Performance Measurement Tools

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Mausmi Ambastha's ISD
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OPERATION AND QUALITY

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ABOUT STITCH DIARY

Stitch Diary is an educational blog by industry expert Mausmi Ambastha.
This is an attempt to educate people about the global apparel industry concepts.
What is the difference between SMV and SAM?
How can you optimize WIP in your industry?
What does NAFTA hold for the apparel industry?
All this and a lot more on www.stitchdiary.com

ABOUT MAUSMI

Mausmi, is an established expert in the garment industry with over 13 years of experience.Her brain child ThreadSol is a practical reflection of her ideology – “Buy what you need, use what you have!”
Mausmi, holds a Masters degree in Fashion Technology from NIFT, Delhi (India) and is also B.Tech in Computer Science. She has written over 20 publications for several leading apparel magazines like Stitch World and Fibre2Fashion.
Prior to ThreadSol, Mausmi did apparel consultancy and training with Methods Apparel in South-east Asia. She has also worked as a faculty at NIFT and loves to teach whenever she gets an opportunity.

INTRODUCTION

Production and quality are two intertwined aspects in production; while industry practitioners often feel these are contrasting aspirations (meaning production and quality cannot be improved simultaneously), consultants and gurus preach to improve both simultaneously. Measuring production and quality parameters thus holds key for bottom-line improvement. Production and operations metrics provide data to management regarding core business functioning. This data shows key performance indicators related to various functions performed by the production staff. Management is able to use this data to provide reports, evaluate employee performance, set goals, recognize trends, project future metrics, and much more.

MAN TO MACHINE RATIO (MMR)

Man to machine ratio is defined as the total available workforce in a factory/organization to the number of operational machines. Companies are following/setting benchmarks MMR for their factories to optimize and hence further control the ever increasing cost of manufacturing.

Man to machine ratio = (Available workforce/ operational machine)

The benchmark value can vary greatly depending upon the production system, product and quality parameters and measurement system followed.

It is advisable for each factory to develop their own benchmarks and strive to reduce them. Alok Apparels have maintained their man-machine ratio well below 1.5:1 as stated on their website. Noble Garments of Bahrain have aman-machine ratio of 1.85:1.

Many factories also consider aman-machine ratio comprising of total employees in the company. This gives them an indication of the total investment that the company is doing on people for each machine in the factory. Various other accounting measurement figures can emerge from here.

EXAMPLE

Factory XYZ has 100 sewing machines. Total direct labour in the factory is 150 and total manpower in the factory is 200.

Therefore, man- machine ratio as per direct labour is 1.5:1 and man-machine ratio as per total manpower is 2:1.

FILE HANDOVER SCHEDULE ACHIEVEMENT

WIP (Work in Progress):

This is inventory that has begun the manufacturing process and is no longer included in raw materials inventory, but is not yet a completed product. WIP can be measured in the whole factory, in a production line or between two operations. WIP can be measured in terms of number of pieces or number of minutes of workload.

Work in Progress in line = Total number of pieces in the line (pieces)

This can be done by simply counting pieces in the line or subtracting total number of pieces loaded to total number of pieces unloaded from the line.

Work in Progress in cutting = Total number of pieces in the cutting (pieces)

Total number of pieces for which fabric has been issued to cutting room subtracted by total number of pieces that have been issued out from cutting room.

Work in Progress between two operations = No.of pieces X SMV (minutes)

On a balance sheet, Work in Progress is considered to be an asset because money has been spent towards a completed product. Because the product has not been completed, however, WIP is valued lower. There are different schools of thought regarding the amount of WIP that should be there in a line and each has their own benefits. A lean system insists on minimum or single piece WIP between operations. A bundle system suggests approximately 30 minutes of work in progress between two operations.

EXAMPLE

Line A in factory XYZ was loaded with 200 pieces of style 1 and 500 pieces of style 2. The factory had given an output of 150 pieces of style 1 and 0 pieces of style 2. Therefore, WIP = 550 pieces.

TAKT TIME

This concept aims to match the pace of production with customer's demand. The purpose of takt time is to precisely match production with demand. It provides the heartbeat of a lean production system.

$$\text{Takt Time} = \frac{\text{Available production time per day}}{\text{Customer's demand per day}}$$

EXAMPLE

A single **8-hour** shift = 480 total minutes. The **start-up** process in the morning = 10 minutes, and shut- down and clean up at the end of the shift = 15 minutes. This 25 minutes is not production time, so it is subtracted from "available minutes" (480 **- 25** = 455). So we would use 455 minutes as the baseline for calculation.

