Unit 29: Manufacturing Planning

Unit code: K/600/0281

QCF Level 3: BTEC Nationals

Credit value: 10

Guided learning hours: 60

Aim and purpose

This unit aims to give learners the knowledge and skills needed to develop production plans and production schedules based on a product specification.

Unit introduction

There are many new technologies involved in planning the manufacturing of products, parts and components but many smaller companies still operate and work with traditional approaches.

This unit will give learners a good understanding of the basic techniques of manufacturing planning and an awareness of scheduling requirements. It introduces learners to different types of production and will give them knowledge of the stock holding policies that still exist in many engineering companies. Knowledge of the costs associated with holding stock can aid future manufacturing strategies and any related business improvement considerations.

Before learners develop a production plan they are expected to know about the general aspects of planning and control and the techniques used to measure efficiency in a product manufacturing system. Some of these techniques could be explored in detail should learners show an added interest in this area.

Learners are required to produce a production plan from a given range of information within a product specification and prepare a production schedule to support the delivery of the production plan. As such this unit provides underpinning knowledge for a range of other units, particularly those associated with business improvement.

Learning outcomes

On completion of this unit a learner should:

1 Know the techniques and policies used to improve product manufacturing efficiency

2 Know about general aspects of planning and control

3 Be able to use a product specification to produce a production plan

4 Be able to produce a production schedule.

Unit content

1 Know the techniques and policies used to improve product manufacturing efficiency

Types of production: jobbing; batch; cellular; flow; mass; automatic

Stock holding policy: types of inventory eg materials, parts, components, tools, consumables, finished goods; stock holding costs eg ordering/replenishment, holding, obsolescence; buffer stock; re-order levels; storage areas; economic order quantity

eg data, $Q = \sqrt{\frac{2C_s r}{C_c}}$

Appropriate techniques: eg method study, value analysis, job design (ergonomics, layout, safety); work measurement

2 Know about general aspects of planning and control

Aspects of planning: capacity measurement eg machine hours, man hours, throughput, department hours; production planning; pre-production planning; other aspects eg information technology, documentation, health and safety, environmental issues

Control: functions eg production control, quality control

3 Be able to use a product specification to produce a production plan

Product specification: aspects relative to manufacturing and not the customer; type of information required for manufacture eg engineering drawings, process description, make and assembly techniques and requirements, materials required, measurements, tolerances and other quality specifications

Production plan: consideration of a product specification and types of production; requirements (processes, materials required, quantities required, tools and equipment, labour required, estimated process times, quality checks)

4 Be able to produce a production schedule

Production schedule: based on the requirements identified within a production plan; presentation techniques eg use of a Gantt chart, critical path network, line of balance technique; data eg completion deadline, customer requirements, capacity available

Assessment and grading criteria

In order to pass this unit, the evidence that the learner presents for assessment needs to demonstrate that they can meet all the learning outcomes for the unit. The assessment criteria for a pass grade describe the level of achievement required to pass this unit.

Assessment and grading criteria		
To achieve a pass grade the evidence must show that the learner is able to:	**To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:**	**To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:**
P1 describe the six different types of production	**M1** explain the circumstances in which cellular production would be better than batch production	**D1** evaluate the use of a production plan when preparing a production schedule and the dangers of the schedule not meeting stock holding requirements
P2 describe a stock holding policy for a given type of inventory	**M2** explain the importance of different types of information in a product specification when producing a production plan and schedule.	**D2** explain how the use of presentation techniques can be used to overcome capacity and production planning problems.
P3 determine an economic order quantity from given data [IE1]		
P4 describe an appropriate technique used to improve product manufacturing efficiency		
P5 describe the aspects of planning		
P6 describe the two functions of control		
P7 use a product specification to produce a production plan		
P8 describe the use of a production schedule		
P9 produce a production schedule from a production plan and given data. [IE1, IE4]		

PLTS: This summary references where applicable, in the square brackets, the elements of the personal, learning and thinking skills applicable in the pass criteria. It identifies opportunities for learners to demonstrate effective application of the referenced elements of the skills.

Key			
	IE – independent enquirers CT – creative thinkers	RL – reflective learners TW – team workers	SM – self-managers EP – effective participators

Essential guidance for tutors

Delivery

Most of this unit will involve a practical approach to delivery, although certain areas rely on a good underpinning knowledge of the different aspects of planning for manufacture. Learners need an overview of the different manufacturing sectors to enable them to use the correct techniques for different applications.

The unit provides opportunities for learners to study particular industrial case material, particularly when it comes to preparing production plans and schedules. Learners may be from a background where such processes exist and may be more motivated if they can plan and schedule manufacturing in an area they are familiar with. Industrial visits will help underpin the breadth of manufacturing planning used.

The learning outcomes are logically ordered and as such learners would benefit from being taught about types of production, stock control and basic improvement techniques, from learning outcome 1, before they produce production plans and schedules. They should also know beforehand about the general aspects of planning and control.

