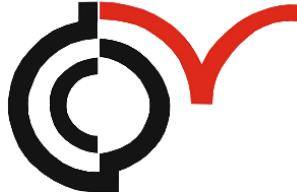


SMART FACTORY,CPDM,IISc



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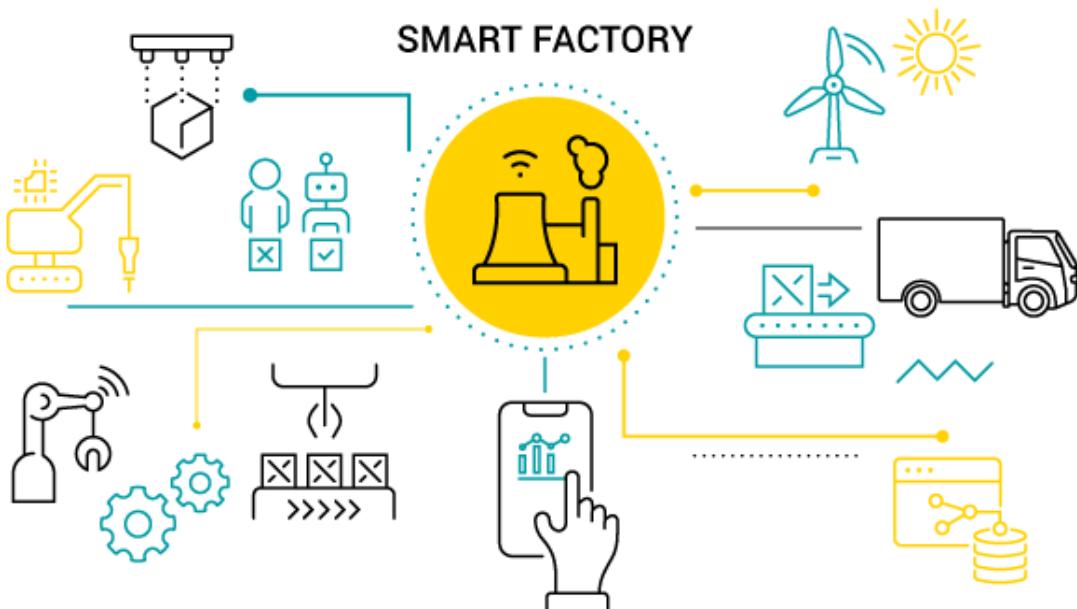
1. Smart Factory Tour
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CHAPTER: 1-

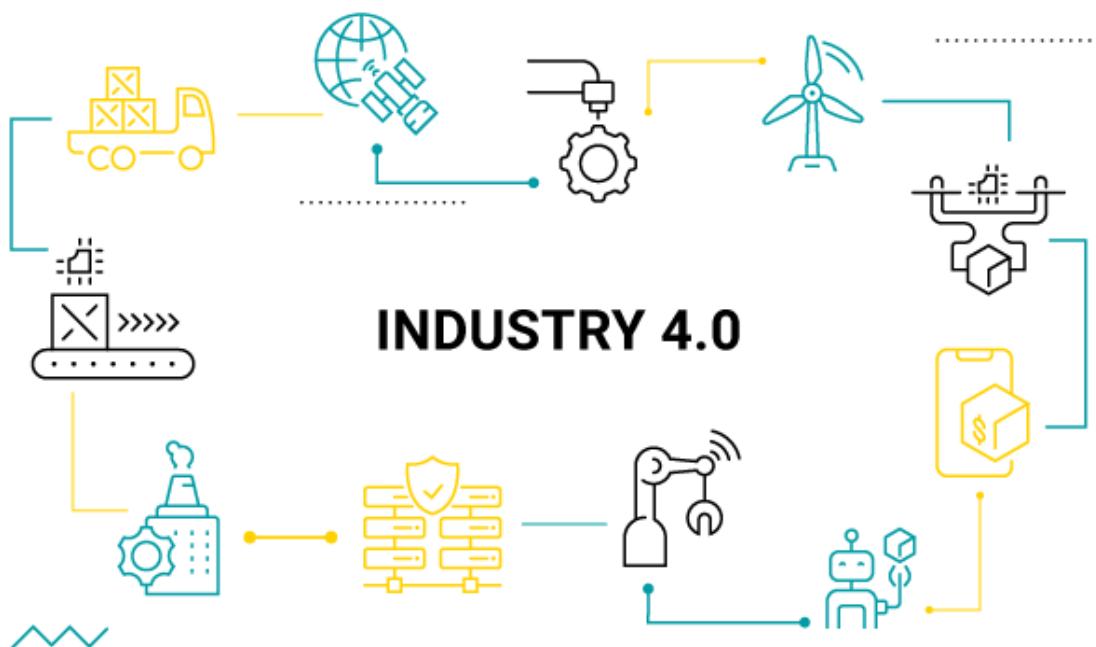
Introduction:

This report is all about Smart Factory(or Industry 4.0) i.e,full automation of Industries,In other words the inclusion of concept of Smart Industry such as the use of Internet of Things, Artificial Intelligence, Machine Learning, etc which makes the different components of the Industry or Factory to communicate with each other like share some useful data for making production effective and cost efficient hence make the production unit a bit smarter(The future product will talk).



What are the main focuses:

- It has the main focus on making Industries Smart(SMART FACTORY 4.0).
- It uses new technologies like IOT(Internet of things), AI(Artificial intelligence), ML(Machine learning) and many more.
- It has a main focus on connecting different components of manufacturing.
- In the Smart industry, all components of production can share data and useful information with each other.
- The Architecture of the smart factory setup has three main components as, MES(Manufacturing execution systems), ERP(Enterprise resource planning) and PLM(Production lifecycle management).
- It has the main focus on the complex production system.

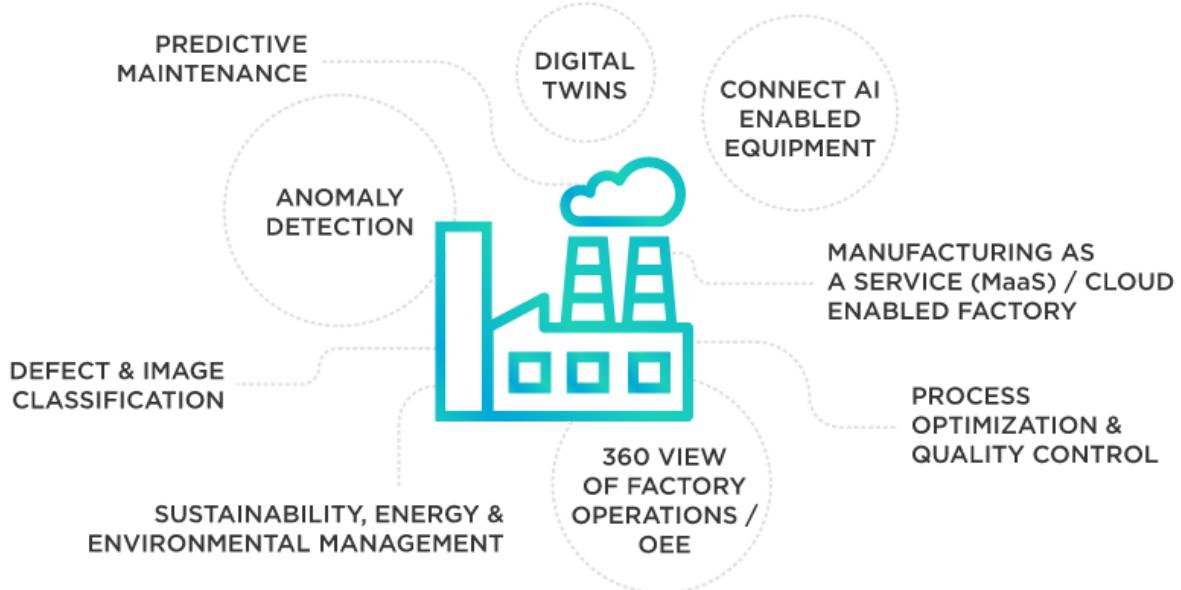


Why is it Important?:

- It is important because it focuses on efficient manufacturing.
- It is important because it focuses on smart manufacturing.
- It is important because it focuses on simulation of products in the virtual world before final manufacturing.
- It is important because it reduces human labour and chance of error in manufacturing.
- It is important because it increases the manufacturing capacity.
- It is important because we can analyse the product before manufacturing to get an innovation in the previous product.
- And the most important advantage is it further reduces cost of production to a greater extent.

Advantages:

- It reduces human resources.
- It reduces the need for skilled laborers.
- It reduces the cost of manufacturing.
- It increases the efficiency of the production and the spontaneity of products as well.
- It helps in new innovations and new discoveries.
- With these applications we can access our product data even with distant places.
- By accessing the data we can avoid any error or disaster in the manufacturing unit or production.



