



Welcome

TA201A Manufacturing Processes

Week-1

02 Aug, 2022

2022-2023 Semester-I

Lecture 1

Introduction to the Course

Acknowledgement

Prof Vivek Verma, Dr. Sudhanshu S Singh and previous instructors



Course Information

Instructor In-Charge:

Dr. Niraj Mohan Chawake
Materials Science & Engineering
Office : Faculty Building 412-A
Phone : 2181
Email : nchawake@iitk.ac.in

Lecture: Tuesday 09:00 - 09:50 (venue L20)

Lab: Monday-Friday 14:00 - 16:50
(Venue- Engineering Metallurgy Lab)

Lab In-charge: Mr. Anil Kr. Verma
Ph. 7978; *Email:* akumarv@iitk.ac.in

Website:
<https://hello.iitk.ac.in/node/3242>



Tutors

Day	Sections	Tutor	Email	Phone
Monday	C3, C4, C15, C16	Dr. Niraj M. Chawake	nchawake@	2181
Tuesday	C8, C9, C11, C20	Dr. Srinu Gangolu	srinu@	
Wednesday	C5, C6, C7, C18	Dr. Sudhanshu S. Singh	sudhanss@	6908
Thursday	C1, C2, C14, C17	Prof. Vivek Verma	vverma@	6527
Friday	C10, C12, C13, C19	Dr. Shikhar Misra	shikharm@	2257

- *If your name or the section is not in the list*
 - *Please contact UG office to know your section*
- *Check with your departmental friends and try to come for the lab sessions*



Teaching Assistants

Day	Roll No.	Name	Mobile no.	Email
Monday	21106033	V S S Manoj Kumar G	9030665844	mkumarg21@
	18106261	Ajay Singh	8810647604	ajaysgh@
Tuesday	21206261	Md Irfan Ali		irfanali21@
	21106029	Satyam Shukla	7292882136/ 9918405672	skshukla21@
Wednesday	21106031	Swastika Paul	9933744971	swastikap21@
	21106028	Satabhisha Ghosh	8336857136/ 8777474679	sghosh21@
Thursday	21106287	Kunal Kishore	9113366358	kunalk21@
	21106288	Rajneesh Pandey	7000123327	rajneeshp21@
Friday	18106268	Kaushal Shakya	8446774162	kashakya@
	21106280	Shubham Jaiswal	7588779816	shubhampj21@
Following TAs will be used for attendance and other jobs related to the course.				
	21106286	Divanshu Kumar (Theory)	8008950284	divanshuk21@
	20106271	Murli Manohar (Theory)	9149973498	murlimhr20@
	18206267	Sandeep Kumar Sahni	7392848010	ssahni@



Marks Distribution

Theory: 40 % weightage of the total

- #Midsem Exam : 40 % of Theory (Tutors + Instructor)
- *Endsem Exam : 60 % of Theory (Tutors + Instructor)

Lab: 60% weightage of the total

- Weekly lab quiz : 10% of lab (TAs + Lab In-charge)
- Weekly Job : 10% of lab (Tas + Lab In-charge)
- Lab examination : 20% of lab (Tutors + Lab In-charge)
- Project Report : 10% of lab (Tutors + Lab In-charge + Instructor)
- Project evaluation : 50% of lab (Tutors + Lab In-charge + Instructor)



Grading

Theory

- There will be a total of 11 lectures starting from 02 August 2022
 - Attending 9 lectures or more will awarded 5% extra marks to theory component (unless scored 100%).
- Attendance will be biometric and gates will be closed by 9:05 AM.

Labs

- Those attending all the labs will earn 5% extra marks in the lab component.
- *No make-up lab will be provided for cultural/ sports activities or casual leaves.*
- If you attend less than 10 labs, you will be deregistered from the course or will be awarded 'F' if the last date for deregistration is over.
- All the lab turns from E1 to E6 are mandatory. The only exception is medical emergency which must be approved by SUGC.
- Only SUGC approved medical cases will be given a makeup lab and any other kind of absence will automatically result in deregistration from the course.
- Absence from project turns (P1-P6) will invite a penalty of 10 marks in the project assuming that project is of 60 Marks (will be prorated appropriately).

