



# Process Design and Selection

Managing Operations within Organization

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# The Importance of Process Design

The physical layout and process design that an organization employs are critical factors for strategic operations management. This is because:

"both the layout and, more specifically, the process provide massive clues about what the organization can do, as well as what it cannot do."



# Process and Product Technology

Investment decisions are critical and must be made with the goal of equipping the company or plant to be more competitive in the marketplace. Furthermore, poor process selection decisions may significantly reduce the company's ability to meet customer demands in specific markets, leading to lost sales and diminished customer loyalty.

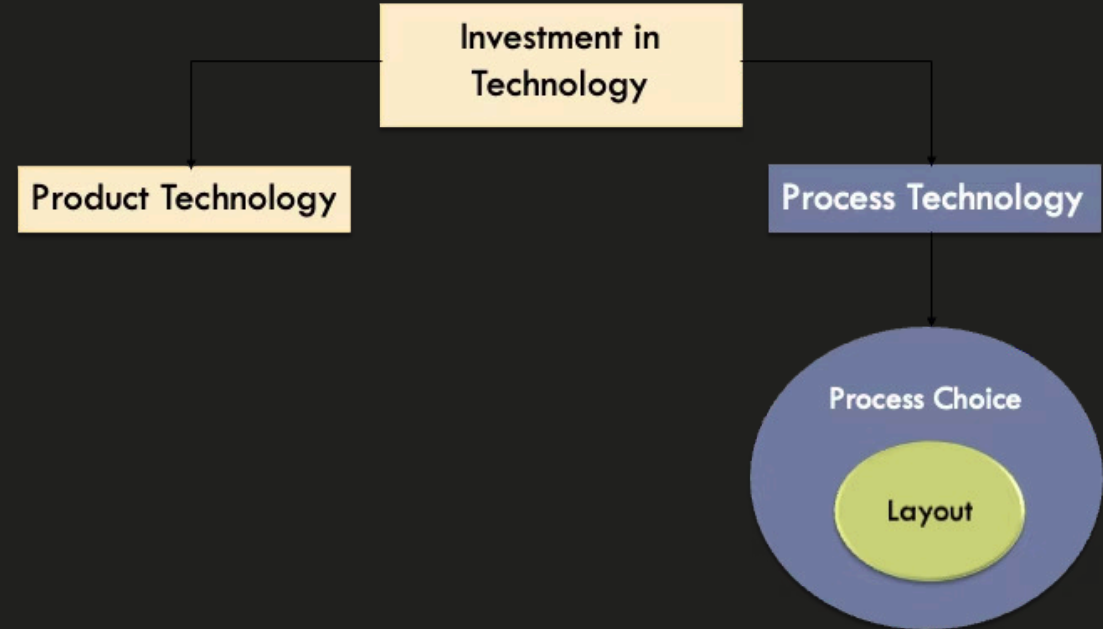
Both process choice and technology are critical because they can improve key competitive factors for customers such as cost, delivery speed, and flexibility.

If appropriate investments are made in technology and process selection, the resulting capacity and capability should become a key component of the firm's competitive weaponry.



# The Relationship Between Process Choice and Layout

Investment in technology — both product and process — directly shapes process choice, which in turn determines the appropriate layout for operations.





# The Financial Factor in Process Automation and Technology

2 things to avoid:

Technophilia

"Throwing Money" at the problem

Not Investing

A False Accounting Issue





## Keller (2001: *Collision*) tells how inappropriate investment was made at General Motors

"While Smith provided the money for automation and supported it completely, he clearly didn't understand it - nor did his engineering staff who encouraged him. With its 260 gleaming new robots for welding, assembling, and painting cars; its fifty automated guided vehicles to deliver parts to the assembly line; and a complement of cameras and computers to monitor, inspect, and control the process, the plant put star's in Smith's eyes. He believed it held the promise of a new era of efficiency and quality and would eventually become a model for all assembly plants. What it became was a nightmare of inefficiency, producing poor-quality vehicles despite the heroic efforts of workers to correct mistakes before they were shipped to dealers" (p.169)



# Layout and Process Choice

There are 4 types of layout:

1

Fixed position

2

Process layout

3

Product layout

4

Hybrid

A hybrid of process and product layouts, based around cells

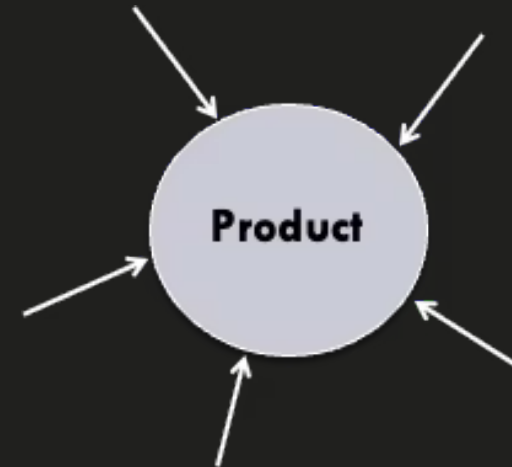


# 1. Fixed position

## Product

This method is used for products that may be heavy, bulky, or fragile, and in this approach, operators come to the product itself. The product is completed 'on site' and is not moved during completion. The product is housed around a particular, focused area.

Operators perform processes on the 'fixed' product. There may be more than one operation performed on the product at the same time. Every operation contributes to the product's completion.





## Examples of Fixed position



### Manufacturing

Examples of fixed positions in manufacturing include shipbuilding, aeroplane fabrication, and various forms of construction.

### In services

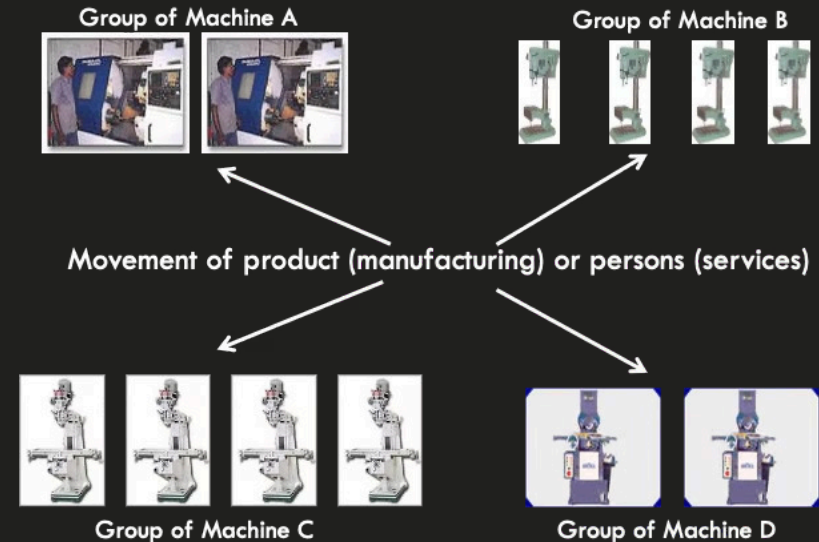
A dentist.



## 2. Process layout

A plant or service location has specific activities or machinery grouped together. The machines are not laid out in a particular, sequential process. Therefore, the product does not move in a specified sequence but will go to a machine center when required for the particular product.

The advantage is the flexibility in both equipment and labor assignments. The breakdown of a particular machine will not halt an entire process, and work can be transferred to other machines in the department.





## 2. Process layout (cont.)

'Random' movement takes place as products are moved according to process requirements. There is no 'flow' as such—each product will have its particular process requirements and will move to each machine group as and when required.

### Examples

#### Manufacturing

Examples of manufacturing include the production of low-volume furniture, haute couture clothing, and jewelry through craft-type manufacture.

#### Services

Hospitals are also laid out like this. Patients move around departments and wards as necessary. Hairdressing is another service example where areas such as washing, drying, and cutting are put in place to complete a range of different styles. A department store (retailing) is also arranged on this basis.





## Examples of Process layout





### 3. Product layout

Machines are dedicated to a particular product—or a very similar small range of products—and each stage of manufacture is distinct from the next. Each of the stations is laid out in an operational sequence specific to the manufacture of a particular product or the provision of a repetitious service offering. This kind of layout has been used in some surgical procedures.



The sequence of operations is designed in a linear, logical succession, where one activity in the line is dependent upon the preceding activity having taken place.