Obviously centres will need to have examples of production plans and schedules. The use of standard templates can be an appropriate way to ensure learners cover the requirements of a professional plan and schedule. Before assessment of learning outcomes 3 and 4, centres will ideally have developed a range of product specifications. Learners who operate in a workplace may have and be able to use materials relevant to their own place of work.

Note that the use of 'eg' in the content is to give an indication and illustration of the breadth and depth of the area or topic. As such, not all content that follows an 'eg' needs to be taught or assessed.

Outline learning plan

The outline learning plan has been included in this unit as guidance and can be used in conjunction with the programme of suggested assignments.

The outline learning plan demonstrates one way in planning the delivery and assessment of this unit.

Topic and suggested assignments/activities and/assessment
Whole-class teaching: • introduction to unit content and structure • introduction to the six production types. *Small group activity:* • research and discuss case study examples of production types in taken from industry. *Individual learner study:* • look at a specific example of a production type and products.

Topic and suggested assignments/activities and/assessment
Whole-class teaching: • introduction to policies in manufacturing industries • class discussion on the role of stock holding • explain inventories, costs and other data. *Small group activities:* • investigating and using data collection techniques • find out what other forms of data are available.
Whole-class teaching: • class discussion on issues in production • explain use of product specifications. *Small group activity:* • research examples of product specifications. *Whole-class teaching:* • class discussion on the need for planning and control • explain use of stock control techniques. *Small group activity:* • investigate stock control policies and required data • group presentation – why do we need planning and control policies?
Preparation for and carrying out **Assignment 1: Types of Production in Manufacturing Industries** (P1, P2, P3 and M1)
Whole-class teaching: • introduction to planning and scheduling • class discussion on the need for stock control and planning • explain central aspects of planning and control. *Individual/small group activity:* • investigate production plans and schedules • investigate at plan templates from industry • review case study examples of templates used in industry.
Preparation for and carrying out **Assignment 2: Product Specifications** (P4, P5 and M2)
Whole-class teaching: • explain how to develop product specifications and plans • explain principles of production scheduling • developing production plans from specifications. *Small group activity:* • review case study examples of production plan templates • investigate and discuss shared product specifications.
Preparing for and carrying out **Assignment 3: Product Planning and Scheduling** (P6, P7, P8, M2, D1 and D2)
Feedback and unit evaluation.

Assessment

It is important that the assessment strategies used are designed to suit the needs of learners and any local industry requirements. Good assessment strategies need to be supported by the proper presentation of appropriate evidence. The portfolio should not contain course notes, research etc unless it is part of the required evidence and assessment.

Work done through the use of case-study material can be used to generate evidence for learners' portfolios. An integrated approach to this unit would be a suitable way for learners to gather evidence, particularly for learning outcomes 3 and 4.

To achieve a pass grade, learners should demonstrate knowledge of types of production, stocking policies and techniques used to improve manufacturing efficiency. Learners are also expected to describe general aspects of planning and control and the use of a production schedule. They should then be able to demonstrate the correct development of a production plan when using a product specification, a schedule and other data.

This unit could be assessed using three assignments. The first assignment could cover learning outcome 1 and its associated criteria (P1, P2, P3, P4 and M1), with a task set for each criterion. For P3, a range of data – such as ordering or replenishment costs per order (C_s), holding costs (C_c) and usage rate (r) – should be given to allow an economic order quantity (Q) to be determined.

Criteria P5 and P6 could be set within a second assignment as separate written tasks.

A final assignment could be developed to cover P7, P8, P9, M2 and both the distinction criteria. A product specification should be made available to each learner for them to use to develop a production plan. They could then be asked to produce a production schedule when given further data, such as completion time and capacity available. Standard templates for both the plan and schedule can be used as this would be similar to industrial practice.

Another task would then need to given, asking learners to provide a written response when describing the use of a production schedule. Further written tasks should also be included to cover M2, D1 and D2.

To achieve a merit grade, learners should be able to explain what parts of the product specification are most important when developing a plan and schedule. A task for M1 could be given to build on the response given to criteria P1, P2 and P3 in the first assignment. A task for M2 should be left until all pass criteria have been attempted and therefore be in the third and final assignment about planning and scheduling.

To achieve a distinction grade, learners should demonstrate a comprehensive knowledge understanding and of manufacturing planning. Learners will confidently evaluate the development of a production schedule when using a production plan and other data in terms of whether that schedule will have an effect on stock holding requirements (D1). They should also be able to explain how information found in Gantt charts and critical path network documents could be used to identify and help overcome any over-capacity problems and how improvements can be made to the production plan (D2). Both criteria require written tasks set in the final assignment.

Programme of suggested assignments

The table below shows a programme of suggested assignments that cover the pass, merit and distinction criteria in the assessment and grading grid. This is for guidance and it is recommended that centres either write their own assignments or adapt any Edexcel assignments to meet local needs and resources.

