Overall learning objectives

Students will be learning to:

- Explore the characteristics of a production system and how to make it more efficient.
- Understand the principles of 'Lean' and 'Just in Time' production principles.
- Apply their understanding to a context.

Overall learning outcomes

Students will be able to:

- Analyse a simple context and comment on its organisation.
- Suggest improvements to make a production process more efficient.
- Collaborate effectively to explore a production process.

Curriculum learning objectives

Technology:

Students should develop knowledge and understanding through:

- Responding creatively to briefs, developing their own proposals and producing specifications for products and associated services.
- Generating, developing and communicating ideas in a range of ways, using appropriate strategies.
- Recognising there are moral, cultural, economic, environmental, and sustainability issues inherent in design and technology.

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Mechatronics Challenger

Sequence of learning activities

Introduction

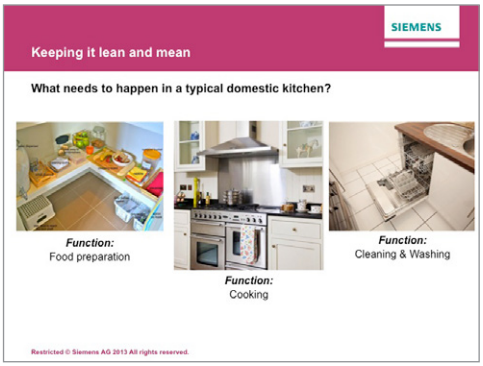
The purpose of this episode is to introduce students to the idea of thinking about how a functional area can be planned in terms of making it fit for purpose. The context is that of a kitchen and the challenge is to consider the various functions that a kitchen needs to fulfil and how these can be reflected in the design to make it more efficient.

Learning objectives

Students are learning to:

- Consider how a kitchen should be designed to perform a range of functions.
- Explore ideas about the design in order to make the kitchen more efficient.

Learning activities



1. **Introduce the idea of a kitchen being fitted out to perform a number of functions. Say that often, in a small kitchen, the design may be restricted by factors such doorways, water supply and drainage. There may not in practice be many options, but in a fairly small room with one person working there this may not matter too much. However in larger kitchen this may be more critical.**

2. **Students should consider functions of a domestic kitchen using stimulus materials such as images and plans:**
   a) Food preparation – storage, work surface and utensils.
   b) Cooking – cooker, grill, hob, etc.
   c) Cleaning and washing – sink, dishwasher, drainage and storage.

3. **Students then consider three (flawed) kitchen designs and critique each of them for effective organisation (see student support sheet 16A).**

4. **Students then design and justify their own plan.**

Outcomes

- Clearly expressed views about the advantages and disadvantages of certain kitchen designs.
- A considered and justified plan for a kitchen with facilities grouped according to function.

Development

Introduction

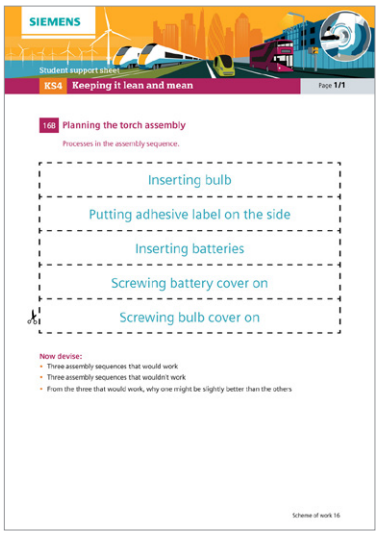
The purpose of this episode is to introduce the students to the context of assembling a product and get them to consider how this process can be made as efficient and effective as possible.

Learning objectives

Students are learning to:

- Analyse a product in terms of the stages of its assembly
- Propose possible sequences for the assembly process
- Evaluate various methods of organising production.

Learning activities


SIEMENS
Student support sheet
KS4 Keeping it lean and mean
Page 1/1
16B Planning the torch assembly
Processes in the assembly sequence.
Inserting bulb
Putting adhesive label on the side
Inserting batteries
Screwing battery cover on
Screwing bulb cover on
Now devise:
- Three assembly sequences that would work
- Three assembly sequences that wouldn't work
- From the three that would work, why one might be slightly better than the others
Scheme of work 16

1. **Teacher introduces concept of LEAN technology and the idea that industry becomes more efficient and effective if these principles are followed. This can be supported by a briefing sheet written with students in mind and which they can respond to, identifying key points.**

2. **Students introduced to context of assembling torches. The teacher explains that the school is to run a camping trip for students in Year 7. They have approached local businesses for sponsorship and one of the companies has offered to provide all the students who participate with a torch to use on the event and to keep afterwards. The torch will have the name of the company on the side. When the torches arrive, they are in bits and need assembling.**

3. **Use a torch to demonstrate (or allow students to explore) the assembly of the components.**
   This might include, for example:
   a) Inserting batteries
   b) Screwing battery cover on
   c) Inserting bulb
   d) Screwing bulb cover on
   e) Putting adhesive label on the side