Pass Percentage : 40%

- Endsem exam and contribution to Group Project are mandatory components of the course
- No makeup for the Midsem exam



Lab Policy

- **You must attend the lab as per schedule for your section only**
(Section change request has to be made to UG office)
- ***Safety***
 - ✓ Appropriate dress/shoes (see manual)
 - ✓ Safety wears (gloves/shield/apron/eye-protection etc.)
 - ✓ Phones not allowed
- **Bring lab manual on every turn**
- **Professional**
 - ✓ Time, safety, courtesy, preparedness etc.



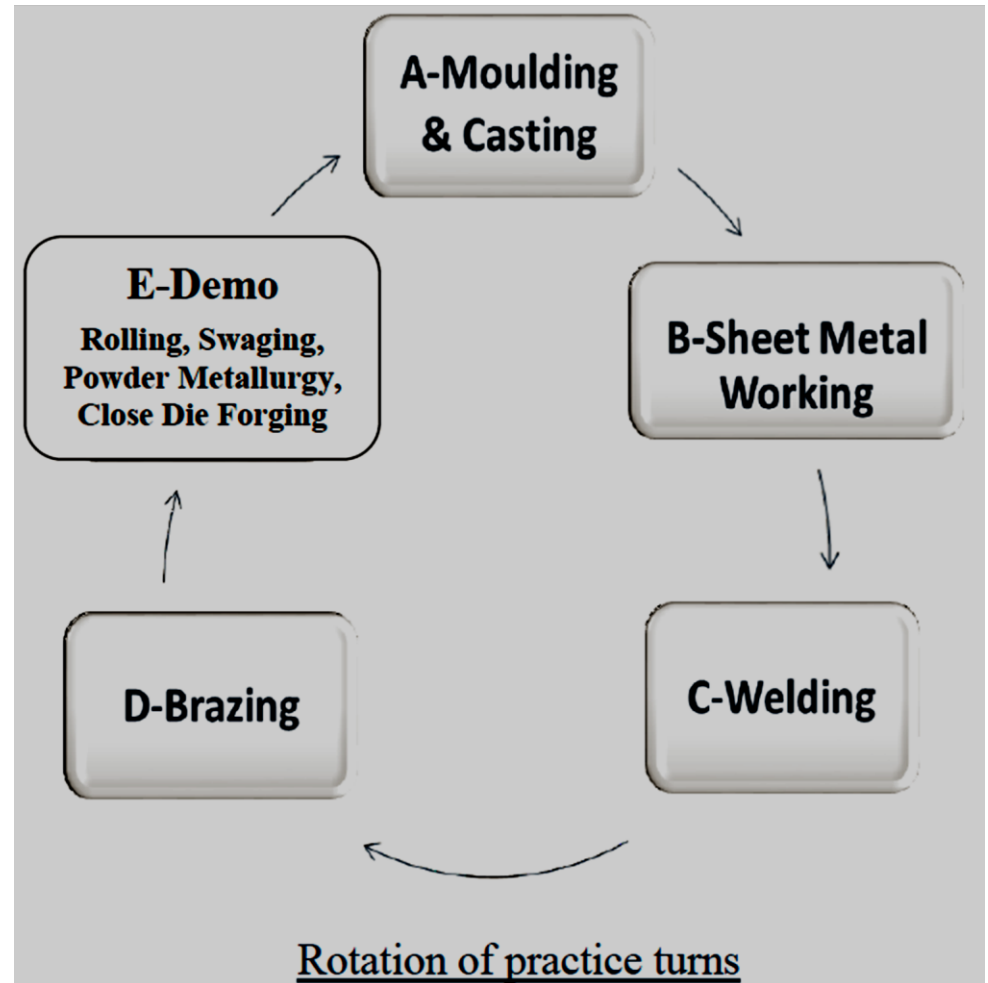
Lab Policy

- **Strictly adhere to lab timings:**
 - ✓ For practice session: A short-quiz at the start of the lab and that will be used for attendance for the first 5 turns. Go through lab-manual and videos on the link (provided by me) for preparation.
 - ✓ For project Lab: Initial attendance (at sharp 2 PM) at the beginning of lab session. Final attendance while showing the work done.
- Attendance in lab is compulsory. Missing 2 lab turn lead to F-grade



Lab/Project Turns

- Practice turns (5):
First to Fifth week
 - ✓ Five groups each day
- Practical laboratory examination & Drawing submission (1 turn)
- Project (6 turns)
- Project Evaluation (1 turn)





Project schedule

Lab Turn	Experiments	Group Project
E-1	Moulding and Casting	
E-2	Sheet-Metal Forming	Project group formation
E-3	Welding Process	Bring a minimum of three project ideas along with the rough sketch. One project idea will be finalized on this turn
E-4	Brazing	Discussion on a finalized project with proper drawing as per engineering norms, including parts drawing (with numbering and materials)
E-5	Object Fabrication	A final discussion on drawing and process (Bring complete report)
LE-1	Lab Exam (Students will be given a task that need perform on the same day)	Final drawing submission.
P-1		Project
P-2		
P-3		
P-4		
P-5		
P-6		
P-7		Project Evaluation



About the Project

- Moving parts in the project will be given extra credit during evaluation.
- Size of the project: 40 cm × 40 cm × 40 cm (**strictly to be followed**) and Total weight for casting objects should not exceed 1.5 kg. Play with aluminium and cast iron per project.
- Oversize/overweight project will affect your final evaluation.
- The Total Project Weight not exceeded 5 Kg.
