



Qualifications and
Curriculum Authority

Criteria for the Diploma qualifications in Manufacturing and Product Design at levels 1, 2 and 3

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CONTENTS

PURPOSE	3
AIMS	4
EQUALITY AND DIVERSITY	5
STRUCTURE	6
THEMES	7
1 LEVEL 1: SUMMARY OF THEMES AND TOPIC TITLES	9
1.1 Level 1 Topic 1: Introduction to Manufacturing [30 GLH]	10
1.2 Level 1 Topic 2: Dealing with Customers and Suppliers [30 GLH]	11
1.3 Level 1 Topic 3: Introduction to Working Practices [30 GLH]	12
1.4 Level 1 Topic 4: Introduction to Product Design and Development [60 GLH]	13
1.5 Level 1 Topic 5: Introduction to Materials Science [30 GLH]	14
1.6 Level 1 Topic 6: Manufacturing a Product [60 GLH]	15
2 LEVEL 2: SUMMARY OF THEMES AND TOPIC TITLES	16
2.1 Level 2 Topic 1: Running a Manufacturing Business [60 GLH]	17
2.2 Level 2 Topic 2: The Global Business World [60 GLH]	18
2.3 Level 2 Topic 3: Working in Manufacturing [60 GLH]	19
2.4 Level 2 Topic 4: Designing and Developing Products [60 GLH]	20
2.5 Level 2 Topic 5: Materials science [60 GLH]	21
2.6 Level 2 Topic 6: Processing Systems [60 GLH]	22
2.7 Level 2 Topic 7: Product Manufacture [60 GLH]	23
3 LEVEL 3: SUMMARY OF THEMES AND TOPIC TITLES	24
3.1 Level 3 Topic 1: Manufacturing Business Principles [60 GLH]	25
3.2 Level 3 Topic 2: Customer Needs and Market Requirements [60 GLH]	26
3.3 Level 3 Topic 3: Supply Chain Management [30 GLH]	27
3.4 Level 3 Topic 4: Management of Resources and Working Practices [30 GLH]	28
3.5 Level 3 Topic 5: Research, Development and the Introduction of New Products [90 GLH]	29
3.6 Level 3 Topic 6: Materials Science [90 GLH]	30
3.7 Level 3 Topic 7: Production and Processing Systems [90 GLH]	31
3.8 Level 3 Topic 8: Management of Production and Processing Operations [60 GLH]	33
3.9 Level 3 Topic 9: Quality Assurance in Manufacturing [30 GLH]	34
4 PERSONAL, LEARNING AND THINKING SKILLS	35
5 FUNCTIONAL SKILLS	35

INTRODUCTION

PURPOSE

The purpose of this document is to record a full set of criteria for Principal Learning. This document should be read in conjunction with the document *Criteria for accreditation of specialised Diploma qualifications at levels 1, 2 and 3* (QCA/07/3112) which defines the overarching criteria for all Diplomas at level 1, 2 and 3 and the *Line of Learning Statement in Manufacturing and Product Design* produced by the Diploma Development Partnership (DDP) representing the industries covered.

NB All references to Guided Learning Hours (GLH) within this document are for the purposes of ensuring that there is sufficient content specified at each level to enable the design of qualifications. GLH are not intended to indicate final unit sizes or design.

The purpose of the Line of learning Criteria is two-fold:

- to provide the regulatory tools (alongside the overarching criteria) which QCA will use to accredit qualifications that are developed for the Diploma and admit qualifications and/or units of accredited qualifications into the Diploma catalogue; and
- to specify the requirements against which awarding bodies will develop their units and/or qualifications for the Diploma and submit qualifications and/or units of accredited qualifications for the Diploma catalogue.

AIMS

The general aims of the Diploma are identified in Section 2 of the document *Criteria for accreditation of specialised Diploma qualifications at levels 1, 2 and 3* (QCA/07/3112).

The Diploma in Manufacturing and Product Design is for all learners, and has particular relevance to 14-19-year-old learners who seek to acquire knowledge and develop skills in the broad context of manufacturing industries.

The purpose of the Diploma in Manufacturing and Product Design at levels 1, 2 and 3 is to introduce learners to the world of manufacturing.

Principal Learning provides the essential knowledge, skills and understanding for all learners within the sector(s) covered. Specialist Learning enables learners to acquire a deeper understanding and/or application of the topics covered in Principal Learning or to explore a related topic with a more local focus.

Each Diploma in Manufacturing and Product Design will:

- contribute to meeting the drivers and needs of the manufacturing industry
- contribute to sustainability and the future of the manufacturing sector
- support the transfer of skills, knowledge and understanding relevant to manufacturing
- provide information about career options within the manufacturing industries
- appeal to learners, regardless of aptitudes and abilities
- give opportunities to practise and acquire essential functional skills in English, mathematics and Information and Communication Technology (ICT), which are relevant to the level and delivered in the context of manufacturing;
- enable individuals to acquire relevant personal, learning and thinking skills (PLTS) in an engineering context;
- offer progression to other Diplomas, to transfer laterally and progress to further education, apprenticeships and training;
- aid effective transition to further education, work-based learning or higher education and to working life
- provide a motivating learning experience for individual, through a blend of general education and applied learning within a coherent and stimulating programme.

EQUALITY AND DIVERSITY

Diplomas will be based on the principles of inclusion listed below. This will ensure that the Diplomas deliver a world-class inclusive and flexible learning experience through a blend of general education and applied learning.