# Examples of product layout

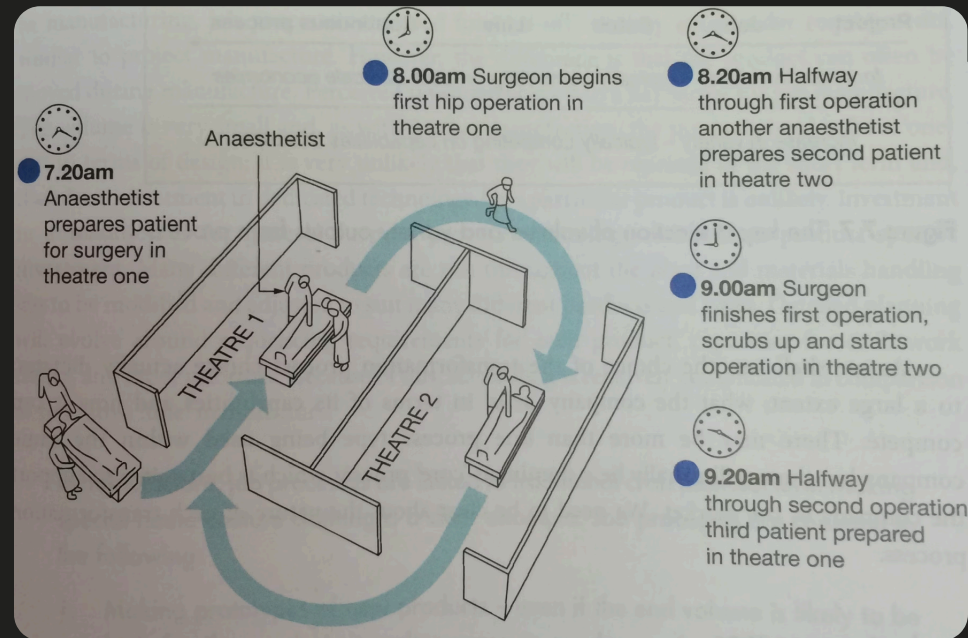
## Manufacturing

This is common in car manufacturing and other high-volume applications.

## Services

It has been used to some degree in high-volume 'standard' provisions, especially where there is a tangible element in the overall offering, e.g., in-house fast-food delivery.

## Example of assembly line surgery



Source: Slack et al. (2010)



## 4. The hybrid process and product layout

Since the previous layout is not dedicated to a particular product family or customer, it is available for a range of products. Another approach is to group machines or activities together around a focused product family cell.

In manufacturing, machines or activities are grouped together in a way that best supports the manufacture of a particular family of products or to provide a cluster of similar services. The variety of products or services around a particular group or 'cell' may be substantial, but the essential nature of the product will remain similar and will, therefore, warrant a cell of its own, distinct from other product family cells.



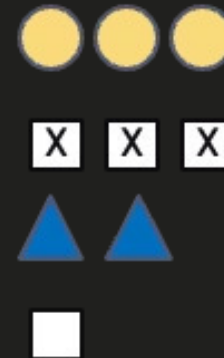
**Group 1**



**Group 2**



**Group 3**



**Group 4**



# Examples of hybrid process and product layout

This clustering/cell approach is common in high-tech manufacturing environments. This approach allows for the simultaneous achievement of high volume and some variety. The same type of approach has been adopted in high-volume, batch-type services, such as call centers in finance-related factors, where calls are routed through to specific, focused areas.



# Process Selection

Process choice will provide essential, major clues about how a firm competes and what it can—and cannot—do. The five types are

