Pearson BTEC Level 4 Higher Nationals in Engineering (RQF)

Unit 17: Quality and Process Improvement

Unit Workbook 1

in a series of 2 for this unit

Learning Outcome 1 and 2

Quality Control Tools and Costing

Contents

INTRODUCTION

Illustrate the applications of statistical process control when applied in an industrial environment to improve efficiency:

- The tools and techniques used to support quality control.
- Attributes and variables.
- Testing processes.
- Quality tools and techniques, including SPC.
- Designing quality into new products and processes using Quality Function Deployment (QFD)

Analyse cost effective quality control tools:

- Costing modules
- The importance of qualifying the costs related to quality
- How costs can be used to improve business performance

GUIDANCE

This document is prepared to break the unit material down into bite size chunks. You will see the learning outcomes above treated in their own sections. Therein you will encounter the following structures;

Purpose — Explains *why* you need to study the current section of material. Quite often learners are put off by material which does not initially seem to be relevant to a topic or profession. Once you understand the importance of new learning or theory you will embrace the concepts more readily.

Theory — Conveys new material to you in a straightforward fashion. To support the treatments in this section you are strongly advised to follow the given hyperlinks, which may be useful documents or applications on the web.

Example — The examples/worked examples are presented in a knowledge-building order. Make sure you follow them all through. If you are feeling confident then you might like to treat an example as a question, in which case cover it up and have a go yourself. Many of the examples given resemble assignment questions which will come your way, so follow them through diligently.

Question — Questions should not be avoided if you are determined to learn. Please do take the time to tackle each of the given questions, in the order in which they are presented. The order is important, as further knowledge and confidence is built upon previous knowledge and confidence. As an Online Learner it is important that the answers to questions are immediately available to you. Contact your Unit Tutor if you need help.

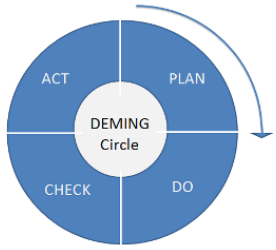
Challenge — You can really cement your new knowledge by undertaking the challenges. A challenge could be to download software and perform an exercise. An alternative challenge might involve a practical activity or other form of research.

Video

Videos on the web can be very useful supplements to your distance learning efforts. Wherever an online video(s) will help you then it will be hyperlinked at the appropriate point.

• Institute a vigorous programme of education and retraining
• Create a structure in top management that will push on the above points every day

He believed that adoption of, and action on, the fourteen points was a signal that management intended to stay in business. Deming also encouraged a systematic approach to problem solving and promoted the widely known Plan, Do, Check, Act (PDCA) cycle.



The Deming Cycle

PLAN: identify an opportunity and plan for change

DO: implement the change on a small scale

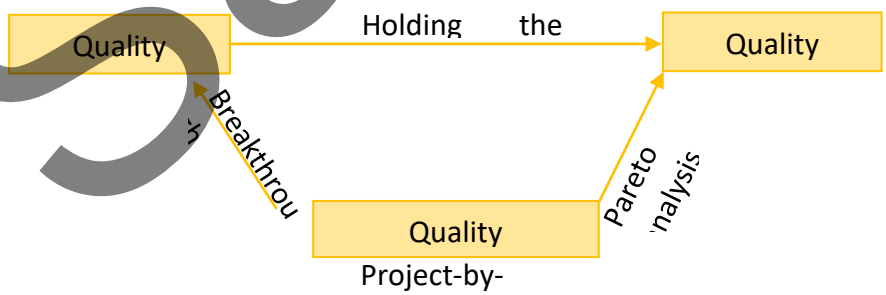
CHECK: use data to analyse the results of the change to determine whether it made a positive difference.

ACT: if the change was successful, implement it on a wider scale and continuously assess the outcome. If the change did not work, begin the cycle again.