Each Diploma will provide:

- a motivating and accessible blend of general and actively applied practical learning for all eligible learners;
- coherent programmes which motivate all learners while, at the same time, catering for the diverse needs of individuals;
- equality of access for all learners to different opportunities to explore the sector.

At the design stage, it is important to ensure that the demands of the equalities legislation are incorporated into the Diplomas, for example the Disability Discrimination Act 1995 and subsequent amendments, The Race Relations Act (Amendment) 2002 and The Gender Equality Duties April 2007.

Units of assessment should not require the demonstration of a particular skill or activity that may pose difficulties for learners with disabilities or learning difficulties, unless it is essential to the integrity of what needs to be assessed for a Line of Learning. In cases where demonstration of the particular skill or activity is essential the awarding body should:

- provide QCA with a justification for accreditation of the qualification on this basis
- consider the implication for the use of reasonable adjustments that will permit access without undermining what is being assessed.

To meet the spirit of these Acts and to promote equality, the design and implementation of the Diplomas should reduce barriers to learning and assessment by considering the needs of the following groups of learners:

- learners who might need a range of alternative approaches and resources to demonstrate knowledge and understanding, for example those with learning difficulties, sensory impairments, physical impairments and language communication difficulties;
- those who work at a pace different from that of most students, for example the gifted and talented, those with difficulties with communication, language or literacy, those with caring responsibilities and those with ill health;
- those from different ethnic, cultural and religious backgrounds, through eliminating bias in terms of race, culture and religion and through recognising the value of diversity and the benefits it offers the sector and all learners;
- learners working in different contexts, for example those in residential institutions such as prisons or hospitals, those from different socio-economic backgrounds and those with different amounts of existing social capital.

It is also important that the Diplomas should avoid gender stereotyping and provide positive role models for learners of both sexes in order to challenge traditional career choices made on the basis of socially constructed norms that are frequently unquestioned.

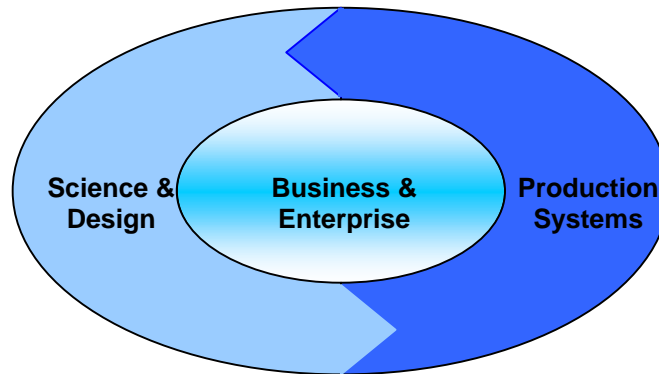
Diplomas must be delivered in environments free from prejudice and discrimination, where all learners can contribute fully and freely and feel valued.

STRUCTURE

Structure of Diplomas in Manufacturing and Product Design			
Level	1	2	3
Total (GLH)	600	800	1080
Principal Learning (GLH)	240	420	540
Generic Learning (GLH)	240	200	180
Additional and Specialist Learning (GLH)	120	180	360

THEMES

The Diploma in Manufacturing and Product Design is structured around the same three integrated themes at each level.



THEME A: BUSINESS AND ENTERPRISE

Manufacturing is responsible for a large portion of the wealth generation in the global economy. This theme will use a range of business and enterprise activities to enable learners to gain practical experience of how the manufacturing industry works. Learners will explore a range of business activities across all areas of manufacturing and consider the importance of these businesses to the local, national and global economies.

THEME B: SCIENCE AND DESIGN

Future product development can only be successful with a deep knowledge of manufacturing technology. It is the combination of both science and design that leads to innovation and the introduction of new products. The theme will consider all aspects of sustainable manufacturing whilst exploring the scientific principles and the properties and characteristics of materials (including new materials).

