



Dr. Babasaheb Ambedkar Marathwada University, Aurangabad (MS)  
Deen Dayal Upadhyay KAUSHAL Kendra

## Bridge Course

# Industrial Automation & Lean Manufacturing Concepts: An Overview

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1. Concept of Factory and Industry
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1. Concept of Factory and Industry

# Preface

- Human beings have been making things for many thousands of years.
- Most products were made on an individual as-needed basis; if a tool was required, it was fashioned by hand.
- As time passed, more complex techniques were developed to help people accomplish fabrication and production tasks.
- Things were still generally made one at a time by craftspeople skilled in various techniques.
- It was only after the Industrial Revolution that manufacturing of products on a large scale became commonplace - **Concept of factory saw daylight**

# Concept of Factory

- A factory, or manufacturing plant, is an industrial building where workers produce, assemble, process, or package goods by operating and supervising machines and processing lines.
- Most modern factories house innovative machinery used for production, gauging, testing, packaging, and a host of other manufacturing related operations.

# Concept of Industry

- Industry can be defined as an economic activity concerned with the processing of raw materials and manufacture of goods in factories. An industry is a classification that refers to a group of companies that are related in terms of their primary business activities.

# Factory v/s Industry

Factory	Industry
A factory is a site or location where the making procedure of business come off.	The industry is a set or collection of businesses that make the same material or service.
The factory is a part of the industry.	The industry is a basic notion or concept.
Factories are accountable for making the development and growth that progress in an economy.	The industry utilizes factory development and growth to progress the economy and the living standards of the public of the country.
Individual entity	Collective entity

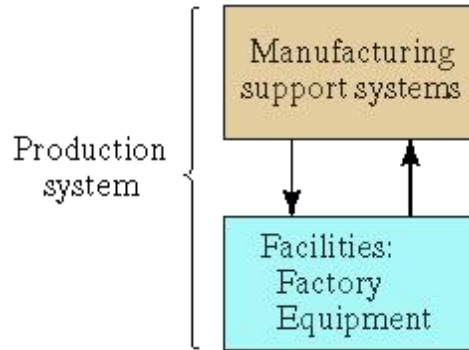
# Generic Perception of Factory / Industry



- Extraction of Raw material
- Manufacturing/ Production
- Testing
- Packaging
- Shipping/Transportation
- Planning
- Research, Development & Design
- Procurement
- Maintenance
- Quality
- IT
- Marketing
- Human Resource



# A comprehensive model



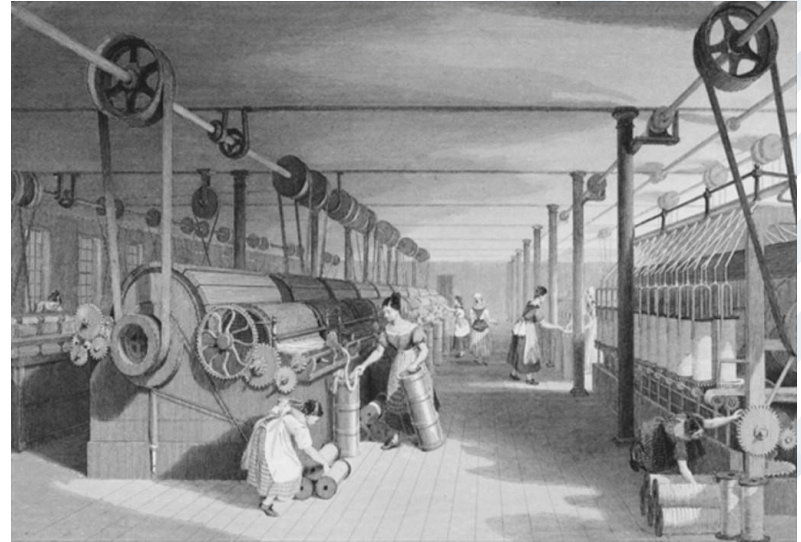
the set of procedures to manage production and to solve technical and logistics problems in ordering materials, moving work through the factory, and ensuring that products meet quality standards

the factory and equipment in the facility and the way the facility is organized (plant layout)