- External color/paint can NOT be used. Don't **polish/grind** cast component used in your project.



Recommended Readings

- Fundamentals of Modern Manufacturing: Materials, Processes and Systems, Mikell P. Groover
- Fundamentals of Manufacturing Processes, G.K. Lal and S.K. Choudhury
- Materials & Processes in Manufacturing, E. P. DeGarmo, J.T. Black and R. Kohser
- Manufacturing Engineering and Technology, S. Kalpakjian
- E.P. DeGarmo: Materials and Processes in Manufacturing, Macmillan



Web References

There are several courses at NPTEL website

- ☐ <https://nptel.ac.in/courses/112106153>
- ☐ <https://nptel.ac.in/courses/112107144>
- ☐ https://onlinecourses.nptel.ac.in/noc22_me28/preview
- ☐ <https://archive.nptel.ac.in/courses/112/107/112107077/>
- ☐ <https://nptel.ac.in/courses/112104122>



Some earlier projects from your seniors





Some earlier projects from your seniors





Some earlier projects from your seniors





Objectives of the course

To discuss and demonstrate fundamental manufacturing process:

- Casting/ solidification
- Metal working processes
- Welding and heat treatment
- Various Powder metallurgical processing routes and to discuss the mechanisms of sintering metallic and ceramic solids
- Plastic injection moulding
- Brazing Process



Objectives of the course

- At the end of this course, whenever you look at a component, you should start asking questions like:
 - ✓ *How to manufacture this Engineering Product?*
 - ✓ *What material was used for this product?*
 - ✓ *What are other materials that can be used ?*
 - ✓ *What process was used?*
 - ✓ *What are other Processes that can be used?*
 - ✓ *What are the deciding factors for Q2-Q5?*
- Hands-on experience: Project
- Project will test Your Craftsmanship



Course Content

Lecture No.	Topic
1/2	Introduction to Course and Introduction to manufacturing:
2, 3, 4	Engineering Materials: Engineering materials - classification Structure of materials Types of materials Properties of materials Microstructure-property interrelationship
5, 6	Casting/ Solidification: Classifications of casting processes Patterns, Core making, Gating system Solidification of pure metals and alloys, shrinkage, gas solubility Riser design Investment casting Casting defects