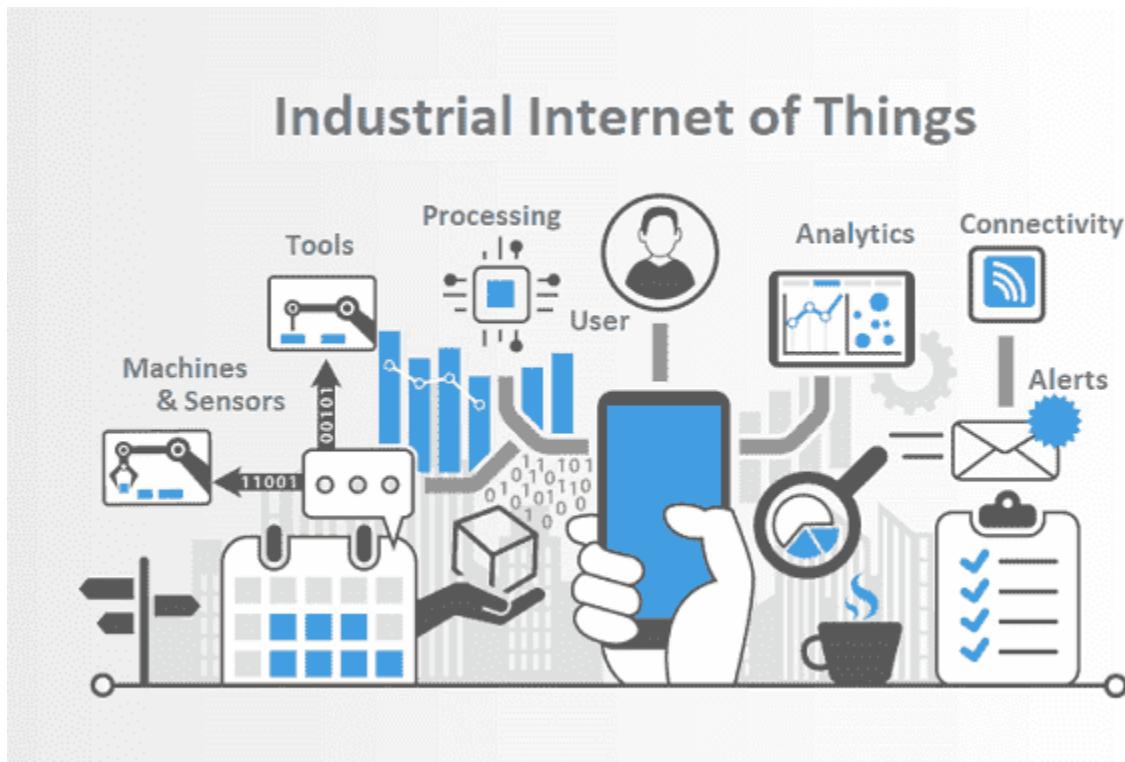
Disadvantages:

- It increases the Unemployment.
- It affects the small scale industries or hand-made industries to a greater extent.
- It reduces the involvement of humans in the manufacturing which affects the life of people.

CHAPTER:2-

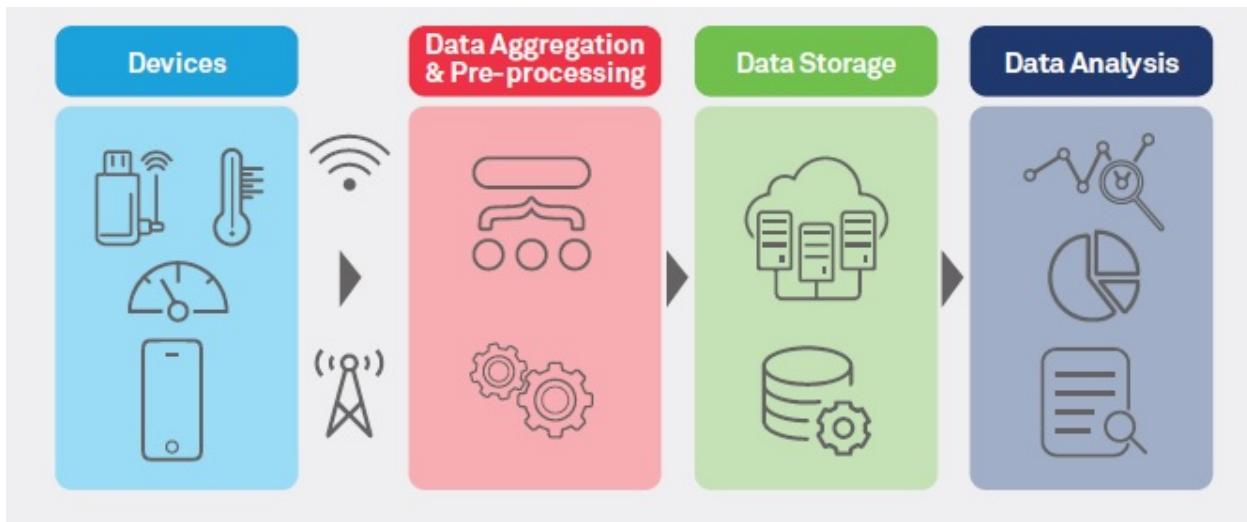
Introduction:

This report focuses more on the use of IOT(Internet of things), AI(Artificial intelligence), ML(Machine learning) and many more. It mainly focuses on the use of different sensors and actuators with our product to make it smart and in turn it will help in increasing the product efficiency and sustainability. It also focuses on different innovations which led to the formation of smart industry or factories and later it also focuses on the economy a bit. Later it also talk about government policies and sustainability of an innovative idea in a real world.



What are the main focuses:

- It mainly focuses on the use of IOT(Internet of things), AI(Artificial intelligence), ML(Machine learning).
- It focuses on the use of different sensors and actuators which gives real-time or real-world data to the cloud which in turn can use that data to control or monitor the product and its life.
- By the use of sensors we can analyse the data given by the sensors to anticipate and avoid it from giving any error.
- It focuses on the use of these sensors and actuators in the medical fields to reduce the burden of human resources and also increase the efficiency of the process.
- It focuses on the use of smart devices in different fields like surgery, ICU, human organs and many more.
- It explains the Evolution of traditional industries into smart industries.
- It talks about policies for startups which led to different innovations and hence increased the pace of smart industries.
- It enlightened the startup scenario of India and how it grows faster day by day and involves the use of smart devices.
- It talks about the economic scenario of India in terms of startups.
- It also talks about startups that involve the use of rural India into the picture and in turn contribute to the economy.
- It also shows the importance of the internet in startups and innovations because it connects all the different parts of India whether it is rural or urban.

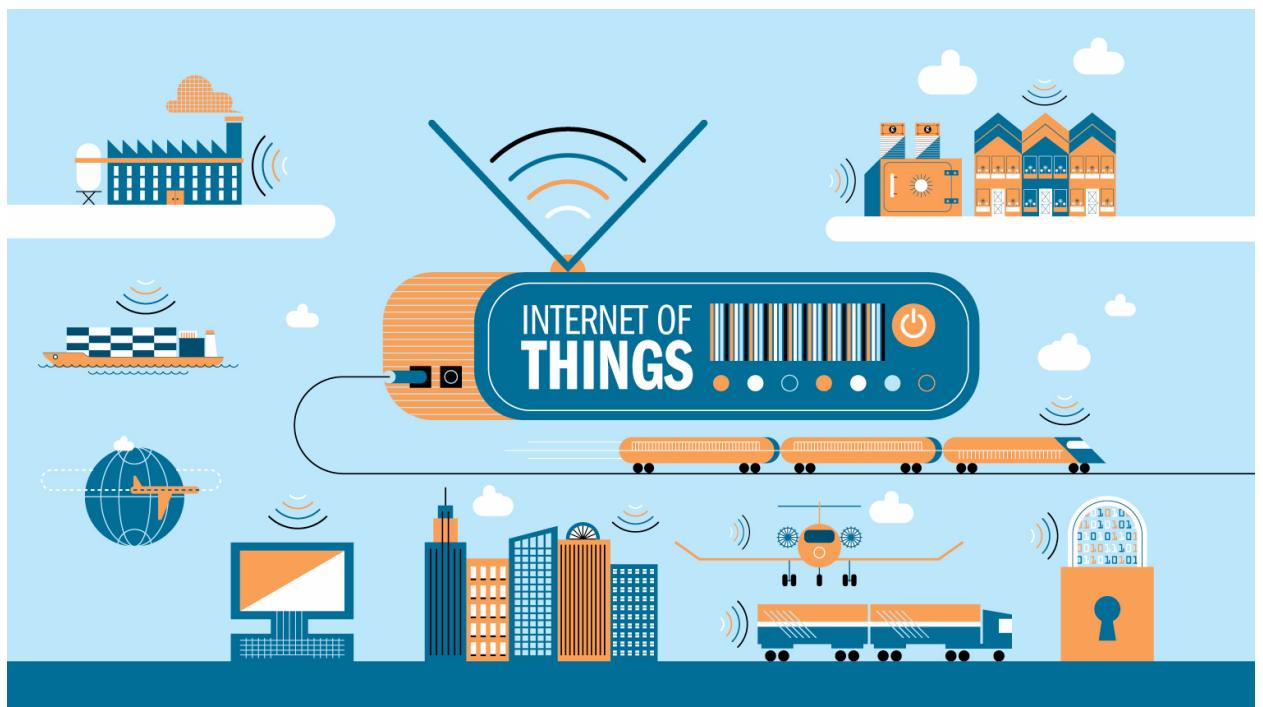


Why is it Important?:

- It is important because it increases the efficiency of the medical system.
- It is important because it can reduce the chance of error in the process.
- It is important because it reduces the cost of the human resource.
- It is important because it makes the health system more handy which in turn can reduce the time of process.
- It is important because it can give future errors by the use of artificial intelligence, with the help of which we can anticipate and can cure the disease.
- The policy reforms are most important to support the startup and innovation culture in india.
- The policy should be supportive to small scale industries to support diversity of innovations.
- It also focuses on the use of the network as a key role in almost all the startups and innovations.
- It is important because it promotes the practice of a distributed economy.

