1. Reasons For Implementing **Quality Control** In Production

https://www.youtube.com/watch?v=ypZiSguq4jM https://www.youtube.com/watch?v=HAQirqw3NWw

1	**Problems In Production**	Manufacturers inspect for defects at the end of a production cycle. When problems are spotted, corrections are made after the fact. This causes a huge amount of waste on the part of the manufacturer, increasing costs with the end result being passed on to the end consumer.
2	**Reduce Production Waste**	Refer to lean manufacturing – TIMWOOD (lo4)
3	**Consistency (E.g. Finished Products)**	Important to the overall success of every business. Providing **consistent**, high quality **products** allows your customers to know exactly what to expect every time they purchase your **products**. This increases trust in your brand and can have a significant impact on the number of **products** you sell.
4	**Reduce Costs**	Optimising the design process and reduce costs **without** compromising **quality**.
5	**Conformity (E.G. Industry Standards – Regulations)**	A manufacturer can only place a product on the **EU market** when it meets all the applicable requirements. The conformity assessment procedure is carried out **before** the product can be sold. The European Commission's main objective is to help ensure that **unsafe or otherwise non-compliant products do not** find their way to the EU market.
6	**Reduce Returns (E.G. Reputation – Customer Perception)**	❑ Allow customers to leave reviews ❑ Include high resolution images. ❑ Include thorough and accurate product descriptions. ❑ Provide excellent customer service. ❑ Remove errors from the products /components.

2. Quality Procedures

The system by which a company guarantees that all of your processes are **controlled** and **repeatable** to ensure the quality of the **final product** is the best it can be.

1	**Quality Control**	**QC** is product oriented. This ensures that standards are followed while working on the product.(size, finish, weight, functionality)
2	**Quality Standards**	Documents that provide **requirements**, specifications, guidelines, that can be used to ensure that materials, products are fit for their purpose.
3	**Quality Assurance**	**QA** is process oriented. An activity to ensure that a company is providing the best possible product. (Stages include designing, employee training, waste management, manufacture processes.
4	**Total Quality Management**	Every member of staff must be committed to maintaining high standards of work in every aspect of a company's operations to ensure customer satisfaction.

In manufacturing, **quality control** is a process that **ensures customers receive products free from defects** and meet their needs.

When done the wrong way, it can put consumers at risk or damage the brand.

For example, the recent defect found in **Takata airbags** (Used in numerous cars - Audi, Toyota, Ford, VW, Honda etc…) resulted in the biggest automotive recall in history. The recall includes almost 69 million airbag inflators and will cost billions of pounds.

Beckfoot

Engineering Manufacture

Unit R112: Quality Control Of Engineered Products
Learning Outcome 2: Be Able To Assess Product Quality From Inspection And Quality Control Techniques

Year 10 / 11

enjoy learn succeed

1. Quality Control Techniques Used In Stages Of Production

Quality control is defined as the process of setting standards and testing to make sure something, like a product or service, is done correctly.

1	Application Of Tolerance	**Tolerance** is the allowable variation for any given size in order to achieve a proper function. **Tolerance** equals the difference between lower and upper limit sizes. + / -
2	Sampling Techniques	**Sampling** is a statistical **quality-control** measure that lets a company determine the quality of an entire product lot by testing randomly selected samples.
3	Comparison	An activity for ensuring quality in products by comparing the part against a **template / model / set of criteria.**
4	Corrective Action	An improvement or series of improvements to a production line **process** or **procedure** to correct the root cause(s) of a **fault / defect** to prevent their recurrence. They are the mechanism that drive **continuous improvement**

2. Application Of Basic Inspection Checks In Stages Of Production

Visual Checks

1	Surface Finish	Defined by the three characteristics of **lay, surface roughness, and waviness**; ❑ **Lay** - the direction of the predominant surface pattern. ❑ **Roughness** - a measure of the total spaced surface irregularities. ❑ **Waviness** - the measure of surface irregularities with a spacing greater than that of surface roughness.
2	Comparisons With Standard	Standards specifications are extremely important technical documents in engineering. A technical standard is an **established requirement**. It is usually a **formal document** that establishes uniform engineering or **technical criteria**. The documents prepared by a professional group or committee.