Course Content

Lecture No.	Topic
7, 8	Joining processes: Fusion welding: Arc (MMAW, SAW, SMAW), Gas welding and resistance welding Fusion zone, Heat affected zone (HAZ) Brazing and Soldering Solid state welding processes Thermit welding
9, 10	Deformation processes: Engineering stress-strain curve Effect of temperature on the workability Extrusion (direct and indirect) Rolling - classification, roll camber, defects Forging (open and closed-die) Wire drawing Defects and Sheet-metal forming
11	Powder Metallurgy Plastic Injection Moulding



Why TA201 ?

Quora



Search Quora

What's the point of courses like TA201 and TA202 in IIT Kanpur?



Answer



Follow · 17



Request

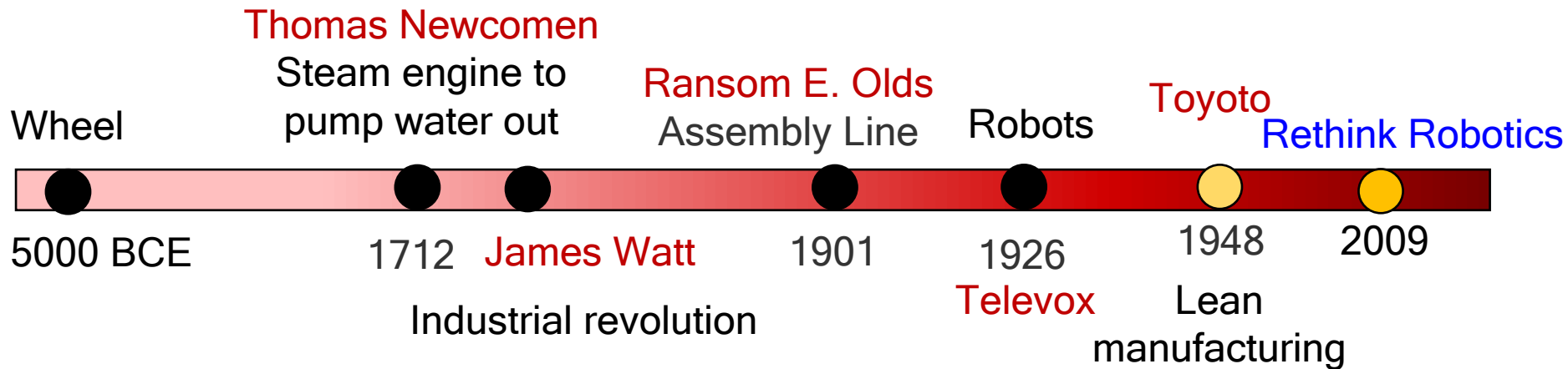


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Manufacturing... Historical perspective