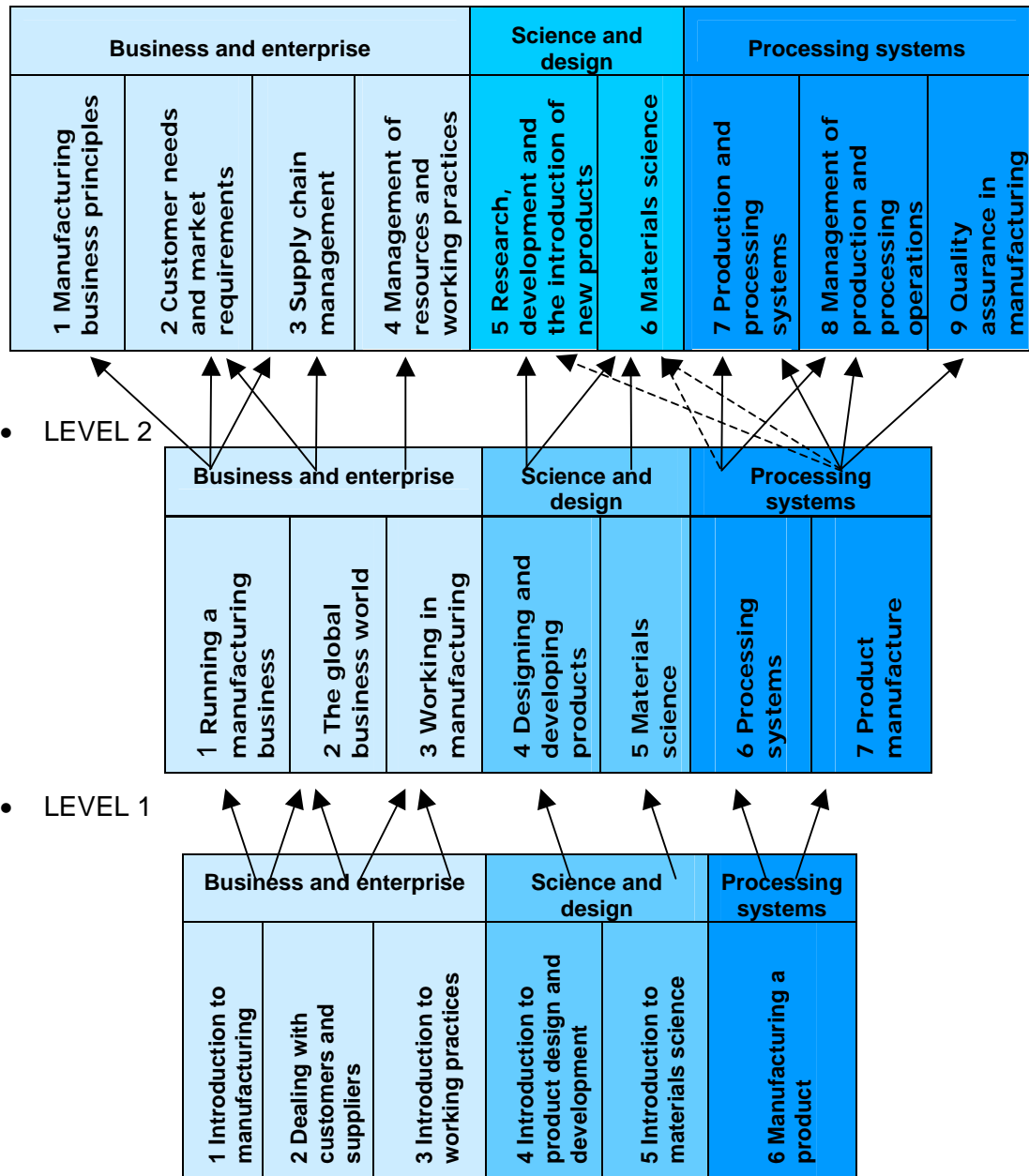
THEME C: PRODUCTION SYSTEMS

This theme will look at implementation and improvement of manufacturing techniques and the development of production methods for the manufacturing of a range of products. Central to the theme will be implementation of quality assurance and continuous improvement techniques.

PROGRESSION ACROSS THE THEMES

The diagram below shows the progression across the three themes from levels 1 to 3.

LEVEL 3



1 LEVEL 1: SUMMARY OF THEMES AND TOPIC TITLES

Themes and topics	GLH
Theme A: Business and enterprise	
Topic 1: Introduction to manufacturing	30
Topic 2: Dealing with customers and suppliers	30
Topic 3: Introduction to working practices	30
Theme B: Science and design	
Topic 4: Introduction to product design and development	60
Topic 5: Introduction to materials science	30
Theme C: Production systems	
Topic 6: Manufacturing a product	60

Flexibility at level 1

Learners taking the level 1 Diploma in Manufacturing and Product Design must take the following three topics.

- 1 Introduction to manufacturing
- 3 Introduction to working practices
- 6 Manufacturing a product.

Learners taking a level 1 Diploma in another line of learning may select any Topic.

1.1 Level 1 Topic 1: Introduction to Manufacturing [30 GLH]

Purpose

The purpose of this topic is to enable learners to understand:

- manufacturing as a business;
- the range of sectors involved in manufacturing and the products they produce; and
- the influence of price, cost and competition.

This topic linked to topics 2 (*Dealing with Customers and Suppliers*) and 3 (*Introduction to Working Practices*).

Scope of content

Learners must know and understand:

1. the main business processes that are used in a manufacturing business
2. the main sectors of manufacturing and what products they typically produce
3. the importance of wealth creation to both the company, community and employee
4. what social, economic and environmental needs an example manufacturing business seeks to meet
5. how the manufacturing industry in the UK has been generally affected by world trading
6. how costs and prices affect the supply of materials and labour
7. the different types of costs that a manufacturing business must meet.

Learners must be able to:

1. use basic manufacturing terminology
2. calculate simple costs (for example, cost of materials and labour within product price, sales per month).

In order to engage with this topic effectively, learners must use the following PLTS:

- independent enquirers

1.2 Level 1 Topic 2: Dealing with Customers and Suppliers [30 GLH]

Purpose

The purpose of this topic is to enable learners to understand:

- why good customer service is important both within the manufacturing business and for its customers and suppliers
- how employees can add value to a manufacturing business by what they do and how well they do it
- how to provide customer service.

This topic is linked to topic 1 (*Introduction to Manufacturing*).

Scope of content

Learners must know and understand:

1. the basic principles of customer service (for example, communicating with customers, personal presentation and keeping accurate customer records)
2. why internal and external customers and suppliers are important to a manufacturing business
3. why and how to follow customer service procedures
4. what laws and moral duties manufacturers and suppliers must follow when selling products and why
5. what legal rights customers have
6. what quality assurance is and why it is important for customer service.

Learners must be able to:

1. present themselves to customers and suppliers in an appropriate manner
2. deal with customers and suppliers, following customer service procedures
3. provide accurate information to customers and suppliers
4. use an organisational database to look up and record information about customers and suppliers.

In order to engage with this topic effectively, learners must use the following PLTS:

- effective participators
- team workers.

1.3 Level 1 Topic 3: Introduction to Working Practices [30 GLH]

Purpose

The purpose of this topic is to enable learners to understand:

- the range of job roles involved in manufacturing and what they involve
- the key laws that apply in the workplace
- how to participate effectively when working as part of a team to produce a product.

