Classification of Production Systems

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Production systems classification

Classification by production method (way of volume creation):

- Single / Unitary
- Batch / Intermittent
- Continuous

Classification by nature of process (type of production technology):

- Discrete
- Process
- Fabrication
- Assembly

Classification by market interaction (standardisation of product):

- Prod. to stock
- Prod. to order
- Repeat
- Single
Wortmann Classification (CODP concept)

- **Engineering**
- **Purchasing**
- **Manufacturing**
- **Assembly**
- **Distribution**

**SUPPLIERS**

- **ETO**

**PRODUCE TO ORDER**

- **PTO**

**PRODUCE TO FORECAST**

- **MTO**

**ETO** - Engineer to order (Project)

**MTS** - Make to stock

**MTO** - Make to order

**PTO** - Purchase to order

**ATO** - Assemble to order

**Customer Order Decoupling Point**
Production systems classification
Correlations

How these products production systems can be classified in the three axes?

- Single
- To order (repeat)
- Discrete fabrication

- Single
- To order (single)
- Assembly

- Continuous
- To stock
- Process

- Batch
- To stock
- Assembly
## Production systems classification

### Correlations

<table>
<thead>
<tr>
<th></th>
<th>Single</th>
<th>Batch</th>
<th>Continuous</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>To stock</strong></td>
<td></td>
<td></td>
<td>Water bottles replenishment</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Commercial clothing</td>
<td></td>
</tr>
<tr>
<td><strong>To order</strong></td>
<td>Pizzeria</td>
<td>Machine tools</td>
<td></td>
</tr>
<tr>
<td>(Repeat)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>To order</strong></td>
<td>Tailored clothing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Single)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Production systems classification

### Correlations

<table>
<thead>
<tr>
<th></th>
<th>Single</th>
<th>Batch</th>
<th>Continuous</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Process manufacture</strong></td>
<td></td>
<td>Semiconductors</td>
<td>Cement, paper, plastic, glass</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Customized mechanical parts</td>
<td>Glasses frame</td>
</tr>
<tr>
<td><strong>Discrete manufacture</strong></td>
<td></td>
<td></td>
<td>Steel or plastic shaping</td>
</tr>
<tr>
<td><strong>Assembly</strong></td>
<td>Shipbuilding</td>
<td>Electronical commodities</td>
<td>Car assembly</td>
</tr>
</tbody>
</table>
## Production systems classification
### Correlations

<table>
<thead>
<tr>
<th></th>
<th>Process manufacture</th>
<th>Discrete manufacture</th>
<th>Assembly</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>To stock</strong></td>
<td>Plastic</td>
<td>Pharmaceutical</td>
<td>Staple</td>
</tr>
<tr>
<td><strong>Repeat</strong></td>
<td></td>
<td>Pizzeria</td>
<td>Machine tools</td>
</tr>
<tr>
<td><strong>Single</strong></td>
<td></td>
<td></td>
<td>Shipbuilding</td>
</tr>
</tbody>
</table>
Production systems classification: McDonald’s case study
Introduction

The fast food restaurant chain McDonald’s was founded in 1940 in San Bernardino, California, as a barbecue restaurant.

- The initial menu was large, including several items which costed less than 60 cents each.

- It included hamburger, barbecue plates, melted cheese sandwiches, etc.

- Opening hours: lunch and dinner time
Since the hamburgers were the most sold products among the items proposed in the menu. In 1948 McDonald’s was refurbished and become a self-service restaurant, with a business mainly based on the hamburgers.

- Menu slimmed-down: only nine items were included, with six drinks and three food choices.
- High quality, cheap and fast food: only 15 cents for the best hamburger of the region, without waiting times.
Introduction

- Over years McDonald’s changed the restaurant culture, focusing on a concept of fast and cheap food.
- This culture reached people of all ages across the globe.
- For this reason, in 1980 the menu increased the variety and included different typologies and sizes of hamburger/cheeseburger, drinks, and snacks, and started to offer also breakfast options.
- But, still the items proposed by the menu were few and standardized, to make the fast and cheap service possible.
Introduction

- In 1981, Burghy, a fast food chain, was founded in Milan. It was inspired by US McDonald’s restaurants and closely followed McDonald’s concept.

- Burghy became a trend among young people in Milan who loved the idea of fast and cheap food, quite different from the Italian culture.

- When McDonald’s entered the Italian market, it was hard to succeed due to Burghy’s strong presence and influence.

- In 1996, McDonald’s owned 38 restaurants in Italy and decided to acquire Burghy, which owned 88 restaurants in Northern Italy, to increase its market presence and secure the leading position.
McDonald’s goal to become a market leader across the globe and to maintain this leading position makes necessary to increase the variety offered within the menu.

The menu has grown rapidly and has became more complex over years.

