Scale of Production

The term 'scale of production' is all about the quantity of products that you're going to manufacture. Commercially there are four main categories for you to learn...

**Jobbing Production — Making a One-Off Product**
1. This is where you're making a *single product*.
2. Every item made will be different, to meet the customer's *individual* and *specific requirements*.
3. This type of production is very *labor-intensive*, and requires a *highly skilled* workforce.
4. Examples are wide-ranging, from made-to-measure furniture to one-off buildings like the Millennium Dome.

**Batch Production — A Specified Quantity of a Product**
1. This is where you're making a *specific quantity* of a particular product.
2. Batches can be *repeated* as many times as required.
3. The *machinery* and *labor* used need to be *flexible*, so they can quickly change from making one batch to making another batch of a similar product.
4. The *time between* batches, when machines and tools may have to be set up differently or changed around, is called *down time*. This is *unproductive* and needs to be kept as short as possible so the manufacturer doesn't lose money.

**Mass Production — High-Volume Production**
1. Making products on a really *large scale*, such as cars or electrical goods.
2. Often uses *expensive specialized equipment* including computer-aided manufacturing (CAM) and industrial robots.
3. As well as all this equipment, you need a *large workforce*.
4. The different stages of production and manufacture are *broken down* into simple repetitive tasks which people are able to learn easily.
5. *Recruitment is relatively easy* — you don't need to employ skilled people.

**Continuous Production — Non-Stop Production 24hrs/day**
1. This involves *non-stop*, uninterrupted production.
2. The specialized equipment required costs so much that it would be too *expensive* to turn it off. So it has to keep running and producing continuously.
3. Examples of continuous production include *oil* and *chemical* manufacture.

Which Category Do I Use in the School Workshop?

If you're making a *single product* that you've designed, with its own specification, it will be *jobbing production*. Sometimes you may work with the rest of the class in small *teams*, all making different parts of a product which then bring together and assemble to produce a number of *identical products*. This will be *batch production*.

It's not what you've got — it's how much you've got of it...

Yup, all that this list boils down to is quantity.

**Manufacturing Systems**

Take a look at these *five main manufacturing systems* and learn how they work.

**Cell Production is Working in Teams to Produce Components**
1. Production stages are *split into individual components*, which are each made by a different production cell.
2. Each cell has a *team* of people working to produce a *single component*.
3. Within each cell the *team is responsible* for all aspects of production, including *quality control* and *maintenance* of the machines.
4. *Advantages* of this method include *teamwork*, *communication*, and *quality*.

**In-Line Assembly is Used for Mass Production**
1. Most of the production line is *automated*.
2. *Unskilled labour* is used mainly for *assembly*, with a small number of semi-skilled operators making sure there is a continuous flow along the production line.
3. A *disadvantage* of this system is the *lack of flexibility* when compared with cells.

**Flexible Manufacturing Systems Use Semi-Skilled Workers**
1. The FMS approach is based on the belief that the *key* to successful manufacturing is a *flexible workforce* and *flexible machinery*.
2. Individual people are *semi-skilled*, being able to do a *variety* of jobs.
3. It works well with *batch production*, where *change* and *flexibility are essential*.

**Concurrent Engineering Needs Good Communication**
1. This is where different stages of the design process can overlap (one can start work before the other has finished) — which saves time.
2. It's essential to make sure there are *good communication links* between all the stages of the design process, e.g., marketing, research, design, planning, manufacture and distribution.
3. The *overall aim* is to design and make the product with *maximum efficiency*.

**Just-in-Time Manufacturing Needs Detailed, Forward Planning**
1. For just-in-time manufacture (JIT), you only buy materials and components *as and when you need them*.
2. This removes the need for *large stockpiles of resources*, saving money and space.
3. Everything has to be kept on *time*, or things can easily go wrong.

**Cell production — hold on, am I in the Biology book by mistake...**

Darned useful stuff this — especially if you're going to go anywhere near the manufacturing industry when you leave school. Well, even if you're not, you still have to learn it for the old GCSEs.
CAD/CAM and CIM in Industry

All this computer-aided stuff is here to make life a little bit easier for everyone. You need to learn what all the abbreviations mean, and how they're useful in industry. (More on this on page 21.)

**CAD/CAM — Computer-Aided Design and Manufacture**
1. CAD (Computer-Aided Design) is all about using computers to help design a product.
2. CAM (Computer-Aided Manufacture) refers to any part of the manufacturing process that's controlled by a computer system.
3. CAD/CAM (Computer-Aided Design and Manufacture) is the process of joining CAD and CAM systems together. This involves the use of specialized computer software that converts data from drawings into machinable instructions.