This topic is linked to topics 1 (Introduction to Manufacturing) and 6 (Manufacturing a Product).

Scope of content

Learners must know and understand:

1. the range of departments and job roles in different sized manufacturing businesses within a sector
2. what different job roles involve and how the work of different departments or teams link in a manufacturing business
3. what responsibilities employers and employees have to each other
4. why effective teamwork is important in manufacturing
5. why health and safety and environmental laws must be followed
6. why codes of conduct must be followed
7. what equality and diversity requirements are set for manufacturing businesses.

Learners must be able to:

1. behave responsibly in a workplace
2. carry out their own responsibilities and supporting others to meet targets
3. contribute to identifying health and safety risks and meeting environmental requirements.

In order to engage with this topic effectively, learners must use the following PLTS:

- team workers
- self-managers
- reflective learners.

1.4 Level 1 Topic 4: Introduction to Product Design and Development [60 GLH]

Purpose

The purpose of this topic is to enable learners to understand:

- how customer and client needs influence the design of products and how they are specified
- how products are design and developed for manufacturing;
- how to analyse product designs, gather feedback from customers or clients and describe what products need to be like (product design specification).

This topic is linked to topics 5 (*Introduction to Material Science*) and 6 (*Manufacturing a Product*).

Scope of content

Learners must know and understand:

1. what the features and intended benefits of example manufactured products are
2. what a product design specification is for and how it is developed
3. why product analysis is important to the design and development process
4. how to analyse whether an example product is suitable for the customer or client
5. how computer aided design (CAD) has influenced design in manufacturing
6. what issues manufacturers must consider in the design of a product (for example, legislation, costs, aesthetics, sustainability, ease of manufacturing, customer or client needs)
7. how different materials are selected for example products.

Learners must be able to:

1. carry out user tests to analyse products and design issues
2. select suitable materials for products from a range of given materials
3. draw up a product design specification for an example product.

In order to engage with this topic effectively, learners must use the following PLTS:

- creative thinkers
- independent enquirers.

1.5 Level 1 Topic 5: Introduction to Materials Science [30 GLH]

Purpose

The purpose of this topic is to enable learners to understand:

- the basic chemical, biological and physical properties and characteristics of materials that are important to different products and production processes within a sector
- how to carry out simple tests safely on different raw materials and finished products.

This topic is linked to topics 4 (*Introduction to Product Design* and development) and 6 (*Manufacturing a Product*).

Scope of content

Learners must know and understand:

1. the main properties, characteristics and uses of a range of different materials within an example sector
2. what testing and measurement methods can be used to investigate the nature and composition of raw materials and finished products in a sector
3. what basic scientific theories can be understood from the testing methods used
4. what the results of tests can be used for
5. what health and safety laws apply to the measurement and testing of materials.

Learners must be able to:

1. carry out basic testing and measurement techniques
2. follow safe working practices
3. record, present and store the results of investigations.

In order to engage with this topic effectively, learners must use the following PLTS:

- independent enquirers.

1.6 Level 1 Topic 6: Manufacturing a Product [60 GLH]

Purpose

The purpose of this topic is to enable learners to understand:

- the appropriate technical and practical skills needed to manufacture a product to a given specification by following standard operating procedures
- how to contribute safely, efficiently and effectively to manufacturing a product
- what laws and regulations apply to manufacturing a product.

This topic is linked to topic 3 (*Introduction to Working Practices*), 4 (*Introduction to Product Design and Development*) and 5 (*Introduction to Material Science*).

Scope of content

Learners must know and understand:

1. the processes and stages involved in an example manufacturing operation
2. what properties and quantities of raw materials are required to make a finished product
3. what plant and equipment is required to manufacture a product
4. the laws manufacturers must meet in the production of a product
5. why product design specifications are important and what can happen if they are not followed
6. why it is important not to waste materials, time and other resources
7. how computers and control systems are used in process operations
8. what would change if a product were manufactured in different quantities.

Learners must be able to:

1. follow standard operating procedures for the manufacture of a product, including:
 - a. gathering relevant materials
 - b. calculating quantities of materials
 - c. using appropriate tools and equipment
 - d. checking quality and meeting production targets
 - e. meeting health and safety guidelines.

In order to engage with this topic effectively, learners must use the following PLTS:

- team workers
- effective participators.

2 LEVEL 2: SUMMARY OF THEMES AND TOPIC TITLES

Themes and topics	GLH
Theme A: Business and enterprise	
Topic 1: Running a manufacturing business	60
Topic 2: The global business world	60
Topic 3: Working in manufacturing	60
Theme B: Science and design	
Topic 4: Designing and developing products	60
Topic 5: Materials science	60
Theme C: Production systems	
Topic 6: Processing systems	60
Topic 7: Product manufacture	60

2.1 Level 2 Topic 1: Running a Manufacturing Business [60 GLH]

Purpose

The purpose of this topic is to enable learners to understand:

- how a manufacturing business is structured and how the different functions, roles and responsibilities work together to create a profitable and sustainable enterprise
- why budgeting, cash flow and financial management are critical to business success
- how to complete and interpret basic financial records (such as, cash flow forecast, balance sheet and profit and loss account).

This topic is linked to topics 2 (*The Global Business World*) and 3 (*Working in Manufacturing*).