If customer's demand was 300 units per day, then the takt time would be: 455 available minutes/300 required units of production = 1.52 minutes.

This time can be used to balance operations and operators to make them close to the takt time to create a more balanced line. The concept was widely utilized within Toyota in the 1950s and was in widespread use throughout the Toyota supply base by the late 1960s.

THROUGHPUT TIME/FLOW TIME

This is the amount of time required for a product to pass through a manufacturing process, thereby being converted from raw materials into finished goods.This can be measured by identifying a garment and noting down the time when it enters the production line and finally exits the production line after processing. This time that the garment spent on the production line is known as throughput time.

This concept can also be applied to a part or a sub assembly. Throughput time consists of the following:

a. Processing time
b. Inspection time
c. Movement time
d. Queue time/Waiting time

In order to decrease throughput time and thereby increasing the system's output, one should try to reduce one of the four above mentioned times. It is often noted that the bulk of the time is not spent in processing but on inspection, movement and waiting. Therefore, throughput time can be reduced by focussing on reduction of one of the three times.

EXAMPLE

A production line consisted of 5 operations of 2 minutes each where the 5th operation was end-line inspection. There was 10 minutes of WIP between each operation. There was 3 minutes of movement time between 4th and 5th operation

Processing time = 8 minutes Inspection time = 2 minutes
Movement time = 3 minutes Waiting time = 40 minutes
Therefore, total throughput time = 53 minutes.

THROUGHPUT RATE/FLOW RATE

This is the average rate at which units flow past through a specific point in the process.
This is the rate at which the system achieves its goals.

$$\text{Throughput rate} = \frac{\text{Daily output}}{\text{Daily working hours}}$$

The unit of throughput rate is output per unit time. The maximum through put rate is the process capacity. Hourly output is measured in almost every factory; through put rate is simply an average rate of output.

EXAMPLE

Factory XYZ has daily output of 450 pieces in Line A and the line works daily for 8 hours.
Therefore, throughput rate is 56 pieces per hour.

MACHINE UTILIZATION

The time during which the machine is actually being utilized for the purpose of production. This is a simple measure to see how much time is machine being utilized and how much time is spent in handling or preparation for the machine.

$$\text{Machine utilization} = \frac{\text{Actual running time}}{\text{Time available}}$$

Actual running time: Time spent on running the machine in each cycle (for a sewing machine this is the only time when the needle is moving) X pieces produced per shift or per day.

Time Available: The total working time in the shift or the day. (This will exclude any non-workingtime, machine downtime, etc).

In a sewing line, the only time when the needle is moving is the time when the system is actually producing garments. Rest of the time it is either handling or doing other non-productive works.
Machine utilization may vary from style to style (fabrics that require more handling will have lower machine utilization), level of automation in the machine, type of production system, line layout, etc. This metric should be used in view of all other factors involved.

EXAMPLE

Style 1 , operation 5 had a total SMV of 1.5 minutes out of which total machine time is 0.65 minutes. The operation produced 220 pieces per day.

Time available = 480 minutes - 20 minutes of machine downtime and 10 minutes of non - working time.

Therefore, machine utilization = (0.65 x 220) / 450 = 31.7%

OVERALL EQUIPMENT EFFECTIVENESS (OEE)

Overall equipment effectiveness is another metric which is increasingly being adopted by the garment industry.OEE is a crucial measure in TPM that tells you how well your equipment is running. It links three elements in one percentage: the time the machine is actually running; the level of utilization of machine running time; and the quality of good output.

OEE = Availability x Performance x Quality

a. Availability compares the actual time the equipment was producing parts (uptime) to the time it was scheduled to produce parts (scheduled production time)

Total available (operating) time =
Planned production time - (Down time+unscheduled time)

$$\text{Availability} = \frac{\text{Total available (operating) time}}{\text{Planned production time}}$$

b. Performance compares actual production versus standard number of pieces that should have been produced.

$$\textbf{Performance} = \frac{\textbf{Total time produced}}{\textbf{Total available (operating) time}}$$

c. Quality emphasises the conformance to quality standards.

$$\textbf{Quality} = \frac{\textbf{Good pieces produced}}{\textbf{Total pieces produced}}$$

As per the article "Total productive maintenance in RMG sector A case: Burlington Ltd., Bangladesh" published in Journal of Mechanical Engineers, Bangladesh in June 2007, OEE, was calculated in the garment factory at 59%. The factor was successfully utilized to identify problems and achieve an improved OEE of 65%. The article further claims that OEE can be further improved to 85% by eliminating all the causes. 85% is considered as a standard for Japanese industries.