3. Use Of Inspection Equipment In Stages Of Production

Measuring Equipment	Micrometers
Digital Vernier Calipers	Gauges
Comparators (E.G. Master Components; Jigs/Fixtures)	X-rays And Ultrasonics

4. Techniques For Evaluating Product From Quality Control Checks

Quality control involves testing of products and determining if they are within tolerance for the final product.

The purpose of the testing is to determine any needs for corrective actions in the manufacturing process.

1	Comparison Of Product Against Specification - criteria
2	Precision And Accuracy Achieved In Making Processes
3	Quality Of Outcome
4	Measurement (E.G. Important Dimensions; Datum Edges/Faces)
5	Safety Checks (E.G. Consumer Safety; Non-destructive Tests)

Notes	
	QA is **process** oriented and **QC** is **product** oriented **Quality Assurance** - the whole package of making components (Workforce training, machine maintenance, Management, Customer care / service) . **Quality Control** ensures that the standards are followed while working on the product.(measuring, scanning, weighing, testing the actual product).

Beckfoot

Engineering Manufacture

Unit R112: Quality control of engineered products

Learning Outcome 3: Know how modern technologies can be used in quality control

Year 10 / 11

enjoy learn succeed

1. Applications Of Modern Technologies

Non-destructive Testing – **testing** techniques used by industry to evaluate the properties of a material, component, or structure for defects **without** causing damage to the original part

1	Visual Inspection	Used extensively to evaluate the condition or the quality of a component. It is easily carried out, **inexpensive** and **usually doesn't require special equipment**. Visual Testing is the **primary** evaluation method.
2	Ultrasonic Testing	A method of measuring the thickness or internal structure of a **test** piece through the use of high frequency sound waves. A common example is to test the thickness of the object, for example, to monitor pipework corrosion.
3	Dye Penetrant	A **widely applied** and **low-cost** inspection method used to check **surface-breaking defects** in metals, plastics, or ceramics. For ferrous components **magnetic-particle** inspection is often used instead for its detection capability. Used to detect casting, forging and welding **surface defects** such as **hairline cracks.** leaks in new products, and fatigue cracks on in-service components
4	X-ray Crack Testing	A slow and expensive **NDT** method, it is a dependable way to detect **cracks** and voids in weld interiors. Makes use of **X-rays** or gamma **rays**.
5	3D Scanning	3D Laser Scanning is **a non-contact, non-destructive** technology that digitally captures the shape of physical objects using a line of laser light. 3D laser scanning is a way to capture a physical object's exact size and **shape into the computer world** as a digital 3-dimensional representation.
6	CMM Measurement Checks	A **coordinate measuring machine (CMM)** is a device that measures the geometry of physical objects by sensing discrete points on the surface of the object with a probe.

2. Applications Of Modern Technologies

1	Use Of Robotics	**Robots** are used to perform tasks too dangerous or dirty for humans to perform; ❑ Robots used in manufacturing create **efficiencies** from raw material handling to finished product packing. ❑ Robots can be programmed to operate **24/7** in lights-out situations for **continuous production.** ❑ Robotic equipment is highly **flexible**. – Make different designs. ❑ Manufacturers need to embrace automation to stay **competitive**. ❑ Automation can be **highly cost-effective** for nearly every size of company.
2	Computer Integrated Engineering (CIE)	**Computer-integrated engineering** (CIE) is the engineering approach of using **computers** to control the entire manufacture process
3	Computer Integrated Manufacture (CIM)	This is the **complete** automation of a manufacturing facility such as a factory. All functions are under computer control. This starts with **computer aided design**, followed by **computer aided manufacture**, followed by **automated storage and distribution**. One integrated computer system controls all that happens.
4	Automatic Inspection/ Rejection	Manual **inspections** are typically based on sampling. It can be a slow process and opens up the chance for error. An **automated** system can **inspect** the all products / parts.

Beckfoot

Engineering Manufacture

Unit R112: Quality control of engineered products
Learning Outcome 4: Know the principles of lean manufacturing

Year 10 / 11

enjoy learn succeed

1. Categories Of Waste; (7 Lean Wastes – TIMWOOD),

1 Transportation – Moving materials

Transport itself adds no value to the product, so **minimizing** these costs is essential. This means having one **factory** closer to another in the **production** chain, or minimizing the costs of transportation using more efficient methods.

