

ROLE OF MECHANICAL ENGINEERING IN SOCIETY

Useful link: <https://www.youtube.com/watch?v=q79bl99rWFM>

Mechanization has always been an ingrained characteristic of the human race. Whenever we faced any hurdles in achieving a particular task, we turned to creating machines that do the job for us. The same trend still continues today with the immense skills of professionals we know as Mechanical Engineers.

- Mechanical Engineering create and develop mechanical systems for all of humankind
Concern with principles of force, energy and motion.

- Eliminates excessive usage of resources by optimizing and improving efficiency and build things that make the world a better living place.

- Reduces human effort and makes work easy.

- Without mechanical engineering, we would not have things like engines, generators, elevators or even air conditioning. While we might not even realize it, we most likely use something that has been mechanically engineered every day.

- Mechanical engineering plays a critical role in manufactured technologies, from cars to airplanes to refrigerators. It enables you to do many daily activities with ease, as it brings helpful technologies to our modern society. It is one of the most important subdivisions of engineering, because without it, many of the technologies we use every day would not be available.

- It plays a crucial role in all ways of living: Transportation, Medical, Agricultural, Defence, Power generation, household appliances.

Transportation:

The distance that once took days for us to cover using biological modes of transport can now be achieved in mere hours and minutes. This tremendous leap has been possible only with the help of mechanically powered transportations that we came to know as automobiles. Development of the combustion engine by mechanical engineers paved the way to a new generation of society by opening up doors to faster modes of communication over long distances which inevitably led to a healthy cultural exchange that is much required for any form of modernization. However the development did not stop there, more durable cars were developed with lighter and compact engines and it was not long before the Wright Brothers developed an even lighter engine and decided to put wings on it. The results as expected were ground breaking and changed the face of transportation. Everything starting from cars, ships, railways to airplanes made it possible to traverse the world and aid in a healthy cultural exchange. You only need to look around you to see how such an invention has helped our society as a whole

Agricultural Mechanization:

Just like the transportation, the agricultural field too reaped the benefits of modified mechanized farming machinery to increase the production and reduce the time taken to do so

manually. Mechanization of the farming sector was an important leap by Mechanical Engineers as the urban society grew and nourishment in large quantities was then required to feed the increasing population. Without the implementation of the modern machinery like water pumps, tractors, harvesters, etc. developed by the mechanical engineers, our society as a whole would have been still hobbled and would have never attained its full potential.

Household Appliances and Waste Management:

Mechanical engineers have always played a crucial role in the development of various household appliances and mechanized items that make our lives easier and help us to focus on the more important aspects of life. Today, we all can very well enjoy a comfortable life with the help of appliances such as heaters, air conditioners, and refrigerators. Every workplace in the modern world has a ventilated central cooling and/or heating system. Such systems are also used to purify the air and help in manufacturing processes that require a specific temperature. The effect of such appliances in our lives has been amazing. They have improved our self-development and family lives by empowering more individuals to acquire a living outside the home and contribute altogether to the economy. This would not have been possible without the mechanical engineers who spend a major portion of their time in trying to develop such machines. Likewise, waste management has also played a pivotal role in our society by keeping it clean, hygienic and free of diseases. And as you may know, waste disposal trucks, treatment facilities, and water purification systems are all significant contributions of mechanical engineers towards our society. We can safely conclude that all the technological achievements that we see today in our society are a derivation of the first engineering leaps by mechanical engineers that were later refined, improved, modified, and used to create more modified and advanced technologies that came about later. Simply stating that mechanical engineering is an important aspect is a gross injustice to such an enormous field. It is due to such professionals because of whom we are comfortably leading our current way of life. Therefore, pursuing a career in such a field is the best decision you can make if you have a knack for it.

Mechanical engineering is the study, design, development, construction, and testing of mechanical and thermal sensors and devices, including tools, engines, and machines. Mechanical engineering careers centre on creating technologies to meet a wide range of human needs.

