

Oefententamen Production Planning & Quality control

Dit is een oefententamen van de voorganger van het vak 'Production Planning & Quality control'. Volgens de docent kan dit oefententamen gebruikt worden ter voorbereiding op het tentamen.

Vraag 1 Principes van Lean Production

a. Waar staat de afkorting SMED voor?

- Single- minute exchange of dies
- Bedacht door Shigeo Shingo
- Reducing the total setup time through a combination of eliminating the unnecessary steps, improving the necessary steps, and doing some steps in parallel rather than in sequence.

b. Benoem de stappen in een SMED benadering?

Stage 1: Identify internal and external steps

- internal step is a step that must be performed while the machine of operation is stopped. Internal setup time is the same as downtime.
- External step is a step that can be performed while the operation is running.
- The primary focus in setup-time reduction is on internal time alone.

Stage 2: convert internal steps to external

Stage 3: Improve all aspects of the setup operation

- as long as the average total of internal and external setup time exceeds the average run time, the setup time constrains the number of lots.
- Reducing setup time focuses on simplifying and standardizing procedures on existing equipment.
- The setup should take less than 10 minutes and involve no more than a single touch procedure. (OTED, one touch exchange of dies)

Stage 4: abolish setup

- reduce or eliminate differences between parts
- make multiple kinds of parts in one step
- dedicate machines to making just one item (no change-over)

c. Op welke manieren kan Pull production verspilling verminderen?

Vraag 2: Groepsgewijze productie

d. Noem 4 mogelijke voordelen van groepsgewijze productie ten opzichte van een functionele inrichting; waardoor ontstaan deze voordelen?

it does not seek to reduce variety in the kinds of products offered to customers. GT (group technology) seeks to reduce variety in the kinds of products produced by the manufacturer. This is achieved by identifying and exploiting the similarities between

different products, similarities such as physical characteristics dimensions, geometrical shapes and materials. GT also identifies and exploits similarities in the processes and operations employed to make products.

e. Wat verstaat u onder Statistical Process Control (SPC)

SPC is a method for tracking, identifying and controlling process changes. Assuming that a process starts out doing what it is supposed to, then as long as there is no fundamental change the process is considered suitable and in control.

Since process variation is ongoing and expected, a way is needed to distinguish whether a given measured variation is due to common or special causes – whether the process is in control or out of control. With SPC, samples from the process are periodically inspected, and the results are plotted on control charts. A control chart has upper and lower control limits, and as long as the results stay within the limits and appear random, the process is assumed to be in control. Results that fall outside the limits or appear nonrandom suggest an out-of-control situation, in which case the process is stopped and a special cause is sought.

SPC procedure:

1. periodically select from the process a sample of items, inspect them, and note the result
2. Because of common or special causes, the results of every sample will vary. Determine whether the cause of the variation is common or special
3. Take action depending on what was determined in step 2

Risk of Error

Type I error: concluding that a process is out of control when it is in control
The probability of a Type I error is alpha, α .

Type II error: concluding that a process is in control when actually it has moved out of control. As alpha is reduced, the risk of a type II error is made larger because the UCL and LCL are further away from the CL.

Situations process is out of control

1. A point lies outside the control limits
2. any two of three consecutive points fall in the same A zone
3. four out of five consecutive points fall in the same B zone
4. Eight or more consecutive points lie on the same side of the CL
5. 8 or more consecutive points move continuously in the same direction, either upward or downward.

Run diagram

One restricting on the use of SPC is that the size of the population must be large enough for sampling. When the size is too small to employ sampling, then tracking and control decisions must instead be based upon screening. To detect process shifts that might result in nonconformities, a tool that can be used with screening is a run diagram. A run diagram looks similar to a control chart, though it has no statistical basis. The center line is usually the target value, and the upper and lower limits are the spec limits. To use a run diagram you inspect and plot every unit, monitor the pattern of points, and make a judgment. The judgment is completely subjective.

Rol van operators en professionele kwaliteitscontroleurs bij wel en geen TQM

Geen TQM

SPC is solely done bij experts in departments charged with assuring quality. Only professionals are allowed to construct charts and take samples since knowledge of statistical concepts and construction and application of control charts are considered beyond the comprehension of the average worker. Only quality engineers are allowed to diagnose and remedy special causes. Other people, the line workers, operators and assemblers might collect samples and plot them, but interpretation of results and follow-up action are always left to others.

Wel TQM

In TQM organizations, SPC is done by experts too, however the experts there are the operators and the workers. This is the concept of on-line quality. The line workers take samples, use it with a control chart and determine when a process appears out of control and then decide what to do about it.

This fits in the TQM because early warning and rapid feedback are the crux of process control.

Although trusting workers with most of the responsibility, it does not diminish the importance of roles of former inspectors and professionals. The quality professionals take on responsibility for backing up and assisting the workers. They teach SPC and inspection methods and develop sampling and inspection techniques.