01

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Project

02

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Job

03

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Batch

04

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Line

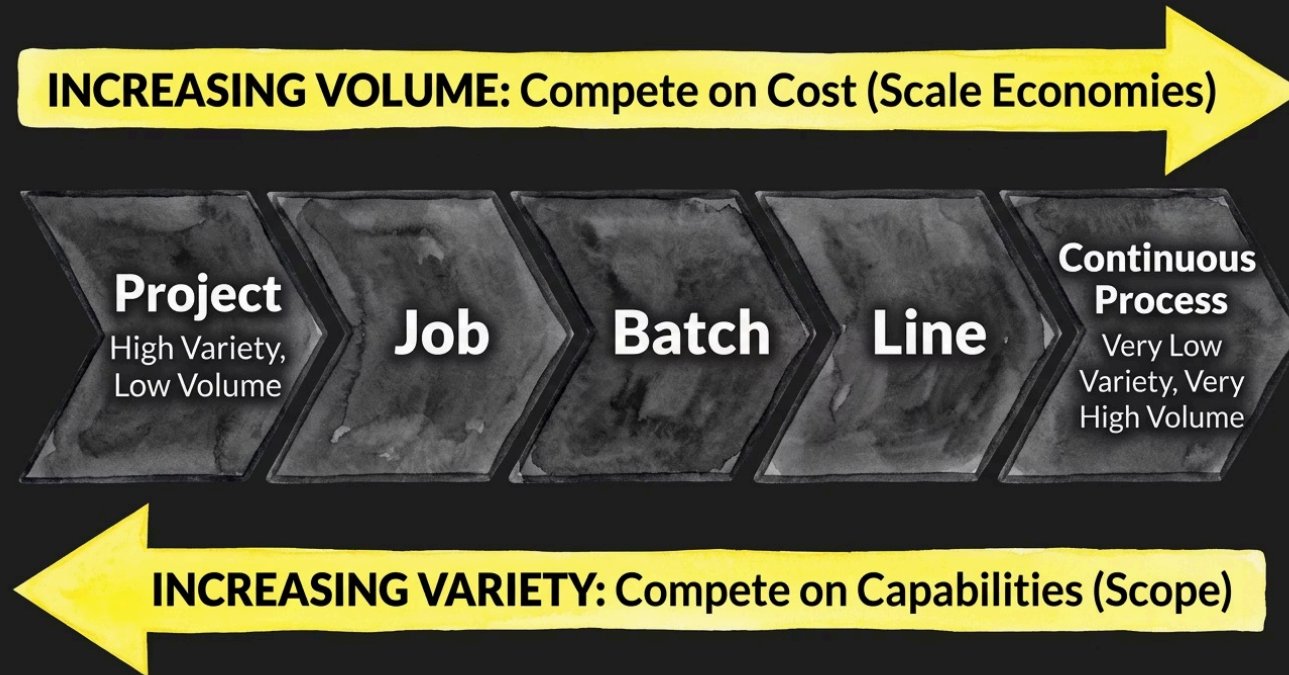
05

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Continuous process



# The Key Distinction of **Volume** and **Variety** Outputs from Process Choice





# 1. Project process

In the 'project' manufacturing environments, the nature of the products is often large-scale and complex. The **designs** of the products undertaken in project manufacturing are, essentially, **unique** by virtue of their not being repeated in exactly the same way. The process tends to be 'fixed.' Scheduling of projects tends to be undertaken in a 'phased-completion' program, where each phase of completion will be distinct and separate from other subsequent, or parallel, stages.





## Examples of Project process

### In manufacturing

- Major high-tech projects, such as flight simulator manufacture.
- Construction in all forms, such as bridge construction, tunnel construction, and shipbuilding, is a common application of project process choice.

### In services

Consulting—the relationship, expectations, and outcomes with each client should be seen as 'unique.' This means that the project process is linked to the product layout.





## 2. Job process

In manufacturing, job processes are used for 'one-off' or very small order requirements, similar to project manufacture. However, the difference is that the product can often be moved during manufacture. Perceived uniqueness is often a key factor for job manufacture. The volume is very small, and the products tend to be a 'one-off' in terms of design; it is very unlikely that they will be repeated in the short term.





# Key characteristics

Investment in automation is for general-purpose process technology rather than product-specific investment.

Many different products are run throughout the plant, and materials handling has to be modified and adjusted to suit many different products and types.

Detailed planning will evolve around sequencing requirements for each product, capacities for each work center, and order priorities; because of this, scheduling is relatively complicated in comparison to repetitive 'line' manufacture.



# Examples:

## In Manufacture

Craft manufacture, such as making special haute-couture clothing. The job processes are as follows.

1. Making prototypes of new products—even if the end volume is likely to be high, it makes sense to produce a 'one-off' or very low volume, which lends itself to job manufacture.
2. Making unique products such as machines, tools, and fixtures to make other products. The process choice (job) is linked to the process layout.

## In Service

Services include car repairs and hospital services.



# 3. Batch process

As volume begins to increase, either in terms of individual products or in the manufacture of similar types or families of products, the process will develop into batch manufacture. The difficulty is that competitive focus can often become blurred, leading to challenges in maintaining product quality and meeting customer expectations. Therefore, the key is to map the range of products in terms of either 'job' or 'line' characteristics. The results can be rearranged either in terms of the **similarity of finished products** or **by common process groupings**.





# Key characteristics

**Automation**, especially for lower volumes of batch manufacturing, tends to be **general purpose** rather than dedicated to a particular product whose volume does not demand product-specific investment in automation.