Scope of content

Learners must know and understand:

1. how different sized manufacturing businesses are structured in terms of functions and roles and what effect this has on the way they operate
2. the laws that apply to manufacturing, who sets them and how they are enforced
3. why budgets, cash flow and financial targets are important in a manufacturing enterprise
4. the basic categories of costs and components of a balance sheet and a profit and loss account
5. how costs vary in relation to the volume of production and the ways businesses increase income and decrease costs
6. why it is important to calculate break even points.

Learners must be able to:

1. use basic financial terms (for example, profit, loss, cash flow, margins, VAT or return on investment)
2. enter data onto a financial spreadsheet
3. interpret basic financial documents (for example, cash flow forecast, balance sheet or profit and loss account)
4. calculate and check the accuracy of basic costs and break even figures.

In order to engage with this topic effectively, learners must use the following personal learning and thinking skills:

- independent enquirers.

2.2 Level 2 Topic 2: The Global Business World [60 GLH]

Purpose

The purpose of this topic is to enable learners to understand:

- how manufacturing responds to social, economic, environmental and sustainability issues
- how the global market impacts on products and marketing
- the relationship between the customer, the business and their suppliers
- how products are marketed and why the approach varies across different markets and products.

This topic is linked to topics 1 (*Running a Manufacturing Business*) and 3 (*Working in Manufacturing*).

Scope of content

Learners must know and understand:

1. how manufacturing businesses address social, economic, environmental and sustainability issues within a sector
2. what general effects the world market economy and global trading has had on manufacturing industry in the UK
3. the links between different business processes relating to customers, suppliers, product development and delivery
4. how marketing is used as a tool to promote different products in different markets.

Learners must be able to:

1. interpret basic statistical data about manufacturing
2. present information about markets and customer needs.

In order to engage with this topic effectively, learners must use the following PLTS:

- independent enquirers
- creative thinkers.

2.3 Level 2 Topic 3: Working in Manufacturing [60 GLH]

Purpose

The purpose of this topic is to enable learners to understand:

- the roles, functions, career and training opportunities in manufacturing
- how employees can add value to a company by their attitudes and behaviours, and how they can make a difference through problem solving and innovation
- the responsibilities that employers and employees must and should show
- how to work as part of a team to contribute to different stages of the production process.

This topic is linked to topics 1 (*Running a Manufacturing Business*) and 2 (*The Global Business World*).

Scope of content

Learners must know and understand:

1. what technical and administrative support roles are needed within a sector
2. what legal, social and ethical responsibilities are placed on employers and employees
3. how equality and diversity requirements are put into practice in the workplace
4. the role of trade unions and employee groups in manufacturing
5. what laws, rights and moral duties apply to employees in manufacturing businesses
6. how individuals' roles, responsibilities, behaviours and actions influence the achievement of team goals
7. why efficient and effective team working is important in manufacturing business
8. what careers, pre-entry and on-the-job training are available within a manufacturing sector.

Learners must be able to:

1. carry out agreed responsibilities safely, effectively and efficiently and support others to meet team goals
2. seek clarification from an appropriate person when what they have been asked to do is not clear and
3. report issues or problems to a responsible person.

In order to engage with this topic effectively, learners must use the following PLTS:

- effective participators
- reflective learners
- team workers

2.4 Level 2 Topic 4: Designing and Developing Products [60 GLH]

Purpose

The purpose of this topic is to enable learners to understand:

- how the different stages of research and development add value to products and manufacturing processes
- the range of factors that affect product design and development
- how to draw up a product design specification based on product analysis, the client brief or customer research.

This topic is linked to topics 5 (*Materials Science*) and 7 (*Product Manufacture*).

Scope of content

Learners must know and understand:

1. the design process and basic principles of good design
2. why research, design and development are important in manufacturing and what is involved
3. what factors may affect the design and manufacture of a product (for example, cost, concern for the environment or new developments in materials)
4. how social, economic and sustainability factors are taken into account the development and design of a manufactured product (for example, values and beliefs of others, sustainability, fair trade and human rights)
5. how to evaluate whether the features and benefits of a manufactured product meet the client's or end user's needs
6. what the product design specification for a manufactured product includes and why it is needed
7. how to design a prototype and draw up a product design specification to meet a client brief of customer research.

Learners must be able to:

1. design and carry out surveys to explore customer needs
2. analyse the design of manufactured products
3. interpret a client brief or customer research
4. develop design ideas for a prototype, using CAD where appropriate
5. draw up a simple product design specification for a manufactured product.

In order to engage with this topic effectively, learners must use the following PLTS:

- independent enquirers
- creative thinkers.

2.5 Level 2 Topic 5: Materials science [60 GLH]

Purpose

The purpose of this topic is to enable learners to understand:

- how scientific and technical developments, and future requirements (such as, biodegradable, 'smart' or nano-materials) affect production processes
- how the chemical, biological and physical properties and characteristics of materials affect the manufacture of products
- how to test and process example materials.

This topic is linked to topic 4 (*Designing and Developing Products*).

Scope of content

Learners must know and understand:

1. what materials, scientific processes and principles are used to manufacture products within a sector and increase productivity and sustainability
2. what testing, analysis and measurement methods are used for a variety of materials
3. how to investigate the chemical, biological and physical properties of materials
4. the main chemical, biological and physical properties and uses of example materials
5. how laboratory activities for investigating materials differ from commercial activities.

Learners must be able to:

1. use scientific terminology, symbols and units
2. prepare materials for investigation in line with health and safety and organisational guidelines
3. test, analyse and measure example materials safely
4. record observations and measurements
5. analyse results and draw conclusions.

In order to engage with this topic effectively, learners must use the following PLTS:

- independent enquirers
- self-managers.