# Age of Transformation

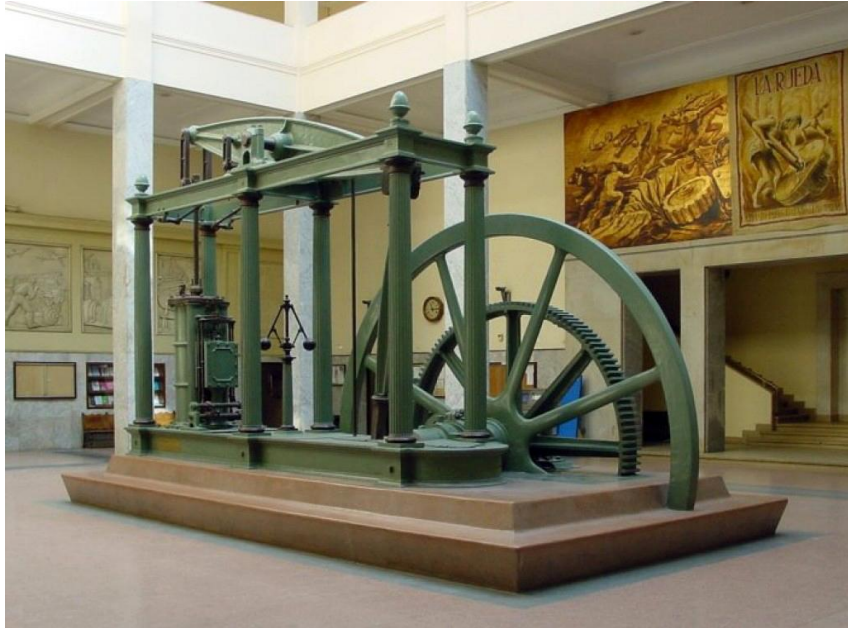


A view of early 17<sup>th</sup> Century Blacksmith shop in Scotland



The First Industrial Revolution began in mid-18<sup>th</sup> century England and was brought on by the invention of the steam engine. Textiles were the leading industry of the Industrial Revolution.

# Steam Powered the Wheels



James Watt transformed the steam engine from a reciprocating motion machine to a rotating motion machine suited to industrial applications.

An advertisement for Hoag & Hampson portable steam engines. The illustration shows a man in a white apron standing next to a large, black, portable steam engine. The engine has a large flywheel and a tall chimney. The text is arranged in a decorative border around the illustration.

96 MAIDEN LANE, NEW YORK  
HOAG & HAMPSON, GENERAL AGENTS

**PORTABLE STEAM ENGINES,**  
OF THE CELEBRATED WOOD & MANN MAKE,  
ESPECIALLY ADAPTED FOR DRILLING AND PUMPING OIL WELLS.

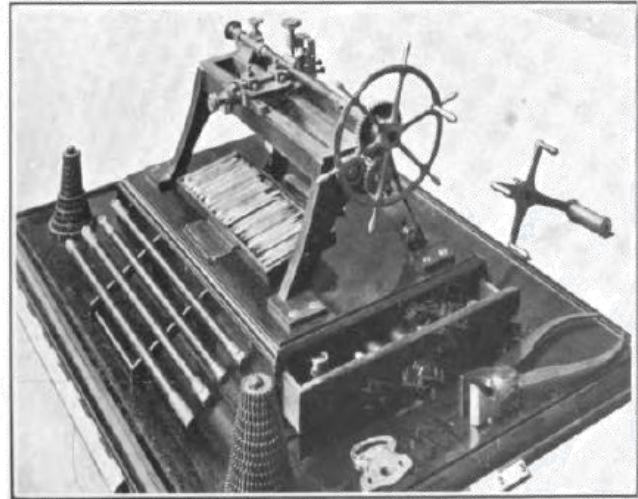
For ELEGANCE and SIMPLICITY, for Workmanship and Material, for important Improvements in both Engine and Boiler, the result of 15 years' experience in their manufacture, for general adaptability and economy, and for power and durability, we challenge a comparison with any other Portable Engine made.