Advantages:

- It makes the health system more reliable and efficient.
- The use of sensors and actuators helps the purpose of data source which can help in many ways.
- The use of cloud services also helps in analysing the data at any time which can improve the product quality.
- We can check the future performance of any smart devices such as medical devices which will help in controlling some or a particular issue.
- We can reduce the error by the use of smart devices in medical systems.
- It also affects the economy of the country in a positive way as to include the contribution of rural india.
- Nowadays many startups and innovations focus more on involvement of rural india.



Disadvantages:

- In Fact the internet connectivity is not good in most of the rural parts of the country.
- The lack of infrastructure in the rural parts of the country.
- The lack of policies for rural India for supporting smart industries in rural parts of the country.
- The gap of economy between rural and urban parts of the country.

CHAPTER:3-

Introduction:

This report talks about CNC(Computer numerical control) machines and its applications and its various machining capabilities. It also talks about subtractive manufacturing. It talk about different manufacturing machines including CNC machines.



What are the main focuses:

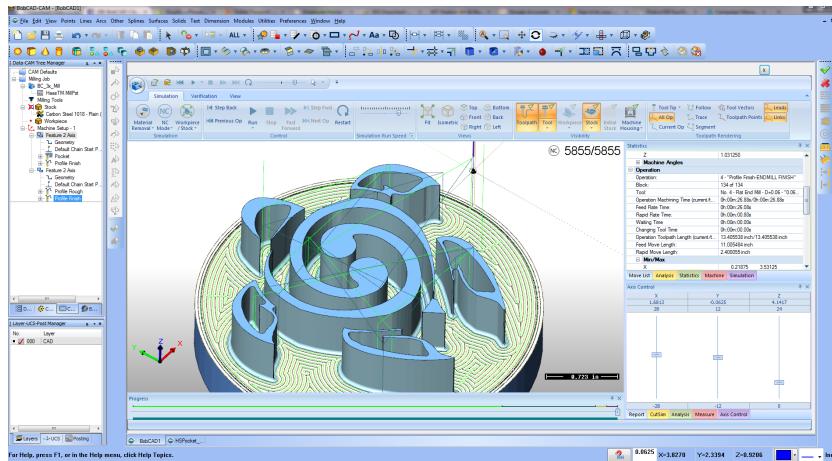
- It mainly focuses on CNC(Computer numerical control) machines.
- It talks about different manufacturing machines such as Drill machines, Lathe machines and last CNC machines.

-
- Drill machines make drills in the stationary materials while Lathe machines do with the moving materials but in CNC machines,it does all possible operations.
 - A CNC machine removes or casts a product in which material can move in utmost five directions.
 - CNC machines has 3 and 5 degree of freedom as(X-axis, Y-axis, Z-axis and rotation about X or Y axis)
 - A CNC machine has a wide variety of tools which can operate automatically.
 - CNC machines operate on subtractive manufacturing techniques.
 - CNC machines operate with the help of G and H code which were given in the computers.
 - It can work with a wide variety of materials ranging from plastic to metal such as aluminium.
 - Before making the final product a virtual software does all the simulation for the real world operations.
 - It uses CAD(Computer-aided design) software for simulation before final manufacturing.
 - It has various KPI(Key performance indicators) which can help in checking productivity,safety and quality.



Why is it important:

- It increases the efficiency of the production.
- It reduces the cost of production.
- It consumes less time than traditional manufacturing techniques.
- It can produce a wide variety of products ranging from a bolt to a car.
- It produces a finished product for the market.
- The error of producing a disable product is less.
- Product simulation is a big advantage over traditional manufacturing.



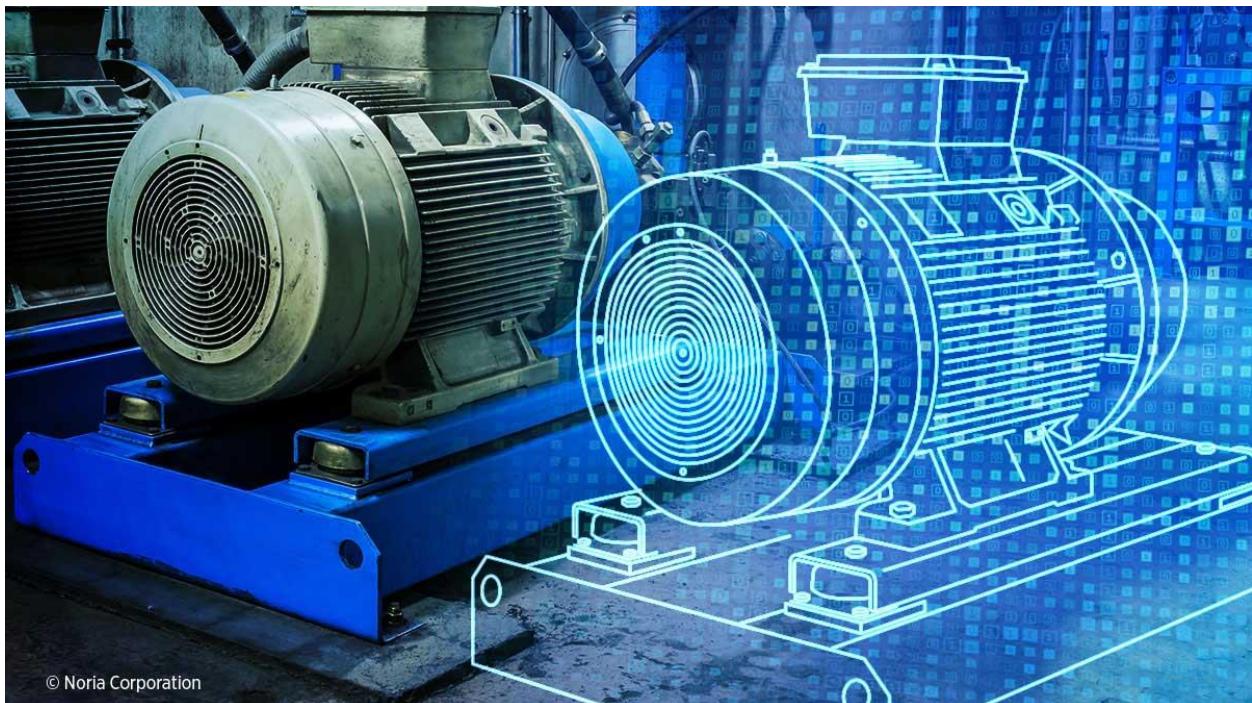
Disadvantages:

- The wastage of raw material is large in subtractive manufacturing.
- The cost of CNC machine setup is quite large.
- It reduces the involvement of human resources which can cause unemployment.
- It requires highly skilled workers to manage production.

CHAPTER:4-

Introduction:

This report will talk about various topics such as, Additive Manufacturing, AR/VR/MR, Haptics, Robotics and Autonomous Systems, Mass customisation, Digital Twin and Simulation, Data Visualisation, Data Analytics, Standards for Industry 4.0, OT and embedded systems for Industry 4.0, Product Service Systems, Digital Supply Chain, Lifecycle Management, Sustainability and Industry 4.0.



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What are the main focuses:

- There is a big difference between additive and subtractive manufacturing techniques.
- Additive manufacturing machines have three hardware parts as, Energy source, powder hopper, Re-coater.
- It has different types of technologies for additive manufacturing such as Powder bed fusion, Direct energy deposition, Binder jetting, Ultrasonic additive manufacturing, etc.
- Additive manufacturing processes can be categorized into four parts as, Hardware and feedstock, Process physics, Metallurgy, Post processing.
- This report talks about Human collaborative robots, this is how robots collaborate with humans to do a particular work which can be dangerous.
- Robotics will talk about different robots like social robots which can do a variety of operations like interacting with humans and mobile robots which can operate in all the mediums like air, land and fluid.
- Mobile robots can assist in industries for production and can also be very useful in pandemic situations.
- Social robots are also very helpful in pandemic situations.
- Haptics will talk about science and technology of touch.