The PDCA cycle is also known as the Deming cycle, although it was developed by a colleague of Deming, Dr Shewhart. It is a universal improvement methodology, the idea being to constantly improve, and thereby reduce the difference between the requirements of the customers and the performance of the process. The cycle is about learning and ongoing improvement, learning what works and what does not in a systematic way; and the cycle repeats; after one cycle is complete, another is started.

1.2 Dr Joseph M Juran

Juran developed the quality trilogy – quality planning, quality control and quality improvement. Good quality management requires quality actions to be planned out, improved and controlled. The process achieves control at one level of quality performance, then plans are made to improve the performance on a project by project basis, using tools and techniques such as Pareto analysis. This activity eventually achieves breakthrough to an improved level, which is again controlled, to prevent any deterioration



Juran believed quality is associated with customer satisfaction or dissatisfaction with the product, and emphasised the necessity for ongoing quality improvement through a succession of small improvement projects carried out throughout the organisation. His ten steps to quality improvement are:

• Build awareness of the need and opportunity for improvement
• Set goals for improvement

- Organise to reach the goals
- Provide training
- Carry out projects to solve problems
- Report progress
- Give recognition
- Communicate results
- Keep score of improvements achieved
- Maintain momentum

He concentrated not just on the end customer, but on other external and internal customers. Each person along the chain, from product designer to final user, is a supplier and a customer. In addition, the person will be a process, carrying out some transformation or activity.

1.3 Armand V Feigenbaum

Aramand Feignbaum was the originator of "total quality control", often referred to as total quality. He defined it as:

> "An effective system for integrating quality development, quality maintenance and quality improvement efforts of the various groups within an organisation, so as to enable production and service at the most economical levels that allow full customer satisfaction".

He saw it as a business method and proposed three steps to quality:

- Quality leadership
- Modern quality technology
- Organisational commitment

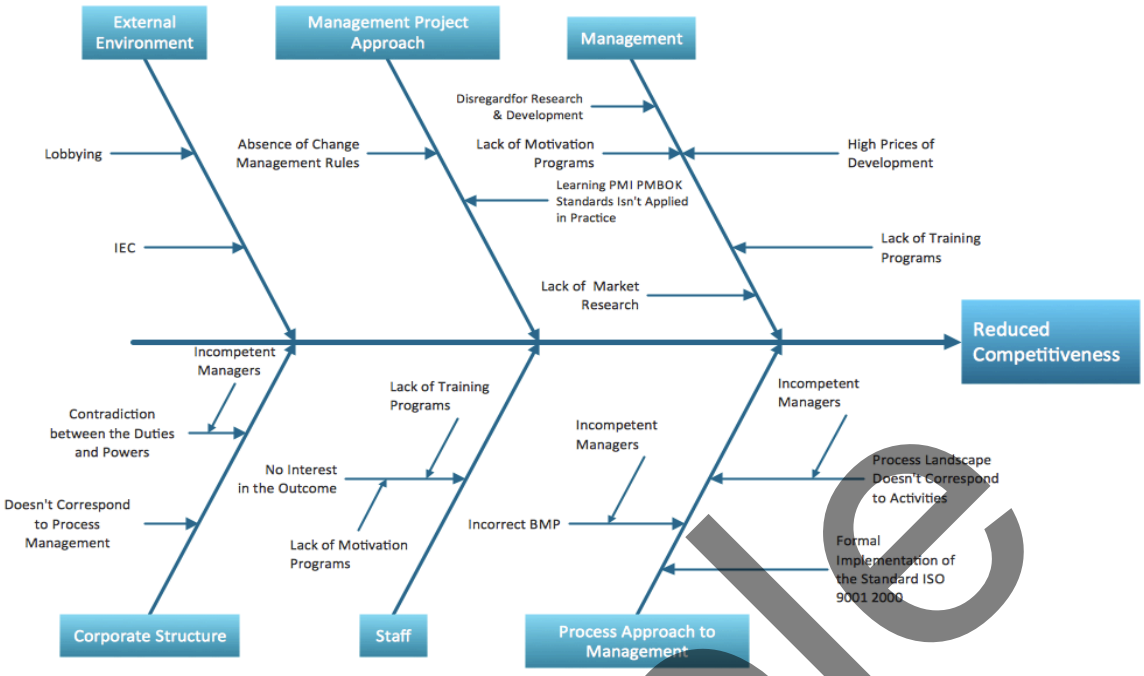
1.4 Dr Kaoru Ishikawa

Dr Ishikawa made many contributions to quality, the most noteworthy being his total quality viewpoint, company-wide quality control, his emphasis on the human side of quality, the Ishikawa diagram and the assembly and use of the "seven basic tools of quality":

- Pareto analysis: which are the big problems?
- Cause and effect diagrams: what causes the problems?
- Stratification: how is the data made up? (replaced by flow-charts in newer versions).
- Check sheets: how often it occurs or is done?
- Histograms: what do overall variations look like?
- Scatter charts: what are the relationships between factors?
- Process control: charts which variations to control and how?

He believed these seven tools should be known widely, if not by everyone, in an organisation and used to analyse problems and develop improvements. Used together they form a powerful kit.

One of the most widely known of these is the Ishikawa (or fishbone or cause and effect) diagram.

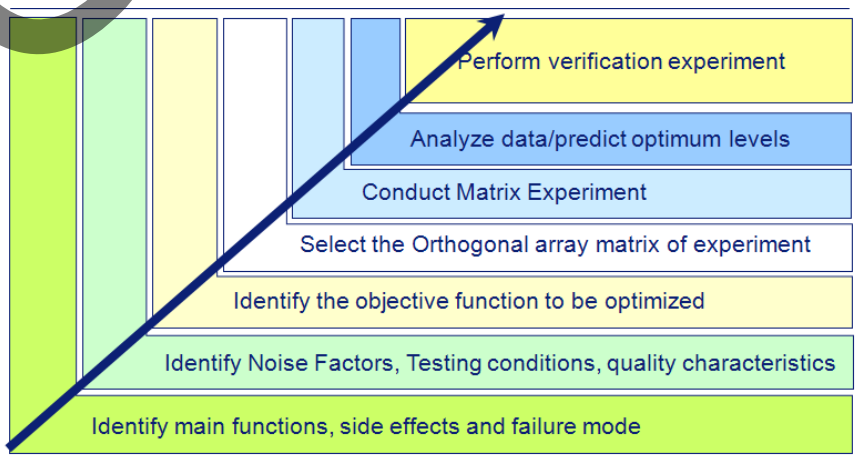


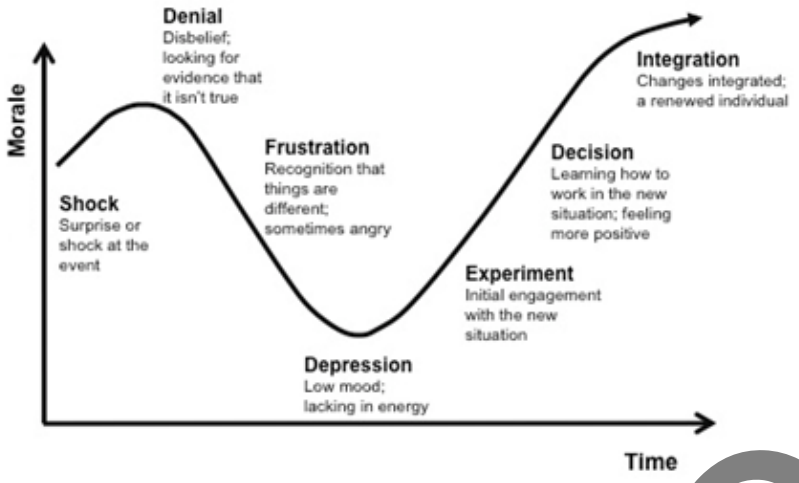
Like other tools, it assists groups in quality improvements. The diagram systematically represents and analyses the real causes behind a problem or effect. It organises the major and minor contributing causes leading to one effect (or problem), defines the problem, identifies possible and probable causes by narrowing down the possible ones. It also helps groups to be systematic in the generation of ideas and to check that it has stated the direction of causation correctly. The diagrammatic format helps when presenting results to others.