2.6 Level 2 Topic 6: Processing Systems [60 GLH]

Purpose

The purpose of this topic is to enable learners to understand:

- the main manufacturing processes and systems and how to maximise efficiency while maintaining safety
- why quality assurance and control are central to cost-effective production
- what aspects of production may need to be checked and how to measure quality at different stages of production.

This topic is linked to topic 7 (*Product Manufacture*).

Scope of content

Learners must know and understand:

1. what different processes are used within a manufacturing enterprise
2. how technology is used to maximise efficiency within a manufacturing enterprise
3. how the processes would differ if a product was manufactured in different quantities
4. what may happen if health and safety laws and guidelines are not followed
5. what control procedures are used for the safe use of tools, equipment and plant to manufacture a product
6. what critical control points and procedures are selected and used to protect a product during each stage of manufacture
7. what measuring equipment is used to monitor quality of a product and the services used to manufacture it (for example, heat, light or power)
8. why it is important to calibrate equipment regularly and accurately.

Learners must be able to:

1. apply control techniques safely in line with relevant laws and guidelines
2. use measuring equipment safely to check quality to a given tolerance.

In order to engage with this topic effectively, learners must use the following PLTS:

- reflective learners
- team workers
- effective participators.

2.7 Level 2 Topic 7: Product Manufacture [60 GLH]

Purpose

The purpose of this topic is to enable learners to understand:

- the technical skills needed to work as an effective part of a production team within a manufacturing enterprise
- the constraints on working practices, such as compliance with new health safety laws, environmental impact of waste disposal and energy use
- how to follow standard operating procedures for a product.

This topic is linked to topics 4 (*Designing and Developing Products*) and 6 (*Processing Systems*).

Scope of content

Learners must know and understand:

1. why it is important to follow product design specifications, standard operating procedures and integrate operations when manufacturing a product
2. why following health and safety legislation is so important in the workplace
3. what methods are used to maximise efficiency in the manufacturing process (for example, lean manufacture and maintenance systems)
4. why it is important to consider environmental impact and cost (for example, of remanufacture, recycling materials and the safe disposal of waste materials)
5. what different energy resources are used and their costs (including renewable resources)
6. how products can be packaged within a sector
7. how products and materials are transported and stored within a sector.

Learners must be able to:

1. Contribute to manufacturing a product by following a standard operating procedure, in line with the specification and agreed tolerances, including:
 - a. interpreting a product design specification and standard operating procedure
 - b. calculating the quantities of materials
 - c. setting up or calibrating equipment
 - d. applying quality control methods
 - e. checking work, checking progress and meeting production targets
 - f. following healthy and safe guidelines.

In order to engage with this topic effectively, learners must use the following PLTS:

- team workers
- effective participators
- self-managers.

3 LEVEL 3: SUMMARY OF THEMES AND TOPIC TITLES

Themes and topics	GLH
Theme A: Business and enterprise	
Topic 1: Manufacturing business principles	60
Topic 2: Customer needs and market requirements	60
Topic 3: Supply chain management	30
Topic 4: Management of resources and working practices	30
Theme B: Science and design	
Topic 5: Research, development and introduction of new products	90
Topic 6: Materials science	90
Theme C: Production systems	
Topic 7: Production and processing systems	90
Topic 8: Management of production and processing operations	60
Topic 9: Quality assurance in manufacturing	30

3.1 Level 3 Topic 1: Manufacturing Business Principles [60 GLH]

Purpose

The purpose of this topic is to enable learners to understand:

- how manufacturing enterprises are structured, managed and lead
- how economic, environmental, political and social factors affect business operations and sustainability
- the influence of financial planning and cost management on profitability.

This topic links to topics 2 (*Customer Needs and Market Requirements*), 3 (*Supply Chain Management*), 4 (*Management of Resources and Working Practices*) and 8 (*Managing Production and Processing Operations*).

Scope of content

Learners must know and understand:

1. why entrepreneurship and leadership are important in manufacturing today
2. the key business structures and functions (for example, relating to customers, suppliers, product development and delivery)
3. what key economic, environmental, political and social issues affect manufacturing (for example, the world market economy, global trading and corporate social responsibility)
4. how an example manufacturing enterprise seeks to meet both social and economic demands
5. how manufacturing enterprises develop policies to make sure they comply with environmental, employment, financial and business legislation
6. what financial planning techniques are used to run a manufacturing enterprise successfully (for example, accounts, budgets, cost benefit analyses and returns on investment)
7. how to evaluate risk against benefits to sustain the long term viability of a manufacturing enterprise
8. what techniques manufacturing enterprises use to improve performance.

Learners must be able to:

1. evaluate and recommend policies in line with strategic and legal requirements
2. interpret and construct accurate key financial planning documents.

In order to engage with this topic effectively, learners must use the following PLTS:

- independent enquirers.

3.2 Level 3 Topic 2: Customer Needs and Market Requirements [60 GLH]

Purpose

The purpose of this topic is to enable learners to understand:

- how manufacturing businesses gather and use data about customers and markets to inform product development and delivery
- how businesses respond to their ethical and legal responsibilities (such as, customer protection, the environment and disability)
- how the relationship with customers can be managed to promote sales and improve profits.

This topic links to topics 1 (*Manufacturing Business Principles*), 3 (*Supply Chain Management*), 4 (*Management of Resources and Working Practices*) and 5 (*Research, Development and the Introduction of New Products*).