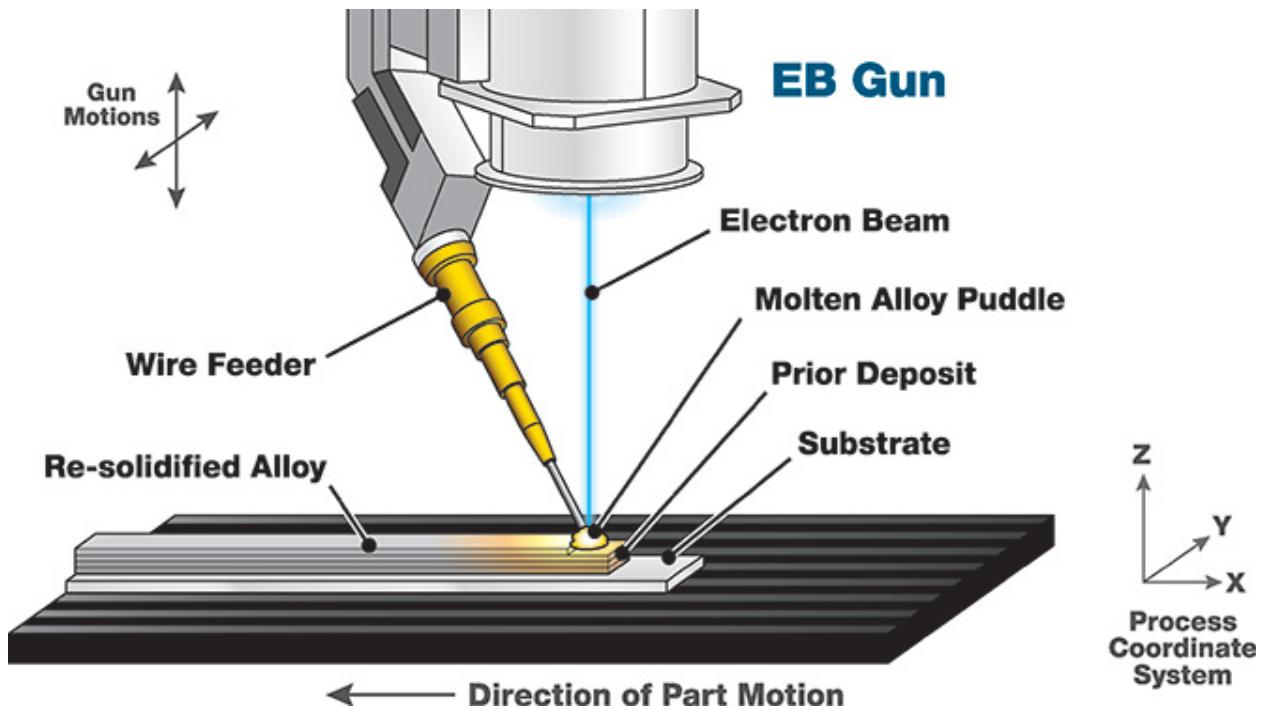
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- Haptics is a combination of different interdisciplinary technologies.
 - It tells about what you are seeing and what your perception is different.
 - It talks about the process of sensation and manipulation as haptics is a combination of these two.
 - Embedded system is a combination of hardware devices and software.
 - It talks about CPU and Microprocessor.
 - It talks about different types of computers.
 - Microcontrollers are the backbone of the embedded systems as there are various types of microcontroller in the market with different functionality.
 - Embedded systems are the backbone of the IOT(Internet of things) which is used to gather data from a device which in turn is used to control or analyse.
 - It talks about different types of transfer protocols which are used in embedded systems to communicate with the server.
 - Now it talks about augmented reality and virtual reality.
 - It talks about data visualization and visualization pipeline.
 - It talks about sustainability and standards.
 - It talks about a smart manufacturing ecosystem and manufacturing capability support.
 - It talks about different layers of smart manufacturing such as PLM, ERP, MES.
 - It talks about economy, Society and Environment.
 - It also talks about different design strategies.
 - It talks about the digital twins which can be the biggest innovation because we can simulate a product and analyse it for a period of time and then start manufacturing.



CHAPTER:5-

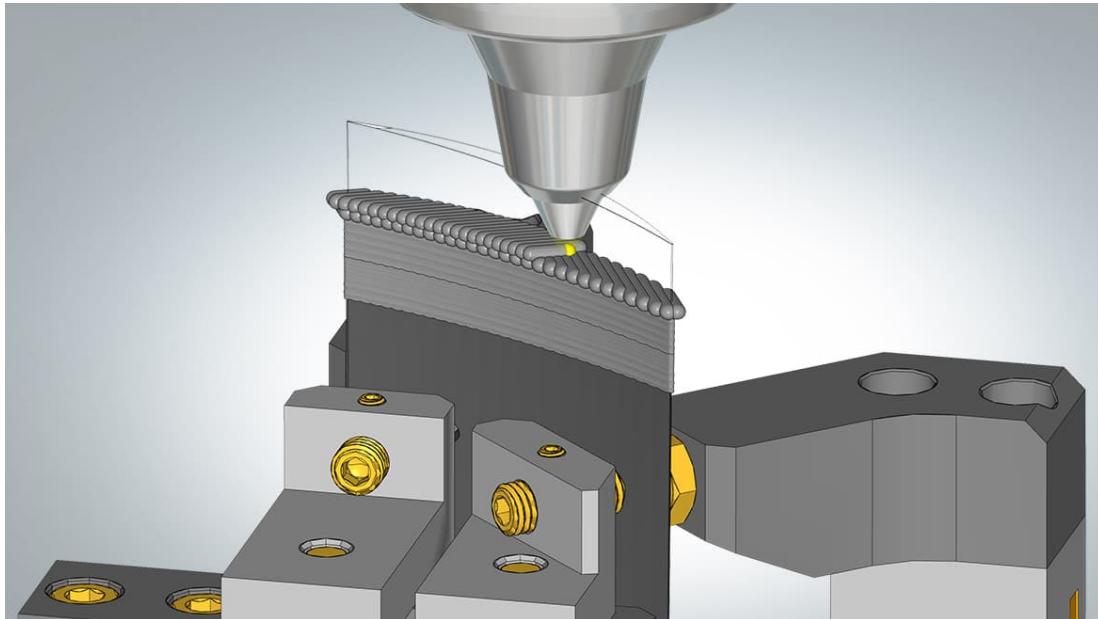
Introduction:

This report will mainly talk about additive manufacturing techniques. It talks about DED(Direct energy deposition) machines. This further talks about different operations of DED machines and also talks about Hybrid manufacturing techniques(subtractive plus additive manufacturing).



What are the main focuses:

- It starts with a Laser DED AM machine which has two monitors attached with it, one is used to monitor the process and other is used to feed the codes of CAM software.
- There are two powder hoppers to load materials for the process.
- The hardware portion is kept in the glass to avoid environmental attack on the materials because it consists of powder form.
- It has two arms to manually operate when needed.
- It can use a wide variety of materials for the process.
- A DED machine has five degrees of freedom like CNC machines i.e, it can move the platform in five directions for the process.
- Before going into the final manufacturing of a particular product we do slicing and hatching using CAM software.
- It also has a dashboard to check quality, safety of the product using various KPI(Key performance indicators).



Why is it important:

- It is a very important manufacturing technique as it uses additive manufacturing techniques which is more cost efficient than subtractive manufacturing like CNC machines.
- It reduces the wastage of materials to a greater extent than traditional manufacturing techniques.
- It is versatile as a CNC machine and can use different types of materials.
- It is used for repairing damaged parts of the machine by slicing and hatching in the software and then producing machine codes for the final process.

Disadvantages:

- It uses raw material in the powder form which can cause oxidation of powder.
- With AM the finished product is not obtained as in CNC machines.
- Requires good skilled workers with full knowledge of the machine.
- Again can impact on the involvement of humans in the process which could lead to unemployment.
- The process of providing raw materials in powder form can be a bit difficult because it requires technology to produce it.

CHAPTER:6-

Introduction:

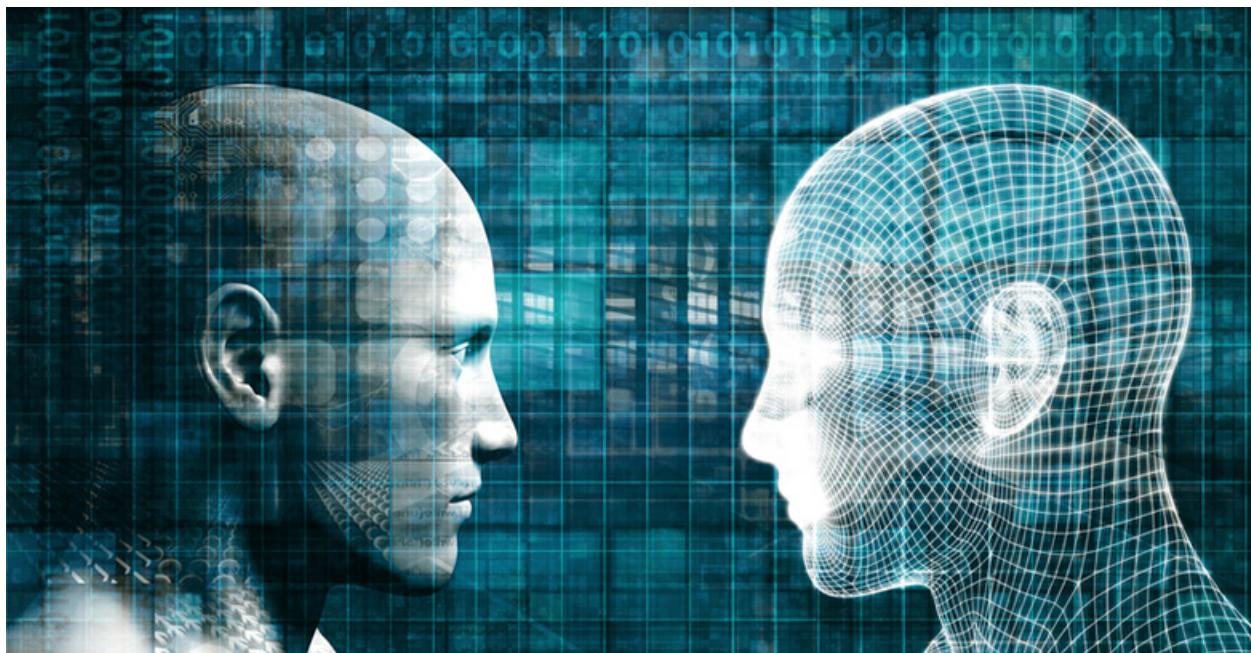
This report will talk about Digital Twins.What is a Digital twin and why we needed a digital twin of a product and what are the applications and limitations of a digital twin.It also talks about the use of many open source software for digital twins.