**CIM — Computer-Integrated Manufacturing**
1. CIM is the system by which different stages of the design process are linked together by a central computer system.
2. A lot of different people are involved in making even the simplest of products and they all need to be aware of what the others are doing.
3. CIM helps coordinate all the different stages in the process using a central computer database.
4. With this system no stage is carried out in isolation, as communication is made easy through the central computer system.

5. The really clever bit is the software held on the central computer. It will automatically update any changes made and alert all the related stages. For example if a change is made in a CAD program, the software will automatically change the corresponding CNC program that controls the manufacturing machines. This can save a lot of time and eliminate some costly mistakes.

Confused Between your CADs & CIMS or your CANs & CATs?
1. CAD — Computer-Aided Design — designing on the computer.
2. CAM — Computer-Aided Manufacture — machining with computers.
3. CAD/CAM — Computer-Aided Design & Manufacture — links CAD & CAM.
4. CIM — Computer-Integrated Manufacturing — links many different stages.
5. CNC — Computer Numerical Control — runs computer-controlled machines.

Feee — it were never like this when I were a lass...

Amazing, all this stuff they can do nowadays. Although probably not if you used to be a craftsman who no longer has a job because all this work's now being done by computers.

Advertising and Marketing

In industry, just making something isn't good enough — you've got to be able to sell it.

**There are Five Key Roles in the Design Process**
A product developed for industry not only needs to work, and fulfill its design purpose — it also needs to make a profit. Along the way, there are key people who have important roles to play:
1. **Client** — identifies a need, gives the designer a clear brief, carries out market research and raises money for the project.
2. **Designer** — develops the client's ideas, sets out a specification and produces detailed working drawings of the final design.
3. **Manufacturer** — plans and carries out manufacturing, safely and efficiently, to produce consistent results and make a profit.
4. **Retailer** — gives customers what they want, at an affordable price.
5. **User** — gets a high quality product that works, fulfills a need and is good value for money.

**Legislation — BSI and ISO**
1. **BSI** — the British Standards Institution is a quality control organisation. It sets out standards, testing procedures and quality assurance techniques.
2. **Kitemark** — any product meeting BSI standards is given a Kitemark, as long as the manufacturer can ensure all their products are of the same standard.
3. **ISO 9000** — the ISO 9000 is an internationally agreed set of standards (see p41).
4. **Drawing conventions** — the ISO standards give specific ways of drawing things (e.g. circuit diagrams), so that anyone looking at a standardised drawing can read it in the same way.

**There are Two Main Types of Marketing**
You either need to find out what people want, or convince them that they want your product.

1. **Advertising Standards** — the ASA (Advertising Standards Authority) regulates all advertising in the UK. It makes sure that adverts are legal, honest, responsible and fair.
   1. **Media** — advertising media include newspapers, magazines, mail, television, radio, cinema, posters, e-mail and the Internet. All advertising aims to influence people, and convince people to buy a product.
2. **Market Research** — this is often useful to find out who your customers are and what their needs are. It can be carried out using published statistics, surveys or questionnaires.

**Designing Your Own Questionnaire**
1. Write your questions carefully, so the answers give you information you can use.
2. Be brief, relevant, clear and informative.
3. Multiple-choice questions are often a good idea.

According to my research, Birmingham Rag Market's the best...
Marketing's such a tricky thing that it's easy to see why companies are so fond of market research. Even if it's a pain in the neck for everyone else who ends up with a doormat covered in junk mail...
Good Working Practice

In school, good working practice is all about forward planning and organisation.
In industry it means pretty much the same thing — it’s just done on a much larger scale.

Quality Control — Controlling the Quality of a Product

Nothing like stating the obvious, eh? (see p41 for more stuff on QC)
1) Quality control is easy to include and monitor in any project if you build it into a flow chart.
2) Many of the questions / decisions (diamond symbols) will form quality control points automatically.

Flow Charts — Project Planning Using Symbols

1) A flow chart is a simple diagram showing the order that things happen in (also see p8).
   It works just as well for a simple school project or a complex manufacturing process.
2) There are standard symbols used, so that once you know the basics you’ll be able to read and understand any flow chart.
   All the shapes are linked with simple arrows, which guide the reader through the chart.

   A start/finish shape is used for the start and finish of a flow chart.
   A rectangle is used to show a process or action.
   A diamond is used for decisions or questions.

3) Often small sections of a project have their own flow chart, to avoid any single chart getting too complicated.
   A summary chart can be used to give an overview of the whole project.
   Leaving the details of each section for the smaller charts.
4) Splits or loops in a flow chart are important where questions need to be asked.
   If you’re including a question, think about all the possible answers, and where those will lead you on the flow chart.