SMV IMPROVEMENT

It is the percentage reduction of standard time of the garment. The IE team's job involves scrutinizing each operation on the line and trying to improve the operation. This can be done by method improvement, workplace engineering, applying new machinery or attachment, garment engineering, etc.

$$\text{SMV Impro.} = \frac{\text{Orig. SMV} - \text{New SMV} \times 100}{\text{Orig. SMV}}$$

If the factory knows cost/ min., then this can be directly interpreted as money.

Money saved / day =
Number of minutes saved x pieces produced per day x cost / min.

The above saving can only be realized if the method in the new SMV is adopted by the operators and the production happens according to the new system. This is commonly used by the IE Department to evaluate the improvement done by its members and to establish their contribution to the company.

VALUE ADDED TIME (VA)

In Lean philosophy,"value" is determined by customer's point of view. It refers to what the customer is willing to pay for and, what creates value for the end product.

A value adding element is one which is carried by the final product. Value added processes are those which are essential for conversion of raw material into finished products as per customer's demand. The time taken to do the value adding process is known as value added time.

QUALITY

Quality is non-negotiable and must be built in the garment. A lot has been said about quality, and industry in general is aware about its importance. The correct measures can pave the way to improved quality levels that most factories strive to achieve.

Right First Time/First Time Right

Our goal should be to spend time and energy only once while creating a product. Energy should not be wasted on repair or rework. This time spent on rectification is borne by the company and hence the margin on that product is reduced.

Right First Time =
(Number of good product produced / no of total product produced) x 100

Number of good products produced: Total No. of products passed without any repair, rework or rejection.

Number of total products produced: Total No. of products produced/ inspected in the line. This will include all goods including scrapped, reworked and rejects. Care should be taken to count the repaired products only once.

This can be applied at every inspection point or at the end of each process. This will evaluate the quality level of that department.

EXAMPLE

In factory XYZ, if end line inspection table inspected 450 garments in a day and there were 50 garments that needed repair or were rejected, then value of Right First Time at mid line is 88.89%.

PERCENTAGE DEFECTIVE LEVEL

This term is also known as defect percentage. It is the basic measure of quality percentage that most factories use at the end line and in the finishing department.

Percentage Defective Level =
(Total defective garments / total garments produced) x 100

This can be calculated on hourly, daily, line wise or on complete order. Factories measure defect percentage on hourly basis to continuously monitor quality. Lesser the defect percentage better is the quality performance. This can be measured at any inspection point.

EXAMPLE

Example: Percentage defective level for previous example is 11.1%.

DEFECTS PER HUNDRED UNITS (DHU)

The ratio of number of defects per lot or sample, expressed as a percentage.It is possible that one garment may have more than one defect. Each defect is counted separately as every defect represents additional work load of repair and rework.the end line and in the finishing department.

Defects per hundred units =
(Number of defects found/ number of garments inspected) x 100

This is a very important measure of quality on production floor and analysis of this data can also highlight quality bottlenecks.

EXAMPLE

As per previous example, out of the 50 garments that were rejected out of the 450 inspected, there were 20 garments which had 3 defects each, 20 garments which had 2 defects each and 10 garments had 1 defect each. Total defects in 450 garments were 110. Therefore, DHU is 24.4.

AQL (ACCEPTABLE QUALITY LEVEL)

An acceptable quality level is an inspection standard describing the maximum number of defects that could be considered acceptable during the random sampling of an inspection. AQL table determines two key elements:

a.Number of samples to be inspected.
b.The limit between acceptability and refusal, when it comes to defective products.

The defects found during inspection are sometimes classified into three levels: critical, major and minor. Different companies maintain different interpretations of each defect type. In order to avoid argument, buyers and sellers agree on an AQL standard, which they use as a reference duringpre-shipment inspection to evaluate quality.

Before using AQL tables, three things must be determined:

a.Lots size,
b.Inspection level,
c.AQL level for both major and minor defects.

"I want no more than 1.5% defective items in the whole order quantity", means the AQL is 1.5 for both major and minor defects. Critical defects often have zero tolerance.

EXAMPLE

Buyer for factory XYZ follows "general inspection level II", and AQL 1.5 for both major and minor defects. For a lot size of 450 pieces, a sample size of 50 pieces should be taken and if 3 or more defects are found the shipment is rejected.

LOOKING TO TAKE YOUR APPAREL KNOWLEDGE TO THE NEXT LEVEL?

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120+ customers in **15** countries plan **1** billion pieces annualy with ThreadSol products.