Opening hours increased to assure different types of service (breakfast, snack, coffee, lunch, dinner, etc.) from 06:30 am to 3:00 am.
• What is the BOM of a McDonald’s finished product?
• What is the BOM of a McDonald’s finished product?
A simplified example of hamburger menu BOM:
A simplified example of hamburger menu BOM:
What is McDonald’s production process?
McDonald’s production process

- What are McDonald’s raw materials?
- What are McDonald’s WIP?
- What is McDonald’s finished product?
McDonald’s production process

- **Preparation**
  - Tomatoes
  - Lettuce
  - Meat or alternatives
- **Cook**
  - Toast
  - WIP
  - Liquid
- **Assembly**
  - Lettuce
  - Cheese
  - Sauce
  - Packaging
- **Fry**
  - Potatoes
  - French fries
- **Final Assemble**
  - Hamburger packed
  - French fries packed
  - Napkins
  - Tray
- **Deliver**
  - Container
  - Straw
How can you classify this production process?

Classification by market interaction
(standardisation of product)

Prod. to stock

Prod. to order

Classification by production method (way of volume creation)

Continuous

Batch / Intermittent

Single / Unitary

Classification by nature of process
(type of production technology)

Process

Discrete

Fabrication

Assembly

Repeat

Single
## McDonald’s production process - classification

<table>
<thead>
<tr>
<th>Sub-system</th>
<th>Nature of process</th>
<th>Production method</th>
<th>Market interaction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard bun toasting</td>
<td>Process</td>
<td>Single</td>
<td>MTS – high demand MTO – low demand</td>
</tr>
<tr>
<td>Gluten free bun toasting</td>
<td>Process</td>
<td>Batch</td>
<td>MTO</td>
</tr>
<tr>
<td>Meat cooking (Angus and Chicken)</td>
<td>Process</td>
<td>Batch</td>
<td>MTS – high demand MTO – low demand</td>
</tr>
<tr>
<td>Vegan burger cooking</td>
<td>Process</td>
<td>Batch</td>
<td>MTO</td>
</tr>
<tr>
<td>Cheese and sauce preparation</td>
<td>Discrete fabrication</td>
<td>Batch</td>
<td>MTS</td>
</tr>
<tr>
<td>Vegetables preparation</td>
<td>Discrete fabrication</td>
<td>Batch</td>
<td>MTS – high demand MTO – low demand</td>
</tr>
<tr>
<td>Standard hamburger assembly</td>
<td>Assembly</td>
<td>Batch</td>
<td>MTS – high demand ATO – low demand</td>
</tr>
<tr>
<td>Special hamburger assembly (gluten free &amp; vegan)</td>
<td>Assembly</td>
<td>Single</td>
<td>MTO</td>
</tr>
<tr>
<td>Potatoes frying</td>
<td>Process</td>
<td>Continuous</td>
<td>MTS</td>
</tr>
<tr>
<td>French fries packing</td>
<td>Assembly</td>
<td>Single</td>
<td>MTO</td>
</tr>
<tr>
<td>Drink drawing</td>
<td>Process</td>
<td>Single</td>
<td>MTO</td>
</tr>
<tr>
<td>Final assembling</td>
<td>Assembly</td>
<td>Single</td>
<td>ATO – high demand MTO – low demand or special requirements</td>
</tr>
</tbody>
</table>
The classification of production processes by market interaction depends on different factors:

- Demand volumes
- Demand seasonality
- Delivery lead time vs total production lead time
- Customization required
- Customization offered
- Demand predictability
- Customer sensitivity to special offers
- Product shelf-life
- …
McDonald’s production process - classification

McVEGGIE®

GLUTEN FREE BURGER

CRISPY McBACON®

BIG MAC®

McTOAST®

PROVA I MENU DA 4,90€.*
What are the main advantages of MTS/MTO choices?

<table>
<thead>
<tr>
<th></th>
<th>MTS</th>
<th>MTO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Service level</td>
<td>high</td>
<td>low</td>
</tr>
<tr>
<td>Flexibility</td>
<td>low</td>
<td>high</td>
</tr>
<tr>
<td>Inventory costs</td>
<td>high</td>
<td>low</td>
</tr>
<tr>
<td>Stock-out costs</td>
<td>low</td>
<td>high</td>
</tr>
<tr>
<td>Engineering change order costs</td>
<td>high</td>
<td>low</td>
</tr>
<tr>
<td>Resources saturation</td>
<td>high</td>
<td>low</td>
</tr>
</tbody>
</table>
New McDonald’s production process

McDonald’s in the last years applied a new strategy to be more competitive within the market, by assuring high variety and maintaining at the same time a good service level.

The new strategy is based on:
• Quality (local foods, food safety certifications)
• Innovation (special month burgers, special menu)
• Customization (mass customized menu)
• Service level (just in time production systems)
New McDonald’s production process

<table>
<thead>
<tr>
<th>Elapsed time</th>
<th>0:00</th>
<th>0:11</th>
<th>0:31</th>
<th>0:45</th>
<th>1:30</th>
</tr>
</thead>
<tbody>
<tr>
<td>Task time (seconds)</td>
<td></td>
<td>11</td>
<td>20</td>
<td>14</td>
<td>0</td>
</tr>
<tr>
<td>Task</td>
<td>1. Order</td>
<td>2. Bun toasting</td>
<td>3. Assembly with condiments</td>
<td>4. Wrapping of patty with bun</td>
<td>5. Order picked up immediately to keep it fresh</td>
</tr>
</tbody>
</table>

Order read on a video screen

- Buns
- Toaster
- Condiments
- More personnel added during busy periods
- Heated cabinet for the grilled patties
- Heated landing pad

(Heizer & Render)