2 Inventory – What is in stock but not used

Inventory waste refers to the waste produced by unprocessed inventory. This includes the waste of **storage**, the waste of **capital** tied up in unprocessed inventory, the waste of **transporting** the inventory, the **containers** used to hold inventory, the **lighting** of the storage space, etc.

3 Motion – Motion by a person or a machine

Motion could refer to anything from a **worker moving** to pick something up on the factory floor to additional **wear and tear** on machines.

4 Waiting – slowed or halted production

if one task along the chain takes longer than another, then any time the employee in charge of the next task spends **waiting** is wasted. The task that takes more time must be made more efficient.

5 Over-processing – making of components which is unnecessary

Painting an area that will never be seen or adding features that will not be used are examples of over-processing. Essentially, it refers to **adding more value than the customer requires**.

In lean manufacturing, waste is any expense or effort that is expended but which does not transform raw materials into an item the customer is willing to pay for.

2. Sustainable Design

Reduce or completely eliminate negative environmental impacts through thoughtful **designs**

1	**Material Reduction**	Dematerialisation & the type of materials used.
2	**Life Cycle Analysis**	Assessing environmental impacts at all the stages of the life-cycle of a product. Environmental impacts are assessed from **raw material extraction** and **processing**, through the product's **manufacture**, **distribution** and **use**, to the **recycling or final disposal** of the materials composing it.
3	**End-of-life Disposal**	**Land fill, Recycle, Reuse.**
4	**Recycled Materials**	At the design stage, at the end of life.

6 Over-production – Making too much of a product that goes unused

More **raw materials** than necessary are consumed, the product may spoil or become obsolete, which requires that it be thrown away and, if the product involves hazardous materials, more hazardous materials than necessary are wasted, resulting in extra emissions, extra costs of waste disposal, possible worker exposure, and potential environmental problems resulting from the waste itself.

7 Defects – a product deviating from the standards of its design

Defective products must be **replaced**, they require human labour to process it, they might potentially **lose customers**, the resources put into the defective product are wasted because the product is **not used**.

3. Causes Of Waste In Manufacturing

1	**Time**	Time is money.
2	**Materials**	Purchasing too much, throwing away too much
3	**Resources**	Work force / Machinery and its maintenance / buildings
4	**Processes**	Where a production line goes wrong or is too long.
5	**Supply**	Just-In-Time manufacturing
6	**Space**	Lighting / Heating space & maintenance.

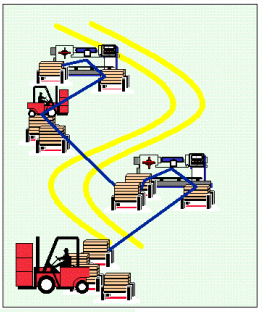
4. Methods Of Reducing Waste

Design For Manufacturing Assembly (DFMA) – techniques are focused on individual parts and components with a goal of reducing or eliminating expensive, complex or unnecessary features which would make them difficult to manufacture.

1	**Common Fixing Strategy**	Disassembly of **multimaterial** products into **monomaterial** is essential for product life extension, to ease **maintenance** and **repair** operations, and also for **material recovery.**
2	**Standardised Components**	Use standard parts or components will **reduce the cost of new designs**
3	**Complexity Reduction**	**Fewer parts** leads to less mistakes in assembly and a reduction in time.
4	**Make Versus Buy**	Choosing between manufacturing a product in-house or purchasing it from an external supplier.

Transportation

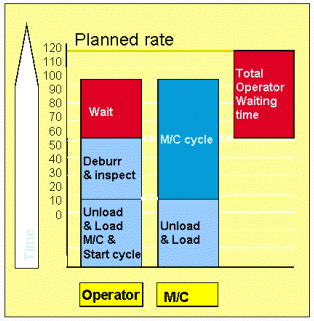
Poor layout exacerbates transportation wastes



- Transport waste is material movement that is not directly associated with a value adding process
- Processes should be as close together as possible and material flow directly from process to process without any significant delays in between
- Excess transportation may be caused by :
  - Poor layouts
    - Large distance between operations
  - Lengthy, or complex material handling systems
  - Large batch sizes
  - Working to faster rate than customer demand (overproduction)
  - Multiple storage locations