Role of Mechanical Engineering in Industries:

Mechanical Engineer will play a vital role in the sustainable development of the industry and the society. Starting from the conceptualization of the product to the design, manufacturing, sales and service to the end of life of a product i.e, recycling, mechanical engineer will play his role.

To start with, to design a product mechanical engineer has to conceptualize the product, draw the preform of the product, then apply the mechanical design and will build the product for its strength.

Mechanical engineer role as a manufacturing Engineering is a huge. Studying the design, laying out the tooling for the production and optimize the raw material consumption in manufacturing a component requires huge skills as a mechanical Engineer.

Mechanical Engineer also play a vital role in the logistics. Procuring the materials for the production, maintaining the adequate material in the stores, dispatching the finished products to the Consumer is the role of a Logistic Engineer.

Mechanical Engineer also works as a safety Engineer in an Industry. Taking care of the human resources, machineries, equipment's and planning out the safer working conditions and ensuring the safety of the operations is the responsibility of the safety engineer.

Mechanical Engineer plays a vital role in the overall growth of the economy as well as the Society. Meeting the demand for a product to the optimum utilization of the resources are taken care by the mechanical Engineers. Designing a product for longer product life cycle and reutilization/ recycling the product reduces the dependency of the materials by the industry. Also, developing newer equipment's, devices for harnessing the renewable sources energy reduces the dependencies on the fossil fuels. This in turn contribute the green energy, low or no emission of carbon and its compounds.

Following are few of the areas where in Mechanical Engineer play his role in an industry:

Design Engineer, Production Manager, Safety Engineer, QA Engineer, Logistic Manager, Data analyst, Drafts man, Sales Executive, Customer Service etc.,

Emerging Trends and Technologies in Different Sectors

Energy:

Here are a few emerging trends in energy system projects for 2022 and years to come

1. Organizations have made a goal of significantly reducing CO₂ emissions to mitigate climate change. To address CO₂ emissions of existing assets, energy companies have regained interest in Carbon Capture and Storage technologies. Carbon Capture and Storage, also known as CCS, is the process of seizing carbon dioxide before it enters the atmosphere, transporting it into a storage location, and isolating it for years to come.
2. Governments and energy companies are now investing in renewable energy sources, moving away from fossil fuels.
3. Model-based design and system simulation have helped to support innovation and combat the costly inputs that many of these large-scale projects bring about.
4. Energy storage systems have emerged as key enablers for a wide deployment of renewable energy sources. The main goal of storage projects in power applications is to store the renewable power surplus and use it later. The challenge for companies is to find a cheap, efficient, scalable, and dispatchable solution using standard components and materials for the creation of these storage systems.
5. Many companies are turning to the most abundant element in the universe – hydrogen. Hydrogen is an incredibly versatile energy source with the potential to replace many existing technologies, bringing forth more sustainable and long-lasting alternatives for every industry. Governments are heavily investing in hydrogen related projects and there is significant research and development work ahead of us. Design and simulation tools at the component and system level can help engineers shorten the development time and make the right decisions at every stage of the value chain.

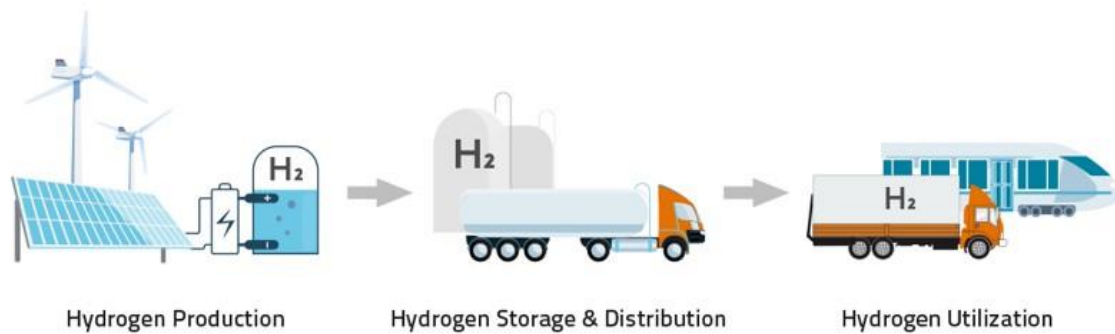


Figure: The hydrogen value chain

Manufacturing

Recent economic pressures and labor shortages have forced manufacturers and factories to become more flexible and efficient by the following ways.

