGY	2	2	0	4	2	2	0	4
7	FOUNDRY METROLOGY	2	0	0	2	2	0	0	2
Grand Total(Incuding 12% absentism)					41				38

Transmission Metrology Lab						A SHIFT		B SHIFT	
Area	Activity	Manpower		Work content per part in Minute	No of jobs/shift	SMM	Req manpower	SMM	Req manpower
		A-Shift	B-Shift						
CMM	Lifting of job, set up, data entry, Testing	1	1	20	15	300	1	300	1.0
Gauge Calibration	Callibration of snap gauge using slip gauge, Data entry	3	0	20	45	900	2		
Special Guage Calibration	Dial gauges	1	0				1.0		
Torque Wrench Calibration	Lifting of job, set up, data entry, Testing	2	1	13	30	390	1	390	1
Incharge	Review of Urgent parts, guidance of trainees, Tools QA, Urgent gauge calibration, Metrology machine issue, Clearing of parts from lab in minimum time.	1	1				1.0		1
Total Net manpower per shift		8	3				4.8		1.9
Manpower per shift (Roundup)		8					5		2
A+B Shift Manpower (incl 12% absenteeism)		11				6		3	

Engine Metrology Lab						A SHIFT		B SHIFT	
Area	Activity	Manpower		Work content per part in Minute	No of jobs/shift	SMM	Req manpower	SMM	Req manpower
		A-Shift	B-Shift						
CMM	Lifting of job, set up, data entry, Testing	1	1	50	10	500	1	500	1
Gauge Calibration	Callibration of snap gauge using slip gauge, Data entry	3	0	15	25	375	1		
Slip gauge Calibration	Callibration of slip gauges	1	0	20	20	400	1		
ULM	Callibration of Go-No go gauges	1	1	40	10	400	1	400	1.0
Torque Wrench Calibration	Lifting of job, set up, data entry, Testing	1	1	43	11	473	1	473	1
CMM(BLOCK LINE)	Setup approval, Sample inspection before production	1	0	42	10	420	1		
Tools Inspection	Inspection of tools used in line(Mandrel)	1	0	20	10	200	1.0		
Total Net manpower per shift		9	3				7		3.0
Manpower per shift (Roundup)		9					7.0		3
A+B Shift Manpower (incl 12% absenteeism)		12				8		3	

Plant 1 Metrology Lab

Area	Activity	Manpower A-Shift	Manpower B-Shift	Work content per part in Minute	No of jobs/shift	A SHIFT SMM	A SHIFT Req manpower	B SHIFT SMM	B SHIFT Req manpower
CMM	Line Complaint, New Product, Sample from Frame line 1,2,3 and Assembly line 1,2,3 & 4	2	2	65	10	650	2	650	1.5
Total Net manpower per shift		2	2				2		1.5
Manpower per shift (Roundup)		2					2		2
A+B Shift Manpower (incl 12% absenteeism)		4				2		2	

Plant 3 Metrology Lab

Area	Activity	Manpower A-Shift	Manpower B-Shift	Work content per part in Minute	No of jobs/shift	A SHIFT SMM	A SHIFT Req manpower	B SHIFT SMM	B SHIFT Req manpower
CMM	SIGNA PIST ANALYSIS, NEW PRODUCT, CAB & COWL MEASUREMENT,MEASUREMENT AND INSPECTION OF WELDING FIXTURE, LONG MEMBER INSPECTION	2	2	280	1	280	1	280	0.7
Total Net manpower per shift		2	2				1		0.7
Manpower per shift (Roundup)		2					1		1
A+B Shift Manpower (incl 12% absenteeism)		4				2		2	

Rear Axle Metrology Lab

Area	Activity	Manpower A-Shift	Manpower B-Shift	Work content per part in Minute	No of jobs/shift	A SHIFT SMM	A SHIFT Req manpower	B SHIFT SMM	B SHIFT Req manpower
CMM	Lifting of job, set up, data entry, Testing	2	2	50	10	500	1	500	1.2
Height gauge	Insepection of height of jobs								
Profile Projector	Magnification and measurement of Intricate Profile								
Tools Inspection	Inspection of tools used in line(Mandrel)								
Total Net manpower per shift		2	2				1		1.2
Manpower per shift (Roundup)		2					1		2
A+B Shift Manpower (incl 12% absenteeism)		4				2		2	

Front Axle Metrology Lab						A SHIFT		B SHIFT	
Area	Activity	Manpower A-Shift	Manpower B-Shift	Work content per part in Minute	No of jobs/shift	SMM	Req manpower	SMM	Req manpower
CMM	Lifting of job, set up, data entry, Testing	2	2	70	10	700	2	700	1.7
Total Net manpower per shift		2	2				2		1.7
Manpower per shift (Roundup)		2					2		2
A+B Shift Manpower (incl 12% absenteeism)		4				2		2	

Foundry Metrology Lab						A SHIFT		B SHIFT	
Area	Activity	Manpower A-Shift	Manpower B-Shift	Work content per part in Minute	No of jobs/shift	SMM	Req manpower	SMM	Req manpower
CMM	Pattern, Corebox, Toolong, Casting, Sample, New Product	2	0	160	5	800	2	0	0.0
Total Net manpower per shift		2	0				2		0.0
Manpower per shift (Roundup)		2					2		0
A+B Shift Manpower (incl 12% absenteeism)		2				2		0	

The above study covers a wide range of places starting from Vehicle factory III and concluding at all the Metrology Labs.

CONCLUSION:

1. The study helped us to assess the current workload of the company.
2. It helped us to arrive at the required headcount to handle the current quality assurance services.
3. It will also help the organization to identify new areas and future services and allocate requisite manpower.
4. It will also help the company to assess the impact of reallocation and its impact on efficiency and workload
5. It can help the organization to identify risks, clarify what needs to be done, and sets fair expectations.
6. It is also beneficial in understanding the possible changes in the business and evolving an appropriate strategy to cope with the emerging scenario.

SUGGESTIONS AND IMPLEMENTATIONS:

1. The department in which production is not going on now can redirect their manpower to wherever necessary.

2. This might lead to a reduction in the recruitment of trainees as the people already present can easily complete the requirements by shuffling.
3. Installation of CCTV cameras might help to monitor the activities of the deployed personnel.
4. Time-to-time assessment of the skill levels of the manpower will also help the organization to place the right person in the right place and thus increase overall productivity and efficiency.
5. Growth in this business environment needs to be driven by both optimizing manpower and balancing it with the right mix of skills and abilities.

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