What are the main focuses:

- It talks about how the digital twin works as it gathers data from a physical system and analyses it for the real world scenario and comes up with a solution as a digital twin.

-
- It talks about different open source softwares like OpenPLC, Eclipse Ditto, FreeCAD, SimFlow, UI path studio for the simulation and formation of a digital twin.
 - It talks about a chamber which can cool and warm simultaneously when needed as it has two fans for cooling and a thermal sensor and a peltier for warming it.
 - A digital twin can be used as a simulator for a physical system to predict the future behaviour of the physical system on the bases of past and present data analysis.
 - Digital twins are used with the integration of smart industries 4.0 which could lead to an innovation and ease of manufacturing.
 - It also talks about the construction of the digital twins as there are mainly two types of models such as physical based models and data driven models.
 - Different sensors mounted on a physical system provide a huge amount of data which can be used by the software to produce a digital copy of the physical system.
 - Digital twins are also used in the formation of Robotic process automation which could use repeated human actions and try to mimic it and replace it with robots which could help in reducing human interventions and also increase the efficiency of the process.



Why is it important:

- It is important because it uses past and present data to manipulate the future behaviour of the physical systems.
- We can analyse the data gathered by sensors to anticipate in the manufacturing and production.
- It can be an important part of the smart factory 4.0.
- It can be very helpful to the internet of things which could lead to innovations.
- We can use digital twin concepts in almost any field which make it versatile and effective at the same time.
- We can make the product in a virtual environment by using free open source softwares like openPLC, SimFlow, etc.

Advantages:

- We can create very complex devices with a little ease with the help of the digital twin concepts.
- Biggest achievement of the digital twin is that we can predict the future behaviour of the physical system by analysis of the past and present data gathered by all the sensors mounted on the physical systems.
- We can also make Robots more smart by using digital twins.
- Digital twins can also avoid any future disaster by the device by predicting its life.
- We can also achieve time to time repair of the system by analysis of the data.

CHAPTER:7-

Introduction:

This report will talk about polymer additive manufacturing techniques. How different physical models can be made using additive manufacturing techniques, different designs can be achieved by using polymer additive manufacturing techniques. It also shows how a finished product can be produced with the help of the AM techniques.

Polymer AM technology characteristics overview

RESIN BASED			POWDER BASED			FILAMENT	
Vat Photopolymerization	Material Jetting	Powder Bed Fusion	Binder Jetting	FDM			
SLA Stereo-lithography ↓ Cured with laser	DLP Digital Light Processing ↓ Cured with projector	CDLP Continuous Digital Light Processing ↓ Cured with LED and oxygen	MJ Material Jetting ↓ Cured with UV light	MJF Multi Jet Fusion ↓ Fused with agent and energy	SLS Selective Laser Sintering ↓ Fused with laser	BJ BINDER Jetting ↓ Joined with bonding agent	FDM Fused Deposition Modeling ↓ Extrusion through nozzle
Cured by laser beam	Cured by light from DLP projector	Continuous curing of photopolymer by light from DLP projector	Dispersion of photopolymer by printhead + exposure	Dispersion of fusing agent by printhead + heating	Thermal energy from laser sinters regions of a powder bed	Deposition of (colored) glue on polymer powder	Deposition of molten material through nozzle
Build speed 	Build speed 	Build speed 	Build speed 	Build speed 	Build speed 	Build speed 	Build speed
Key materials (selection) Engineering Standard 	Key materials (selection) 	Key materials (selection) 	Key materials (selection) 	Key materials (selection) 	Key materials (selection) 	Key materials (selection) 	Key materials (selection)
Mechanical properties 	Mechanical properties 	Mechanical properties 	Mechanical properties 	Mechanical properties 	Mechanical properties 	Mechanical properties 	Mechanical properties
Surface quality 	Surface quality 	Surface quality 	Surface quality 	Surface quality 	Surface quality 	Surface quality 	Surface quality
Build costs 	Build costs 	Build costs 	Build costs 	Build costs 	Build costs 	Build costs 	Build costs

Source Roland Berger



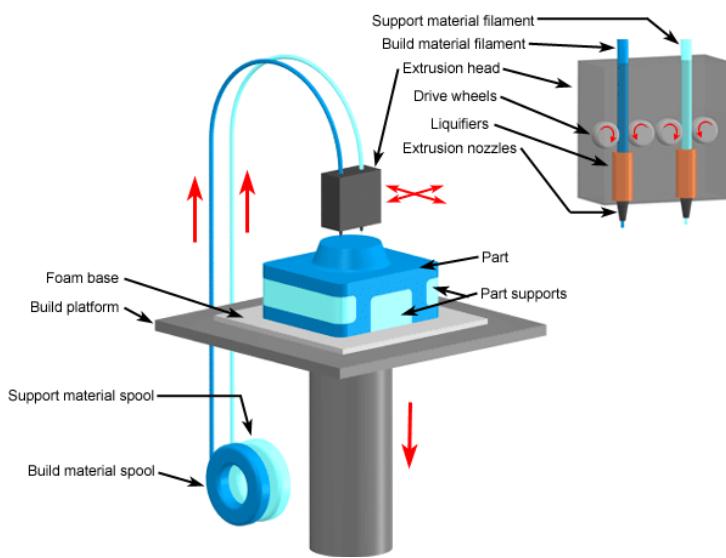
What are the main focuses:

- It starts with digital design of a particular object which is then converted into a digital format which can be understood by 3-D printers to achieve additive polymer manufacturing products.
- The digital format of an object contains all the information about the geometry of the prototype and has all the information about the object surface and dimensions for the printer.
- It supports materials like PLA, ABS, PC, Nylon, etc.
- Different materials have different temperatures of fusions.
- Polymer AM printer has three main fundamental units such as a material station, a chamber which has two material extrudors with nozzle size of 400, 600, 800micron and the air manager which regulates the air pressure of the chamber.
- The air manager avoids harmful UFB particles and improves the quality of the product.
- Iisc lab has several traditional printers to demonstrate the fully autonomous manufacturing.
- These printers have different components like extruders and stepper motors for controlling the motion of the axis and material.
- Now the print model is given to the software for slicing in which there are different parameters for the model which is a bit of a complex process.
- Printers data is also used by an Iiot platform for future behaviours.
- The software produces G-code and M-code for the final product to be manufactured by the AM 3-D printers.

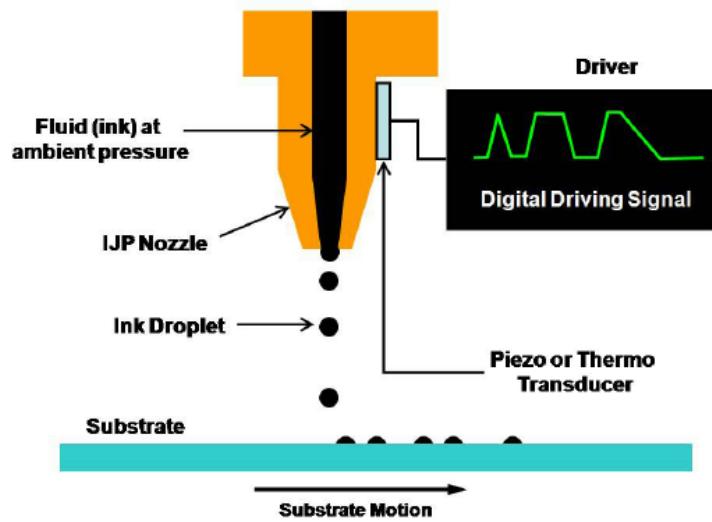


Applications:

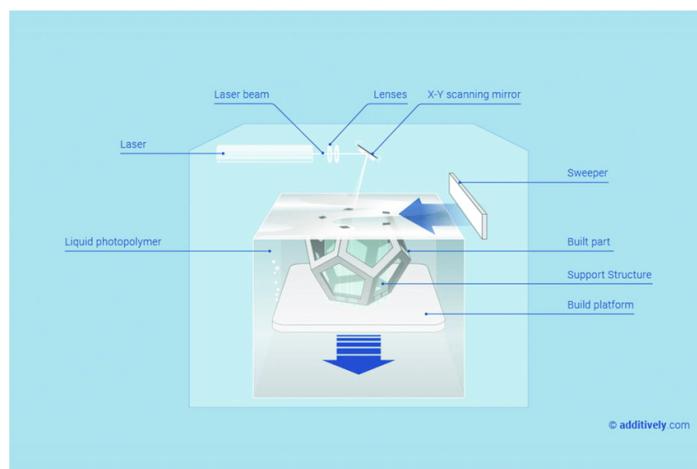
- It is used in Fused deposition modeling (FDM) technique as, This technique is the most used for the fabrication of polymer-based materials. This technique was described in Crump's patent]. Polymer thermoplastic is extruded from a movable FDM head and then deposited layer by layer and then solidified into final parts. PC, PLA and ABS polymers are commonly used materials for this process.