1.5 Dr Genichi Taguchi

Taguchi believed it is preferable to design product that is robust or insensitive to variation in the manufacturing process, rather than attempt to control all the many variations during actual manufacture. To put this idea into practice, he took the already established knowledge on experimental design and made it more usable and practical for quality professionals. His message was concerned with the routine optimisation of product and process prior to manufacture rather than quality through inspection. Quality and reliability are pushed back to the design stage where they really belong, and he broke down off-line quality into three stages:

- System design
- Parameter design
- Tolerance design





The original five stages of grief – denial, anger, bargaining, depression and acceptance – have been adapted over the years. There are numerous versions of the curve in existence; however, the majority of them are consistent in their use of the following basic emotions, which are often grouped into three distinct transitional stages:

Stage 1 Shock and Denial

Stage 2 Anger and Depression

Stage 3 Acceptance and Integration

Each person reacts individually to change, and not all will experience every phase. Some people may spend a lot of time in stages 1 and 2, whilst others who are more accustomed to change may move fairly swiftly into stage 3. Although it is generally acknowledged that moving from stage 1 through stage 2 and finally to stage 3 is most common, there is no right or wrong sequence. Several people going through the same change at the same time are likely to travel at their own speed, and will reach each stage at different times.

2.5 Focus i.e. internal and external customers

The term customer is most commonly associated with someone who purchases goods or services. However, Joseph Juran (see 1.2 above) expressed the view that organisations have both internal and external customers, and, internal customers have a direct link to a positive external customer experience. The external customer is the person who purchases the goods or services, while the internal customer is anyone within an organisation who at any time is dependent on anyone else within the organisation. So, an internal customer can be a co-worker, another department, or a distributor who depends upon an organisation to provide products or services which in turn are utilised to create a deliverable for the external customer. In the diagram below, the 'Customer' in the centre is the focus for the departments and functions surrounding it: these are the 'internal customers'.

In recent years, there has been a move toward gauging internal customer satisfaction in much the same way as organisations have been polling external customers' views for many years i.e. the satisfaction survey. One model comprises five steps:

1. Have each department identify who is/are their internal customer/s and who is/are their internal supplier/s.
2. Request each department to talk to their internal customer/s and ask them specifically what is needed for them to do their jobs that they provide.
3. Have them ask these internal customers what they currently do that disappoints them in delivering what they provide.
4. Request they ask these internal customers what they could do that would delight them and make their jobs easier.
5. Document all of the above.

When employees (internal customers) are satisfied with their treatment and given the correct tools to do their jobs, external customers are more likely continue to do business with the company.

2.6 Quality management: the application of supporting theories

Quality management has four components; quality planning, quality assurance, quality control and continual improvement. These include procedures, tools and techniques that are used to ensure that the outputs and benefits meet customer requirements.

The first component, quality planning, involves the preparation of a quality management plan that describes the processes and metrics that will be used. The quality management plan needs to be agreed with relevant stakeholders to ensure that their expectations for quality are correctly identified. The processes described in the quality management plan should conform to the processes, culture and values of the host organisation.

Quality assurance provides confidence to the host organisation that its projects, programmes and portfolios are being well managed. It validates the consistent use of procedures and standards, and ensures that staff have the correct knowledge, skills and attitudes to fulfil their project roles and responsibilities in a competent manner. Quality

- Horizontal or flat structures. Here there are fewer layers and more people in each layer. Decision making may need to take account of several groups within a layer. However, communication is usually more effective. Flat structures often work well with skilled and motivated workers.

- Matrix structures**.** Sometimes the business needs to use people with a variety of skills who are drawn from many parts or functional areas of the business such as marketing, operations, finance and human resources. These can be organised into teams to complete projects.