EXAMINE AND JUDGE FOR YOURSELF.  
Full information given and orders for all sizes promptly filled by  
**HOAG & HAMPSON, 96 Maiden Lane, N. Y.**

# ...And Wheels turned the language of manufacturing



Henry Maudslay  
*Founding Father of Machine Tool Technology*



Maudslay's Screw Cutting Lathe  
(1800)

# Industrial Revolution (18<sup>th</sup> Century –later half)

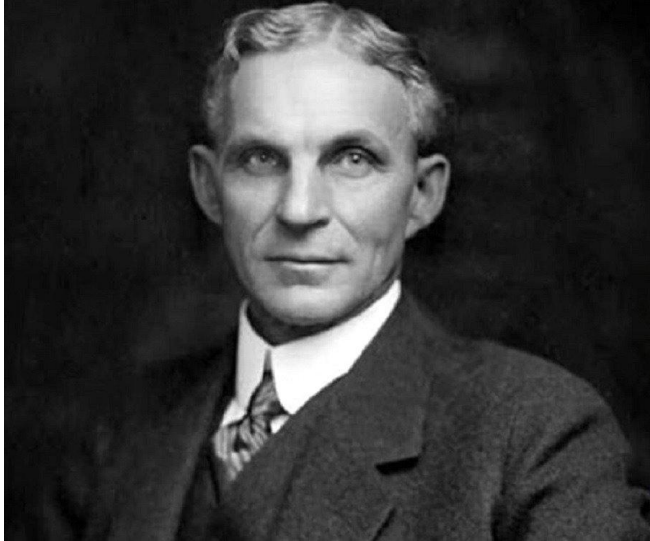


A view of Textile Industry in Manchester (1850s) – one of the townships where first industrial revolution took place

The factory setting proved to be an efficient environment for mass production during the Industrial Revolution, in England (*second half of 18<sup>th</sup> Century*)

At this time, factories simply served as buildings where laborers gathered to produce goods using simple tools and machinery

# Modern Concepts in Factory Setting



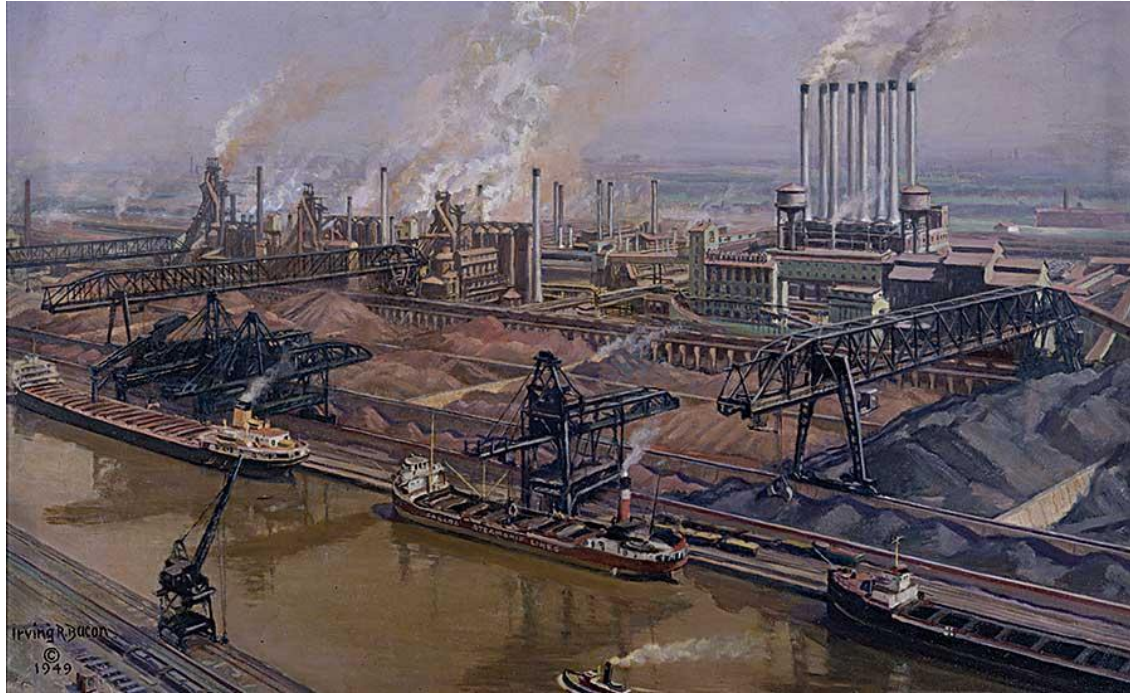
In the early 20th century, **Sir Henry Ford** advanced the factory concept further with the innovation of mass production in order to meet a growing demand for his Model T automobiles