- It is used in Inkjet 3D printing (IJP) techniques such as, The first patent for IJP was awarded in 1951 . IJP technology was then modified and developed at Massachusetts Institute of Technology in 1993 as a rapid prototyping process . This technology is based on powder processing and a jet was used to deposit matter onto paper.



- It is also used in Stereolithography (SLA) such as, The patent for SLA was awarded in 1986 . SLA technology uses UV light or an electron beam in order to initiate a chain reaction of the polymeric resin. Parts are produced by selectively UV curing a resin layer-by-layer. Acrylic and epoxy polymers are typically used materials in SLA. A post-treatment such as heating was used for printed parts with SLA to achieve a desired physical performance.



CHAPTER:8-

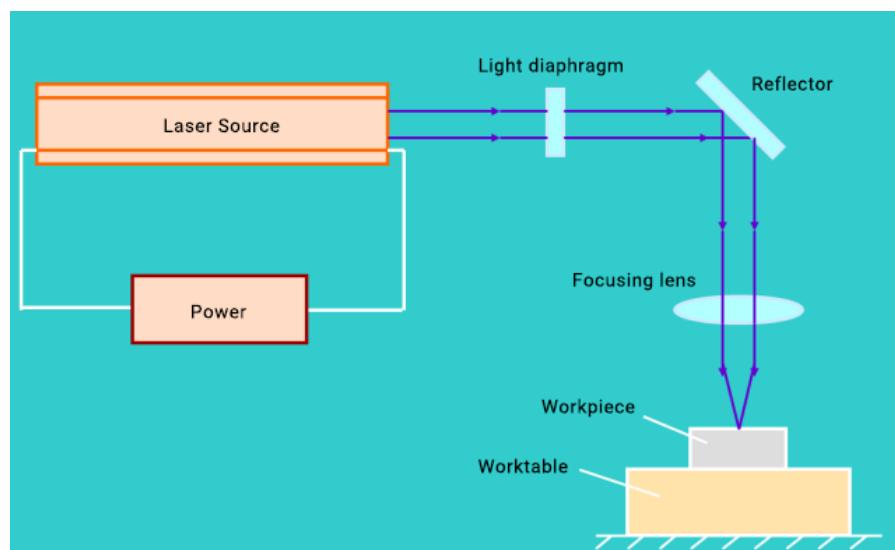
Introduction:

This report will talk about new technology emerging in the industries as Fibre optic laser cutting technology.Why it is used in the industries extensively.What are their applications and also talk about its precision and quality of the product it produced.



What are the main focuses:

- Fiber optic laser cutters utilize amplified light that is channeled through a fiber optic cable
- The light is then straightened and delivered by a lens that is hyper focused on the material being cut.
- This delivery system provides extremely accurate cutting of numerous types of materials in various thicknesses.
- Laser cutting solutions display extraordinarily high electrical efficiency, which results in lower customer costs.
- The primary advantages of cutting flat sheet metal with Fiber laser technology are derived from its monolithic, Fiber-to-Fiber, compact solid state design configuration that is maintenance free and provides a lower cost of operation than can be achieved with comparable CO₂ lasers
- The focused beam of even a 2kW Fiber laser demonstrates a 5X greater power density at the focal point when compared with a 4kW CO₂ laser.
- It also possesses a 2.5X greater absorption characteristic due to the shorter wavelength of the Fiber laser.
- Possibly the most valuable advantage of fiber laser cutting is the price



- Another advantage in using fiber optic laser cutting is the increase in cutting speed.
- The fiber optic configuration will not only save power each and every time it is used, but due to the lower energy requirements it helps increase the life expectancy of the hardware as well.
- Top beam quality, less focused spot, finer cutting lines, faster cutting speeds, and better cutting results. The cutting surface of the laser cutter for metal is smooth and beautiful without secondary processing.
- The use of German fiber laser, Panasonic Japan servo motor, the United States imported laser cutting head, the key components of product quality and safety protection, the life of laser cutter for metal up to 100,000 hours.

Why Choose Fiber Laser Cutting Machine?

Fiber Laser Cutting Machine, has following advantages

- 1.Excellent Laser Beam Quality: Fiber laser has smaller focus diameter and high work efficiency, high accuracy and cutting quality.
- 2.High Cutting Speed: cutting speed is more than 65m/min.
- 3.Stable Running: adopting the top world import fiber lasers, stable performance, key parts can reach 100,000 hours.
- 4.High Efficiency for Photoelectric Conversion : Compare with CO2 laser cutting machine ,fiber laser cutting machine have 3 times photoelectric conversion efficiency.
- 5.Low Cost: Save energy and protect environment. Photoelectric conversion rate is up to 25-30%. Low electric power consumption, it is 20%-30% of CO2 laser cutting machine.
- 6.Free of Maintenance: Fiber optical transmission, fiber line transmission, no need reflect lens, without optical adjustment, save maintenance cost.
- 7.Easy Operations: fiber line transmission, no adjustment of optical path;
- 8.Super Flexible Optical Effects: compact design, compact and easy to flexible manufacturing requirements.

CHAPTER:9-

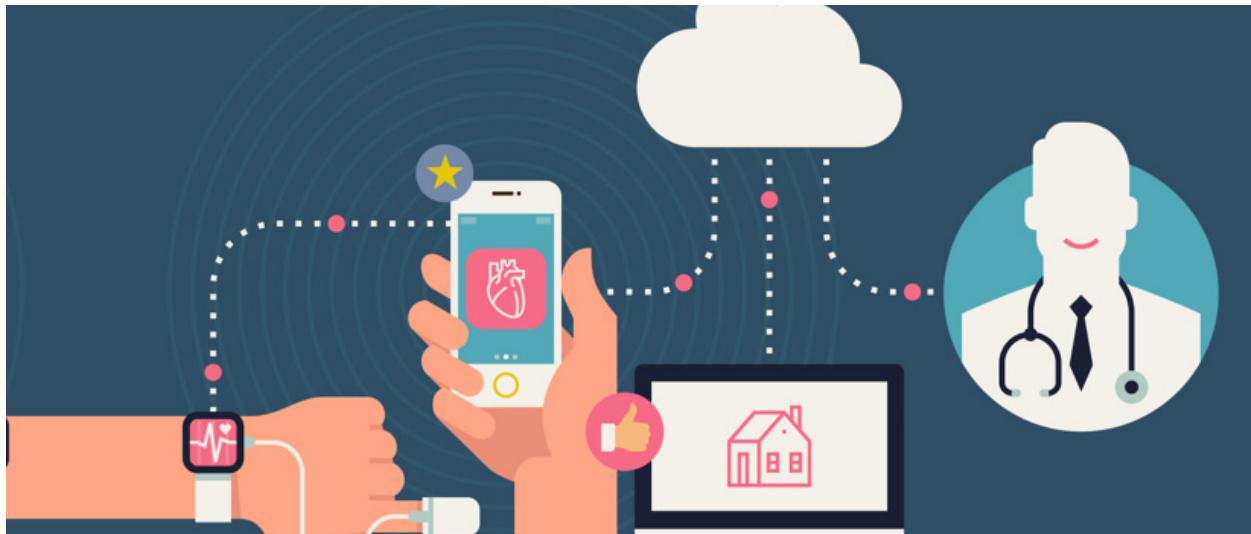
Introduction:

This report will talk about role of medical devices in healthcare and the use of advance microengineered devices for detection and cure of any communicable or non-communicable disease. It also talks about detection of different diseases like breast cancer, brain tumour, skin cancer, tissue cancer, etc and the reduction of burden of traditional huge data and analysis.



What are the main focuses:

- It talks about the critical role of medical devices in the healthcare system as there are only 1.3 hospital beds per 1000 patients, 0.7 doctors per 1000 patients, 18% of patients are from communicable diseases and 82% are from non-communicable diseases.
- If the person is diagnosed earlier in the stage of diseases then it can be curable but for this we need the use of smart medical devices.
- India's contribution to the medical devices industry is very less as 1.3% of total USD 335 billion.
- But it is constantly increasing which goes upto 28% by the year 2025.
- It shows the dependency of the imports of medical devices is quite large as compared to the export scenario.
- It also focuses on the use of biomedical sensors, microengineered devices and many electronic devices which could help in predicting complex diseases like brain tumours.