**Scheduling is complicated** and has to be completely reviewed on a regular, ongoing basis—this applies to new products and 'one-offs' that may be required, together with relatively high-volume, standard products: all of these types will need to be scheduled.

Operators have to be able to **perform a number of functions**—this is obviously true of 'job'-type processes. In batch, though, this flexibility is crucial in that it will allow operators to move to various workstations as required.

Where automation is being used, **setup time should be short**: the ideal setup time is quick enough to accommodate run lengths of just one unit, switching over to other models and volumes as and when required.



# Examples

## Manufacture

Bread making, where batches of similar types are produced. In general, batch processes link to process layout, although high-volume batches will tend to have a type of line (product) layout, depending upon how often the product is reproduced.

## Services

Call centers: The response message to many telephone call centers is 'press "1" for this service; press "2" for that service,' and so on, which is considered to be a routing procedure.





## 4. Line process

A 'line' process becomes more appropriate as the volume of a particular product increases. Each stage of manufacture will be distinct from the next, and value and cost are added at each stage of manufacture until the product is completed. The line is dedicated to a particular product (with possible variations of models) and introducing new products that are significantly different from the former product is difficult or even impossible to realize on an existing line manufacturing process.





# Key characteristics

- Process times should be fast - which is critical in order to satisfy delivery speed requirements.
- There should be simplification in production planning and control and the tasks themselves should also be simplified for each workstation.
- There should be small amounts of work in process: in fact, work in process (which, in accounting terms, can be viewed as an asset) is a liability to the company which can ruin cash-flow and stifle quick response to market requirements.
- Materials handling between stations should be placed as closely as possible to each other.
- Materials flow and control are critical: **Just-in Time** lends itself most noticeably to 'line' or very high volume batch production. Stock-outs have to be avoided although, at the same time, excess stock is a waste and a liability, rather than an asset (materials can be viewed as an asset on the balance sheet which is misleading and alien to world class manufacturing).



# Examples

Manufacture: High volume, 'standard' products such as particular models of cars, TVs, hi-fi, VCRs and computers. The process choice (line) ties it to the product type of layout.





## 5. Continuous process

This is used when a process can (or must) run all day for each day of the year on a continuous basis.

### Volume

The volume is typically very high and the process is dedicated to making only one product type.

### Investment

Huge investment in a dedicated plant is often required.

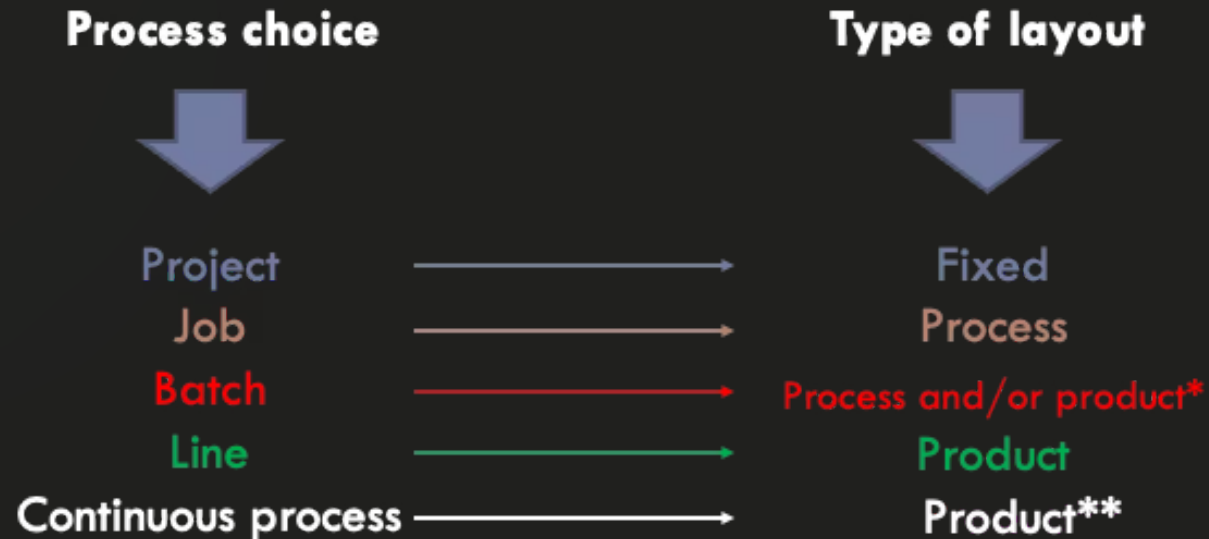
## Example

Manufacturing: a chemical refining plant, steel works, and very high-volume food processing.