Delhi Iron Pillar

The Rustless Wonder

Late Prof R Balasubramaniam
MSE, IIT Kanpur



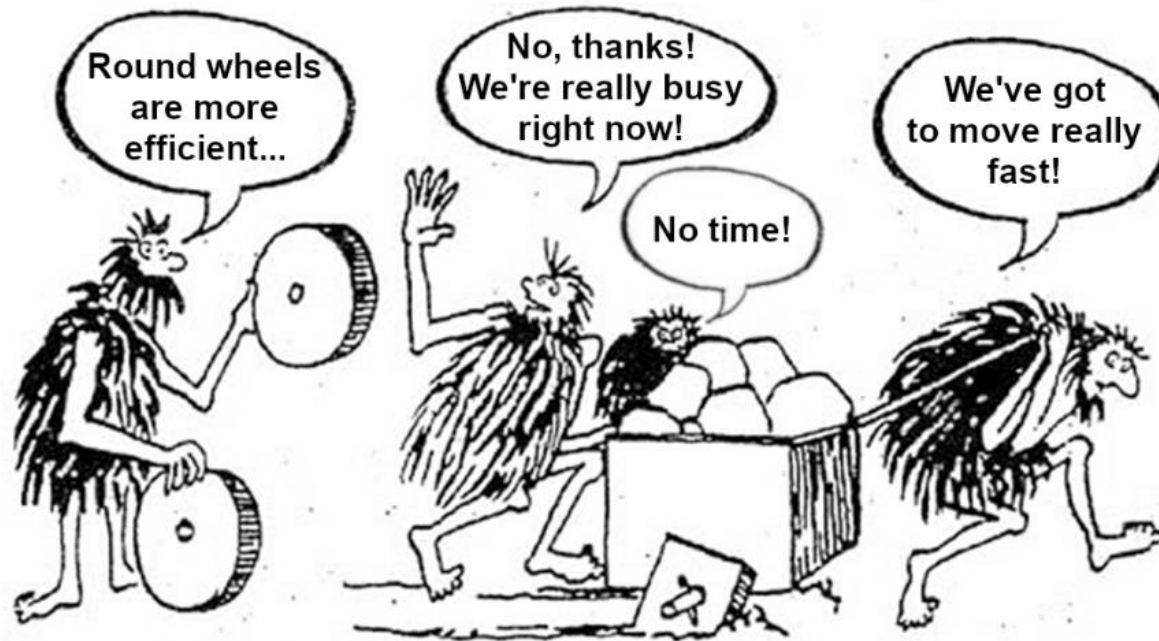
We have lost the
manufacturing process



Courtesy: Google Images



A picture is worth a thousand words



WHY REINVENT THE WHEEL WHEN YOU DON'T HAVE TO?



Reinventing the wheel.
Knowing *when* and *how*.



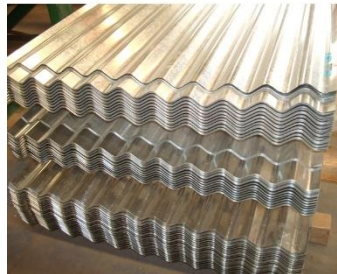
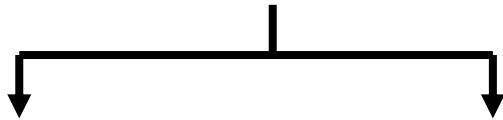
Courtesy: Google Images



Use of Rolling



Billets



Roof



Pipes



Rebars (Saria)

Speed up to 120 m/s

Courtesy: Google Images



Manufacturing ?????

- Manufacture is derived from the Latin words
 - *Manus* (hand) & *Factus* (make)
- **Definition:**

The application of physical and chemical **processes** to alter the geometries/shape, properties and appearance of a starting material in order to **make and assemble** it into a product.
- **What is Manufacturing?**
 - ✓ Making and assembling of goods & articles
 - ✓ Shaping & treating materials to perform desirable functions