Scope of content

Learners must know and understand:

1. why marketing operations, organisation and strategy are important
2. how iconic manufacturing achievements have met market requirements and customer needs
3. what marketing and sales structures and techniques are used to promote a product to the customer
4. what market research techniques can be used to explore customers needs and values
5. how analysis techniques can be used to explore market growth or decline (for example, political, economic, social and technological – PEST; political, economic, social, technological, legal and environmental – PESTLE)
6. what laws and codes of practice apply to consumers, sales and marketing
7. why quality standards are important in customer service
8. how example manufacturing businesses identify and try to meet different customer's needs and values.

Learners must be able to:

1. devise and carry out market research
2. analyse statistical data on market requirements.

In order to engage with this topic effectively, learners must use the following PLTS:

- independent enquirers
- creative thinkers.

3.3 Level 3 Topic 3: Supply Chain Management [30 GLH]

Purpose

The purpose of this topic is to enable learners to understand:

- the principles of supply chain logistics
- how supply and demand can be integrated within and across companies
- how supply chain problems can be solved through procurement, logistics and lean manufacturing
- how to contribute ideas and draw up plans to solve supply chain problems.

This topic links to topics 1 (*Manufacturing Business principles*), 2 (*Customer Needs and Market Requirements*), 4 (*Management of Resources and Working Practices*) and 8 (*Managing Production and Processing Operations*).

Scope of content

Learners must know and understand:

1. how supply chain operations are structured and the relationships within the supply chain process
2. what laws apply to supply chain logistics
3. why cost effective supply chain management is important in lean manufacturing
4. why companies need to maintain 'customer focus' throughout the supply chain
5. the main methods of transporting, storing, recycling and safe disposal and goods and materials within a sector
6. why it is important to compare suppliers and supply chain logistic systems (for example, in terms of products, services, prices and impact on environment)
7. how raw materials and supplies are procured to meet the requirements in a product design specification and cost constraints.

Learners must be able to:

1. map and evaluate the supply chain process
2. gather data on and make decisions about potential suppliers
3. calculate quantities of materials or supplies needed.

In order to engage with this topic effectively, learners must use the following PLTS:

- independent enquirers.

3.4 Level 3 Topic 4: Management of Resources and Working Practices [30 GLH]

Purpose

The purpose of this topic is to enable learners to understand:

- the key employment and operational practices in manufacturing
- how supervisory skills can be used to make sure that each individual contributes to achieving organisational goals.

This topic links to topics 1 (*Manufacturing Business Principles*), 2 (*Customer Needs and Market Requirements*), 3 (*Supply Chain Management*) and 8 (*Managing Production and Processing Operations*).

Scope of content

Learners must know and understand:

1. what the entry requirements and on the job training opportunities are for different roles within a manufacturing sector
2. what supervisory responsibilities and skills are required in manufacturing
3. how individuals and teams work together to achieve individual, team and organisational goals
4. why relationships are important between integrated operations in manufacturing a product
5. what employment laws and social, ethical and legal rights and duties apply to employers and employees
6. what roles legislative bodies play in regulating and enforcing laws within a manufacturing sector.

Learners must be able to:

1. take a lead when working as part of a team
2. follow appropriate legislation and guidelines.

In order to engage with this topic effectively, learners must use the following PLTS:

- effective participators
- reflective learners
- team workers.

3.5 Level 3 Topic 5: Research, Development and the Introduction of New Products [90 GLH]

Purpose

The purpose of this topic is to enable learners to understand:

- the stages of product development (for example, market research analysis, research, prototyping and piloting) and how they are used to develop and introduce new products
- the importance of innovation, sustainability and the principles of continuous improvement to manufacturing
- how economic, ethical and environmental issues impact on the design and development of new products
- how to solve product design and development problems.

This topic links to topics 2 (*Customer Needs and Market Requirements*), 6 (*Materials Science*) and 7 (*Processing and Production Systems*).

Scope of content

Learners must know and understand:

1. why research and development are important and how the findings of market research analysis can be used to inform the design of a product
2. how the design process, prototypes, testing and trials are used
3. how product design and new developments in manufacturing technology can enhance sustainable manufacturing methods
4. what laws need to be followed in the design of a product
5. what detail a design specification needs to contain and how it is used in the manufacturing process
6. how issues and principles inform the design process (for example, economics, ethics, environmental impact and continuous improvement)
7. how to revise a product design specification following feedback (for example, from clients, customers or the production department).

Learners must be able to:

1. gather customers views about a product or range of products
2. analyse customer feedback and suggest improvements
3. analyse and evaluate products or prototypes
4. design a product for manufacture
5. produce a product design specification.

In order to engage with this topic effectively, learners must use the following PLTS:

- creative thinkers.

3.6 Level 3 Topic 6: Materials Science [90 GLH]

Purpose

The purpose of this topic is to enable learners to understand:

- the chemical, physical and biological properties and structure of materials and how they are exploited different products and manufacturing processes
- how to carry out different investigation techniques safely
- how science and technology are being used in manufacturing to increase productivity.

This topic links to topics 5 (*Research, Development and the Introduction of New Products*), 7 (*Processing and Production Systems*) and 8 (*Managing Production and Processing Operations*).

Scope of content

Learners must know and understand:

1. why testing materials for characteristics is important (for example, chemical composition, electromagnetic properties and the behaviour of materials on a molecular level)
2. what laws, regulations and guidelines are applied to maintain safety
3. how to investigate the properties, structure and types of bonding found within common materials within a manufacturing sector using appropriate techniques (including non-destructive testing)
4. the characteristics, properties and uses of materials within a manufacturing sector (including 'smart' materials and biomaterials)
5. how the characteristics and properties of example materials can be changed and exploited in different products and manufacturing processes
6. how to produce a secondary material from a primary material
7. why and how scientific principles and technology can be applied to manufacturing processes within a sector and to increase productivity.