Accessible Automation

New technologies that have made automation more accessible to manufacturers are changing the way companies operate. “Automation for all” is the next step in the industry.

Automation is made possible with easy-to-use robotics solutions, user-friendly Manufacturing Process Management (MPM) systems, and human-robot collaboration. With manufacturing automation, organizations are reducing costs, optimizing workflows, and increasing their bottom line.

Mobile Robotics

One of the primary drivers of this manufacturing trend is autonomous mobile robots (AMRs). While robots used to mean ultra-sophisticated technology that required trained roboticists, new robotics technology is making automation attainable for companies of all sizes.

Internet of Things (IoT)

The Internet of Things helps manufacturers connect to and monitor the various components of their operations, gaining insight never before possible. This connectedness gives manufacturers valuable data that enable them to change, optimize, and improve every facet of their manufacturing process.

Using smart sensors and cloud connectivity powered by the internet, IoT is propelling the advancement of the industry. Companies are improving safety, saving money, streamlining manufacturing, and even creating new products with IoT capabilities.

Enterprise Resource Planning (ERP)

ERP systems help manufacturers automate different areas of operations under one comprehensive system. This universal touchpoint then gives manufacturers the insight they need to oversee the entire manufacturing operation and make improvements and adjustments where needed.

Universal Connectability

“universal connectability” is the idea that technologies are now being made to connect with any device or system. System-agnostic solutions can be fit to any manufacturing setup, as the device itself and its operating technology can work with a wide variety of operations. Essentially, technology and manufacturing advancements can now be tailor-made to your operations, without the cost of a fully custom solution.

Industry 4.0

A term created to describe the current trend in manufacturing toward “smart factories,”

The widespread adoption and understanding of the latest manufacturing tech – IoT, the cloud, advanced computers, robotics, and the human workforce – all work together to empower Industry 4.0. Companies looking to stay relevant, competitive, and thrive in the marketplace must take advantage of the technological advancements that have sparked the fourth revolution in the manufacturing industry.

Artificial Intelligence (AI) and Machine Learning

Because companies have access to more data than ever before, tools that enable them to make the most of that data, like artificial intelligence and machine learning, are having a major impact on manufacturing. AI doesn’t mean walking, talking robots, but instead refers to a computer system’s ability to recognize trends and infer logical conclusions that can help manufacturers make data-driven decisions.

AI and machine learning can help improve many aspects of a manufacturing operation, such as:

Inventory management

Supply chain visibility

Warehouse cost reduction

Asset tracking

Forecasting accuracy

Transportation cost reduction

And more

Predictive Maintenance

Additive Manufacturing

Additive manufacturing is a fast-growing trend in the industry as it is first and foremost a significant time and cost-saving tool. We are seeing this manufacturing trend growing at an accelerating rate, especially in the metal fabrication industry and among manufacturers who build with metal components. New selective laser sintering (SLS) technology for 3D printing metals enables companies to build metal products in-house and realize significant cost savings by eliminating tooling costs and dramatically shortening product development time. Most exciting is that 3D printing enables cost effective mass production of metal parts that were previously impossible to make.

Collaborative Robots (CoBots)

The addition of robotics and automation to the manufacturing industry has sparked concerns about possible negative impact on the workforce. What manufacturing trends are showing is just the opposite – robots and people working together, collaboratively, in factories and warehouses can get more work done, faster and more safely.

Automated Picking

Automated picking is achieved when a robot is used to travel throughout the warehouse grabbing the correct product, leaving people to do more skillful work in the fulfillment process. These advances in manufacturing and logistics are improving efficiency – where a human worker could pick between 60 and 80 orders an hour, an automated system can pick up to 300 in the same time frame as per the statistics available.

Automotive Sector

Artificial Intelligence: Artificial intelligence (AI) application in automobiles enables drivers to improve safety. Some modern cars like the 2022 Toyota Tundra can apply such technology and automatically light up in the dark. The headlights sense oncoming cars and dim. This is because artificial intelligence makes the automatic activity of beam control possible. It helps to improve a driver's vision on the road, which increases road safety.

3D Printing in Car Manufacturing: 3D printing enables manufacturing companies to perform rapid prototyping. This accelerates the production of vehicles in the design phase and testing. Car manufacturers print designs they need with 3D printing technology. It is a technology that helps save time in the manufacturing of automobiles.

Biometric Seat Capabilities: Biometric seat capabilities improve a driver's personal experience in a vehicle. This technology collects data from a driver's face and palms. The information measures anxiety levels and advises the driver when to take a break. This helps avoid fatigue and enhances a driver's performance on the road.

Big Data Analytics: Analytics helps to make data-driven decisions in a vehicle's lifecycle. Data collection and analysis helps in predictive maintenance, provides fleet information to managers, and alert authorities if an accident occurs.

Autonomous Vehicles: Self-driving cars aim to transform transportation in various ways. For example, it reduces the number of human drivers and at the same time, makes transportation safer. Fewer human drivers on the road mean the chances of driver negligence or fatigue are lower. Autonomous vehicles also use advanced technologies like computer vision and pedestrian behavior-prediction. Such technologies help in avoiding obstacles on the road. It also predicts the movement of a pedestrian, like a leg movement or eye contact.

Shared Mobility: Shared mobility reduces the number of cars on the roads and reduces pollution. Car-as-a-service (CaaS) ensures fewer petrol and diesel cars on the road to keep the air clean.

Automatic Lift Gate: Automatic lift gate technology is helpful when you want to get into your car, and your hands are full. The car can sense your keys and open them automatically.

Electric Vehicles: Companies that make electric vehicles aim to produce cars that are easy to maintain. This means producing trucks with fewer parts. Companies continue to work towards finding these solutions. For example, some companies might consider using parking spaces as charging stations. Technology makes it possible for the charging station to know how much power each vehicle needs. Software technology also controls how each car is charged in terms of speed.

Aerospace:

With the aerospace industry continually making improvements, here are some of the aerospace engineering technology trends.

Structural Health Monitoring (SHM)

Structural health monitoring involves the observation and analysis of a system over time using periodically sampled response measurements to monitor changes to the material and geometric properties of engineering structures such as bridges, airplanes, and buildings. The foundation of structural health monitoring is the ability to monitor structures using embedded or attached nondestructive evaluation (NDE) sensors and to utilize the data to assess the state of the structure.

Advanced Materials

Innovative materials can be used in a wide variety of areas - from lighter, more agile aircraft and emerging hypersonic systems, to personal protection equipment and anywhere risks or damage can be reduced. Progress in developing advanced materials is expected to address the integration of functions such as energy harvesting, camouflage, structural and personal health monitoring. For example, graphene is a carbon-based material, which is merely one atom thick and can be used to make batteries that are lightweight, durable, and applicable in high capacity energy storage - plus, they charge more rapidly than a typical battery.

Additive Manufacturing (3D Printing)

Reducing weight is paramount to the aerospace technology industry due to increasing performance in areas of speed, capacity, fuel consumption, emissions, and more. This realization is leading the aerospace and defense industry to look for applications of 3D printing in its newest products, from seat frameworks to air ducts.

Supersonic Flights

Supersonic flight is when an aircraft travels faster than the speed of sound. US airline United has announced plans to buy 15 new supersonic airliners and "return supersonic speeds to aviation" in the year 2029. Supersonic flights sound familiar? Such passenger flights ended in 2003 when Air France and British Airways retired Concorde. The new Overture aircraft will be produced by a Denver-based company called Boom, which has yet to flight-test a supersonic jet. United's deal is conditional on the new aircraft meeting safety standards and noise pollution concerns.

Utilizing Internet of Things (IoT) to Anticipate Maintenance Issues

Aircraft maintenance and repair companies are widely using Internet of Things technology for predictive maintenance of aircraft parts and equipment. An IoT-based predictive maintenance solution can help to predict potential damage for example by collecting data from ultrasonic and vibration sensors attached to the spindle of a CNC machine. Analyzing the collected data helps to identify fragile spindles and tools before they break. IoT technology is used to send critical data from engines, wing flaps, bleed valves, and landing gear to technicians for preventive maintenance. This data aids technicians to create maintenance schedules, procure parts, and schedule relevant workers to fix equipment.

Artificial intelligence (AI)

The aerospace technology industry is also benefiting from artificial intelligence and the use of machine or active learning in research and education. Machine learning offers the ability to gain new insights into materials by employing artificial intelligence to discover new patterns and relations in the data. AI can handle far more complex problems than humans, and can run the gambit of thousands of outcomes within moments compared to how long the human brain takes to process information.

For instance, in order to create the next generation of technology, researchers at the United States Air Force Research Laboratory (AFRL) are using machine learning, AI and autonomous systems to exponentially increase the speed of materials discovery and lower the cost of technology.

Autonomous Flight Systems

Implementing autonomous technologies has been a growing trend across several industries, and the aerospace industry is no exception. Much of this has been focused on increasing autonomous flights, with the end goal being to launch fully human-free flights. While this may still be several years away, investments and innovation will consistently be geared toward this in the coming years. We might see planes being cut down to just one pilot and subsequently becoming autonomously operated in the coming years. This has already occurred with drones, although this technology will obviously need to be scaled-up before it's ready for passenger planes and longer journeys.

Marine Sector:

Shipbuilding

Modernization of shipbuilding techniques has unlocked multiple benefits like creative freedom for designing, better ways for waste management, simplicity to build custom units, efficient inventory management, automation, cost-savings, and much more is achieved. Shipbuilding innovations have also proved to be a friend to the environment as for their abilities to calculate precise amounts of raw materials required and effective waste management procedures.

Ship propulsion

Technological escalations in ship propulsion and powering techniques are one of the major trends in the maritime industry. Efficient, energy-saving engines, better propulsion techniques, use of alternative fuels, switching to renewable sources of energy are some of the highlights of the changes happening in propulsion engineering. The environment is abundantly benefited by this innovation in engineering, suppressing harmful emissions, and reducing fuel costs by up to 20%.

Smart Shipping

One of the major shifts in maritime technologies is smart shipping. For as long as the traditional means of shipping are concerned, they are soon to be outdated. The sophistication of digital technologies is allowing seafarers to perform shipping in more efficient, economical, smarter, and faster ways. Leveraging systematic data-tracking, machine learning, and AI, tons of factors including vessel performance, fuel efficiencies, cost-cutting, safety compliances, vessel routing, operational capabilities can be improved. Not to mention, smart data-tracking will help gain better ways to protect the environment.

Smart Materials

The traditional materials used today are rapidly getting replaced by smarter, and highly advanced materials. These advanced materials will give better vessel performance, and mainly the possibilities to upload newer features. This advancement in machinery will adopt compatibility for software innovations of the future.

Better Communication

With ships travelling across the world and crossing oceans, sharp communication equipment is a must. Radio communications, Very High Frequency (VHF) signals are capable of transmitting large amounts of data across long distances. With installations of technologies like 5G, the maritime industry will be able to communicate effectively and efficiently. Live tracking, cargo monitoring, distress calls, HD video conference calls, and much more would be possible with upgrades in communication technologies.