# Ford's Philosophy



Through a combination of the employment of **precision manufacturing**, the **division of highly specialized labor**, the use of **standardized and interchangeable parts**, and the creation of a **continuously rolling, precisely timed assembly line**, *Ford* was able to drastically reduce assembly time per vehicle and ultimately decrease production costs.

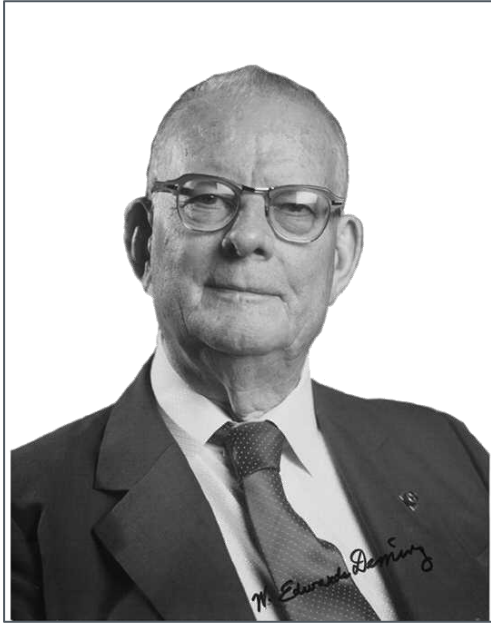
# Ford's River Rouge Plant



Once upon a time, the Rouge was the only place on earth where one could witness the entire automaking process in one day



# Statistical Control of Industrial Process



Dr. William Edwards Deming

## Plan-Do-Check-Act

(Deming's Cycle / Shewhart Cycle)

Deming was one of the key architects of Japanese post-war economic miracle of 1950 to 1960

Japan rose from the ashes of war on the road to becoming the second-largest economy in the world through processes partially influenced by the ideas Deming taught

# Challenging Every Vertical- The Toyota Way

## The Toyota Way

Sakichi Toyoda

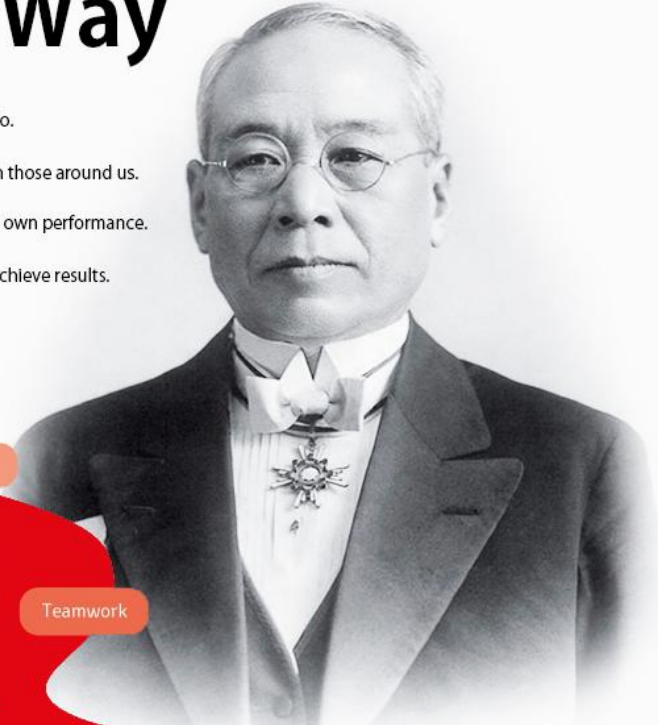
**Challenge** When we embrace a challenge, we also commit ourselves to challenging what we know and do.