Criteria covered	Assignment title	Scenario	Assessment method
P1, P2, P3, P4 and M1	Types of Production in Manufacturing Industries	A written activity requiring learners to look at a case study of real life production and stock control.	Written responses to case study based questions about the key features of different production types and describing a stock holding policy and the techniques used to improve efficiency.
P5, P6 and M2	Product Specifications	A written assignment and oral questioning on developing a product specification for an existing product and designing a common specification template that accounts for control functions in production.	A whole group activity with learners creating a product specification for a real world product they have access to and describing a product template for use in further assignments that describes planning and control aspects of production.
P7, P8, P9, M2, D1 and D2	Product Planning and Scheduling	Presenting a production plan and schedule based on a product specification. Write up report on the presentation and production schedule.	Presentation and accompanying documents that describe the use of a production schedule and other data. Written report on presentation evaluating the use made of the production schedule and the presentation techniques used.

Links to National Occupational Standards, other BTEC units, other BTEC qualifications and other relevant units and qualifications

This unit forms part of the BTEC Engineering sector suite. This unit has particular links with the following unit titles in the Engineering suite:

Level 1	Level 2	Level 3
		Computer Aided Manufacturing

The unit also contributes towards the knowledge and understanding for the SEMTA Level 3 National Occupational Standards in Engineering Leadership, particularly Unit 4: Schedule Engineering Activities.

Essential resources

A range of production data and information as described in the unit content is needed for learning and assessment. Ideally, examples and data from industry will be provided and access to manufactured products will be required.

Employer engagement and vocational contexts

Centres should make use of potential local employer links in order to provide learners with opportunities to see manufacturing planning and scheduling techniques in an industrial setting.

There are a range of organisations that may be able help centres engage and involve local employers in the delivery of this unit, for example:

- Work Experience/Workplace learning frameworks – Centre for Education and Industry (CEI, University of Warwick) – www.warwick.ac.uk/wie/cei
- Learning and Skills Network – www.vocationallearning.org.uk
- Network for Science, Technology, Engineering and Maths Network Ambassadors Scheme – www.stemnet.org.uk
- National Education and Business Partnership Network – www.nebpn.org
- Local, regional Business links – www.businesslink.gov.uk
- Work-based learning guidance – www.aimhighersw.ac.uk/wbl.htm

Indicative reading for learners

Textbooks

Slack N, Chambers S and Johnston R – *Operations Management* (Prentice Hall, 2003) ISBN 0273679066

Timings R L – *Basic Manufacturing* (Newnes, 2004) ISBN 0750659904

Waters D – *Inventory Control and Management* (John Wiley and Sons, 2003) ISBN 0470858761

Delivery of personal, learning and thinking skills

The table below identifies the opportunities for personal, learning and thinking skills (PLTS) that have been included within the pass assessment criteria of this unit.

Skill	When learners are ...
Independent enquirers	identifying questions to answer and problems to solve in order to determine economic order quantities analysing a production plan to produce a production schedule.

Although PLTS are identified within this unit as an inherent part of the assessment criteria, there are further opportunities to develop a range of PLTS through various approaches to teaching and learning.

Skill	When learners are ...
Independent enquirers	analysing and evaluating production information and judging the value of different stock control techniques
Creative thinkers	trying out alternative ideas on production planning and scheduling and questioning the assumptions of existing plans
Reflective learners	assessing their own contributions to planning and specification development and identifying further contributions they can make
Team workers	taking responsibility for their own contributions to developing a common template and having confidence in their own solutions to production scheduling
Self-managers	working towards clear, common goals of template production and organising their own thinking in a coherent form.

Functional Skills – Level 2

Skill	When learners are ...
ICT – Find and select information	
Select and use a variety of sources of information independently for a complex task	researching different production types and existing product specifications in manufacturing industries
Access, search for, select and use ICT-based information and evaluate its fitness for purpose	using company websites and manufacturing sector websites to identify common control systems
ICT – Develop, present and communicate information	
Enter, develop and format information independently to suit its meaning and purpose including: • text and tables • images • numbers • records	describing types of production, stock holding policies and techniques for improving manufacturing efficiency describing and aspects of planning and control functions
Bring together information to suit content and purpose	using a product specification to produce a production plan
Present information in ways that are fit for purpose and audience	describing the use of a production schedule producing a production schedule from a production plan and given data explaining the importance of different types of information in a product specification when producing a production plan and schedule explaining how the use of presentation techniques can be used to overcome capacity and production planning problems
Evaluate the selection and use of ICT tools and facilities used to present information	explaining how the use of presentation techniques can be used to overcome capacity and production planning problems
English	
Speaking and listening – make a range of contributions to discussions and make effective presentations in a wide range of contexts	engaging in group and whole-class discussions over industry issues
Reading – compare, select, read and understand texts and use them to gather information, ideas, arguments and opinions	extracting information on production types from case studies
Writing – write documents, including extended writing pieces, communicating information, ideas and opinions, effectively and persuasively	describing features of production plans and schedules and evaluating how they deal with common issues.