# The Link Between Process Choice and Layout



\* The link between Batch and the type of layout would depend upon volume and variety—in low volume/high variety Batch, Process layouts would be used; in high volume/low variety Batch, Product layouts would be appropriate.

\*\* Continuous process differs from line because a line process can be stopped at a particular stage, and the product will remain at that stage of production; in a continuous process, stopping is an exception and is very costly (e.g., shutting down a blast furnace).



# Summary of Process Characteristics

Types	Characteristics
Project	Highly flexible—individualized output results in high unit costs; mobile and flexible staff are required; quality is determined by individual customer requirements.
Job	Significant flexibility is required, though the volume is generally higher than when compared to projects. There is some repetition in the system and many more common elements in the process than occur with projects. The unit costs are relatively high compared to processes with higher volume, but the setup costs are relatively low.
Batch	Some flexibility to handle differences between batches is still required, requiring some investment in set-up for each batch. Higher levels of specialization are required in both people and machines.



# Summary of Process Characteristics

Types	Characteristics
Line	Highly specialized people and machines allow high rates of throughput and low unit costs. Limited flexibility usually associated with this process. Quality levels consistent.
Continuous process	Usually non-discrete products produced over a significant period of time. Very high levels of investment required and limited possibility for flexibility due to highly dedicated processes. Commonly highly automated.



# Key headings linking process and layout

## Process Choice/Type of layout

Line/high vol. Batch  
Product Layout

Job/low vol. Batch  
Process Layout



### Key headings

Product Design  
Product Demand  
Scheduling  
Maintenance  
Worker Skill  
Throughput Time  
Unit Cost  
Major Concern

'Standard'  
Relatively Stable  
Relatively Easy  
Absolutely Vital  
Generally Semi-Skilled  
Short  
Low  
Line Balancing

Specialized  
Erratic And Uncertain  
Difficult  
Important  
Generally Highly-Skilled  
Long  
High  
Department Layout



## The Link Between Process Choice and Marketing Strategy



Project



Job



The firm sells a wide variety Of products or designs and there is the perception of customisation for each customer. Order sizes are small or 'one -off'. New products are required on an on-going basis and the firm 'sells' its capability of design and innovation.