Learners must be able to:

1. calibrate equipment safely
2. safely test complex materials (for example, a metallic artefact, bio fuel or soap) and products (for example, a textile, paper, cardboard or bricks)
3. present and interpret results
4. make decisions about product design, development or manufacturing based on the results of tests.

In order to engage with this topic effectively, learners must use the following PLTS:

- independent enquirers.

3.7 Level 3 Topic 7: Production and Processing Systems [90 GLH]

Purpose

The purpose of this topic is to enable learners to understand:

- what is involved in manufacturing a product and how manufacturing processes compare for batch, small- and large-scale production and continuous processing
- how to contribute efficiently and effectively to the manufacture of a product
- how advanced technology and control methods are used in manufacturing processes
- how to contribute to the efficient and safe manufacture of a product to meet customer needs, product design specification and business objectives.

This topic links to topics 5 (*Research, Development and the Introduction of New Products*), 6 (*Materials Science*), 8 (*Managing Production and Processing Operations*) and 9 (*Quality Assurance in Manufacturing*).

Scope of content

Learners must know and understand:

1. how an example enterprise applies manufacturing principles to the processes it uses (for example, right – quantity, quality, cost, place and time)
2. the key stages and features of the operations and processing systems involved in manufacturing a product
3. how production processes are planned and improved to maximise efficiency
4. what effects manufacturing a product in different quantities would have (for example on cost, quality, people or utilisation of plant)
5. how advanced technology is used in a manufacturing process
6. the standard operating procedures and product design specification that applies to a manufacturing process
7. how control technology, control methods and safety controls are used to protect a product, the people involved on the shop floor and the environment
8. the legislation manufacturing operations must comply with.

Learners must be able to:

1. follow standard operating procedures and product design specifications
2. contribute efficiently and effectively to the manufacture of a product
3. use tools, equipment and plant and dispose of resources safely in line with relevant guidelines
4. monitor quality and tolerances against a product design specification.

In order to engage with this topic effectively, learners must use the following PLTS:

- effective participators
- self-managers
- team workers.

3.8 Level 3 Topic 8: Management of Production and Processing Operations [60 GLH]

Purpose

The purpose of this topic is to enable learners to understand:

- the key organisational and management principles and techniques used to maximise productivity and minimise waste
- how to plan and maintain resources in line with health, safety and environmental requirements
- how to review manufacturing operations and identify opportunities for improvement.

This topic links to topics 1 (*Manufacturing Business Principles*), 3 (*Supply Chain Management*), 4 (*Management of Resources and Working Practices*), 6 (*Materials Science*), 7 (*Production and Processing Systems*) and 9 (*Quality Assurance in Manufacturing*).

Scope of content

Learners must know and understand:

1. how an example enterprise manages production and processing operations to meet agreed output requirements
2. how lean manufacture and other methods can be used to maximise efficiency
3. why and when manufacturing plant and equipment needs to be maintained
4. why and how to recycle and safely dispose of manufacturing materials, by-products and waste
5. what affect poor maintenance, wasting materials, resources and energy may have on the cost of manufacturing a product
6. how risk assessment is used in a manufacturing workplace
7. how to select and use problem solving and fault finding techniques to answer the right questions.

Learners must be able to:

1. monitor and record the inputs and outputs of a production process against the specification
2. carry out risk assessments for health, safety and the environment
3. use problem solving techniques to find ways to improve quality or efficiency
4. use fault finding techniques on manufacturing plant and equipment.

In order to engage with this topic effectively, learners must use the following PLTS:

- reflective learners
- independent enquirers.

3.9 level 3 Topic 9: Quality Assurance in Manufacturing [30 GLH]

Purpose

The purpose of this topic is to enable learners to understand:

- the importance of quality assurance in all aspects of manufacturing business
- the principles of total quality management and the use of common management systems for quality assurance
- how to monitor the quality of a product using appropriate techniques.

This topic links to topics 5 (*Research, Development and the Introduction of New products*), 7 (*Production and Processing systems*) and 8 (*Managing Production and Processing Operations*).

Scope of content

Learners must know and understand:

1. what quality means in manufacturing and how poor quality can affect profit margins
2. what quality control processes are used within a manufacturing sector
3. why tolerances are important and how they are defined in product design specifications
4. what an internal and external audit involves
5. how standards are implemented and monitored using quality management systems (for example, ISO 9000 and IIP) within a manufacturing enterprise.

Learners must be able to:

1. use measuring techniques to monitor the quality of a manufacturing process, product or service (for example, heat, light or power)
2. carry out a basic quality audit (for example, on a company, department or process)
3. analyse data, interpret and present results and recommendations.

In order to engage with this topic effectively, learners must use the following PLTS:

- independent enquirers
- reflective learners.

4 PERSONAL, LEARNING AND THINKING SKILLS

Awarding bodies must design learning outcomes and assessment objectives which clearly include opportunities for the development of Personal, Learning and Thinking Skills. Awarding bodies must provide a clear mapping of the coverage of Personal, Learning and Thinking skills within their submission. This should be at the level requested under each topic within the criteria i.e. 'Independent Enquirers, Creative Thinkers etc'.

5 FUNCTIONAL SKILLS

Components and qualifications based on these criteria must provide opportunities for learners to develop and apply functional skills within sector specific contexts. Awarding bodies must provide a summary of appropriate opportunities identified.