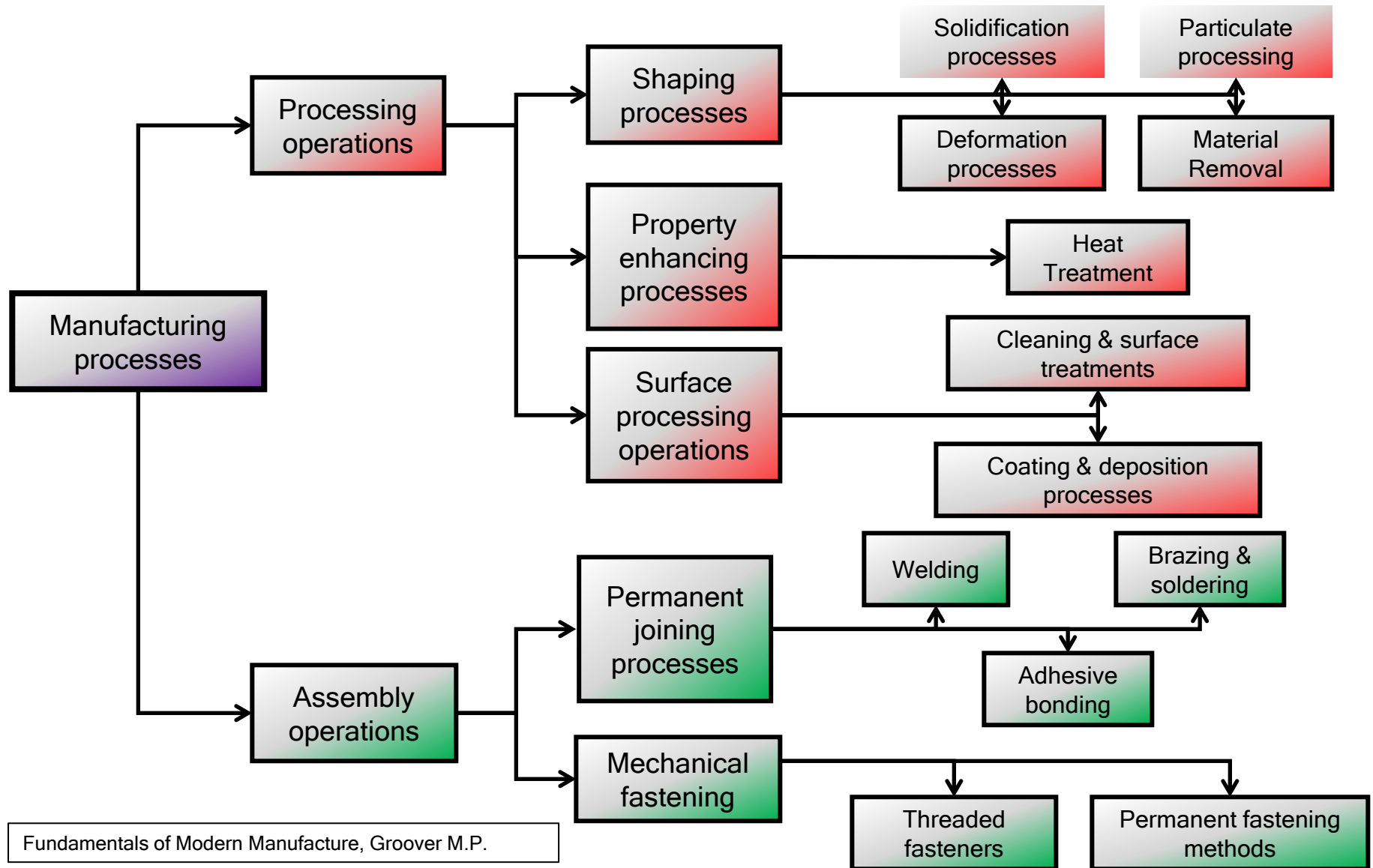
Manufacturing... producing wealth?

List of countries by manufacturing output			
Rank	Country or region	Millions of \$US	Year
	<i>World</i>	13,739,251	2019
1	China	3,853,808	2020
2	United States	2,269,200	2020
3	Japan	1,027,967	2018
4	Germany	678,292	2020
5	South Korea	406,756	2020
6	India	365,030	2020
7	Italy	280,436	2020
8	France	241,715	2020
9	United Kingdom	227,144	2020
10	Indonesia	210,396	2020
11	Russia	196,649	2020
12	Mexico	185,080	2020
13	Canada	159,724	2017
14	Ireland	153,311	2020
15	Spain	143,052	2020
16	Brazil	141,149	2020
17	Turkey	135,596	2020
18	Switzerland	133,766	2020
19	Thailand	126,596	2020
20	Netherlands	99,940	2020

Wikipedia



Classification of Manufacturing Processes



Fundamentals of Modern Manufacture, Groover M.P.



