

### Overall learning objectives

- Identify key features of a production line process and how it can be made more effective
- Monitor a simulated process and identify skills needed to make it work efficiently
- Understand concepts such as 'Just in Time manufacturing' and 'Lean manufacturing' and apply them to the process.

### Overall learning outcomes

- Identify how a production line can be run efficiently
- Reflect upon the critical skills and evaluate their own performance
- Relate concepts such as 'Just in Time manufacturing' and 'Lean manufacturing' to the context of an assembly line.

## Curriculum learning objectives

Students should have the opportunity to:

### Technology:

- Students should develop knowledge and understanding through:
- Actively engaging in the processes of design and technology to develop as effective and independent learners;
- Making decisions, considering sustainability and combining skills with knowledge and understanding in order to design and make quality products;
- Analysing existing products and produce practical solutions to needs, wants and opportunities, recognising their impact on quality of life;
- Developing decision-making skills through individual and collaborative working;
- Developing skills of creativity and critical analysis through making links between the principles of good design, existing solutions and technological knowledge.

### Extended learning – Siemens Digital Badges

Help your students showcase their achievements further and reward them with a Siemens Digital Badge.

Get your pupils to earn their Mechatronics badge by registering at [www.openbadgeacademy.com/siemens](http://www.openbadgeacademy.com/siemens)

Find out more at [www.siemens.co.uk/digitalbadges](http://www.siemens.co.uk/digitalbadges)



Mechatronics  
Challenger

## Introduction

The purpose of this episode is to introduce the context to the students and get them to understand what a successfully organised and managed assembly line needs to be able to do. It should be drawn out that it not only needs to be able to produce items that are fit for purpose and meet customers' requirements but also that it has to run efficiently, making best use of resources such as manpower and components.

### Learning objectives

- Understand what an assembly line is and what it does.
- Consider how it should be planned and run.
- Understand the terms 'Just in Time manufacturing' and 'Lean manufacturing'.

### Learning activities

1. Introduce the idea of an assembly line and the concept of a multi-stage process being broken down into individual stages. Teams of workers are dedicated to one stage; they repeat that process on each component that comes along.
2. Illustrate this by asking one student to remove various items of clothing and school equipment. This might include sweater, tie, shoes, glasses, pen, etc. Set up an assembly line along which this student moves, having various items added. Ask questions such as:
  - a) Does the order matter? (Sometimes, sometimes not)
  - b) What happens if one of the processes runs out of components? (The whole assembly lines stops)
  - c) If the process was used with a number of students, what are the implications of them being different sizes, etc? (Need specialised components, such as sweaters).
3. Explain that for an assembly line to run well, components have to be interchangeable. Explain that the first example of this was the Colt 45 revolver. Until this time, gun components were custom fitted to each other; i.e. they weren't interchangeable. Samuel Colt realised that interchangeability would make production more efficient.
4. Show video of MINI assembly line and draw out the common features with 'getting a student ready for school' – sequence of stages in a logical order, dependent upon a supply of components.
5. Ask students why, although a supply of components is essential, it might not be a good idea to run with large stocks. Draw out that stocks have to be paid for and therefore stockpiles drain funds. There are other advantages too; upgraded components can be incorporated quickly without having to use up the previous version and there can be a reduction in storage facilities and management. Introduce the concept of 'Just in Time' manufacturing and say that this is used in car production with vehicles such as MINIs.
6. Introduce the idea of Lean manufacturing and the concept of every stage and process being reviewed in terms of the extent to which it adds value in the eyes of the customer. Relate this to the 'getting a student ready for school' activity and ask for suggestions about additional features (combing hair, polishing shoes, etc). Explain that production designers and managers have to consider this; mass produced items are usually sold in a competitive market and customers will choose items that are 'good value'; this comes back to production line design and management.

### Outcomes

- Suggest how a basic example of an assembly line can be made more efficient
- Explain the concepts of terms 'Just in Time manufacturing' and 'Lean manufacturing' and relate them to basic contexts

## Development

### Introduction

The purpose of this session is to engage students in exploring how an assembly line can be run in an efficient and effective way. This is done using an interactive activity based on the production of MINI cars in response to orders but also making effective use of resources such as component stocks and manpower.