Waiting

Waiting time results from failure to synchronise activities



- Waste of waiting is any idle time produced when two interdependent processes are not completely synchronised
- Operators are kept waiting, or simply work slowly whilst the machining cycles
- Waiting results from:
  - Poor man / machine coordination
  - Long changeovers
  - Unreliable processes / quality
  - Batch completion, not single piece transfer between operations
  - Time required to perform rework

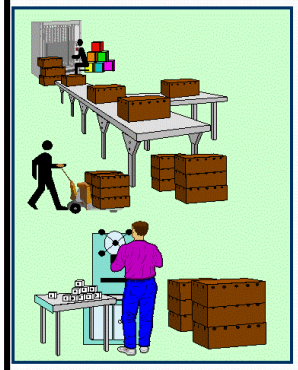
Defects

Right first time avoids scrap & rework

- Waste of correction includes additional work performed on a product or service
- Caused by or unclear operating procedure / specifications
- Defects are caused by
  - Inadequate training
  - Skills shortage
  - Incapable processes
  - Incapable suppliers
  - Operator error
  - Excessive stock
  - Transportation

Inventory

Stock wastes space and effort



- Inventory waste is stock and work in process in excess of the requirements necessary to produce goods or services 'just in time'
- Unnecessary inventory that accumulates before or after a process is an indication that continuous flow is not being achieved
- Excess inventory be caused by
- Lack of balance in work flow, forcing inventory build-up between processes
- Large batch sizes
- Failure to observe first in first out - stagnant materials
- Incapable processes
- Long changeover time
- Not adhering to procedures

Overproduction

Avoid overproduction by balancing supply to demand

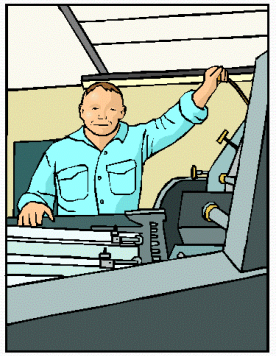
- Overproduction is the worst kind of waste because it causes other wastes and obscures the need for improvement
- Overproduction waste results from producing more (or faster) than required
- Overproduction is caused by
  - Large batch sizes
  - Unreliable processes
  - Unstable schedules
  - Unbalanced cells or departments
  - Working to forecast / inaccurate information not actual demand

Categories Of Waste;
7 Lean Wastes – TIMWOOD

Transport Waste
Inventory Waste
Motion Waste
Waiting Waste
Over-Production Waste
Over-Processing Waste
Defects

Motion

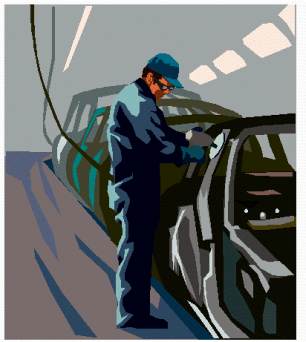
Work smarter not harder



- Waste of motion is any motion of man and / or Equipment that does not add value to the product or service
- Wasteful motion is caused by:
  - Poor workstation layout - excessive walking, bending reaching
  - Poor method design - transferring parts from one hand to another
  - Poor workplace organisation
  - Large batch sizes
  - Reorientation of materials

Over-processing

Clear, standardised instructions avoid over-processing



- Over processing is putting more into the product than is valued by the customer,
  - painting of unseen areas
  - unnecessarily tight tolerances
  - cleaning and polishing beyond the level required
- The goal is to do only the level of processing to match that which is useful and necessary
- Over-processing is caused by:
  - No standardisation of best techniques
  - Unclear specification / quality acceptance standards

