

Pearson BTEC Levels 4 Higher Nationals in Engineering (RQF)

Unit 14: Production Engineering for Manufacture

Unit Workbook 4

in a series of 4 for this unit

Learning Outcome 4

Wider Manufacturing System

4.1 Production systems:

4.1.1 Production Performance Criteria

Purpose

Production performance rating is important in any production floor, but more so for batch production. Production performance is tracked using Key Performance Indicators (KPIs), a selection of different aspects to analyse. KPIs may include:

- Cycle times
- Product quality relative to the expectations
- Rejection rates
- Down time

While the ability to repeatedly produce sellable products is vital. Once this has been achieved KPIs will continually be updated to more complicated goals such as reducing costs and increasing output capacity with minimal expenditure.

Not all KPIs will focus on performance however, and we need to define more precise indicators in order to evaluate properly. It's also important to note that some indicators are a standalone parameter, and some need to be based on previous results (relative).

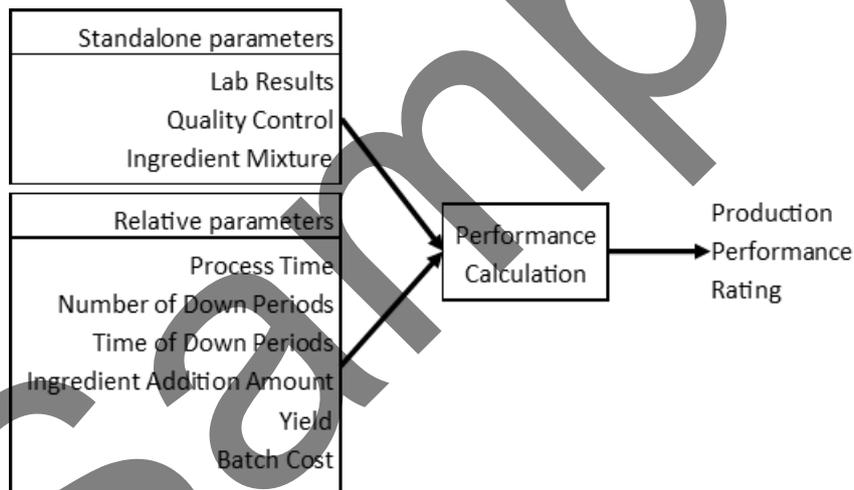


Fig.4.1: Standalone and relative parameters for calculating production performance rating

The key principles in calculating the performance rating are:

1. Compare KPIs to a target or the standard
2. Weight each input according to its importance to production performance
3. Normalise the result and keep it between 0 – 100%

Rather than compare each batch to its predecessor, manufacturers will select a standard batch, which enables a quick decision as to whether or not the batch is successful. The better and worse ratings are important to analyse, we need to ask ourselves “what was different?” and “why did/didn’t that work?”. It could be due to changes in equipment, personnel, ingredients or just the time of day.

In a lot of cases, it is better to analyse the worst performing batches, this helps develop plans and procedures to mitigate them, and will mean there is less production variability.

4.1.2 Through-Put Rates and Yield Rates

Theory

While it's always important to push through as much product as you need, it's important to know the difference between throughput rates and yield rates

Throughput Rates

The number of products produced per unit time (per hour / per minute). This does not consider the quality of the product produced.

Yield Rates

The number of sellable products produced per unit time. Yield rates (Y) can be calculated using Eq.4.1, where, T is the throughput rate, G is the percentage of satisfactory parts made, and R is the percentage of defective units that can be reworked to satisfactory level

$$Y = T(G) + T(1 - G)(R) \quad (\text{Eq.4.1})$$

Example

A company is producing 100 car chassis a day, the percentage of satisfactory chassis is 80% and the company can rework 30% of the defective chassis. Calculate the yield rate for the company's work day.

$$Y = T(G) + T(1 - G)(R) = 100(0.8) + (100)(1 - 0.8)(0.3) = 86 \text{ chassis}$$

The company now wants to cut corners to increase the yield rate. The throughput has been escalated to 110 chassis per day. The percentage of satisfactory chassis has dropped to 75%, but 30% of the faulty products can still be reworked, is there a higher yield?

$$Y = T(G) + T(1 - G)(R) = 105(0.75) + 105(1 - 0.75)(0.3) = 86.625 \text{ chassis}$$

Theoretically, the yield has increased, but the company can't make 0.625 of a chassis, so at such low production rates, there would be no difference.

4.1.3 Cost Effectiveness

Making a manufacturing line as cost effective as possible is the main goal for any engineer. There are many aspects of the manufacturing process that can be looked at, from the suppliers, to the delivery service, and everything in between. Cheaper is not always the better option, but then again, the most expensive one may not be the best option either. It's important to weigh the performance and risks with the cost of the purchase.