**Respect** We accept personal responsibility for what we do, and build mutual trust and understanding with those around us.

**Kaizen** We strive to identify where and how changes can be made to benefit the business, the team, or our own performance.

**Teamwork** Every member of a team is given the opportunity to do their best and the accountability to achieve results.

**Genchi Genbutsu** Genchi Genbutsu – “going to the source” – is about checking the facts yourself, so you can be sure you have the right information you need to make a good decision.



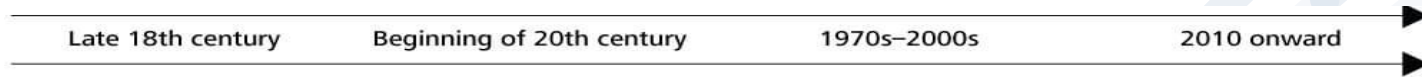
# Semiconductor Devices Stepped In



The transistor was successfully demonstrated on December 23, 1947 at Bell Laboratories

The three individuals credited with the invention of the transistor were William Shockley, John Bardeen and Walter Brattain.

# Industrial Revolutions



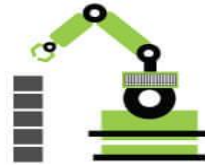
## First industrial revolution: Power generation

- Introduction of the power loom in 1784
- Mechanization of production facilities with water and steam power



## Second industrial revolution: Industrialization

- Introduction of the assembly line in slaughterhouses in 1870
- Electrification drives mass production in a variety of industries



## Third industrial revolution: Electronic automation

- Development of the first programmable logic controller (PLC) in 1969
- Growing application of electronics and IT to automate production processes



## Fourth industrial revolution: Smart automation

- Increasing use of cyber-physical systems (CPS)
- In January 2011, Industry 4.0 was initiated as a “Future Project” by the German federal government
- With the introduction of IPv6 in 2012, virtually unlimited addressing space becomes available
- Governments, private companies, and industry associations have been focusing on Industry 4.0 and making investments since the 2010s

Sources: Germany Trade & Invest, “INDUSTRIE 4.0—Smart manufacturing for the future,” July 1, 2014; National Academy of Science and Engineering, “Securing the future of German manufacturing industry: Recommendations for implementing the strategic initiative Industry 4.0,” April 2013; Deloitte analysis.

# Modern Manufacturing Scenario



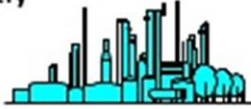

Computer Integrated Manufacturing



Automotive Assembly Line

# Process Industries v/s Discrete Industries

Chemical, Food, and Beverage manufacturing processes are different from automobile production!

	<b>Process Industry</b> 	<b>Discrete Industry</b> 
Production	Product is manufactured by mixing, blending and transforming chemicals, liquids or food stuffs	Product is manufactured by assembly of distinct items
Breaks or Stoppages	Difficult and costly to Start & Stop. Dependent on Production Sequence.	Easy to Start and Stop. Independent of Production sequence.
Shortage of Input Component	More Flexibility in altering production lot size (above minimum) to continue production	If sufficient quantity of components is not available to assemble then production must be halted.
Inventory	Mainly maintained at Finished Product level	Lot of Work-In-Progress inventory
Example	Pharma, Food, Chemicals	Automobile, High Tech

# Process Industries v/s Discrete Industries



Process Industry Shop Floor



Discrete Industry Shop Floor

## Prime Challenges for a production unit in today's scenario

- Continuously changing and diversified nature of end product
- Highest priority on quality
- Uncertain demand density

Production Units are needed to be extremely flexible in their operations to satisfy different market segments.





End of Content 1



# Thanks!

Any questions?

You can find me at:

[k2me@rediffmail.com](mailto:k2me@rediffmail.com)