Processing Operation

- *Alters shape, physical properties, or appearance of a material to add value*
- Three categories of processing operations:
 - [Shaping operations](#) — alter the geometry of the starting work material
 - [Property-enhancing operations](#) — improve physical properties without changing shape
 - [Surface processing operations](#) — to clean, treat, coat, or deposit material on exterior surface of the work.



Shaping Process

- **Solidification processes** - starting material is a heated liquid or semi-fluid
- **Particulate processing** - Starting material consists of powders
- **Deformation processes** - starting material is a ductile solid (commonly metal)
- **Material removal processes** - starting material is a ductile or brittle solid



Courtesy: Google Images



Property Enhancing Process

- Performed to improve mechanical or physical properties of work material
- Heat treatment of metals and glasses
- Sintering of powdered metals and ceramics
- Part shape is not altered, except unintentionally
- Unintentional warping of a heat treated part

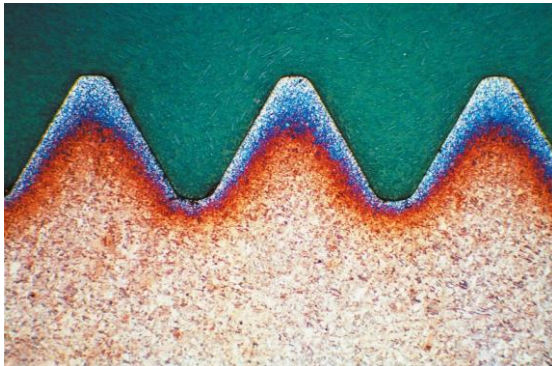


Courtesy: Google Images



Surface Processing Operations

- Operation is carried out only on the surface
- No change in shape and size is intended
- Sand blasting
- Case-hardening
- Coating and deposition processes (eg. chromium plating)