4.1.4 Sustainability

Sustainability is becoming more important with the current global concern regarding climate change, the human population is also harvesting more resources than the earth can replenish. The results of this are the social and legislative pressure placed on companies to develop a more sustainable manufacturing system. Companies need to reduce as much pollution as possible, whether it is regarding their waste, or the sound they produce, or eliminating any toxic materials used. Sustainable manufacturing doesn't just benefit the environment, it can also improve employee, product and community safety.

4.1.5 Flexibility and Reliability

Flexibility is more important for smaller manufacturing lines, ones that cannot rely on years of producing the same product for that product. The ability to be flexible and reduce any lead times for new products is a very attractive selling point to a company with a design request.

Reliability, however, is important for manufacturing systems, suppliers and retailers of every size, if you are unreliable, companies will not be interested to do business with you, and if you can't sell your product, your company will soon be in dire straits. This will be with regards to payment and sticking to deadlines. Sticking to deadlines requires monitoring the reliability of the manufacturing systems in place, they need to be regularly serviced and maintained to ensure there as few breakdowns as possible.

4.1.6 Optimising Supply Chain Performance and Management

There is no right way to optimise the supply chain performance, but some of the important factors to consider are:

- 1. Build a Responsive Supply Chain:** Utilise all the source data such as sales and use social media to identify trends and demands much earlier so your supply chain is faster at responding.
- 2. Focus on Core Strengths:** Many companies try to cut costs by trying to do as many things internally as possible, this means that members of the workforce are not devoting enough time playing to their strengths. Some simpler and more repetitive tasks can always be outsourced.
- 3. Develop Data Driven Forecasting:** Work with your retailers, suppliers and manufacturers to find what is selling, what is not, find trends and change your orders accordingly.

4.1.7 Collaboration

Collaboration between suppliers, manufacturers and retailers is vital to all three, one cannot survive without the other two. The most important factor of collaboration is communication, all three need to talk to each other, whether this is to organise orders and other contracts, or to inform them that they need to amend the order or let those who are dependent on them know that there are delays with the orders.

4.2 Production Errors and Rectification

Purpose

Production errors can be very dangerous if not discovered before release. One of the more recent recalls is the Samsung Galaxy Note 7, a defective battery was causing chaos as they caught fire seemingly at random, with some people getting treated for burns as the battery exploded in their pockets, once social media started lighting up with more images of burned out Note 7s, Samsung issued a global recall just over a week after the first report of the faulty product.

4.2.1 Cost of Production Errors

Theory

Production errors are expensive, and the cost rises exponentially the longer it is left unnoticed. If a production error occurs, every product has to be tested and fixed, provided the product is fixable. Production errors can delay the release of a product, and delays in product release can impact the projected sales for a company, as a delay may force the customer to look elsewhere for a competitive product.

Product recalls are also hugely expensive; in 2007, nearly nine million Mattel toys were recalled from fears that the Chinese made toys contained toxic levels of lead in their paint, which cost Mattel at least \$30 million (around £15 million at the time). A Salmonella scare for Cadbury's in 2006 cost an estimated £20 million and saw a 14% drop in sales.

While it is expensive to recall the products, it will be more expensive if the product is not recalled in time and it causes damage. UK Law states "If you are liable for harm caused by an unsafe product, you can be sued by anyone who is harmed - even if they didn't buy the product themselves. You can be sued for compensation for death or injury. You can also be sued for damage or loss of private property caused by faulty goods if the damage amounts to at least £275. The amount that can be claimed will depend on the harm suffered. There is no upper limit. Many businesses take product liability insurance to protect them from legal costs and damages awards."

However, you will need to produce that there is a direct economic loss and the product was not misused. For example, my new microwave has just caught fire and damaged my kitchen, no one was injured, the kitchen will need to be completely redone. The company that produced the faulty product only has to pay for what has been destroyed.

Any injuries can also be classed as a direct economic loss, if it keeps you off work, or if there are any medical bills associated (more commonly a factor in the United States). For example, in 2006/2007 pharmaceutical giant Merck recalled an arthritis drug Vioxx after it was found that taking the drug for at least 18 months saw an increased risk in heart attacks and strokes. The company's sales for Vioxx dropped by \$725 million and agreed to pay \$4.85 billion to settle 27,000 lawsuits with regards to the drug, bringing the overall cost to \$5.575 billion (£2.8 billion).

From the company's point of view, however, there is more than just the legal costs of reparations to the customer. A lot of companies will face a huge drop in share prices, and the reputation of the company is tarnished. But it does all depend on how the situation is handled, for example, while Samsung have had a huge, and highly publicised failure with regards to the Note 7, the Galaxy S8 has been regarded as a huge success, and Samsung have recently released the Note 8, which has sold in record numbers in United Kingdom and Ireland.