Taguchi Loss Function

Continuous improvement in this context can be expressed in terms of the Taguchi loss function. The loss refers to cost incurred or profits forgone by deviating from a target value. The amount of loss is a direct function of the degree of deviation from the target value, and for that reason alone it is important to reduce variability. Also given that the minimum loss occurs at the target value. The loss, as a function of the deviation from the target, is expressed by a quadratic equation;

$$L = k (\text{deviation})^2 = k (x - M)^2$$

x = actual value

M = target value

K = loss constant

Type Control Chart

- X-bar charts
- R-charts
- p-charts
- c-charts

X-bar charts

\bar{X} = the mean of sample $i = \Sigma X/n$

Since any given process produces variable outputs, we must settle for a process that furnishes outputs that are on average. To monitor the average we use an X-bar chart. The purpose of an X-bar chart is to make sure a process remains centered, that the average of the process is hitting the prespecified, sought-after value.

R-bar charts

R = the range of sample $i = X_{\max} - X_{\min}$ of sample i

R-bar chart is a chart based upon variability. There is always variation in the process in the sampling results. Although some variation around the target value is expected, only a certain amount is expected for a process with prespecified parameters. Processes that have smaller variability are in general more desirable than those with larger variability. Once an acceptable deviation level has been set for a process, then the process variability itself should be monitored to make sure it does not change. It is common practice to monitor the variability of a process with an R-bar chart.

Variability = spreiding van een variabele.

X-bar and R-bar charts are used to monitor characteristics that are measurable, that is, characteristics that are represented in terms of a continuous numbering scale. Physical characteristics such as dimensions, weight, temperature, pressure, and speed can be monitored. These charts are referred to as variables control charts.

When a characteristic is monitored not by measuring it, but rather by classifying it or by tallying it then an attributes control chart is used. This is the p-chart and the c-chart.

p-chart

A p-chart or proportion chart is used to monitor the proportion of items in a process that fall into a certain category.

c-chart

A c-chart is used to monitor the number of times a characteristic (such as a defect) occurs in a single unit. A unit is whatever is being inspected, such as a single part, a product, a batch of products or a physical space or region.

f. Onderhoudsmanagement

Breakdown repair

Breakdown repair is the practice of caring for equipment when it breaks. Breakdown repair is the worst kind of maintenance. Like inspecting for product defects, it focuses on problems after they have occurred, not on diagnosing the problems to keep them from happening again. Equipment breakdown and malfunction directly contribute to wastes such as waiting, inventory and product defect. Manufacturers need to move beyond breakdown repair.

Ways:

Preventive maintenance (PM)

PM is the practice of tending to equipment so it will not break down and will operate according to requirements. It entails understanding and maintaining all the physical elements of manufacturing so they consistently perform at the levels required of them. Well-functioning equipment is a good thing in general, it is a prerequisite for JIT and TQM. For many companies PM is but a stepping stone to another, higher level of equipment maintenance, TPM

Total productive maintenance (TPM)

the purpose of TPM is squeezing the ultimate potential from equipment. The ultimate potential of a piece of equipment depends on its unique function and operating environment and in particular on how well the equipment meets requirements such as availability, efficiency and quality. TPM moves beyond preventing breakdowns and includes equipment restoration and redesign. A goal of TPM is to upgrade equipment so it performs better and requires less maintenance than when it was new.

Maintainability

The effort and the cost of performing maintenance. One measure of maintainability is mean time to repair (MTTR). High MTTR is an indication of low maintainability.
 $MTTR = \Sigma(\text{downtime for repair}) / \text{Number of repairs}$

Reliability

The probability that equipment will perform properly under normal operating circumstances.

$R = \text{number of successes} / \text{number of repetitions}$

Availability

The proportion of time equipment is actually available to perform work out of the time it should be available

$A = \text{actual running time} / \text{planned running time}$

$\text{planned running time} = \text{total plant time} - \text{planned downtime}$

$\text{Actual running time} = \text{planned running time} - \text{all other downtime}$

Efficiency

Is a measure of how well a machine performs while it is running. There are two kinds of efficiency; Rate efficiency and Speed efficiency.

Rate efficiency; the machine is running but is it producing output?

$RE = (\text{actual production volume}) * (\text{actual cycle time}) / \text{actual running time}$

Speed efficiency: is the machine producing output at the right speed?

$SE = \text{Design cycle time} / \text{Actual cycle time}$

Performance efficiency (PE) = RE * SE

$PE = \text{actual running time} - \text{time for interruptions} / \text{actual running time}$

Quality rate

Is an index for the equipment's ability to produce output that is nondefective or conforms to requirements.