4. **Now challenge students to explore this sequence and identify which stages have to come before another and which could be in any order (see student support sheet 16B). Ask students to work**
   in groups and devise:
   a) Three assembly sequences that would work
   b) Three assembly sequences that wouldn't work
   c) From the three that would work, why one might be slightly better than the others

Learning activities, cont'd

5. **Ask students now to imagine that they were working in a team to assemble a batch of, say, 100 torches from components. Present three models of organising the production and ask them to consider the advantages and disadvantages of each. Indicate that an efficient system will not only complete the task but also:**
   a) Use the minimum of manpower
   b) Avoid waste
   c) The three models are:
      i) Each student has a supply of all the components and assembles complete torches.
      ii) Students are arranged in a row and each undertakes one stage in the assembly process. E.g. the first might put the batteries in the body, then passes it to the second, who screws the battery lid on, etc.
      iii) Students are arranged in small teams, each of whom perform a sub-assembly. The part assembled torches are then stored temporarily before going on to the next sub-assembly. For example, the first sub-assembly might be the batteries going in and the lid being screwed on. The part assembled torches then await the next sub-assembly, such as the label being applied.

6. **Ask students to identify advantages and disadvantages with each of the three models. For example, they might indicate that:**
   a) The first model gave each student the satisfaction of producing complete torches; it is also clear which students are working most effectively in terms of the quantity and quality of the output. However each of the students needs to be continuously supplied with all of the components and they all have to be good at all of the stages.
   b) This model enables students to focus on one stage, at which they will get to be good and fast. Supply is simple. However if one stage takes longer there could be a 'bottleneck', which slows the whole process down.

Outcomes

- Development of possible assembly sequences.
- Critical evaluation of those sequences.

Further development and plenary

Introduction

The purpose of this episode is to introduce students to the concepts of Lean and JIT (just in time) manufacturing and to support them in applying these to contexts previously introduced. It also provides an opportunity for the teacher to draw ideas together.

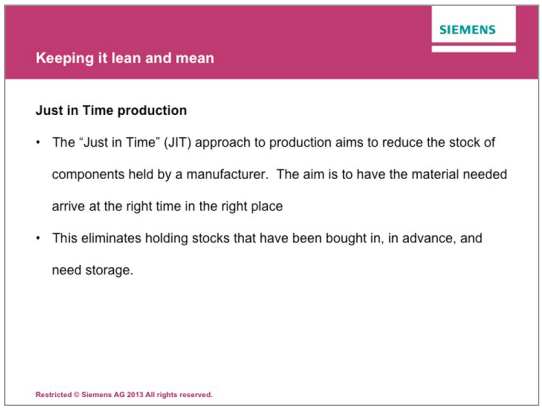
Learning objectives

Students are learning to:

- Understand the concepts of Lean and JIT manufacturing
- Apply these concepts to familiar contexts

Learning activities

1. **Explain that the design of production systems is an essential part of the manufacturing industry. Introduce the idea of Lean manufacturing (see Slide 11) and explain that it involves a relentless focus upon what adds value to a product from the point of view of the customer, i.e. what the customer is prepared to pay for. For example, if the torch had a decorative chrome ring on it, the manufacturer should identify what that adds to the value of the torch and whether what it costs to include the ring is more than the added value. Ask students to consider whether there are any features of the torch that should be questioned from this point of view.**



2. **Add that the Lean manufacturing also looks at planning and processes. For example, in the assembly of the torch, attention should be given to:**
   a) Whether components are being stockpiled in advance
   b) How the work stations are arranged
   c) Whether there are any waste materials (such as the packaging of components)
   d) How the finished items are stored and transported.

3. **Explain that another important idea in manufacturing is the 'Just in Time' (JIT) approach (see Slide 12), in which components, rather than being stockpiled at the assembly line, only arrive more or less as they are needed. Ask students to consider this in the context of assembling torches and to consider advantages and disadvantages of this. Present them with the context of torches now being assembled by students and sold to raise funds for a charity that students had nominated. The components are bought in, assembled, sold and after the components are paid for the profit goes to the charity. The batteries and bulbs come from an electrical supplier who requires payment five working days after delivery. The torches are sold on a market stall in the local town on a Saturday morning. Ask students to consider how the school might try to arrange the arrival and assembly of the torches using a JIT approach.**

Learning activities, cont'd

4. **Draw out from the discussion that a JIT approach would:**
   a) Reduce the need for storage space.
   b) Avoid being left with obsolete components if the design changed
   c) Reduce money being paid out for components before the torches are sold.
   d) However, if the components are out of stock there is little time to source them elsewhere.
   e) Running out of just one component stops the whole assembly process.
5. **Finally students are encouraged and supported to identify key points about Lean and JIT technology for their learning.**

Outcomes

- Justified views about some of the implications of Lean manufacturing to a practical context.
- Suggestions about the implications of JIT manufacturing to a practical context.