Time Planning Means Forward Thinking

1) Good planning is often just a question of thinking ahead.
   What will need to be done in a project and in what order?
2) One example of a planning tool is a Gantt chart (also see p8). This is a table where you plot activities or stages in a project against time.
3) If realistic time limits are set at the start, then you can use the chart to monitor your progress through a project.
   The marked out areas can be shaded in as they’re completed.
4) Some stages on a Gantt chart will overlap, meaning that you can start one section before the previous section is finished.
   Others won’t overlap, simply running one after another.

I’ve told you once, I’m telling you again — always plan ahead

Well no one said D & T was going to be “fun fun fun all the way” — or if they did, they were lying.
This is pretty tedious, but presumably you do care what grade you get, so I suggest you learn it.

Jigs, Moulds and Templates

Jigs, moulds and templates are pretty handy things all round — they save you a lot of work.
In industry they’re used to increase the speed and efficiency of the production process.

Templates are Used to Make Repetitive Shapes

1) Templates are very easy to make and simple to use.
2) You can use them to reproduce any number of identical shapes from one original pattern (template).
   The original is used to draw, scribe or cut round.
3) Templates need to be strong and hard-wearing so that they can be used repetitively without wearing down.
4) Afterwards, the components can be checked against the templates for accuracy.

Jigs Help Manufacture Repetitive Components

1) A jig guides the tools that are working on a component.
2) Jigs come in many different shapes and sizes and can be specifically made for a particular job.
3) They’re designed to speed up production and simplify the making process.
4) A drilling jig gets rid of the need for complex marking out.
   It can also help cut down on errors, and make sure every component is identical.
5) Some jigs are a standard size and shape and could be used on many different jobs.
   E.g. a dovetail jig enables complex dovetail joints (see p19) to be machined with a router, very quickly and easily, and with minimal measuring and marking out.

Moulds — Reproduce 3-D Shapes

1) Moulds are most commonly used in plastic manufacturing, in processes such as vacuum forming, compression moulding and blow moulding. See p14-15 for more on moulding.
2) Once an accurate mould has been made, detailed plastic shapes can be formed with it over and over again.
3) Industrial moulds are expensive to produce, so a manufacturer needs to be certain of their design, and needs to be able to make large numbers of their product to make it cost-effective.

Design Your Own Jigs, Moulds and Templates...

As part of your GCSE project, you could design and make very simple jigs, moulds or templates to help you produce some of your components.
By doing this you will also be able to illustrate how, in theory, you could put your product into small-scale batch production.

No — this page has nothing to do with Scottish dancing...

This is a pretty groovy section (compared with the rest of the book). It’s got all those colourful little pictures and everything. Well, I like it anyway. You can suit yourself. But I suggest you learn how this stuff saves time in industry and how it could be used to improve your project.

Section Six — Industrial Awareness
Revision Summary for Section Six

Congratulations, you’ve made it through Section Six. There’s a load of important stuff in this section, so you need to revise it well. You can be sure that there’ll always be an exam question on some area of ‘Industrial Awareness’. Try these questions again and again until you know all the important facts and details off by heart.

1) Give a simple definition of “scale of production”. What are the 4 main types?
2) How many products would you make in jobbing production?
3) What type of production would you use to make a specific quantity of a product?
4) Why, in the above production method, do machinery and labour need to be flexible?
5) a) What is large-scale production (e.g. production of cars or electrical goods) called?
   b) How are the tasks broken down, and what skill level is needed of the workforce?
6) In continuous production, why do the machines have to run non-stop?
7) Describe cell production, and list 3 advantages of it.
8) Describe in-line assembly, and give one disadvantage of it.
9) What does FMS stand for? What does this approach see as the key to successful manufacturing?
10) Which manufacturing system needs good communication links between stages?
11) What does JIT stand for? What things does it eliminate?
12) Which of the manufacturing systems is best? Explain how you would choose.
13) What does CAD stand for, and what’s it all about?
14) What does CAM stand for? What processes does it refer to?
15) Explain the process of CAD/CAM. What does it involve?
16) Describe CIM. What does it do, and what’s the really clever bit?
17) List some of the advantages of using CIM.
18) What are the 5 key roles in the design process? Describe each in detail.
19) What does BS stand for? Describe what it sets out to do.
20) Sketch a Kitemark and explain what it stands for.
21) What is the ISO 9000? What does it aim to do?
22) Why does part of the ISO outline specific drawing requirements?
23) Which authority regulates all British advertising?
24) Explain the role of the media in advertising? What’s the main purpose of an advert?
25) Why is market research important?
26) If you were designing a questionnaire, how would you structure the questions?
27) What is a flow chart?
28) Sketch the standard symbols used in a flow chart, and explain what each one represents.
29) When would you use a split or loop in a flow chart?
30) What’s the point of planning ahead in a project?
31) Sketch a simple example of a Gantt chart, and explain how to use it.
32) How can you build quality control into a flow chart? What would it be used for?
33) What are templates used for?
34) What is a jig? Why are drilling jigs useful?