### Learning objectives

- Understand the representation of a system and how it relates to the real system.
- Understand how running a production line involves monitoring a number of factors.
- Control factors to improve productivity.

### Learning activities

1. Show students video clips of the MINI production line and ask them to identify key features about how it is organised. Draw out that:

- Components and sub-assemblies (such as engines) are added, building the car up to a finished unit
- Items are added in a logical order; some items have to be added before others
- Different options are available, such as paint schemes
- The supply of components is essential to keeping the whole process under way
- The organisation of personnel is critical.



2. Now introduce the interactive activity. Explain that this is a simplification and adaptation of the real process; it is not a direct copy. Nevertheless the skills needed to make a success of this are similar to those that real production managers and designers have to cope with. Say that the purpose of the activity is for students to experience what it feels like to manage a production process and to learn how to do so successfully. Explain that success is defined by:

- The number of units completed according to customers' orders in the allocated time
- Keeping stock levels low, whilst avoiding stalling the process because components aren't available.
- Using manpower most effectively.

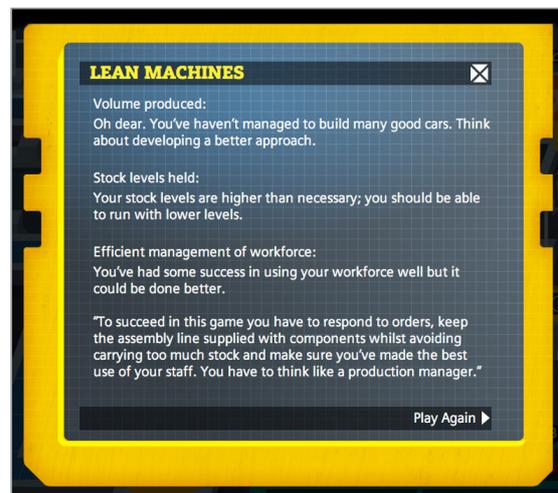
3. Ask students to explore the game and experiment with finding out how it works. After a few minutes ask students a number of questions whilst referring to a large image of the interactive. These might include:

- How do you find out what the customer has ordered?
- How do you start a car on the assembly line?
- How do you make sure the right components and manpower are available?

4. Then give students the chance to use the interactive more and try to obtain a higher score. Discuss with students as they use the activity how they can improve their productivity.

5. Then take feedback. Steer the discussion to a more strategic level by using questions such as:

- How do you get a high score?
- Is it better to have more cars or fewer cars going through at once? What is the optimum number?
- How do you make sure that cars have a clear run through?
- What are the more crucial things to watch out for and monitor?
- What skills do you need to be an effective production manager?



## Outcomes

- Analyse a system in terms of key features
- Reflect on their own performance in managing a system and evaluate the skills being developed

## Introduction

The purpose of this episode is for students to draw together key points and identify the critical features of an effective system.

### Learning objectives

- Reflect on their experiences of running the production line interactive and identify key factors in being successful
- Relate this experience to real production processes and suggest how they can be made more effective.

### Learning activities

- 1. Remind students, if necessary, of the way the interactive works and ask them to identify key aspects to getting a good score.**
- 2. Ask students to reflect on what they've learned about assembly lines and to consider these aspects. Get them to think about not only the interactive but how it relates to a real assembly line. In particular ask them to focus on these points:**
  - a) What are the challenges involved in meeting customer orders? Does a good production process have more 'customer options' or fewer?
  - b) How do you decide what stock levels to maintain? What might encourage you to maintain higher, or lower, stock levels?
  - c) What are the challenges involved with making best use of available manpower?
  - d) What skills do you need to run a production line successfully?
- 3. Draw together key points from this and summarise. Explain that many processes involve such decisions and that there are often compromises or 'trade-offs' that have to be made.**

### Outcomes

- Identify the key factors in a manufacturing process
- Suggest how it can be made more efficient.