Statement	Which of the 7 lean wastes?
1. Writing a 30 quality page report when a short 2 page summary would have done	Transportation / Inventory / Motion / Waiting / Defects / Over-processing / Over-production
2. Having to order more mechanical components as the first components ordered and fitted were incorrect	Transportation / Inventory / Motion / Waiting / Defects / Over-processing / Over-production
3. Having both electronic records and paper quality control records	Transportation / Inventory / Motion / Waiting / Defects / Over-processing / Over-production
4. Putting the wrong address on a box of parts	Transportation / Inventory / Motion / Waiting / Defects / Over-processing / Over-production
5. Packaging the wrong components	Transportation / Inventory / Motion / Waiting / Defects / Over-processing / Over-production
6. Excessive packaging used to pack a parcel	Transportation / Inventory / Motion / Waiting / Defects / Over-processing / Over-production
7. Having 3 spreadsheets to record the same quality control information	Transportation / Inventory / Motion / Waiting / Defects / Over-processing / Over-production
8. Drilling the wrong size hole	Transportation / Inventory / Motion / Waiting / Defects / Over-processing / Over-production
9. Waiting for your customer to approve a design change	Transportation / Inventory / Motion / Waiting / Defects / Over-processing / Over-production
10. Moving parts from department to department	Transportation / Inventory / Motion / Waiting / Defects / Over-processing / Over-production
11. Putting extra sticky tape over a self-sealing parcel	Transportation / Inventory / Motion / Waiting / Defects / Over-processing / Over-production
12. Using extra keyboard strokes when programming a machine (not using shortcuts)	Transportation / Inventory / Motion / Waiting / Defects / Over-processing / Over-production
13. Having to reach down to pick up a component from a storage bin	Transportation / Inventory / Motion / Waiting / Defects / Over-processing / Over-production
14. Holding 10 years supply of nuts and washers	Transportation / Inventory / Motion / Waiting / Defects / Over-processing / Over-production
15. Receiving 200 pieces of work from the previous process when your capacity is 30 per day	Transportation / Inventory / Motion / Waiting / Defects / Over-processing / Over-production
16. Hunting around the factory floor for a tool	Transportation / Inventory / Motion / Waiting / Defects / Over-processing / Over-production
17. Stocking every size of nut and bolt imaginable	Transportation / Inventory / Motion / Waiting / Defects / Over-processing / Over-production
18. Having nuts but no bolts of the correct size in stock	Transportation / Inventory / Motion / Waiting / Defects / Over-processing / Over-production
19. Having to deliver electronic components to a different city	Transportation / Inventory / Motion / Waiting / Defects / Over-processing / Over-production
20. Making a few extra printed circuit boards	Transportation / Inventory / Motion / Waiting / Defects / Over-processing / Over-production
21. Stock control barcode reader does not work	Transportation / Inventory / Motion / Waiting / Defects / Over-processing / Over-production
22. Having pliers, screwdrivers and cutters at your workstation	Transportation / Inventory / Motion / Waiting / Defects / Over-processing / Over-production
23. Running out of steel bar	Transportation / Inventory / Motion / Waiting / Defects / Over-processing / Over-production
24. Order of key components has not yet arrived to complete job	Transportation / Inventory / Motion / Waiting / Defects / Over-processing / Over-production
25. Using sprung washers when they are not required	Transportation / Inventory / Motion / Waiting / Defects / Over-processing / Over-production

Statement	Which of the 7 lean wastes?
1. Writing a 30 page report when a short 2 page summary would have done	Over-processing
2. Having to order more mechanical components as the first components ordered and fitted were incorrect	Defects
3. Having both electronic records and paper quality control records	Over-processing
4. Putting the wrong address on a box of parts	Defects
5. Packaging the wrong components	Defects
6. Excessive packaging used to pack a parcel	Over-processing
7. Having 3 spreadsheets to record the same quality control information	Over-processing
8. Drilling the wrong size hole	Defects
9. Waiting for your customer to approve a design change	Waiting
10. Moving parts from department to department	Transport

Statement	Which of the 7 lean wastes?
11. Putting extra sticky tape over a self-sealing parcel	Over-processing
12. Using extra keyboard strokes when programming a machine (not using shortcuts)	Motion
13. Having to reach down to pick up a component from a storage bin	Motion
14. Holding 10 years supply of nuts and washers	Inventory
15. Receiving 200 pieces of work from the previous process when your capacity is 30 per day	Over-production
16. Hunting around the factory floor for a tool	Motion
17. Stocking every size of nut and bolt imaginable	Inventory
18. Having nuts but no bolts of the correct size in stock	Defects
19. Having to deliver electronic components to a different city	Transport
20. Making a few extra printed circuit boards	Over-production
21. Stock control barcode reader does not work	Defects
22. Having pliers, screwdrivers and cutters at your workstation	Inventory
23. Running out of steel bar	Defects
24. Order of key components has not yet arrived to complete job	Waiting
25. Using sprung washers when they are not required	Over-processing