Batch



Line



Continuous Process

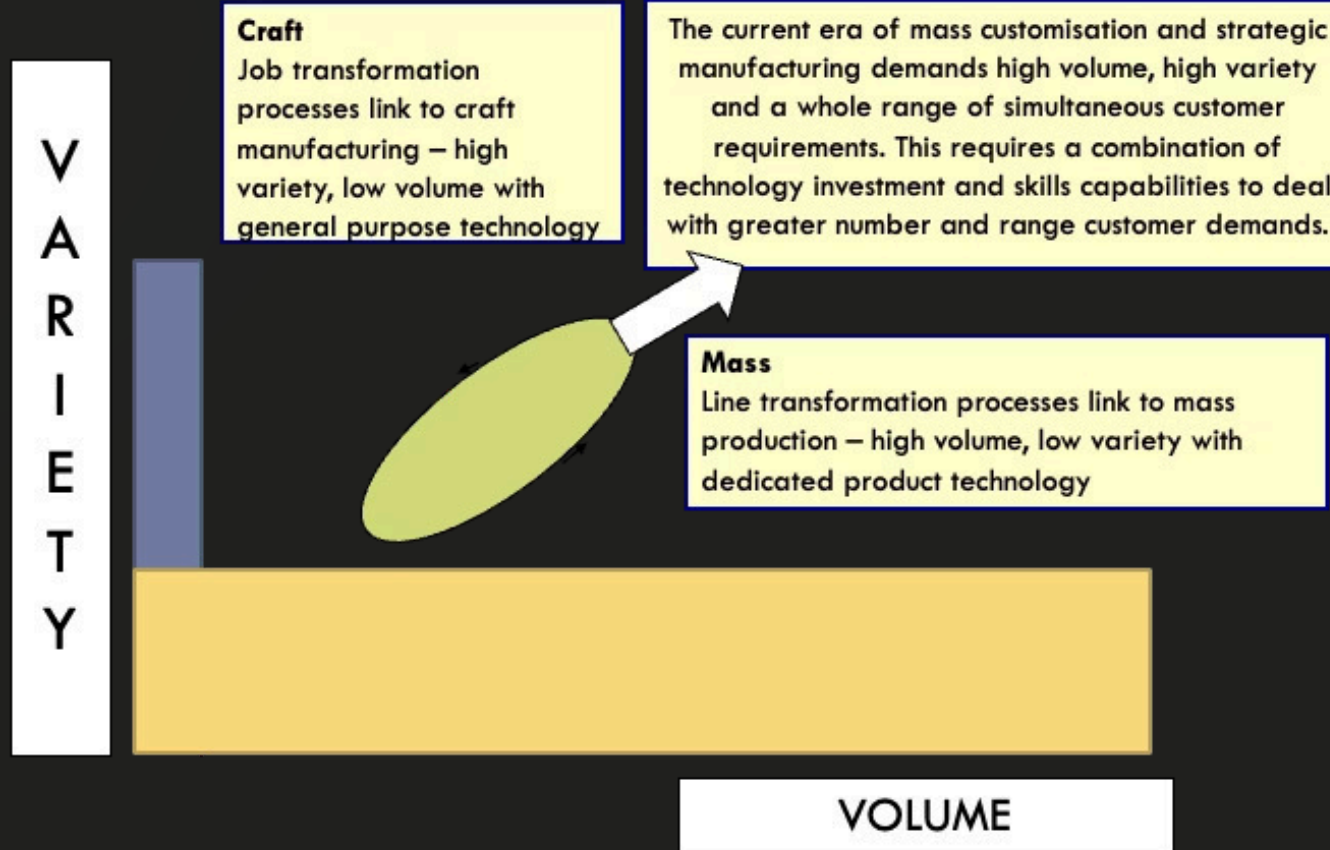


The firm sells a narrow range of 'standard' products but in high volume. New product introductions are difficult because the plant is dedicated around specific products

Batch has to be managed by initially mapping products according to 'job' or 'line' characteristics and then focusing the plant to support these cells of manufacture