$Q = (\text{actual production volume}) - (\text{defect output}) / \text{actual production volume}$

Overall Equipment Effectiveness (OEE)

$OEE = A * PE * Q$

Predictive maintenance

For cases where it is difficult or impossible to determine the useful life of a component or piece of equipment, a common practice is to employ predictive maintenance to give warning about potential failures. Rather than perform periodic scheduled maintenance tasks, predictive maintenance performs periodic, scheduled inspections, the results of which are used to determine specific PM tasks and replacement of components.

Predictive maintenance is always performed in conjunction with PM and an element or aspect of PM.

Predictive maintenance is also called *condition-based* maintenance because items remain in service on the condition that potential failure is not detected. When inspection indicates an impending problem, a closer inspection or immediate remedial action is scheduled.

g. Pull production

Is in een Pull systeem voorraad gewenst/nodig?

A pull system reacts immediately to changes or problems anywhere in the process, if a stage faces a problem and ceases to send signals upstream., the upstream stages also cease, at least until the signals resume. A small amount of inventory called a buffer is held between stages to allow downstream demand to be filled immediately while upstream operations work to meet requests for more. The amount held in the buffer is controlled by using a prespecified number of standard containers. The number of containers corresponds to the number of cards deemed adequate for the system to meet demand. Because the number of cards/containers is regulated, the amount of in-process inventory required for a process to function smoothly can be held to a small quantity.

Beschrijf het (belangrijkste) verschil tussen Pull en Push productie

klassiek pull systeem = Kanban (toyota)

klassiek push systeem = MRP (material requirements planning)

verschillen:

- *Timing* (time when production or transfer of batches is signaled)

Compleet verschillend voor de 2 systemen.

Push: push systems specify order releases of production schedules using lead times and global information from the master schedule.

Pull: order release does not occur until the level of stock at the downstream buffer reaches a prespecified minimum. The actual withdrawal of material from the buffer eventually results in an authorization signal being sent upstream to produce a new batch.

- *Batch Size* (size of production batches and order shipments)

Push: batch sizes are determined in advance by a central planning staff using lot-sizing rules and requirements from the master schedule. Batch-sizing decisions are based upon global information such as demand forecasts, available capacity, existing stock levels, job routings and bills of materials.

Pull: batch sizes are determined at the shop-floor level according to the demand and replenishment requirements of downstream inventory buffers. However, the size and numbers of containers for carrying inventory are based on the schedule of the final operation, which is determined from global demand information (same as push).

- *Priorities* (basis for priority of orders when there are multiple orders for production and/or shipment)

Push: schedules in push systems may incorporate priorities based on rules. Final decisions about priorities are made on the shop floor depending on the status of work at each station.

Pull: workstation operators in pull production use categories on a sequence board to determine job priority. The size of the categories is determined using global information.

- *Interface* (procedure for handling unanticipated orders that require immediate attention)

Push: decisions about unanticipated orders rest with upstream workstations, though ordinarily the schedule is frozen so that no new requests will be honored. Sometimes the schedules are regenerated and priorities are reset, in this case decisions are based on plantwide information.

Pull: pull systems conform to daily quotas using schedules for the final operation, although daily production at each workstation always depends on decision about requirements at downstream workstations.

Eisen voor succesvolle toepassing van pull production

Successful functioning of the card-based pull system requires understanding and conformes to certain rules.

1. Downstream operation withdraw only the quantity of items they need from upstream operations.
2. Each operation produces items in the quantity and sequence indicated by the cards.
3. A card must always be attached to a container. No withdrawal or production is permitted without a kanban (=card).
4. Only non defective items are sent downstream.
5. The production process is smoothed to achieve level production. Small demand variations are accommodated in the system by adjusting the number of cards.
6. The number of cards is gradually reduced to decrease WIP and expose areas that are wasteful and in need of improvement.

In pull systems, the inventory in the stock point is kept as small as possible, usually by carrying it in containers of stadardized size and by restricting the number of containers.

Pull production is also called Just in Time (JIT) production. Its goal is to eliminate in-process inventory, that is with zero inventory in the buffers. JIT seeks to have every stage in a process produce and deliver materials downstream in the exact quantities and at the exact times requested.

Conveyance kanbans (C-kanban)

A conveyance kanban is an authorization to move a container from an upstream, outbound buffer to a downstream, inbound buffer. No containers can be withdrawn from an outbound buffer unless a C-kanban has been issued. A system that only uses C-kanbans is called a single-card kanban because it only uses one kind of kanban. Upstream workstation produce according to an order list or a daily schedule.

Production kanbans (p-kanban)

the p-kanban is used to authorize production of parts or assemblies. In a system that utilizes this kind of card, no production is allowed without it. Except at the final staion in the process, there are no production schedules, just P-kanban authorizations. A system that uses both c-kanbans and p-kanbans is called a two-card pull system.

The number of C-kanbans specifies the maximum number of full containers at an inbound buffer. The number of P-kanbans specifies the maximum number of full containers at an outbound buffer.