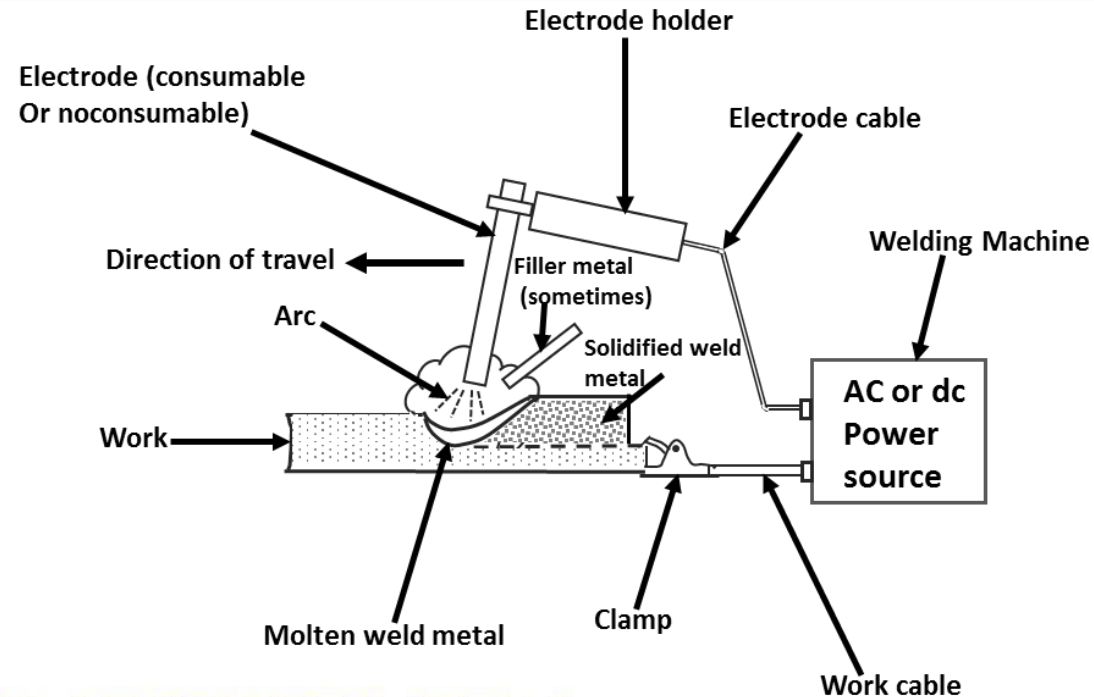


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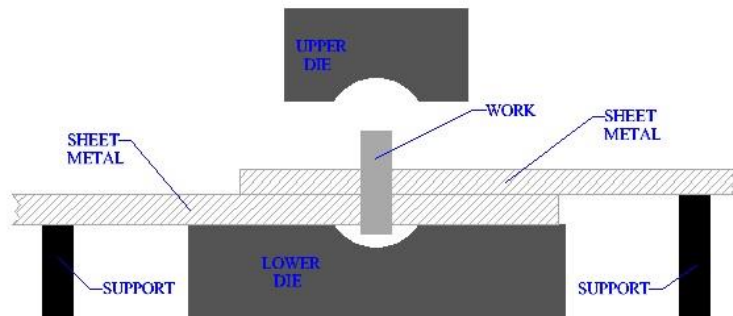


Assembly Operations

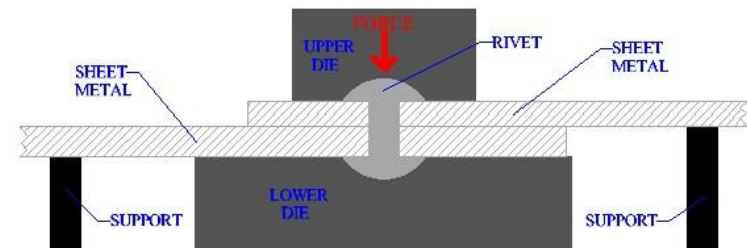
- Join two or more components to create a new entity
- Two types are
 - **Permanent** (eg. welding)
 - **Mechanically fastened** (eg. threaded fasteners)



RIVETING OF SHEET METAL



WORK IS SET IN PRE MADE HOLES



ENERGY FROM DIE COMPRESSION FORMS RIVET



Automotive Industry

Top 20 motor vehicle producing countries (2021)

Country	Motor vehicle production (units)
China	26,082,220
USA	9,167,214
Japan	7,846,955
India	4,399,112
South Korea	3,462,404
Germany †	3,308,692
Mexico	3,145,653
Brazil	2,248,253
Spain	2,098,133
Thailand	1,685,705
Russia	1,566,317
France †	1,351,308
Turkey	1,276,140
Indonesia	1,121,967
Canada	1,115,002
Czech Republic	1,111,432
Slovakia	1,000,000
United Kingdom	932,488
Iran	894,298
Italy	795,856

- Automotive industry began in 1890 with manufacture of horseless carriage.
- US was the major producer of automobiles for several decades. It was overtaken by Japan and then by China

Wikipedia



Where does India stand in automotive industry?

Largest **TRACTOR** manufacturer

Largest **TWO WHEELER** manufacturer

2nd Largest **BUS** manufacturer

3rd Largest **HEAVY TRUCK** manufacturer

4th Largest **CAR** manufacturer

6th Largest **COMMERCIAL VEHICLE** manufacturer



Export from India

Vehicles Exported From India



Maruti - Alto



Maruti - A Star



Tata - Indica



Mahindra - Bolero



Hyundai - i10



Hyundai - EON



Hyundai - i20



Nissan - Micra



Volkswagon - Polo



Bajaj Auto - Pulsar



Hero MotoCorp – Splendor

(Illustrative List)¹²

ACMA



Export from India

Vehicles Exported From India



Mahindra - Maxx



Mahindra - Alfa



Mahindra - Gio



Piaggio - Ape



Bajaj - Auto



Tata - Magic



Tata



Mahindra



Ashok Leyland

(Illustrative List)