# Manufacturing eras and their impact on process choice



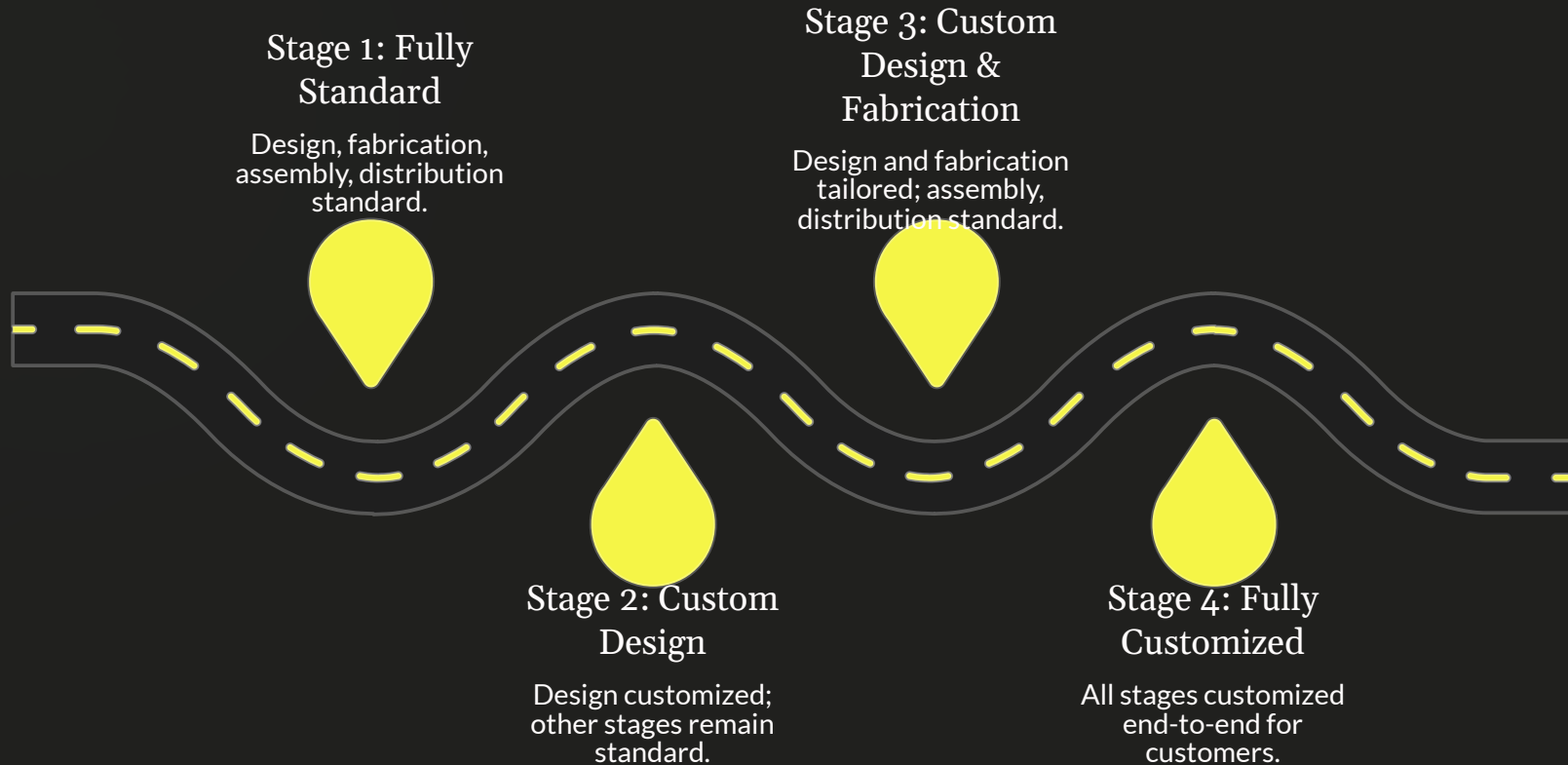


# The Changing Task of Manufacturing Management

Period	Production Task	Finished Product Range	Volume Level	Production Made
1950-1970s (Line processes)	Achieve supposed economies of scale by large production runs of limited range	Narrow	Very high	To stock (just in case)
1980s on (hybrid systems - FMS)	Meet specific customer including cost, delivery, range and flexibility	Wide	As required - volume and variety	For Customer requirements only (Just in Time)



# From 'pure standardization' to 'pure customization'



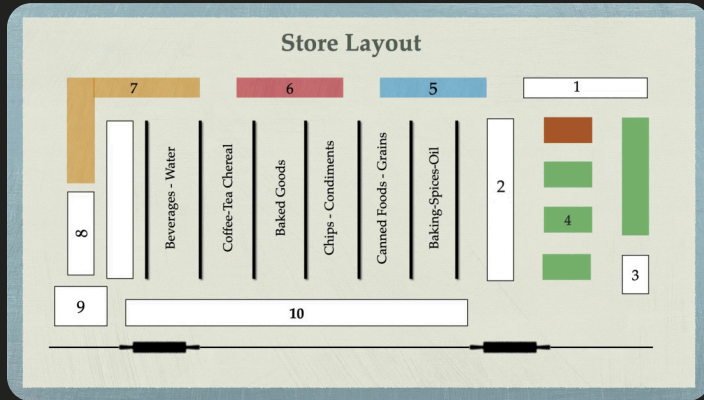
As customization increases, more stages of the value chain—from design through fabrication, assembly, and distribution—become tailored to individual customer requirements.



# Key points

A process choice will indicate what a firm *can and cannot* do. Process choice may significantly influence what the company sells and what it is able to offer.

Layout and Process choice are major strategic importance to manufacturing and services operations. The options to choose from are also essentially similar - it's not an infinite variety but a small number of options and switching between one to the other is by no means cost free - so there is an important strategic objective to align the transformation process with market requirements and to understand the implications of changing.



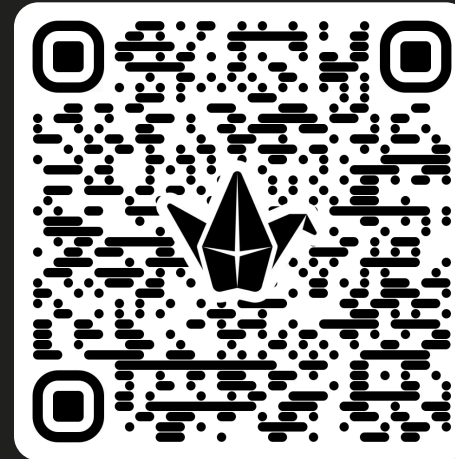
# Test yourself

## Layout Types

Go to Padlet and identify the product type for each number.

Please click the link or scan QR code below.

[Click here](#)





# Resources

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