- It focuses on the development of microengineered devices and sensors which are of few microns in size such as length, height and breadth.
- These microengineered devices are comparable to the size of a hair.
- It also shows the survey report which tells us the reduction of breast cancer just by pre-diagonalization of the disease and the use of microengineered devices.
- It also proposed that we can diagnose the disease by using devices which analyse electrical resistivity, mechanical elasticity and thermal conductivity of the tissues.
- It also talks about the design and development of semi-automated systems for the medical healthcare systems.
- It talks about the study of ETM Phenotyping for the tissues of the patient for diagnosis.
- It deeply talks about the study of the tissues for breast cancer and brain tumours.
- It also talks about the development of different microengineered sensors and their characteristics.



CHAPTER:10-

Introduction:

This report will talk about the working demonstration of haptics devices. It also talks about the details about the device DOF, API interface for device driver and at last the applications of the haptics devices.



What are the main focuses:

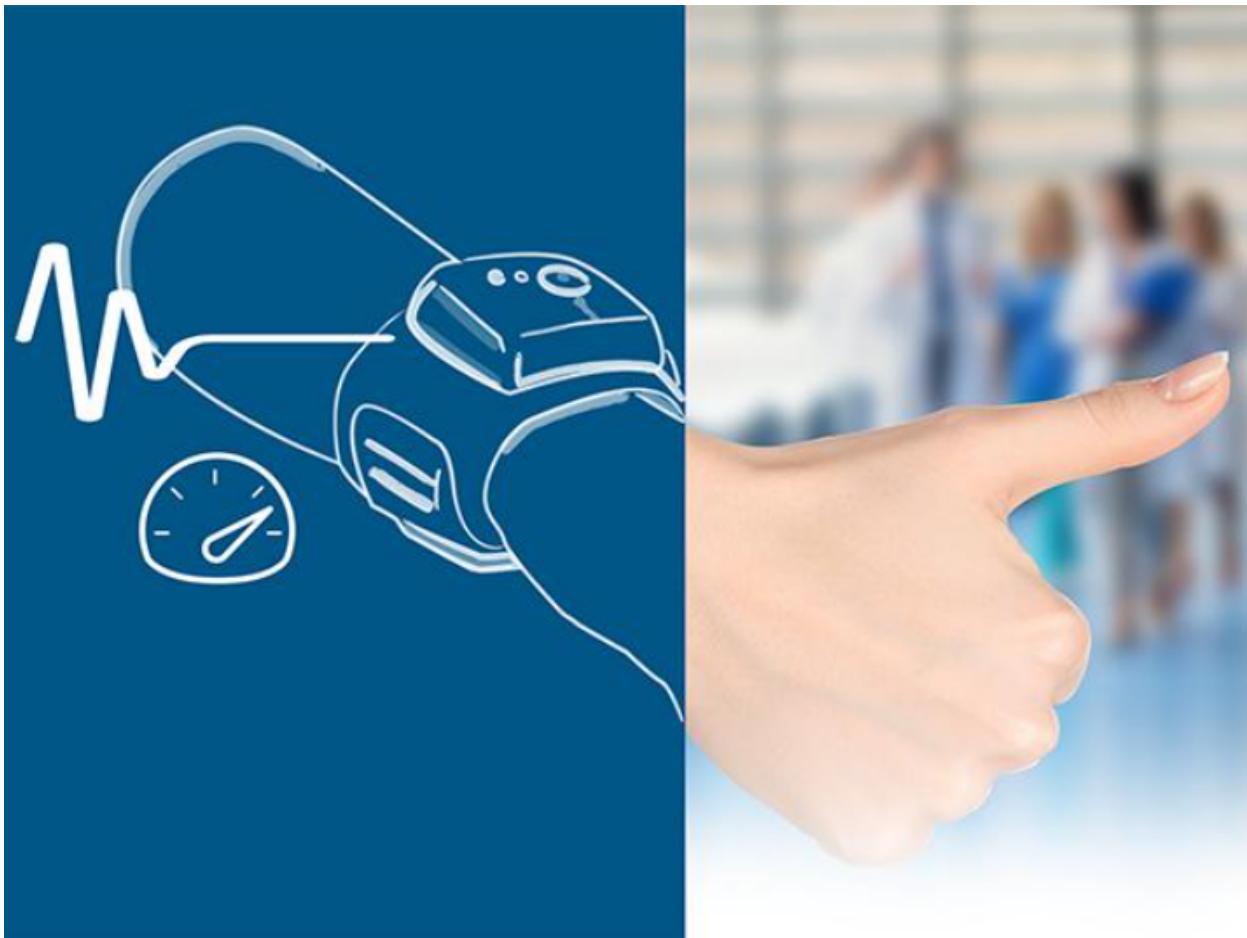
- It talks about the response of a haptic device with respect to the simulation or response of the data gathered from different sensors.
- It talks about the motion of the device i.e, its degree of freedom with response to the simulations.
- It also shows that a huge amount of raw data is gathered by the sensors which is used to anticipate the behaviour of the haptics device for future processes.
- It can sense the human sensation like touch.
- It can create a virtual object which can be sensed by humans by different means.
- It shows the virtual movement of that haptic device by just moving it in the physical world.
- The sensation of touching a physical object can be sensed by using these haptics devices which are just responses of the sensors by humans.
- It will show the coordination of the physical coordinates and the virtual coordinates.
- You can feel the reaction of the virtual process like shifting of boxes, bouncing of the boxes.
- You can set the parameters for the sensation and it will respond according to it like if you set it to bouncing of boxes so when you drop a box you can feel the bouncing response of the box in the real world.



CHAPTER:11-

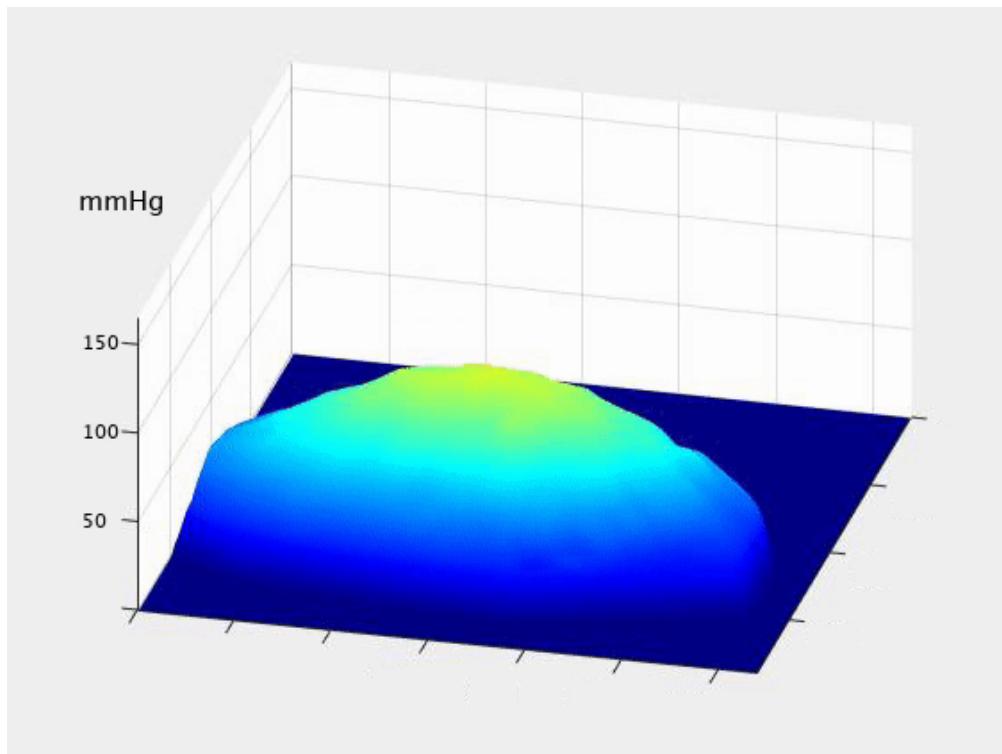
Introduction:

This report will talk about the concept of Dynocardia a new way of measuring blood pressure along the blood vessels. It talk about the visualization of blood pressure along with its measurement by an external process with direct contact to the blood. It also talk about the use of Haptics in the medical field for the treatment of patients.



What are the main focuses:

- It talks about a new way of measuring blood pressure called Dynocardia.
- Dynocardia came up with the new idea of measuring blood pressure, it gives more accurate readings than usual Occlusive arm-cuff devices.
- Occlusive arm-cuff gives inadequate readings about 50% of the time.
- Close to 50% of patients in the ICU get invasive arterial lines so we can monitor their blood pressure continuously.
- If you look at the national data, we're wrongly diagnosing 30% of people with hypertension.
- It created the 3-D image of the blood pressure flowing through the blood vessels.



- It talks about the perception of the clinical researcher and an engineer.
- What we want to do is connect data to the cloud so we can integrate care and improve patient outcomes.
- It also talks about the frequency of the heart beat and the frequency requirement of the sensation to feel.
- It also talks about the virtual CPR technology in which CPR is done with a virtual patient not with a real patient.
- Haptics technology is used in virtual CPR techniques which is basically used to practise CPR.
- It also talks about Haptics Biomedical Robotics, a part of the R & D department.
- It is basically an interdisciplinary branch i.e, a good combination of different technologies all together.
- It also talks about the threshold frequency to get a simulation or sensation which can be detected by a human body.
- It talks about Piezo-actuator drivers.



CHAPTER:12-

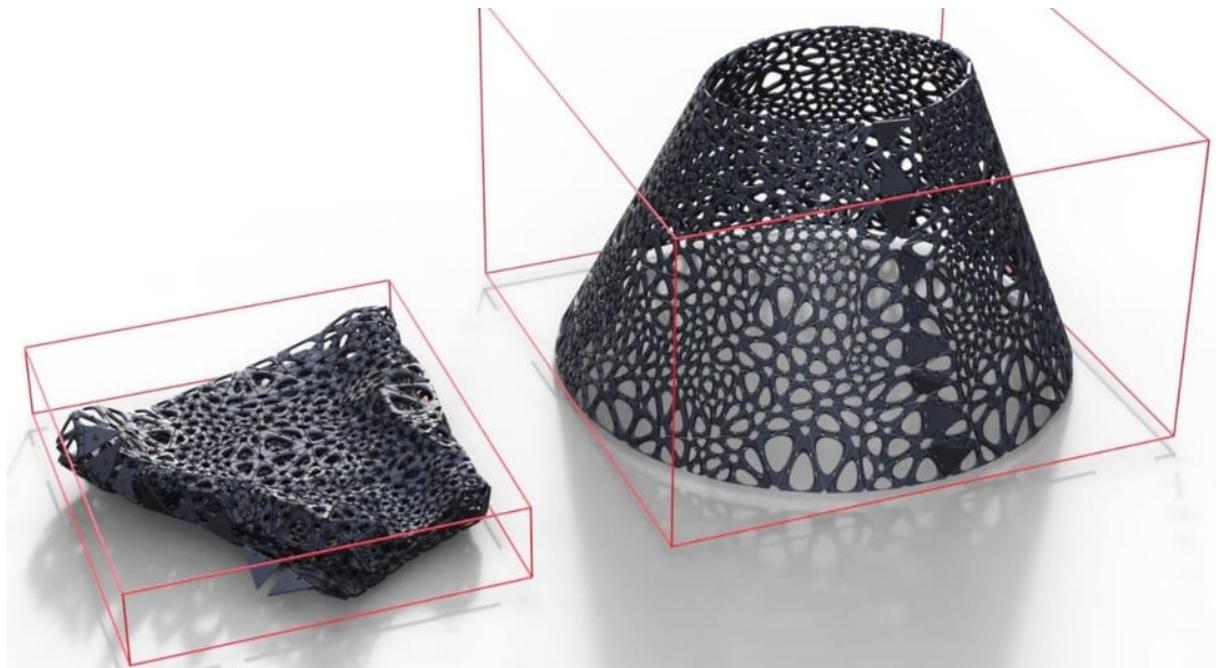
Introduction:

This report will talk mainly about Mass personalisation strategies of additive manufacturing. This will focus on the human centric, safety and health in the working environment. This will also focus on the data driven industries or technologies.



What are the main focuses:

- The main focus of this session is mass personalisation of additive manufacturing.
- The basic pillars of intelligent manufacturing are that it is human centric, focusing more on safety and health of the person working in that environment.
- It also focuses on data acquisition, data analysis and data visualisation.
- It also talks about the advantages of additive manufacturing.
- It also talks about a hybrid additive manufacturing machine with a multi extruder system which is basically a plasma system for AM.
- It also used to print multi material products with a good quality.
- It also talks about more advanced additive manufacturing techniques such as electrochemical additive manufacturing(ECM) in which materials can change their properties according to the environmental conditions.
- It also talks about the usage of more advanced inks which can change their colour with the environment.



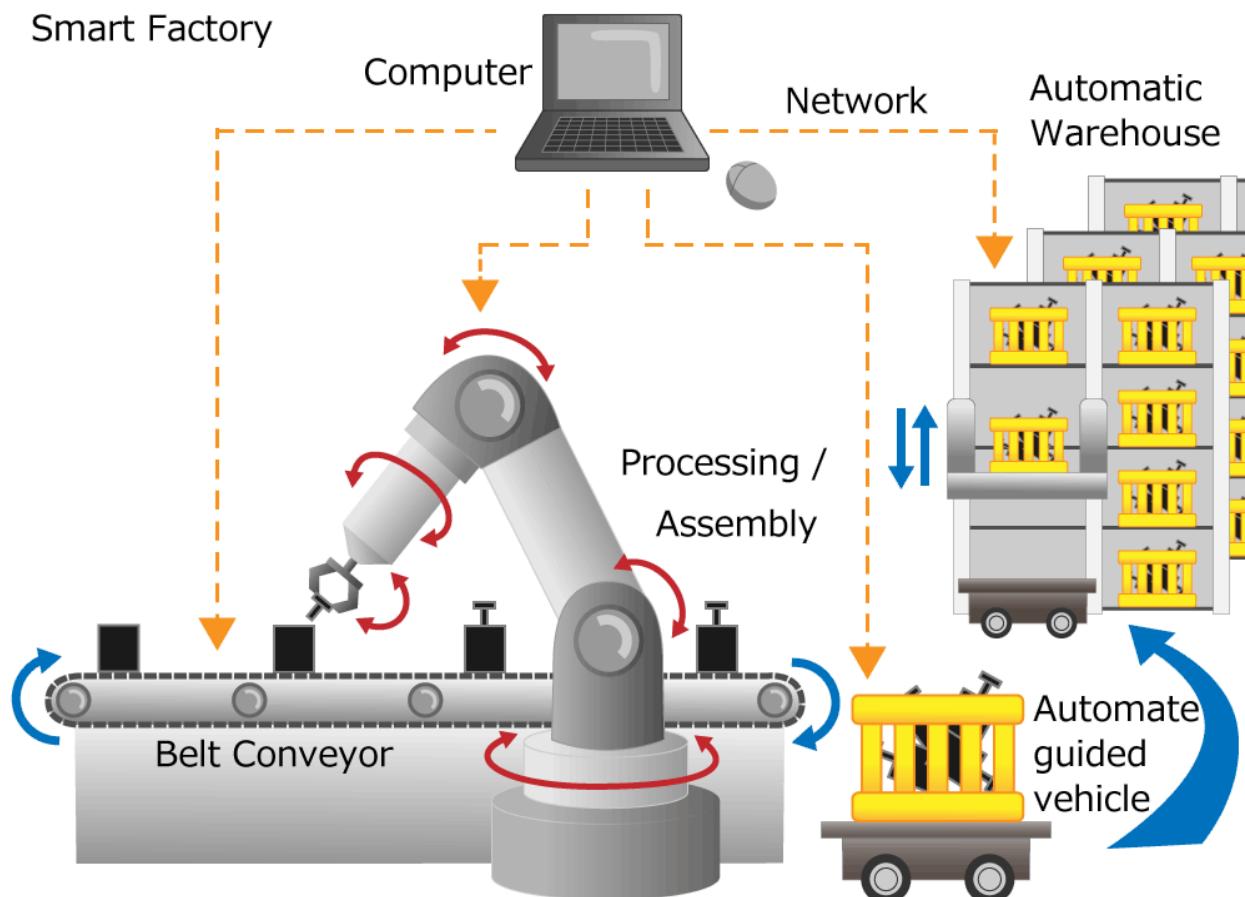
- It also talks about multi material stereo-thermal-lithographic systems.
- It discusses the use of additive manufacturing in the medical field as it can be used to reconstruct a damaged bone or combine two parts of the same bone.
- It simulates the parts of the bone and creates a virtual twin or model with the same properties as the original bone or system which can be used to cure a patient.
- It also talks about the limitation of additive manufacturing as it uses deposition technique or layer for the formation of the product so it is difficult to control the isotropy or crystal structure or spacing of the product.
- Additive manufacturing technology also allows customers to be active recipients not only passive as a consumer and it also shifts focus on mass personalisation.
- It also talks about a new fabrication paradigm in which consumers can upload their design or CAD models to servers and the company delivers their parts straight to their doorsteps.
- AM techniques are used to create some safety products like face masks, face shields and many more.
- It talks about more personal products created by AM 3-D printers like guitars, shoes, helmets and many more.
- Some restaurants also started using additive manufacturing techniques for producing their fancy and personalised food.
- It also shows the use of AM techniques in fields like construction, fashion industries, medical healthcare systems, textile, agriculture and many more.



CHAPTER:13-

Introduction:

This report will mainly talk about the production of DC motors in smart industries and the production of pneumatic cylinders in smart factory with help of autonomous robots. It shows the use of IOT(internet of things) and different sensor data to manipulate and anticipate the simulation of the virtual product before physical manufacturing.



What are the main focuses:

- Smart manufacturing (SM) is a technology-driven approach that utilizes Internet-connected machinery to monitor the production process.
- The goal of SM is to identify opportunities for automating operations and use data analytics to improve manufacturing performance.
- SM is a specific application of the Industrial Internet of Things (IIoT).
- Manufacturers can also analyze trends in the data to try to spot steps in their processes where production slows down or is inefficient in their use of materials.
- The production of DC motors and Pneumatic cylinders are often facilitated by the use of smart manufacturing techniques.
- In a smart factory we can use the data gathered by different sensors for data acquisition, data analysis and data visualisation.
- This data driven approach will help the factory to significantly cut off production cost and reduce time of the oproduction.

Components of a piston rod cylinder:

