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## Certificate of Internship

This is to certify that

**DEEP CHAND CHOUDHARY**

From M.B.M Engineering College, Jodhpur

has Successfully Completed online Internship on **SolidWorks** from

10<sup>th</sup> May2021 to 24<sup>th</sup> June 2021.

We wish all the best for his future endeavors.

A handwritten signature in blue ink, appearing to read "Vineet", written over a horizontal line.

Centre Head



A handwritten signature in blue ink, appearing to read "Manish", written over a horizontal line.

Training Coordinator

**CADD Centre Training Service Private Limited**

[www.caddcentre.com](http://www.caddcentre.com)

**Franchisee: CREATIVE DESIGN & CONSULTANCY**

P.No -11 Shastri Nagar, Ajmer (Raj.)305001

Ph. 0145-2625553, 9351651101

E-mail : [rj.ajmer@caddcentre.com](mailto:rj.ajmer@caddcentre.com)

## **Internship Certificate**

This is to certify that **Mr / Ms Deep Jansari (VT20212630)** has successfully completed  
internship program on **Logistics Optimization Services**  
under the guidance of **Asitkumar Niranjnabhai Shukla (Manager, PSD)**.

The duration of this project was from **1<sup>st</sup> July 2021** to **15<sup>th</sup> August 2021**.

The internship on evaluation fulfils all the stated criteria and student's findings are his/her original work.

I hereby certify his/her work excellent/**good**/satisfactory to the best of my knowledge

We wish him all the best for his future endeavours.



*Rama Shanker*

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**Rama Shanker Singh**  
Chief Productivity Services Department

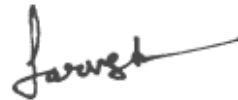
# Certificate of Training

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**Ganesh Kumar Nagal,**

student of MBM Engineering College, Jodhpur, has successfully completed a eight weeks online training on **Ansys**. The training consisted of Introduction to Finite Element Analysis (FEA), Understanding Concepts at Work & Installing Ansys, Introduction to Ansys Software, Static Structural Analysis, Modal, Thermal, & Buckling Analysis, Case Studies and Final Project modules. In the final assessment, Ganesh Kumar scored 83% marks.

We wish Ganesh Kumar all the best for the future.

A handwritten signature in black ink, appearing to read "Sarvesh".

**Sarvesh Agarwal**

FOUNDER & CEO, INTERNSHALA

Date of certification: 2021-06-11

Certificate no. : EE095015-6208-7110-DC9B-183843623ABA

For certificate authentication, please visit [https://trainings.internshala.com/verify\\_certificate](https://trainings.internshala.com/verify_certificate)

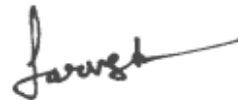
# Certificate of Training

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**Gyanprakash**

from MBM Engineering College, Jodhpur, Rajasthan, has successfully completed a six weeks online training on **3D Printing**. The training consisted of Introduction to 3D Printing, Principles, Technologies, and Materials, The Printing Journey, Applications of 3D Printing, Merits, Advancements, and Scope and Final Project modules.

We wish Gyanprakash all the best for the future endeavours.

A handwritten signature in black ink, appearing to read "Sarvesh".

**Sarvesh Agarwal**  
FOUNDER & CEO, INTERNSHALA

Date of certification: 2021-08-19

Certificate no. : B050874E-JV7A-B57A-2803-67DB26A9IS87

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# Ambuja Cement

Ref No. ACL/HR/2021

September 9, 2021

## TO WHOMSOEVER IT MAY CONCERN

This is to certify that Ms. Khushbu Barmera D/o Sh. Hansraj Barmera student of B. Tech 3<sup>rd</sup> Year (Branch - Production & Industrial) of M.B.M. Engineering College, Jodhpur (Rajasthan) has completed her Summer Training in our organisation from 5<sup>th</sup> July, 2021 to 20<sup>th</sup> August, 2021.

During the above project, we found her a sincere and obedient candidate.

We wish her all the success in her future endeavors.

**Ambuja Cements Ltd.**

**(Unit –Rabriyawas)**



**S.K.Singh**

**General Manager (HR)**



**Ambuja Cement Ltd.  
Unit-Rabriyawas**

# Certificate of Training

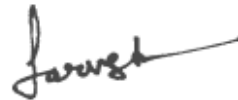
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**Kshitij Saren**

from M.B.M. Engineering College, has successfully completed a six weeks online training on **3D Printing**. The training consisted of Introduction to 3D Printing, Principles, Technologies, and Materials, The Printing Journey, Applications of 3D Printing, Merits, Advancements, and Scope and Final Project modules.

In the final assessment, Kshitij scored 82% marks.

We wish Kshitij all the best for the future endeavours.

A handwritten signature in black ink, appearing to read "Sarvesh".

**Sarvesh Agarwal**

FOUNDER & CEO, INTERNSHALA

Date of certification: 2021-08-01

Certificate no. : 7EB05EE0-4577-FA18-4C7B-E8CAA8B81F2F

For certificate authentication, please visit [https://trainings.internshala.com/verify\\_certificate](https://trainings.internshala.com/verify_certificate)



Letter No. TSLP/L&D/AUG-SIP35

Date: 31/07/2021

**TO WHOMSOEVER IT MAY CONCERN**

This is to certify that **Mr. Kumar Keshav Ram Narayan** (ROLL NO.- 19UPIE1308), a student of Faculty of Engineering, MBM Engineering College, Jai Narayan Vyas University, Jodhpur has undergone **Summer Internship Training** in Tata Steel Long Products Limited, from **31-05-2021** to **20-07-2021**.

During this period, he has successfully completed a project on **Assessment of Ways to Control Sulphur in DRI fines While Optimizing Dolomite Consumption**.

**Mr. Kumar Keshav Ram Narayan** was sincere during his internship training and has shown commitment in completing his project assignment and fulfill the company's norms of attendance, safety and discipline.

We wish success in his future endeavour.

**Ranjeet Chaudhary**  
Learning & Development

**TATA STEEL LONG PRODUCTS LIMITED**

(Formerly known as Tata Sponge Iron Limited)

PO Gamharia, Dist Saraikela-Kharsawan, Jamshedpur 832 108 Jharkhand India  
Tel 91 657 7102265 e-mail [animesh\\_parashar@tatasteellp.com](mailto:animesh_parashar@tatasteellp.com)

CIN-L27102OR1982PLC001091

 Registered Office PO Joda Dist Keonjhar Odisha 758 034 India

# Certificate of Training

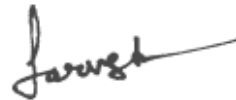
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**Lalit Parihar**

from MBM Engineering College, has successfully completed a six weeks online training on **3D Printing**. The training consisted of Introduction to 3D Printing, Principles, Technologies, and Materials, The Printing Journey, Applications of 3D Printing, Merits, Advancements, and Scope and Final Project modules.

In the final assessment, Lalit scored 88% marks.

We wish Lalit all the best for the future endeavours.

A handwritten signature in black ink, appearing to read "Sarvesh".

**Sarvesh Agarwal**

FOUNDER & CEO, INTERNSHALA

Date of certification: 2021-07-09

Certificate no. : 94565FC0-48DD-34F8-CB9D-406E5E4C7C73

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# Ambuja Cement Limited

## Summer Internship report

(05/07/2021 - 20/08/2021)



Department of Production and Industrial Engg.,

MBM Engineering College,

Jodhpur, Rajasthan

### **Submitted To:**

Prof. Milind Kumar Sharma

(Head of Department)

Production and Industrial Engg.

### **Submitted By:**

Lucky Jarolia

(B.E. Third Year, P&I)



# Ambuja Cement

Ref No. ACL/HR/2021

September 9, 2021

## TO WHOMSOEVER IT MAY CONCERN

This is to certify that Mr. Lucky Jarolia S/o Sh. Dhanpat Singh student of B. Tech 3<sup>rd</sup> Year (Branch - Production & Industrial) of M.B.M. Engineering College, Jodhpur (Rajasthan) has completed his Summer Training in our organisation from 5<sup>th</sup> July, 2021 to 20<sup>th</sup> August, 2021.

During the above project, we found him a sincere and obedient candidate.

We wish him all the success in his future endeavors.

**Ambuja Cements Ltd.**

**(Unit –Rabriyawas)**

  
**S.K.Singh**

**General Manager (HR)**



**Ambuja Cement Ltd.**  
**Unit-Rabriyawas**

Works : PO Rabriyawas, Tehsil - Jaitran, Distt. - Pali, Rajasthan-306709

Tel. : 02939-288011-18, Fax : 02939-288030

CIN : L26942GJ1981PLC4717 Website : [www.ambujacement.com](http://www.ambujacement.com)

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# Preface

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Every student of bachelor of engineering and technology in Production and Industrial engineering, has an essential requirement to do 45 days of internship in any of the well reputed organization.

The purpose of this program is to acquaint the students with practical applications of theoretical concepts taught to them during conduct of their course.

I wish to express my sincere gratitude to Mr. S.K. Singh, General Manager (HRD) for providing me an opportunity to do my internship and project work in “AMBUJA CEMENT LIMITED.”

I also wish to express my gratitude to the officials and other staff members of Ambuja Cement Limited who rendered their help during the period of my internship.

I also thank the head of placement cell Prof. A.K. Verma and Head of P&I department Prof. Milind Kumar Sharma for providing me the opportunity to embark on this project.

It was really a nice experience to have a close comparison between theoretical concept and practical applications in industry. This report depicts all the structural and technical study and analysis of Ambuja Cement Ltd. The outcomes of my analysis is summarized in shape of internship contents of report shows the detail of sequence of these.

# About Ambuja Cement Limited

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Ambuja Cement is one of the leading players in the Indian cement industry and is trusted for its tailor-made product portfolio, suitable for diverse Indian climatic conditions. Our sustainable operations and initiatives help advance the Company's philosophy of contributing to societal well-being.

## Plant Details:

- Plant Name - Ambuja Cement Plant Rabriyawas Rajasthan
- Company - Ambuja Cements Limited (ACL)
- Plant Type - Cement Plant
- Annual Production Capacity - 1.8 million tonnes of cement
- Manufacturing Products – Ambuja Cement, Roof Special, Cool Walls, Buildcem, Powercem and so on.
- Owner of Cement Plant - Ambuja Cement Limited (ACL)
- Company Type – Public limited company
- Shareholders - ACL (54%) and Holcim Group (46%)
- Plant Status – Operational
- Contact Number - +91 (2939) 288011
- Email - shares@ambujacement.com
- Website – www.ambujacement.com
- Address – Rabriyawas, Jaitaran Tehsil, Pali District, Rajasthan
- Pin Code – 306709
- Location Coordinates - 26.297827, 74.126598
- Nearest town - Jaitaran
- District – Pali, Rajasthan

## Management

Name	Designation
Christof Hassig	Director
Jan Jenisch	Vice Chairman
Mahendra Kumar Sharma	Director
Martin Kreigner	Director
N S Sekhsaria	Chairman
Nasser Munjee	Director
Neeraj Akhoury	Managing Director & CEO
Omkar Goswami	Director
Praveen Kumar Molri	Director
Rajani Kesari	Chief Financial Officer
Rajendra P Chitale	Director
Rajiv Gandhi	Co. Secretary & Compl. Officer
Ramanathan Muthu	Director
Ranjit Shahani	Director
Shailesh Haribhakti	Director
Shikha Sharma	Director
Then Hwee Tan	Director

ACL has grown manifold over the past decade. Its current cement capacity is 27.25 million tonnes. The Company has 5 integrated cement manufacturing plants and 8 cement grinding units across the country. ACL enjoys a reputation of being one of the most efficient cement manufacturers in the world. Its environment protection measures are considered to be on par with the finest in the country. It is also one of the most profitable and innovative cement companies in India. ACL is the first Indian cement manufacturer to build a captive port with three terminals along the country's western coastline to facilitate timely, cost effective and environmentally cleaner shipments of bulk cement to its customers. The Company has its own fleet of ships. ACL has also pioneered the development of the multiple, bio-mass, co-fired technology for generating greener power in its captive plants.



# History of Ambuja Cement

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**1981-** The Company was Incorporated on 20th October, as Ambuja Cements Pvt. Ltd. It was jointly promoted by Gujarat Industrial Investment Corporation Ltd. (GIIC) and N.S. Sekhsaria and his associates, Vinod K. Neotia and Suresh Mulani, for setting up a cement project in the joint sector. The Company was converted into a public limited company on 19th March, 1983 and its name was changed to Gujarat Ambuja Cements, Ltd., on 19th May, 1983.

- The Company's object is to manufacture cement.
- The Company adopted the latest dry process precalcination technology incorporating five stage preheater for the main pyro processing system of the cement plant. For grinding the raw material, the Company undertook to instal the latest air swept roller mills of polysius design which were extremely energy efficient.
- A computerised process control system with field instruments supplied by Larsen & Tourbo was also being installed to give consistently high quality cement with maximum productivity.
- In addition, electronic packing machines were being obtained from Haver & Boecker, West Germany, and reverse air baghouse equipment from Zurn Industries, USA.
- The company entered into an agreement with Krupp Polysius AG, (KP) West Germany, for supply of plant, equipment and service for the project, KP agreed to supply raw material and coal grinding vertical roller mills, homogenising and kiln feed, burning, cooling and coal firing equipment and pneumatic transport pumps.
- KP have a collaboration agreement with Buckau Wolf India, Ltd. who are supplying the balance items of the main plant as per KP design. The scope of the agreement with KP provides for complete engineering of the plant, technical documentation and information and supervision of erection and commissioning of the project.

**1983-** All shares subscribed for by signatories to the Memorandum of Association, promoters, etc.

**1985-** A letter of intent was received to increase the installed capacity from 7,00,000 tonnes to 14,00,000 tonnes per annum.

- 146,44,500 No. of equity shares issued at par out of which the following shares were reserved for firm allotment: 38,24,448 shares to GIIC; 21,20,000 shares to overseas companies of non-resident Indian promoters on repatriation basis and 15,50,052 shares to N.S. Sekhsaria, Vinod K. Neotia and their associates.

- Out of the balance 71,50,000 shares, 28,60,000 shares to non-resident Indians with repatriation rights and 8,75,500 shares to employees (including Indian working directors)/workers and business associates of the Company were reserved for preferential allotment. The remaining 34,14,500 shares were offered for public subscription during November. Out of the oversubscription, 33,50,000 shares were retained and allotted to the public.

**1986-** 20,00,000 No. of equity shares issued at par of which 2,00,000 shares allotted to private promoters and their associates and the balance of 18,00,000 shares offered and allotted to the equity shareholders as rights in prop. 1:1.

**1988-** Production declined marginally to 8,02,301 tonnes due to heavy rains in July-August 1989 coupled with flash floods on 16th July.

**1989-** The 12.6 MW diesel generating sets which were imported during 1988-89 were commissioned during the year.

**1990-** Necessary approvals were received for setting up another cement plant with 1 million tonne capacity per annum at village Suli, Tehsil Arki, District Solan of Himachal Pradesh.

**1991-** In order to meet long-term working capital requirements, the Company issued 10,00,000 - 17.5% secured redeemable non-convertible debentures on private placement basis. These debentures would be redeemed in three equal annual instalments commencing at the end of the 6th year from the date of issue of the debentures, at a prem. of 5% of the face value of the debentures.

- In order to part finance its expansion projects, the Company proposed to issue 52,62,500 No. of equity shares of Rs.10 each at a prem. of Rs.190 per share. Out of the total issue, 50,00,000 shares were to be offered to the existing equity shareholders of the Company as rights in the prop. of 1:4 and the balance of 2,62,500 shares were to be

offered to the employees, directors and the business associates of the company.

- In order to part finance its expansion projects, the Company also proposed to issue 52,62,500 - 17.5% secured redeemable non-convertible debentures aggregating to Rs.210.50 crores. Out of the total issue, 50,00,000 debentures were to be offered to the equity shareholders of the Company on rights basis in the prop. of 1 debenture for every 4 equity shares held and the balance of 2,62,500 debentures were to be offered to the employees, directors and business associates of the Company.
- Each non-convertible debenture would be attached with a detachable warrant and the holder of one such warrant would be entitled to apply for and be allotted one equity share of the Company at a price of Rs.300 per equity share (Rs.10 towards face value and Rs.290 as prem.).
- The warrant holders at the time of exercising their right/option to subscribe for their equity shares entitlement would have further option either to pay a price of Rs.300 per share of the Company or to surrender the equivalent number of debentures as subscription for allotment of equity shares.
- GACL Finance Ltd., Concrete Investments, Ltd., and Indo Nippon Special Cements, Ltd. are the subsidiaries of the company.

## **1992**

- The Company undertook bulk cement transportation, by sea, to the major markets of Mumbai, Surat and other deficit zones on the West Coast. Transportation was to be carried out by three specially designed ships. The units bulk terminal at Kodinar and one at New Mumbai was completed and work on the third terminal near Surat began.

## **1993**

- 51,60,165 rights equity shares allotted at a prem. of Rs.190 per share (49,66,815 shares, prop. 1:4; 90,850 shares to employees and 1,02,500 shares to Associates); 1,10,281 shares of Rs.10 each allotted at a prem. of Rs.215 per share on exercise of warrants by warrant holders.

**1994-** The Company's muller location 1.5 million tonne cement project with clinkeriation facility at site in H.P and grinding facility both at Suli & Ropar in Punjab was commissioned. Land was acquired at Sahranpur to serve as another site for grinding cement.

- The Company also undertook to set up a new unit, 'Gajambuja Cement' with an installed capacity of 9.4 lakh tonnes, at the existing premises. The kiln was fired on 1st March 1993 and the unit produced its first batch of clinker on 4th March, 1993.
- The Company undertook to set up the third 1 million tonne cement plant at Ambujanagar. Orders for plant and machinery were placed and the plant was expected to be commissioned by December 1996. This will increase the company's total cement capacity to 4.5 million tonnes.
- 45,65,044 shares allotted on conversion of warrants. 12,21,994 allotted on conversion of aurobonds. 375 rights shares kept in abeyance allotted. 3,02,19,749 bonus shares issued in prop. 1:1 10,00,000 shares allotted to IFC Washington. 4,404 rights shares kept in abeyance allotted.

**1995-** The Company proposed to install one more cement mill at Himachal plant.

- 11,251,829 shares allotted on optional conversion of FCCBs. 7,724 Rights shares kept in abeyance allotted. 7,350 shares allotted on conversion of tradeable warrants.

**1996-** Two more ships 'Ambuja Keerti' and 'Ambuja Shakti' were added to the Fleet. The Company has submitted a proposal to revive Modi Cements Ltd. to IDBI during the year.

- Another 19724 No. of equity shares allotted on conversion of warrants.

**1997-** 100,000,000-10% non-convertible redeemable pref. shares of Rs. 10 each allotted and 30,000,000-12.75% non-convertible redeemable pref. shares of Rs. 10 each redeemed.

- Gujarat Ambuja Cements Ltd.'s (GACL) Kodinar plant is set to commence commercial production with an enhanced capacity by mid-April.
- Gujarat Ambuja Cement Ltd. has offered to set up a multi-crore cement plant in Jammu and Kashmir.
- Gujarat Ambuja Cement Ltd. (GACL) was set up in 1981 as a joint sector company, promoted by Narottam

Sekhsaria and Gujarat Industrial Investment Company (GIIC). Its cement plant which was commissioned in 1985 was set up in technical collaboration with Krupp Polysius, Germany, Bakau Wolf and Fuller KCP.

- Gujarat Ambuja Cement Ltd. (GACL) is setting up two new units with a capacity of 1.5 m.t. each through its subsidiaries.

- The company has signed a memorandum of understanding (MoU), with the promoters of Modi Cement to take control of the sick company and has prepared a revival proposal to be submitted to the Board for Industrial and Financial Reconstruction (BIFR).

**1998-** Gujarat Ambuja Cements to set up a \$20 million clinker Grinding unit in Sri Lanka.

**1999-** Gujarat Ambuja is proposing to set up a greenfield cement plant with a six million tonne capacity in phases in Andhra Pradesh.

- Gujarat Ambuja is setting up a 0.50 MT bulk terminal and a packaging facility at Tuticorin for Rs 16 crore to increase its presence in the south, especially Tamil Nadu.

- Maratha Cements Ltd, a wholly-owned subsidiary of Gujarat Ambuja Cements is to be amalgamated with the latter.

- The company has proposed a bonus shares in the ratio of 1:1.

**2000-** Cement giants Larsen & Tubro (L&T) and Gujarat Ambuja Cements have entered a unique agreement to reduce transportation costs in despatching bulk cement in Gujarat.

- The Company has entered the fray for setting up a slag cement unit near the integrated steel complex of Jindal Vijayanagar Steel Ltd. in Karnataka.

- The Company has entered into a contract with a Soinhalese firm, Mahaveli Marine Cement, to supply around 2.5 lakh tonnes of cement annually.

- Eastern Ambuja Cement, a 92-per cent subsidiary of Gujarat Ambuja Cement, is in talks with Orissa-based Shiva Cement for a possible joint venture.

- The Company has kickstarted its operations in Sri Lanka with the setting up of a cement terminal in the port of Galle, in the south of the island country.

- Ambuja Cement Eastern, a subsidiary of Gujarat Ambuja Cements is making a preferential allotment of equity to its promoters to mop up Rs 30 crore to part-finance its Rs 130-crore expansion project.

- ICRA has downgraded the non-convertible debenture (NCD) programmes of the company.

- Fitch India has assigned a rating of Ind AAA to the Rs 50 crore NCD programme of the company.

## **2001**

- The Company has completed the issue of FCCBs of about \$100 million issued in the international markets.

- Gujarat Ambuja Cements Ltd., the fourth largest cement maker in the country, has closed its issue of secured non-convertible debentures after raising the targeted Rs 200 crore.

- Gujarat Ambuja Cements Ltd is planning to issue fresh equity shares on a preferential basis to non-promoter groups.

- Gujarat Ambuja Cements Ltd (GACL) has received Rs 200 crore from foreign equity investor, Warburg Pincus, as part of its proposed Rs 360-crore investment in the form of equity shares and convertible ants.

- The company will buyback shares worth Rs 50 crore at a maximum share price of Rs 170 per share through the open market route, it said. Gujarat Ambuja Cements has clocked a 112 per cent rise in net profit at Rs 53.23 crore during the first quarter of the financial year 2002-Commercial production commences at Gujarat Ambuja Cements Maratha Cement Works plant

- Board approves merger of Ambuja Cement Rajasthan with the company

- Mops up Rs 50 cr by issuing non Convertible Debentures (NCD)

- Allots 80 lacs warrants to Affinity Investments, an Affiliate of Warburg Pincus Equity Partners L.P

- Securities Appellate Tribunal (SAT) directs Sebi to examine Guj Ambuja deal for ACC stake

**2003-**SEBI finds no violation of Regulation 12 of the SEBI (Substantial Acquisition of Shares and Takeovers)

Regulation, 1997 by Gujarat Ambuja Cements Ltd. with regard to the ACC deal

-Raises \$80 million through External Commercial Borrowings (ECB)

**2004**-BIFR sanctions the rehabilitation scheme for merger of Ambuja Cement Rajasthan with Gujarat Ambuja Cements Ltd.

-Gujarat Ambuja Cements Ltd has informed that Shri NP Ghuwalewala has been appointed as the Wholetime Director of the Company at the Board meeting held today on June 28, 2004

**2005**- Gujarat Ambuja Cement Ltd - Issue of Bonus shares- Gujarat Ambuja gives Rs 25 lakh aid for quake victims- Ambuja Cements has given the Bonus in the Ratio of 1:2-Company has splits its Face value of Shares from Rs 10 to Rs 2

**2006**- Holcim raises stake in Gujarat Ambuja Cements

- Gujarat Ambuja - Change in Accounting Year

**2007**- Company name has been changed from Gujarat Ambuja Cements Ltd to Ambuja Cements Ltd.

**2008**- Ambuja Cements Ltd has appointed Mr. Naresh Chandra as an additional director.

**2009**- The Company launched its knowledge initiative i.e. Ambuja Knowledge Center, to enable industry professionals get a first-hand feel of the world of cement and concrete. During the year, three centers became operational in the cities of Jaipur, Ahmedabad and Kolkata.

-Ambuja Cements - Grant of Stock Option under ESOS

**2010**- On 24th February 2010, Ambuja Cements Ltd (ACL) inaugurated its cement plant (grinding unit) at Dadri, Uttar Pradesh. Capacity: 1.5 million tonnes.- On 27 March, 2010, Ambuja Cements Ltd (ACL) inaugurated its cement plant (grinding unit) at Nalagarh, Himachal Pradesh. Capacity: 1.5 million tonnes.

- In December 2010, the Dadri Grinding Unit in its very first year of operation received the Integrated Management System (IMS) Certification, including ISO 9001:2008, ISO 14001:2004, and OHSAS 18001:2007 by BSI (U.K.).

**2011**-Completes 25 years of operation. Celebrates silver jubilee at all integrated plants.

- Achieves water-positive status, as certified by an independent foundation, Det Norske Veritas. Ambuja Cements gives back to the community double the amount of water the Company consumes at its facilities.

- Ambuja Cements Ltd has acquired 85% equity shares of Dang Cement Industries Pvt. Ltd., Nepal

- Ambuja Cements Ltd has acquired 60% equity shares from the existing promoters of Dirk India Pvt. Ltd.

**2012**- Ambuja Cements announces Allotment of Shares under ESOS category.

- Ambuja presented 2 awards at the CII Sustainability Awards 2012 by Honorable President of India.

- Ambuja Cements Limited's (ACL) integrated plant unit at Chandrapur, (Maharashtra), the Maratha Cement Works (MCW) bagged the gold award for the best safety systems under the Large size category of the FICCI Safety Excellence System Awards 2012

**2013**-Ambuja Cement bagged the Asia's Most Promising Brand & Leader Award at the Asian Brand and Leadership Summit 2013

-ACL Rabriyawas was awarded "Energy Efficient Unit" during the 14th National Award for Excellence in Energy Management 2013

-Ambuja Cements has unanimously approved a proposal to first acquire a 24% stake Holcim

**2014**- Ambuja Cement Foundation - Chirawa has won the UNESCO supported Water Digest Water Award 2013-14

-Ambuja Cement Foundation - Bathinda won the NABARD 'Partnership Excellence Award' in the category of "Improving productivity of crops"

-Ambuja launched a premium quality cement product, AMBUJA PLUS in the state of Rajasthan.

-Ambuja launches AMBUJA PLUS in Gujarat






-Ambuja Cement has launched a new TV campaign after four years, focusing on social awareness.

**2015-17**-Ambuja Cement created another benchmark among cement industries in India, it obtained a whopping

4.03 times water positive factor

- Ambuja Cement won FICCI CSR award 2016 under 'Category 5 - Any Other' for its exemplary Water Resource Management Program
- Ambuja Cement conferred with the Bombay Chamber Civic Award for social development
- Ambuja Cement & ACC win prestigious accolades at CII-ITC Sustainability Awards 2016- Ambuja notches up a perfect score bags six prestigious accolades @ CII-ITC Sustainability Awards 2017
- Ambuja Cement wins two prestigious awards at NCB International seminar
- Ambuja Cement launches 'Ambuja Plus Cool Walls' in Surat
- 'Ambuja Plus Cool Walls' launched in Punjab
- Ambuja Manovikas Kendra bags 'Overall Championship Trophy' at Punjab State Special Olympic Games
- Ambuja Cement wins CII National Award for Excellence in Water Management
- Ambuja Cement bags Yes Bank's prestigious Natural Capital Award 2017
- Ambuja Compecem launched a superior composite cement product for better sustainability a first in the Indian cement industry
- Ambuja Cement a key partner in India's longest highway tunnel in Jammu & Kashmir

## Competitors of company

	COMPANY	SYMBOL
	<u>Ambuja Cements Ltd.</u>	AMBCEL
	<u>ACC Ltd.</u>	ACCLTD
	<u>Heidelberg Cement India Ltd.</u>	MYSCEM
	<u>UltraTech Cement Ltd.</u>	ULTCEM

## Yearly Expenditure vs income data

Rs (in Crores)					
	Dec'20	Dec'19	Dec'18	Dec'17	Dec'16
<b>INCOME</b>					
Net Sales Turnover	11371.86	11667.88	11356.76	10446.85	9267.82
Other Income	372.00	426.52	374.98	359.09	576.23
<b>Total Income</b>	<b>11743.86</b>	<b>12094.40</b>	<b>11731.74</b>	<b>10805.94</b>	<b>9844.05</b>
<b>EXPENDITURE</b>					
Stock Adjustments	114.08	42.80	-76.72	-62.83	-30.19



Raw Material Consumed	874.88	994.42	1013.08	909.33	776.68
Power and Fuel	2251.91	2586.42	2548.99	2234.20	1831.96
Employee Expenses	668.78	672.63	679.57	661.37	593.72
Other Expenses	4815.61	5222.76	5300.38	4764.64	4412.96
<b>TOTAL EXPENSES</b>	<b>8725.26</b>	<b>9519.03</b>	<b>9465.30</b>	<b>8506.71</b>	<b>7585.13</b>
Operating Profit	2646.60	2148.85	1891.46	1940.14	1682.69
<b>EBITDA</b>	<b>3018.60</b>	<b>2575.37</b>	<b>2266.44</b>	<b>2299.23</b>	<b>2258.92</b>
Depreciation	521.17	543.83	548.09	572.92	850.13
<b>EBIT</b>	<b>2497.43</b>	<b>2031.54</b>	<b>1718.35</b>	<b>1726.31</b>	<b>1408.79</b>
Interest	83.05	83.52	82.33	107.19	71.48
<b>EBT</b>	<b>2414.38</b>	<b>1948.02</b>	<b>1636.02</b>	<b>1619.12</b>	<b>1337.31</b>
Taxes	624.28	419.48	19.06	369.55	367.22
<b>Profit and Loss for the Year</b>	<b>1790.10</b>	<b>1528.54</b>	<b>1616.96</b>	<b>1249.57</b>	<b>970.09</b>
Extraordinary Items	.00	.00	-129.95	.00	.00
Prior Year Adjustment	.00	.00	.00	.00	.00
Other Adjustment	.00	.00	.00	.00	.00
<b>Reported PAT</b>	<b>1790.10</b>	<b>1528.54</b>	<b>1487.01</b>	<b>1249.57</b>	<b>970.09</b>

**glossary:** PAT- Profit After Tax

EBT – Earnings Before Tax

EBIT (earnings before interest and taxes) =Net Income+Interest Expense+Tax Expense

EBITDA-Earnings Before Interest, Taxes, Depreciation, and Amortization

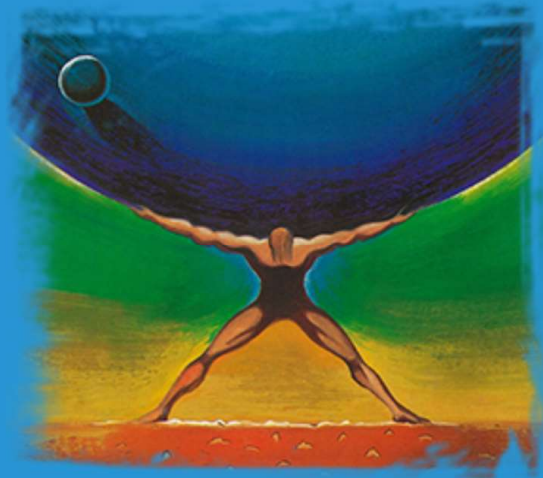
=Operating Profit +DE +AE where: DE=Depreciation expense, AE=Amortization expense

# Vision and Mission

*The bedrock of Ambuja's philosophy*

## VISION

To be the most sustainable and competitive company in our industry.



## MISSION

To create value for all

- Delighted Customers
- Inspired Employees
- Enlightened Partners
- Energised Society
- Loyal Shareholders
- Healthy Environment



## Organization Structure

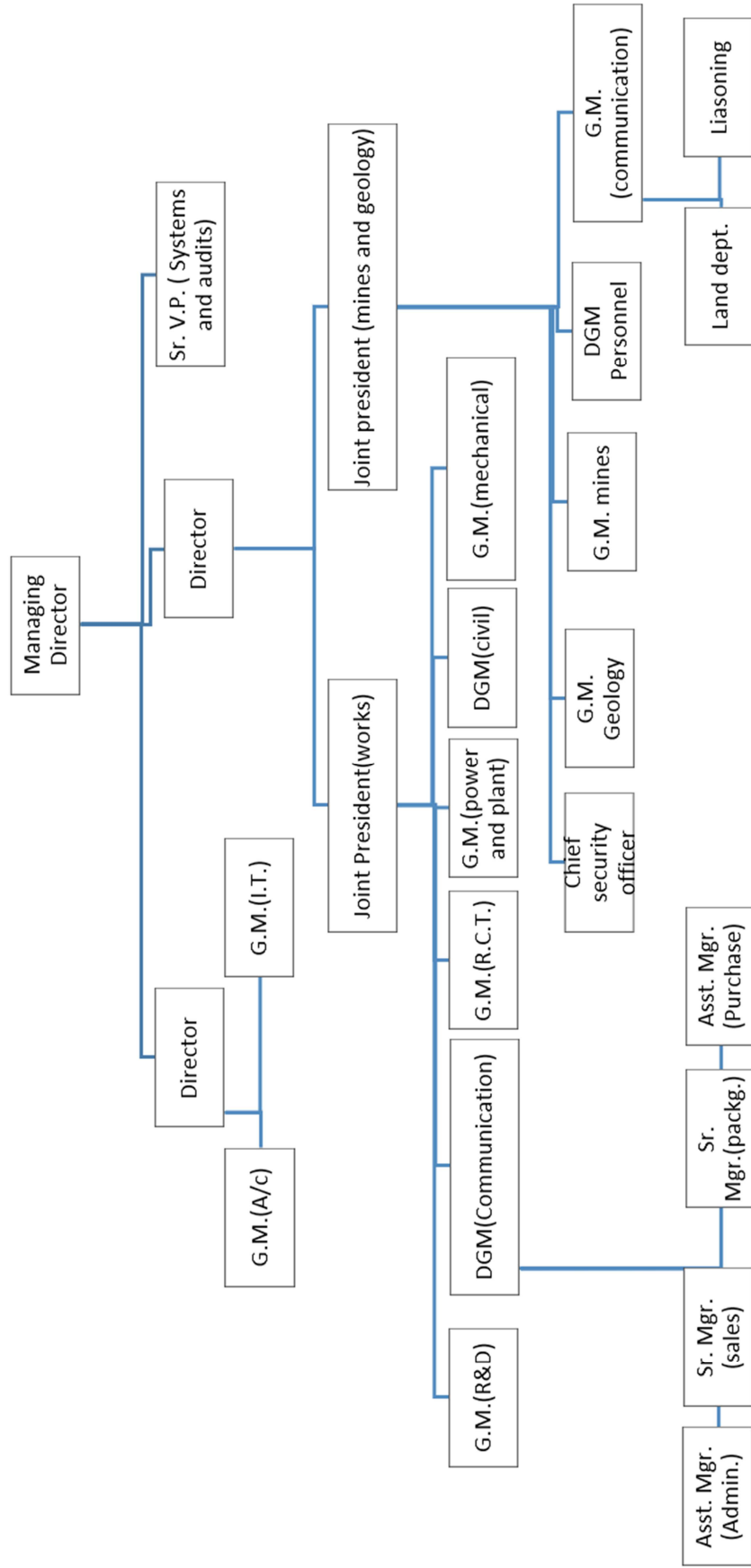
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General organization chart is a blue print of company organization. Anybody understands a position of employees. General organization structure process is very important and hard process.

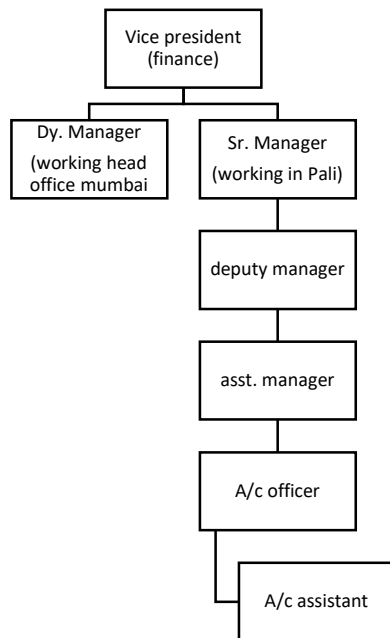
We can understand an authority and responsibility of officers and employees. And also, general structure showed a relationship between officer to officer, employees to employees. And also shown a group activity, so best structure means a best result.

According to my observation, authority is in the hand of top-level management and responsibility rests with medium and low-level management.

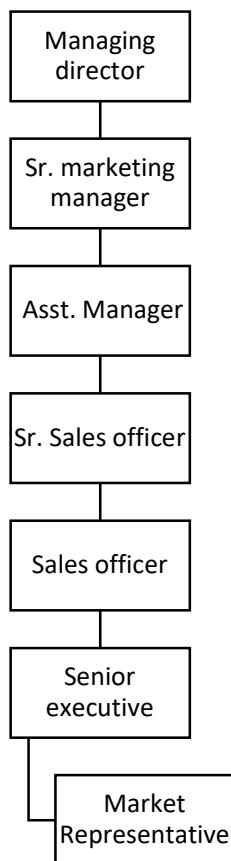
## Organization chart:



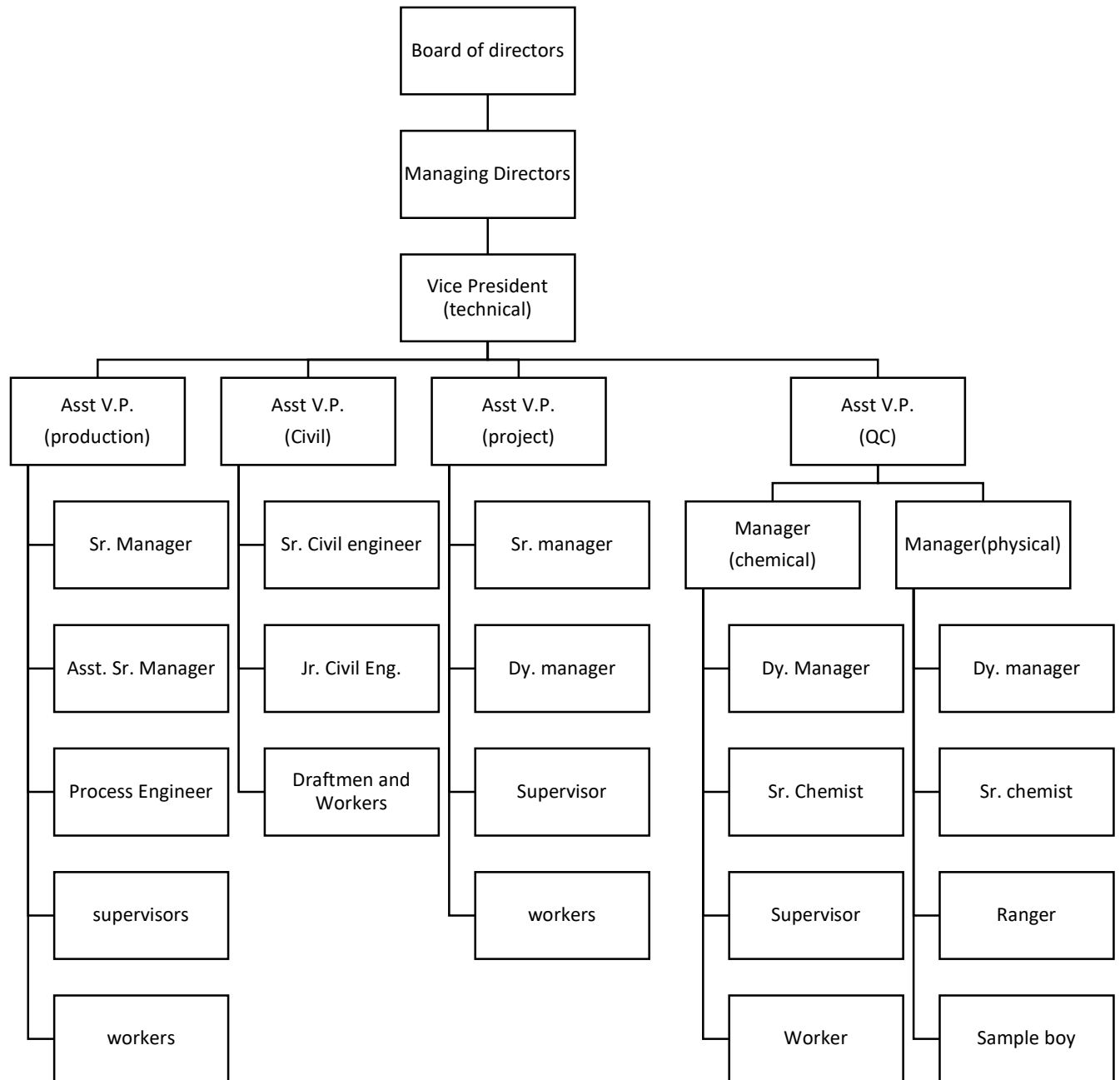
## Finance department hierarchy Chart:



## Marketing Department hierarchy chart:



## Organization Chart of Technical Management:





# Cement Production: Production processes

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Production is the process where raw materials are converted into finished goods. All the processes are different for each product. Production means creation of utilities and covers all the activities of procurement, allocation and utilization of resource such as energy material etc.

Hence Ambuja Cement Rajasthan Limited is a very large company and creates many construction products, I was only focused with the main product of the company which is Portland cement. I will further explain all the processes used for cement production.

Manufacturing means to make semi-finished goods into finished goods and manufacturing process summation of all the steps making semi-finished goods into finished goods.

Every manufacturing firm should have sound manufacturing process to manufacture goods without sound. Manufacturing process, manufacturing cost will be directly reflect in the profit if the organization.

A cement is a binder, a substance that sets and hardens and can bind other materials together. The word "cement" traces to the Romans, who used the term *opus caementicium* to describe masonry resembling modern concrete that was made from crushed rock with burnt lime as binder. The volcanic ash and pulverized brick supplements that were added to the burnt lime, to obtain a hydraulic binder, were later referred to as *cementum*, *cimentum* and *cement*. Cements used in construction can be characterized as being either hydraulic non-hydraulic, depending upon the ability of the cement to be used in the presence of water (see hydraulic and non-hydraulic lime plaster). Non-hydraulic cement will not set in wet conditions or underwater, rather it sets as it dries and reacts with carbon dioxide in the air. It can be attacked by some aggressive chemicals after setting. Hydraulic cement is made by replacing some of the cement in a mix with activated aluminium silicates, pozzolanas, such as fly ash. The chemical reaction results in hydrates that are not very water-soluble and so are quite durable in water and safe from chemical attack. This allows setting in wet condition or underwater and further protects the hardened material from chemical attack (e.g., Portland cement).

The basic raw material required to produce cement are as follows:

1. LIMESTONE
2. RED CLAY
3. GYPSUM
4. COAL
5. FLY ASH
6. SILICA

According to the mode of preparing the raw mix four different processes can manufacture cement:

A. **Wet Process**- In this process, the raw meal is fed to the rotary kiln in wet slurry form. The moisture content of the slurry varies between 30- 40 % and hence relatively long kiln, generally with installations such as chains, segments or crosses, with or without slurry pre-heater, are used.

The fuel consumption is rather high (1350 - 1500 kcal / kg clinker), but the electrical energy consumption (in kWh / t) is less compared to dry grinding. The wet process is rarely used these days and the shift is towards dry process.

**However, the application of this process becomes necessary when:**

Raw materials contain components such as plastic clay, chalk with high moisture content, or carbonate sludge.

Wet beneficiation is necessary to upgrade the chemical characteristics of limestone

C. **Dry Process**- In the dry process, raw materials are ground in the dry state and the resultant raw meal fed to the rotary kiln. Dry process kiln can be of the following types as mentioned here

Long- dry kiln with internal / external heat exchanger

Kiln with suspension pre-heater.

Kiln with suspension pre-heater and precalciner.

Dry process	Wet process
❑ This process is usually used when raw materials are very strong and hard.	❑ This process is generally used when raw materials are soft because complete mixing is not possible unless water is added.
❑ In this process, the raw materials are changed to powdered form in the absence of water.	❑ In this process, the raw materials are changed to powdered form in the presence of water
❑ Dehydration zone requires a somewhat shorter distance than wet process.	❑ Dehydration zone would require up to half the length of the kiln easiest to control chemistry & better for moist raw materials
❑ 74% of cement produced.	❑ 26% of cement produced
❑ kilns less fuel requirements	❑ High fuel requirements - fuel needed to evaporate 30+% slurry water- The kiln is a continuous stream process vessel in which feed and fuel are held in dynamic balance
❑ In this process calcareous material such as lime stone (calcium carbonate) and argillaceous material such as clay are ground separately to fine powder in the absence of water and then are mixed together in the desired proportions. ❑ Water is then added to it for getting thick paste and then its cakes are formed, dried and burnt in kilns.	❑ In this process, raw materials are pulverized by using a Ball mill, which is a rotary steel cylinder with hardened steel balls. When the mill rotates, steel balls pulverize the raw materials which form slurry (liquid mixture). The slurry is then passed into storage tanks, where correct proportioning is done. Proper composition of raw materials can be ensured by using wet process than dry process. Corrected slurry is then fed into rotary kiln for burning.

### Advantages and disadvantages of WET and DRY process

In the drying section of wet process plant, there is weakening of bonds of the crystal lattice which accelerates clinker formation during burning. Wet process consumes less power during grinding. Dry process requires approximately 30 % more power. Quality of clinker in wet process is better due to better homogenization achieved in slurry raw meal, but now, by pneumatic blending, dry raw meal is also homogenized to the same degree. Proportioning of dry raw meal to required composition is easier than doing the same for moist, wet or plastic cake. Wet process plant requires 20 % more silo volume for slurry storage. Heat consumption for wet process is higher (1350- 1500 kcal / kg clinker) whereas for the dry process it may vary from 720- 1100 kcal / kg clinker depending upon the type of kiln being used. There is a higher wear rate of equipment - kiln chains, liner plates etc. in the wet process.

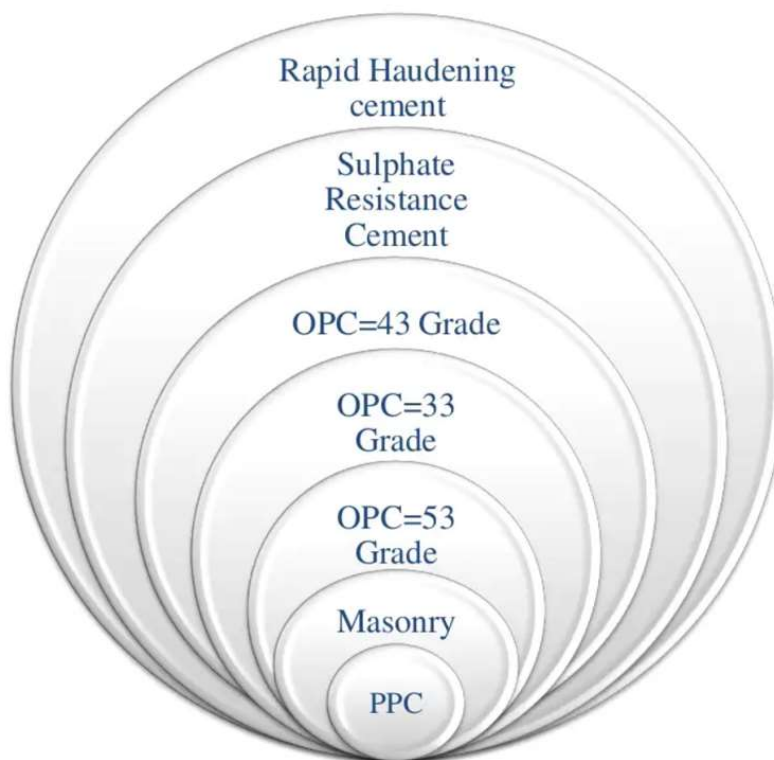
### **Semi - wet Process**

In the semi- wet process, the kiln is fed with raw meal in the form of wet cakes containing 15-20% moisture after partial dewatering of slurry by filtration. Heat consumption in this process is 1000 - 1200 kcal / kg clinker. This process has the advantage of partial fuel saving even wet grinding is resorted to due to the characteristics of the raw material. However, this has not been widely accepted in the industry due to additional energy consumption and high maintenance cost of slurry filtration unit.

### **Semi - dry Process**

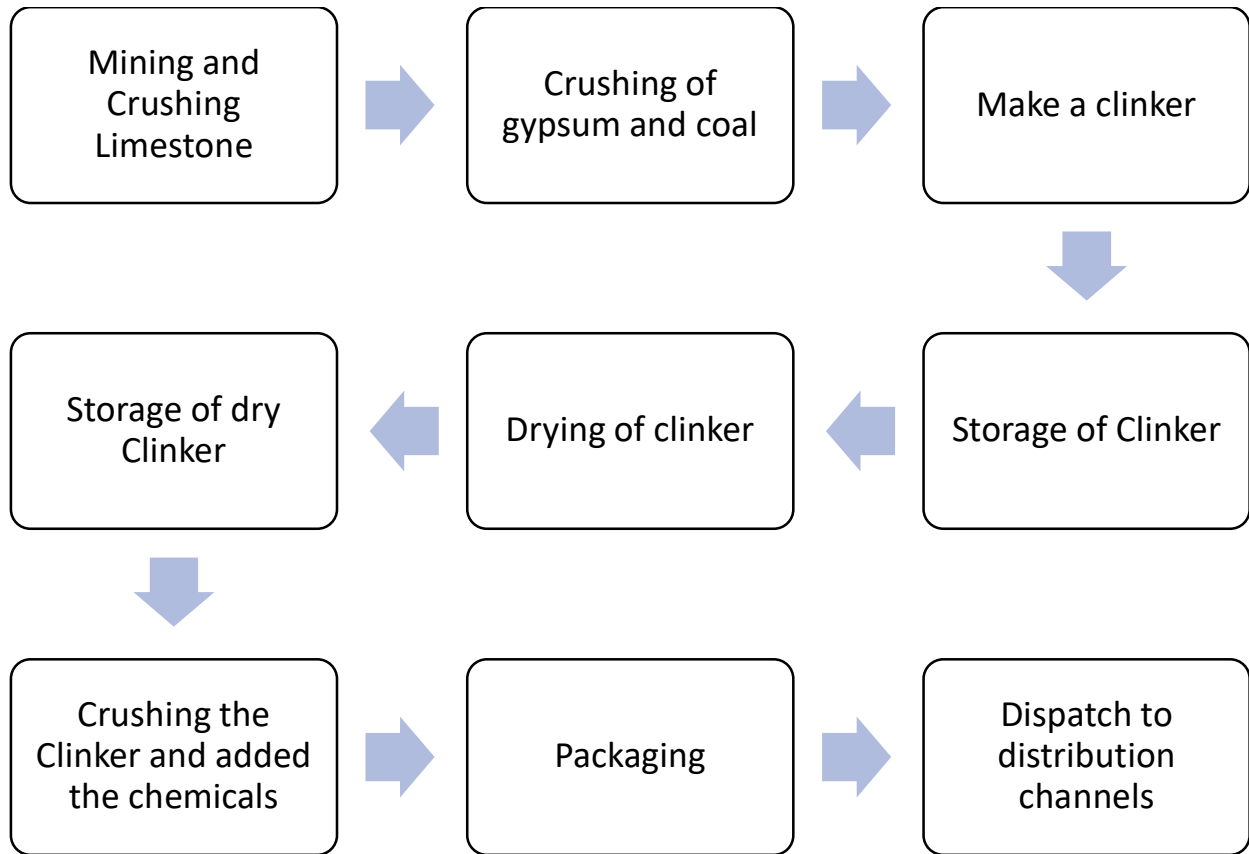
This process was especially evolved to counter the main drawback of the wet process i.e. high fuel consumption. In this process, the raw materials ground in dry condition are homogenized and then nodulised in a pan noduliser of dish or rotary type by adding controlled quantity of water (10- 12 %). Nodules thus produced are fed to the pyro- processing unit. This type of process can only be applied to raw materials having proper plasticity for producing nodules of adequate strength. It is generally adopted where alkali - content in raw materials and fuel is on the higher side and raw material properties exclude the preparation of raw- mix in the dry condition. The raw meal nodules are fed to the pyro- processing plants having either shaft kiln or short rotary kiln with traveling grate.

### **Types of cement Ambuja Cement produces:**



# Cement manufacturing: Process Chart

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**1. MINING & CRUSHING OF LIMESTONE:** Limestone is the basic raw material to produce cement. It is mainly obtained from the open cast mining. The limestone is hauled through dumpers up to the 70 to 75 mm size. The crushing of limestone is done through hopper crushed material passed on the conveyor belt in which the additive material is added to the material.

**2. CRUSHING OF GYPSUM & COAL:** The second stage of cement manufacturing is to crush the gypsum & coal by griddling machine.

**3. MAKE A CLINKER:** Clinker is a precondition to make cement. So, to make cement of clinker is needed. So, to make a clinker all crushed material like limestone, gypsum & coal water with the help of elevator.

**4. STORAGE OF CLINKER:** After a making of clinker, its stored in a one place. It's called silo. As per the requirements clinker is sent at required place weighing bin.

**5. DRYING OF CLINKER:** After making a clinker, it dried in heating machine at 1200–1400-degree Celsius temperature. Minimum 1 hour required for drying the clinker.

**6. STORAGE OF DRY CLINKER:** After the drying a clinker it stored in a one place. It's called silo. As per the requirements, clinker is sent at required place through conveyor belt.

**7. CRUSHING THE CLINKER & ADDED THE CHEMICAL:** Dried clinker is again crushed in the grinding cement mill. And chemical is added as per the grad of cement. After adding the chemicals, this all things are mixing in the raw mill. After this process, all these mixing materials are transferred in to the roller. Rollers exclude the wastage & clean to the cement.

**8. PACKING:** Packing is the final step of cement manufacturing process. Clean cement again stored in a silo and last as per the requirement it come in weight bag through conveyor belt. After this cement bag which have capacity to include 50 kgs. Cement in it.

All this process is done by these following stages:

**(A). MINING STAGE:** The limestone is come out from mine by drilling and blast method. And it is reach at plant by huge damper having carrying capacity of 35 tones.

**(B). CRUSHER STAGE:** Limestone and marl are fed into the crusher plant which crushes the size of 100 mm maximum. This crushed material is taken to the further stage.

**(C). STACKER STAGE:** The stacker makes stock piles for pre blending in about 350 to 400 layers. Sample of limestone are taken out every 5 minutes for analysis in the laboratory to determine their chemical properties, total carbonate. This analysis is done to determine the composition of the stock pile correction where require are done at this stage.

**(D). RAW MILL STAGE:** Raw mill is a vertical roller mill in which crushes the material into fine powder.

**(E). BLENDING SILO STAGE:** In this stage silo blends material by clarification. Material gives correct weight of the fed material or not.

**(F). PRE-HEATER STAGE:** In this stage, passing the material from the top and the hot gases upwards from the kiln so, the materials come down and take heat.

**(G). PRE-CALCIFICATION:** In the pre-calcification the 5% of powdered coal is fired, Because of the ore-heating and kilns are calcified about 85 to 90 % materials is calcined before the materials enter the clinker with calcium oxide (quick lime) and carbon dioxide.

**(H). CLINKERISATION:** This material then enters the kiln, which rotates it with slow speed. The material then enters the sintering zone where. In it the temperature is around 1400 c to 1500 c. Then the clinker is become cooled and it is taken in big bag for bucket storage.

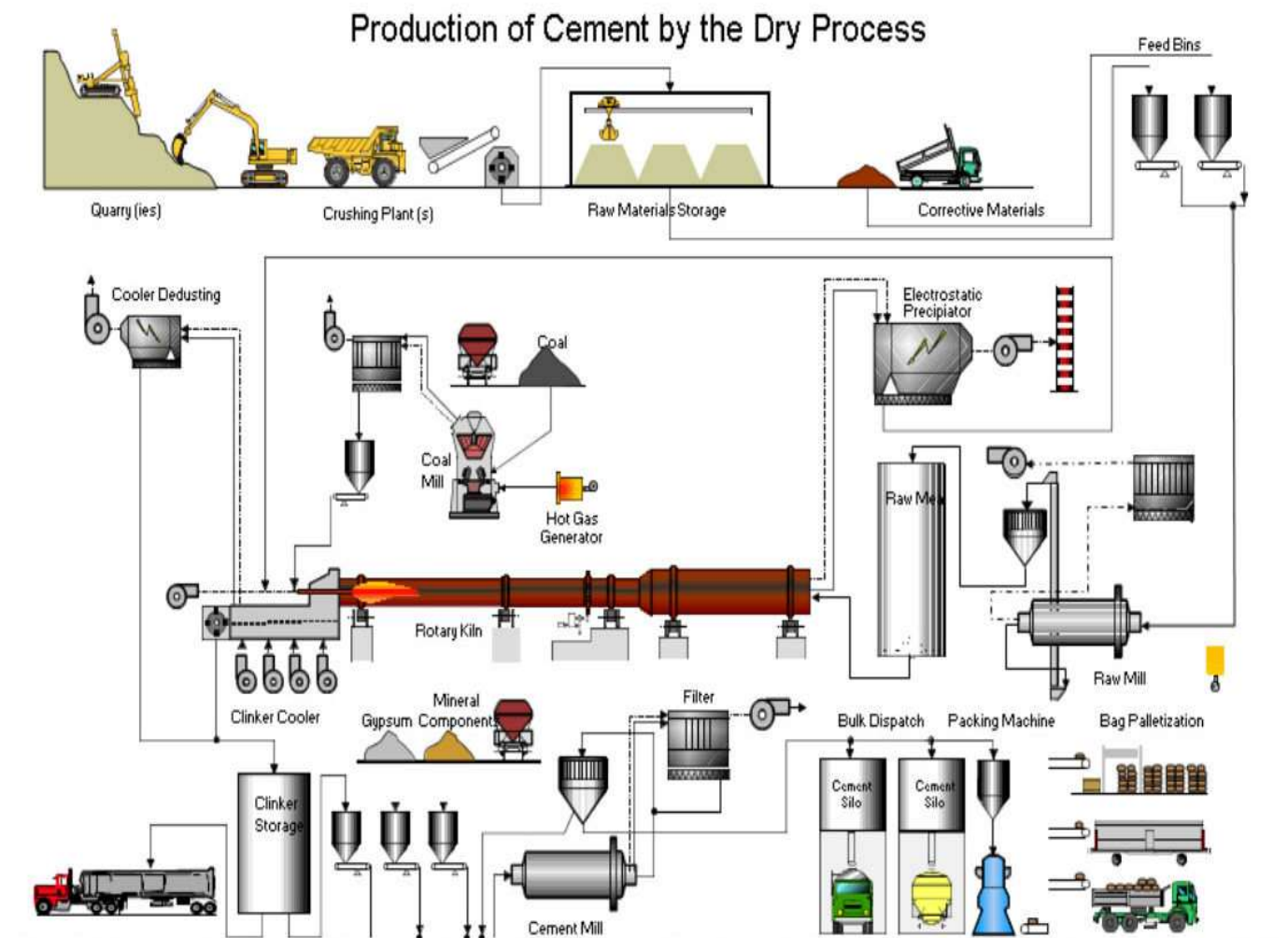
**(I). CEMENT MILL:** In this stage the gypsum is added in cement about 4% to 6%. The gypsum is added because this has effect regarding the setting time of cement thereby providing time for work to be performed in planning the concrete. Then it is gone for packing department as a when required.

**(J). QUALITY CONTROL:** To maintain quality it is required that every stages of manufacturing process is check by proper measurement and in ambuja the whole process right from feeding of raw materials to manufacturing of cement is controlled by Japanese computers. Because of that it is possible to manufacture better than better quality of cement. It use **CCU (Close Circuit Unit)**, in the manufacturing process so, that they have improved their quality of cement and productivity of cement and it is -9000 metric tons per day.



**(K). PACKING:** The final stage of cement is packing. The capacity of each packer is 120mt/hour or 2400 bags per hour the total capacity is 240 tones or 4800 bags per hour. Then they are carried by trucks of wagons for one place to other place.

## Production block Diagram



# Supply Chain Management

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Supply chain management is crucial part of any decisions related to the company's overall growth with a best way of arranging assets and goods.

The main objective in supply chain management, is to use a set of approaches and framework to efficiently integrate **upstream supply chain tiers** (production plant and warehouses, distribution centers, to the **downstream supply chain tiers** such as (Ambuja Cement dealers and retail stores in various places.

To accomplish these kinds of approaches first we need to consider the type of market we are targeting for our business and type of costumers who buy our product. To build a competitive advantage in market company have to establish good relationship with dealers and contractors.

To examine the type of Product that Ambuja cement is producing, I focused on two types of Supply Chains given by **Fisher's supply chains** which are following.

**1.) Physically Efficient Supply Chain (for functional products)-** In this type of supply chains generally product have services have these following qualities-

- a.) Long product life cycle
- b.) Approximately stable demand
- c.) Need of large truck loads to distribute the goods
- d.) Focused on cost minimization
- e.) Low profit margins on product
- f.) Less product diversification
- g.) Less competition in market
- h.) Less need of product development frequently

Examples- food, dairy products, cement and concrete, daily supplies.

**2.) Market Responsive Supply Chain (for innovative products)-** in this type of supply chains products have these qualities-

- a.) Comparatively less product life cycle (about half year to 2 years)
- b.) Demand always follows the new product launch
- c.) Needs faster delivery and less loading transport facilities
- d.) Focused on quick response to changes of market and customer demands.
- e.) High profit margins on sales
- f.) Frequent product diversification
- g.) Higher competition in market
- h.) Highly needed product development facilities



Examples- all electronics device manufacturers like mobile, TV and computer manufacturers

Hence construction works is continuous production in India and having a stable or growing market demand so the appropriate strategy for supply chain must be a Physically efficient supply chain where the production is focused on cost minimization and easy availability of product. In addition, for Ambuja cements there are following considerations are taken into account while designing the supply chain facilities for Ambuja cement.

- 1.) Inventory** – Inventory basically is in the form raw material, work in progress and finished product. It is very critical to manage the inventory as per fluctuating customer demand. The task is if the cement production demand is coming for a day which is either 5000 tons or 6100 tons. So, we should always have a stock of inventory to achieve that goal and prevent backlog orders. Inventory plays a leading role to enable the overall production capacity and penetrates the working management to work on time. So every time we will have to make sure that we have the inventory stock conforming the demand.
- 2.) Logistics**- Logistics design is crucial for moving or settling the finished products and also cost minimization is the foremost criteria for logistic design. Logistics includes distribution centres, transport, transit facility. To determine the best facility all supply chain managers uses all the alternatives available to facilitate the logistic service and then do cost vs benefit analysis and chose the best one among them. Hence ambuja cement is a functional product company so the main focus is to deliver the bulk to the targeted distribution center. Again, cost minimization is taken into account so they calculate per kilometer charge to deliver a Ton of cement and then decides the transport facility. For Rabariyavas plant the logistic facility is of two channels one is Truckloads and second is By Railways.  
Truckloads are used for domestic supply and railways is used for interstate supply for better cost minimization.
- 3.) Network Design**- A typical supply chain network design leads a business to maximize its profit margins and reduces the chance to lose market advantage. Its always best to study the market segment and make decision of current production for accomplishment of the goal.
- 4.) Outsourcing or in house production**- ambuja cement uses in house production to accomplish its business in India. Some crucial considerations are – low labor costs, availability of raw material, easy transport facility, low cost of instruments rather than outsourcing, competitive advantage and less change to leakage of information to other companies.
- 5.) Risks management**-proper risk management is used to conquer this problem.

# Utilities

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The Utility services are as per the following:

Power	Overall Plant Requirement: total 33.7 MW <ol style="list-style-type: none"><li>1. Captive power plant I: 15 MW</li><li>2. Captive power plant II: 18.7 MW</li></ol>
Steam	Overall Plant Requirement is taken care by two 80 TPH FBC boiler, Steam at 64 kgs/cm <sup>2</sup> and 480°C.
Gas Bank (LPG)	Not required in the plant.
Water	The source of water is ground water. The water is stored in a confined place, which has got a capacity of 4500 cubic liters reserves.

# Maintenance

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Type	Unit Details	Observation
Strength	Strength: 1200 persons.	Proper utilization of manpower working in three shifts and one general shift.
Workshop Facility	Routine and minor repairs are carried out in house. Major repairs are being done outside as per company policy.	The system found to be unsatisfactory as proper care is being taken for the equipments.
AMC's/ARC,s	Applicable.	Exists.
Spares	Major spares are available.	Spare equipment available and regularly maintained.
Maintenance Schedule	Schedule is followed.	Maintenance is carried out by the maintenance team for all the departments.
Critical Equipments	Standby of the critical equipments are available.	Satisfactory and maintained.
Interruption losses in past (Fire/M.B.)	Not Reported.	No major losses in past history.

**OVERALL RATING:** Good

# Security

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Strength	2 heads round the clock in three shifts.
Boundary Wall	High Brick Wall or otherwise. Entry is restricted for visitors without prior permission.
Gates	One gate for movement of material and one gate for entry of persons.
Fire Fighting	Dedicated officer appointed; fire station located at distance of 40 kms from the plant.
Entry and Exit	Monitored by security guards and strictly controlled for visitors.
Emergency Watch Tower	6 watch towers in background.
Working Hour	24 hours work is carried out in three 8 hrs shift and one general shift.

**OVERALL RATING:** Good

## Risk Exposures

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S No.	Peril	Exposure	Possibility	Severity	Remarks
1.	Fire/Explosion	High	High	High	Adequate safety measures adopted.
2.	Lightning	Low	Low	Moderate	Earthing and lightning arrestors are provided.
3.	Aircraft Damage	Low	Low	Low	No past history
4.	Riot, Strike, Malicious Damage	Moderate	Low	Low	No past history
5.	Terrorism	Moderate	Low	High	No past history
6.	Bursting/overflow of water pipes/ Tanks	Moderate	Low	Moderate	No past history
7.	Burglary	Moderate	Low	Low	No past history

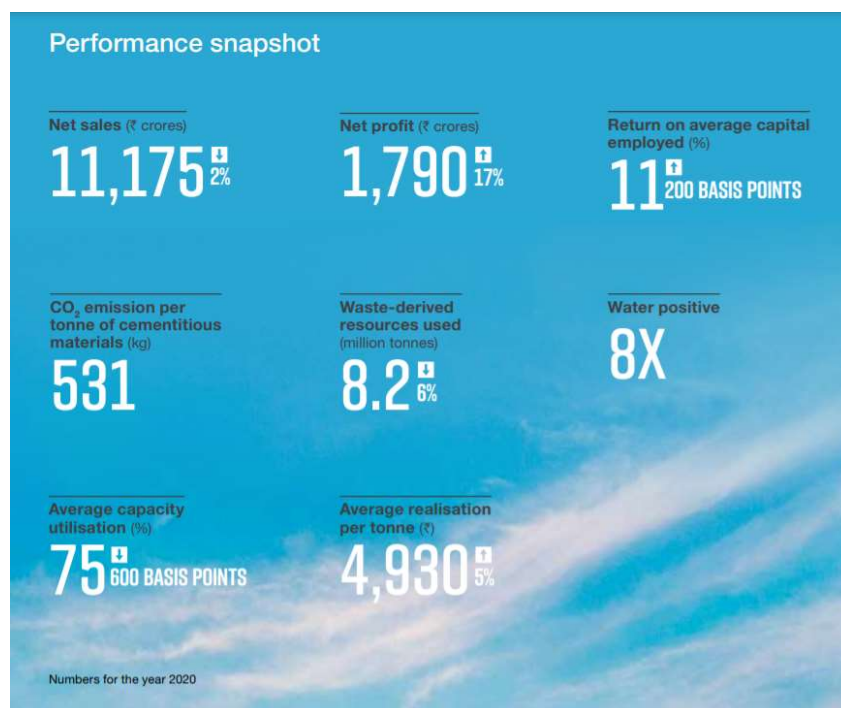
**Remarks**-Any IR related issues reported and Exposes to Riot, Strike and Malicious Damage are considered low and no history of previous RSMD Loss.

## Sustainable development strategies and report

### Sustainable development strategy

Ambuja Cement's sustainable development initiatives cover a wide spectrum—from clean technology harnessing to utilisation of industrial wastes in cement production, energy conservation to exploiting renewable energy resources, emissions reduction to creating institutionalised mechanisms to monitor environmental risks and strict adherence to the Company's 'zero non-compliance' regime.


**True Value approach**- they have adopted True Value accounting method for sustainability, which encompasses the three pillars of sustainability—people, planet, and profit—to emerge as the most competitive and sustainable company in the domestic cement industry. True Value has helped the company to take strategic business decisions through a qualitative measurement of the Company's impact on the environment and society. We have been able to identify a portfolio of cost-effective projects, reduce costs, increase earnings and subsequently increase 'True Value'. company reported incremental growth in 'True Value' over the years, driven by our sustainable, environmental and social interventions and supported by favourable macros at play.



## SUSTAINABLE DEVELOPMENT AMBITION 2030

In line with the sustainability strategy of LafargeHolcim, Ambuja Cement's Sustainable Development Ambition 2030 provides critical thrust to our goal of achieving sustainable growth. It provides us with a broad framework for strategic

interventions to meet the challenges across four thematic areas—Climate, Circular Economy, Environment, and Community.

	 Climate	 Circular Economy	 Environment	 Community
Lead metrics	<b>CO<sub>2</sub> emissions reduced</b> (kg CO <sub>2</sub> /t of cement)	<b>Waste reused</b> (Million tonnes)	<b>Water saved</b> (Freshwater withdrawal: L/t of cement)	<b>Value shared</b> (Million new beneficiaries)
Performance 2020	<b>531</b>	<b>8.2</b>	<b>77</b>	<b>0.3</b>
Target 2030	<b>463</b>	<b>13.5</b>	<b>&lt;75</b>	<b>0.8</b>
SDGs impacted				

\*Other than the above identified Sustainable Development Goals (SDGs), our activities under the four pillars also address various sub-targets of other SDGs.

## Observations

- 1.Cement production is 6000 T per day.
2. Area of the plant is 1600 hectare including the mines.
- 3.The type of supply chain used is Physically Efficient Supply Chain with almost stable or growing demand in market.

- 4.The daily dispatch capacity of the plant is average 500 trailers per day with 13 container filling stations.
- 5.They have their emergency response team (ERT) and emergency phone numbers available for 24 hours and Fire Brigade facility was available for 24 hours in case of any emergency.
- 6.Quality is maintained as per ISI` standards.
- 7.Health, safety, environment and quality policy was taken.
- 8.Main motto of the company is zero harm by following rules and regulations given by state, by continuous awareness among employees and by sharing knowledge with other company.
9. 68 hydrant points are installed.
- 10.Approximately 400 fire extinguishers are installed.
- 11.Pressurized equipments are tested in 6 months.
- 12.There are 2 boilers having capacity of 80 TPH.
- 13.Hydraulic testing is done in 3 yrs in the presence of any competent person.
- 14.Electrical equipments are ISI marked.
- 15.Work permit is required for working 3m and above.
- 16.Lockout and isolation procedure is followed for the equipment.
- 17.No major losses in the past.
- 18.The plant is continuous process plant working in 3 shifts and one general shift.
- 19.They have their own workshop where the repairing of the equipments is carried out and in case of major breakdown; machinery is repaired from outside workshop.
- 20.All equipments are working properly.
- 21.Building regulations was compiled and proper distance is maintained between the equipments.
- 22.They have their own mines at distance of 3kms approx within the premises.
- 23.Annual maintenance plan is carried out annually.
- 24.Spare parts of equipments are available.
- 25.Lightening arrestors are installed in Silos.
- 26.Proper earthing is provided to all electrical drives.
- 27.Log records are maintained for the machines on MAC system regularly.
- 28.Every equipment has its own HAC (Holcim Asset Code) number.
- 29.There are two main gates. One for the entry of employees or visitors and other for the entry of materials.
- 30.Capacity of gearbox is 1000 KW.
- 31.Cement quality is checked every hour.
- 32.Heat lost in the kiln is used in the burning of coal.
- 33.The plant is operated from CCR.
- 34.There are three Silos for the storage of cement each of which is 9000 MT in capacity.
- 35.32tons of coal is burnt per hour to maintain the temperature in the kiln.

36. There are 18 fans in cooler.
37. The critical equipments observed are raw mill, Kiln, Cement Mill.
38. The capacity of clinker Silo is 2300 MT.
39. The capacity of kiln 6000 TPD.
40. There are four packing machines. Capacity of each packing machines is 120 TPH.
41. There are three crushers having capacity of 700 TPH, 900 TPH and 1200 TPH.
42. Awards received:
- a) Greentech Safety Bronze award in cement sector.
  - b) National award for second best improvement in electrical energy performance by Nation Council for Cement and Building Materials.
  - c) Certificate of Merit' by 'Rajasthan State Productivity Council'.
  - d) Nominated for accident-free year 2010.
43. Further expansion of plant can be done within the premises.
44. Upcoming projects:
- a) new power plant having capacity of 6.4 MW based on waste heat recovery system from kiln gases.
  - b) New kiln having capacity of 2800 TPD of clinker production.





# Conclusion

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## Learning Outcomes from this internship:

- Learnt about large scale manufacturing structures and organizations, and how they work to accomplish their goal.
- I was exposed to different production process and value of time in their completion.
- Studied about organization structure of such a large-scale company and co-ordination between higher management decisions to employee work and productivity.
- Learnt about how to manage inventory as per demand of per day goal and inventory allowances to reduce unexpected quality issues.
- Learnt about logistics and distribution levels and management of supply chain.
- Learnt how to design and choose a typical supply chain and how it is important for an organisations.
- Learnt about how the company's balance sheets reflects its overall growth.
- Learnt about sustainable development need in any industry to understand the nature, and make equilibrium between business and mother earth.
- Learnt about risks and accidents happen and their intensity in 24 hour working industries.
- Analyzed the data of dispatch vs incoming order and how it is compensated on daily basis.
- Experienced industrial environment and need of accuracy to profit overall production.

The overall internship experience was too informative and helpful to learn about a typical large-scale industry and its working at different levels and responsibilities. The instructor was knowledgeable and experienced, and gave exposure to the latest techniques of supply chain management and inventory control. Here are some suggestions which should be improved in the factory-

- Employee and manager relationships should be better.
- Safety measures must be modified.
- The transportation service and filling stations can be optimized on basis of time and minimize the time of filling the trucks.
- There is a lot of heat required to maintain the temperature of clinker kiln so some alternatives should be deployed so the consumption of coal can be reduced.



A

Project Study

Report On

“Summer online Training” undertaken at

**“Borana Industries”**

*Submitted In Partial Fulfillment for the*  
*Award of Degree of*  
**Bachelor of Engineering**



2020-2021

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INTERNSHIP

REPORT

ON

BORANA INDUSTRIES

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# INTRODUCTION

## In Plant Training (IPT)

In Plant Training will provide an industrial exposure to the students as well as to develop their career in the high tech industrial requirements. Reputed companies are providing in plant training to Students. Here students are initially get counseled in order to emerge out their interest in various streams and what are all the basic concepts they know on that domain.

After the successful completion of studies students has to face this competitive world with this knowledge to face many problems and to find the right solutions which is to be solved in the minimum duration of time. The in-plant training is get totally different from the class environments.



# OBJECTIVES

- ❖ This training enables us to acquire more practical knowledge.
- ❖ The In-plant training totally different from the class environments.
- ❖ To learn real life application of Management.
- ❖ To relate theoretical concepts and organizational functioning
- ❖ Training will provide an industrial exposure.
- ❖ To study the production level and various stages of production.
- ❖ To learn the company and industrial polices.
- ❖ To study various functions of departments.

# BORANA INDUSTRIES

BORANA PVC PIPE INDUSTRY is an Indian PVC pipe manufacturing company based in JODHPUR, RAJASTHAN, INDIA. Founded in 1984.

Around 75-80 members are working in this company and they manufacture PVC pipes under customers demand. They manufacture pipes ranging from ½ inch to 7 inches which include ISI certified water pipes and also strong electrical wire fencing plastic tubes from the old, waste plastic PVC materials.

They recycle 90% of used and waste PVC materials to manufacture a completely dependable pipe material. They import mixtures from Malaysia and collect the used PVC materials from various parts of Karnataka, Kerala Tamil Nadu & Rajasthan.

In 1984 **BORANA PIPES INDUSTRY** had only 5 employees and now they have got more than 75 employees and most of their manufacturing machines are semi-automatic machines. Their machines are manufactured in such a way that they do not pollute the environment. Water used inside the coolant chambers are properly recycled for later use and no wastes are dumped in the farm or barren lands instead they are properly recycled.

Raw materials used are ordered in MALAYSIAN regions and that include pure form of Calcium Carbonate, CPW oil, Oil wax, button wax and Timonium.

**ADDRESS OF BORANA PVC PIPE INDUSTRY;**

SE-39, MIA BASNI,  
2<sup>nd</sup> PHASE BASNI,  
JODHPUR, RAJASTHAN, PIN CODE (342000)

## POLYVINYL CHLORIDE

**Polyvinyl chloride**, more correctly but unusually poly(vinyl chloride), commonly abbreviated **PVC**, is the third-most widely produced synthetic plastic polymer, after polyethylene and polypropylene.

PVC comes in two basic forms: rigid (sometimes abbreviated as RPVC) and flexible. The rigid form of PVC is used in construction for pipe and in profile applications such as doors and windows. It is also used for bottles, other non-food packaging, and cards (such as bank or membership cards). It can be made softer and more flexible by the addition of plasticizers, the most widely used being phthalates. In this form, it is also used in plumbing, electrical cable insulation, imitation leather, signage, inflatable products, and many applications where it replaces rubber.

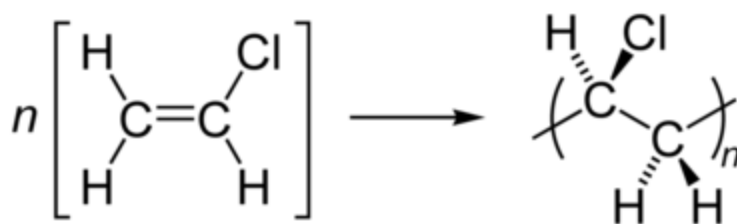
Pure poly (vinyl chloride) is a white, brittle solid. It is insoluble in alcohol but slightly soluble in tetrahydrofuran.

# Discovery

PVC was accidentally synthesized in 1872 by German chemist Eugen Baumann. The polymer appeared as a white solid inside a flask of vinyl chloride that had been left exposed to sunlight. In the early 20th century the Russian chemist Ivan Ostromislensky and Fritz Klatte of the German chemical company Griesheim-Elektron both attempted to use PVC in commercial products, but difficulties in processing the rigid, sometimes brittle polymer thwarted their efforts. Waldo Semon and the B.F. Goodrich Company developed a method in 1926 to plasticize PVC by blending it with various additives. The result was a more flexible and more easily processed material that soon achieved widespread commercial use.

## Production

Polyvinyl chloride is produced by polymerization of the vinyl chloride monomer (VCM), as shown.



About 80% of production involves suspension polymerization. Emulsion polymerization accounts for about 12% and bulk polymerization accounts for 8%. Suspension polymerizations affords particles with average diameters of 100–180  $\mu\text{m}$ , whereas emulsion polymerization gives much smaller particles of average size around 0.2  $\mu\text{m}$ . VCM and water are introduced into the reactor and a polymerization initiator, along with other additives. The reaction vessel is pressure tight to contain the VCM. The contents of the reaction vessel are continually mixed to maintain the suspension and ensure a uniform particle size of the PVC resin. The reaction is exothermic, and thus requires cooling. As the volume is reduced during the reaction (PVC is denser than VCM), water is continually added to the mixture to maintain the suspension.

The polymerization of VCM is started by compounds called initiators that are mixed into the droplets. These compounds break down to start the radical chain reaction. Typical initiators include dioctanoyl peroxide and dicetyl peroxydicarbonate, both of which have fragile O-O bonds. Some initiators start the reaction rapidly but decay quickly and other initiators have the opposite effect. A combination of two different

Initiators is often used to give a uniform rate of polymerization. After the polymer has grown by about 10x, the short polymer precipitates inside the droplet of VCM, and polymerization continues with the precipitated, solvent-swollen particles. The weight average molecular weights of commercial

polymers range from 100,000 to 200,000 and the number average molecular weights range from 45,000 to 64,000.

Once the reaction has run its course, the resulting PVC slurry is degassed and stripped to remove excess VCM, which is recycled. The polymer is then passed through a centrifuge to remove water. The slurry is further dried in a hot air bed, and the resulting powder sieved before storage or pillarization. Normally, the resulting PVC has a VCM content of less than 1 part per million. Other production processes, such as micro-suspension polymerization and emulsion polymer.

## **PIPES:**

Roughly half of the world's polyvinyl chloride resin manufactured annually is used for producing pipes for municipal and industrial applications. In the water distribution market it accounts for 66% of the market in the US, and in sanitary sewer pipe applications, it accounts for 75%. Its light weight, low cost, and low maintenance make it attractive. However, it must be carefully installed and bedded to ensure longitudinal cracking and overbelling does not occur. Additionally, PVC pipes can be fused together using various solvent cements, or heat-fused (butt-fusion process, similar to joining HDPE pipe), creating permanent joints that are virtually impervious to leakage.

In February, 2007 the California Building Standards Code was updated to approve the use of chlorinated polyvinyl chloride (CPVC) pipe for use in residential water supply piping systems. CPVC has been a nationally accepted material in the US since 1982; California, however, has permitted only limited use since 2001. The Department of Housing and Community Development prepared and certified an environmental impact statement resulting in a recommendation that the Commission adopt and approve the use of CPVC. The Commission's vote was unanimous and CPVC has been placed in the 2007 California Plumbing Code.

In the United States and Canada, PVC pipes account for the largest majority of pipe materials used in buried municipal applications for drinking water distribution and wastewater mains. Buried PVC pipes in both water and sanitary sewer applications that are 4 inches (100 mm) in diameter and larger are typically joined by means of a gasket-sealed joint. The most common type of gasket utilized in North America is a metal reinforced elastomer, commonly referred to as a Rieber sealing system.



## PRODUCT PROFILE



## QUALITY ASSURANCE



We firmly believed that quality helps in forming the backbone of any organization. our endeavours are directly towards manufacturing optimal quality corrugated packaging boxes we halved employed well versed quality auditors who strictly monitors ,the enter proceeding of our manufacturing unit

## RESEARCH & DEVELOPMENT

To keep a pace with the emerging market trends, we have employed a diligent team of R&D personnel, which conducts rigors and exhaustive research of the market.

Our professionals read each and every facet of the market, which helps us in developing our research activities are cantered on following parameters:

- \* Design
- \* Raw material
- \* Manufacturing process

After conducting a thorough research, our team offers various implications that might prove

Beneficial for organization. After much planning and scheming, viable suggestions of our researchers are implemented in different units. To keep a large client base abreast with market trends, we constantly develop different units of our organization.

## **Our team**

Our competitive team is the leading force which has driven our organization on the path of success. We have with us a hardworking and sincere team of professionals, who helps us in serving our clients with world-class products.

- \* Engineer
- \* Technicians
- \* R&D executives
- \* Marketing executives

Due to our professionals' innovative approaches, we have managed to make a strong mark in the industry. Further, we also provide them skills development training on regular intervals, so that they can manufacture a range that exceeds the expectations of our reputed clients.

## Clientele:

Being a client centric organisation ,we make sure to offer our client customized solutions so as to garner complete customer satisfaction at client as well as our end.in order to manufacture an optimum range of products ,we make use of the high quality raw materials and offer our products at market leading prices due to these reasons ,we have been able to form a large client base across the global the department of housing and community development prepared and certified an environmental impact statement resulting in a recommendation that the commission adopt and approve the use of cpvc. The commission's vote was unanimous and cpvc has been pieced in the 2007california plumbing code

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# MANUFACTURING INDUSTRY

## MANUFACTURING DEFINITION

The process of converting raw materials, components, or parts into finished goods that meet a customer's expectations or specifications. Manufacturing commonly employs a man-machine setup with division of labor in a large scale production.

Manufacturing industry refers to any business that transforms raw materials into finished or semi-finished goods using machines, tools and labor. Manufacturing sectors include production of food, chemicals, textiles, machines and equipment.

## MEANING

Manufacturing is the production of merchandise for use or sale using labor and machines, tools, chemical and biological processing, or formulation. The term may refer to a range of human activity, from handicraft to high tech, but is most commonly applied to industrial production, in which raw materials are transformed into finished goods on a large scale. Such finished goods may be used for manufacturing other, more complex products, such as aircraft,

household appliances or automobiles, or sold to wholesalers, who in turn sell them to retailers, who then sell them to end users – the "consumers".

Manufacturing takes turns under all types of economic systems. In a free market economy, manufacturing is usually directed toward the mass production of products for sale to consumers at a profit. In a collectivist economy, manufacturing is more frequently directed by the state to supply a centrally planned economy. In mixed market economies, manufacturing occurs under some degree of government regulation.

Modern manufacturing includes all intermediate processes required for the production and integration of a product's components. Some industries, such as semiconductor and steel manufacturers use the term fabrication instead.

The manufacturing sector is closely connected with engineering and industrial design. Examples of major manufacturers in North America include General Motors Corporation, General Electric, Procter & Gamble, General Dynamics, Boeing, Pfizer, and Precision Cast parts.

**Industry** is the production of a good or service within an economy. Manufacturing industry became a key sector of production and labor in European and North American countries during the Industrial Revolution,

upsetting previous mercantile and feudal economies. This occurred through many successive rapid advances in technology, such as the production of steel and coal.

Following the Industrial Revolution, perhaps a third of the world's economic output is derived from manufacturing industries. Many developed countries and many developing/semi-developed countries (People's Republic of China, India etc.) depend significantly on manufacturing industry. Industries, the countries they reside in, and the economies of those countries are interlinked in a complex web of interdependence.

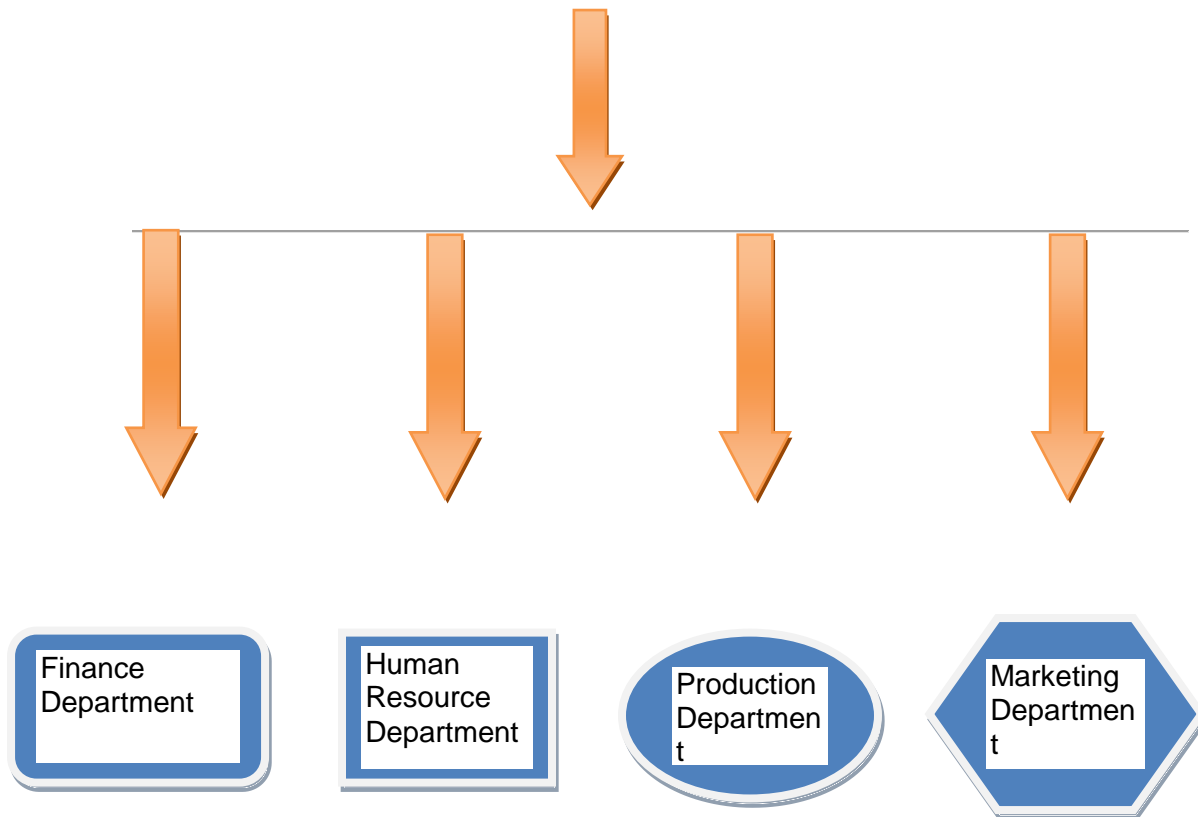
## FUNCTIONS OF DEPARTMENTS

The Major Departments are

1. Finance Department
2. Human Resources Department
3. Production Department
4. Marketing Department



# TYPES OF DEPARTMENTS



# FINANCE DEPARTMENT

## Finance

- ❖ Finance Department is the activity of managing the money to run out the business in a proper manner.

## Finance Functions

- ❖ The financial section of the organisation will keep manual/electronic records of money received and paid out by the organisation.
- ❖ This information will then be used to produce various financial statements for tax purposes and to comply with legal requirements.
- ❖ The information will also be used to produce management accounts to enable senior managers to plan and review business strategy.
- ❖ The finance department or unit may also be responsible for administering employee expenses and salaries.
- ❖ For payment of wages the finance department will need to take into account statutory deductions such as tax, and employee contributions such as pension or loan repayments.

## Finance and Accounting Department Duties

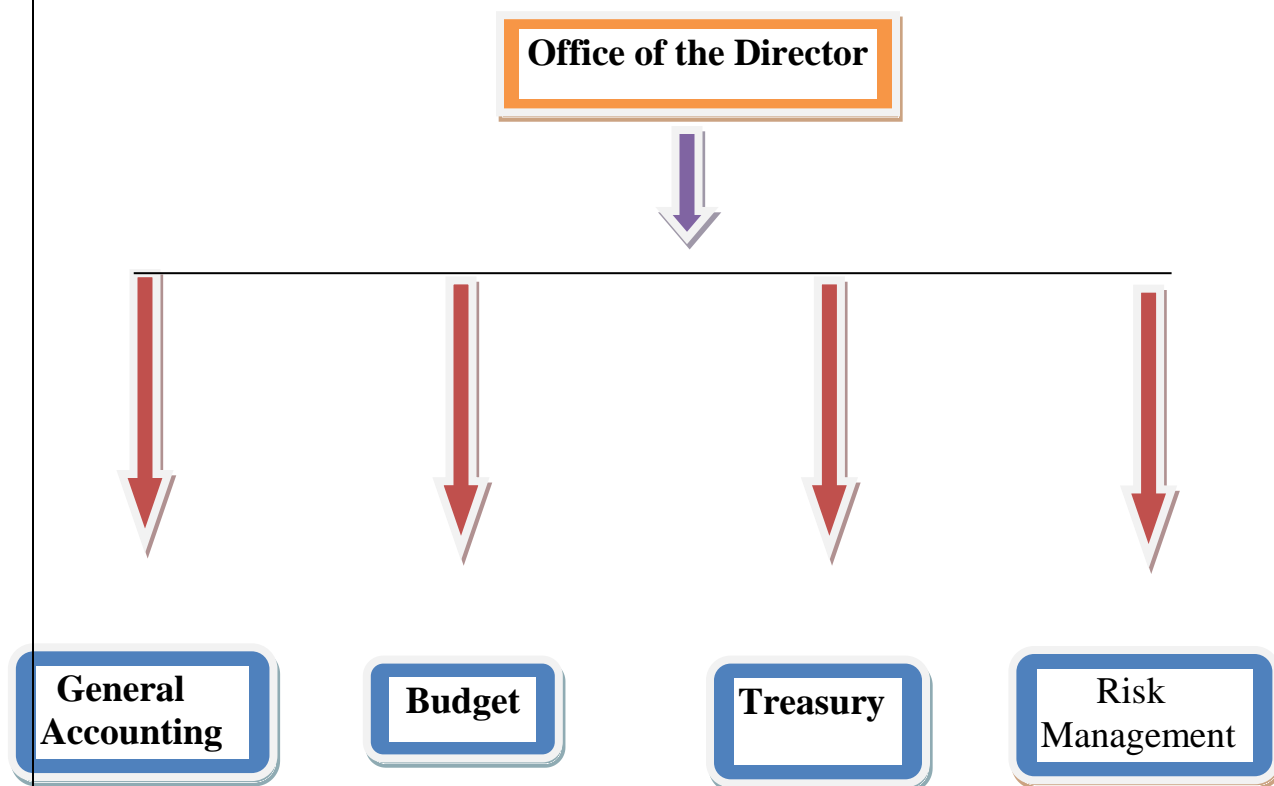
- \* Preparation of budget,
- \* Appropriation of accounts
- \* Re-appropriations,
- \* Surrender and Savings.
- \* Control of Expenditure
- \* Ways & Means position.
- \* Sales Tax,
- \* Entertainment Tax,
- \* Luxury Tax
- \* Entry Tax
- \* Service Conditions
- \* Resource mobilization through loans,
- \* Institutional Finance,
- \* Small Savings,
- \* Credit and Investment

# Finance Department in Organization

- The Finance Department is an organization dedicated to providing quality financial, and judicial services to other City Departments, the City Council, and the citizens of Abilene.
- These services are intended to be provided in a timely, accurate, and cost efficient manner by utilizing quality employees, technological advances, and generally accepted principles while fulfilling legal responsibilities.

The Finance Department continues to respond to organizational and community needs through development of new programs and modification of existing programs. Issues that continue to face the organization are heavy reliance on sales tax, lack of significant revenue growth, and increased expenditure needs to maintain service levels.

# Working Process in the Finance Department



# HUMAN RESOURCES DEPARTMENT

## Involvement of Human Resource Management

- Human Resource Management involves the development of a perfect blend between traditional administrative functions and the well-being of all employees within an organization.
- Employee retention ratio is directly proportionate to the manner in which the employees are treated, in return for their imparted skills and experience.
- A Human Resource Manager ideally empowers inter-departmental employee relationships and nurtures scope for down-the-rung employee communication at various levels.
- Every organization now has an exclusive Human Resource Management Department to interact with representatives of all factors of production.
- The department is responsible for the development and application of ongoing research on strategic advances while hiring, terminating and training staff.
- The Human Resource management is responsible for Understanding and relating to employees as individuals, thus identifying individual needs and career goals.

- Developing positive interactions between workers, to ensure collated and constructive enterprise productivity and development of a uniform organizational culture.
- Identify areas that suffer lack of knowledge and insufficient training, and accordingly provide remedial measures in the form of workshops and seminars.

### Human Resources Planning

1. Forecasting
2. Maintaining personnel inventories
3. Succession planning
4. Modeling career paths

### Training & Development

1. Devising programs
2. Hourly Workers
3. Managerial Staff

### Employment

1. Recruitment
2. Selection
3. Testing
4. Orientation

## Compensation

1. Incentive pay plans
2. Job analysis
3. Job evaluations
4. Wage surveys
5. Performance reviews

## Personnel Research

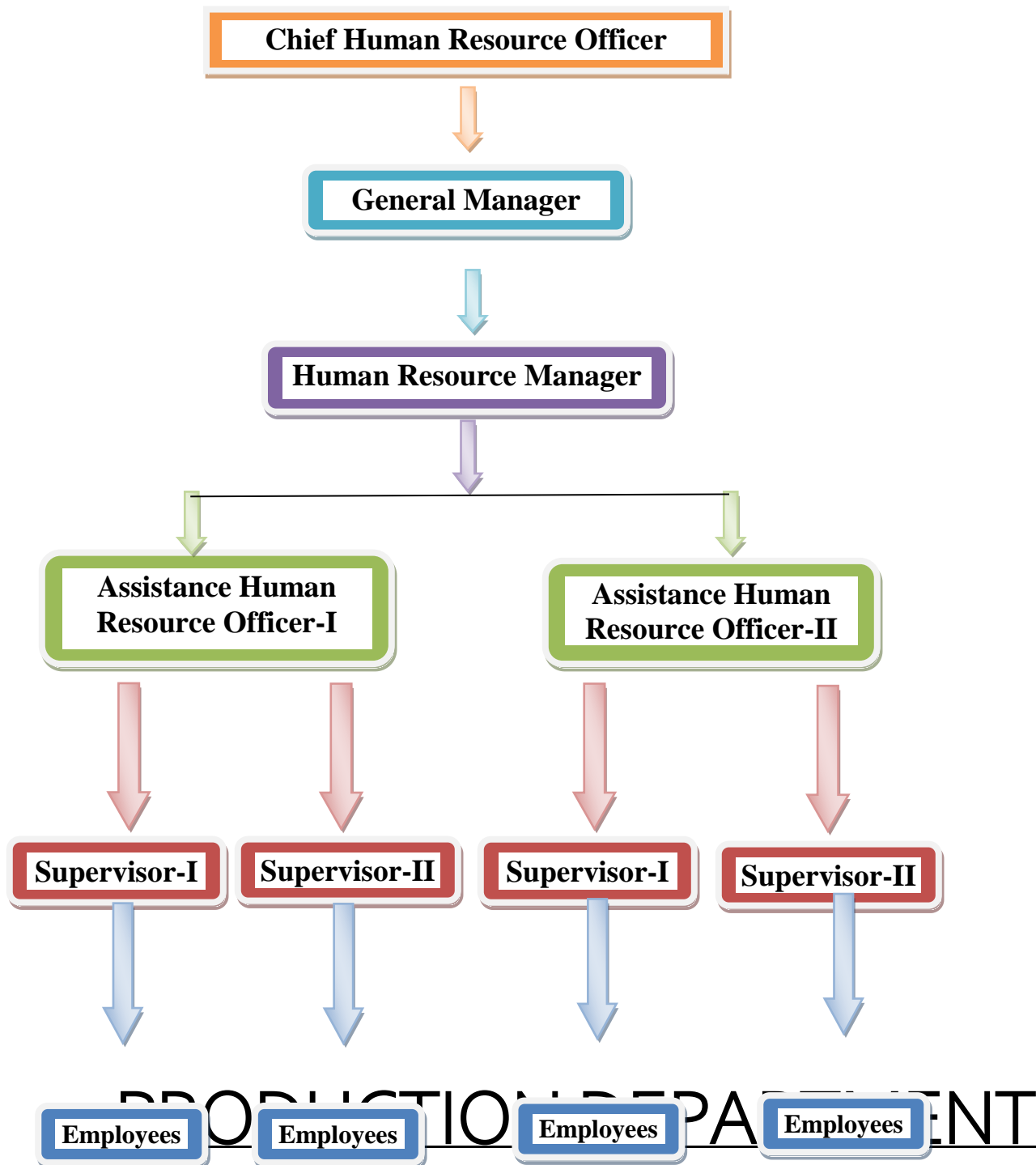
1. Administering opinion surveys
2. Conducting HR audits
3. Publishing statistical analysis

## Functions of Human Resource Department

- Getting Paying Employees
- Paying employees (and Providing Benefits)
- Training Employees



## WORKING STRUCTURE IN HUMAN RESOURCE DEPARTMENT



## Role of Production Department

- ✓ The main role of production is to turn **inputs** (raw materials) into **outputs** (finished goods).
- ✓ Outputs refer to a finished product or service and inputs are the materials that are needed to manufacture certain goods.
- ✓ When a business completes this process they are able to achieve customer satisfaction by producing products that are ready to be used and fit for purpose.

The function of the production department is to produce our products on time, to the required quality levels, at the defined product cost.

Component and materials procurement is another factor that strongly influences production, production targets and delivery. If components cannot be purchased at the target price, profits are down. If components arrive late at our factory production targets may not be met and customers may experience late delivery. Purchasing of components and materials is carried out by the Purchasing section of Production.

## Features of Production Department

## Creation

- The foundation of every production and operations department is the creation of goods or services.
- Traditionally, production included the physical assembly of goods, but production can also include data-based goods such as websites, analysis services and order processing services.

## Customer Service

- The production and operations department contains the customer-facing customer service department that addresses the needs of the customer after the purchase of goods or services.
- The support function usually is served through phone, online or mail based support.

## Profit

- The main function of the production and operations department is to produce a product or service that creates profit and revenue for the company.
- Actualization of profit requires close monitoring of expenses, production methodology and cost of inputs.

## Evaluation

- Every production and operations department must function as self-evaluating entity that monitors the quality, quantity, and cost of goods produced.
- Analysis usually takes the form of statistical metrics, production evaluation and routine reporting.

## FUNCTIONS OF PRODUCTION DEPARTMENT

### Materials:

- ✓ The selection of materials for the product. Production manager must have sound Knowledge of materials and their properties, so that he can select appropriate materials for his product.
- ✓ Research on materials is necessary to find alternatives to satisfy the changing needs of the design in the product and availability of material resumes.

### Methods:

- ✓ Finding the best method for the process, to search for the methods to suit the available resources, identifying the sequence of process are some of the activities of Production Management.

### Machines and Equipment:

- ✓ Selection of suitable machinery for the process desired, designing the maintenance policy and design of layout of machines are taken care of by the Production Management department.

### **Estimating:**

- ✓ To fix up the Production targets and delivery dates and to keep the production costs at minimum, production management department does a thorough estimation of Production times and production costs.
- ✓ In competitive situation this will help the management to decide what should be done in arresting the costs at desired level.

### **Loading and Scheduling:**

- ✓ The Production Management department has to draw the time table for various production activities, specifying when to start and when to finish the process required.
- ✓ It also has to draw the timings of materials movement and plan the activities of man power.
- ✓ The scheduling is to be done keeping in mind the loads on hand and capacities of facilities available.

### Routing:

- ✓ This is the most important function of Production Management department.
- ✓ The Routing consists of fixing the flow lines for various raw materials, components etc.,
- ✓ From the stores to the packing of finished product, so that all concerned knows what exactly is happening on the shop floor

### Dispatching:

- ✓ The Production Management department has to prepare various documents such as Job Cards, Route sheets, Move Cards, Inspection Cards for each and every component of the product.
- ✓ These are prepared in a set of five copies.
- ✓ These documents are to be released from Production Management department to give green signal for starting the production.
- ✓ The activities of the shop floor will follow the instructions given in these documents. Activity of releasing the document is known as dispatching.

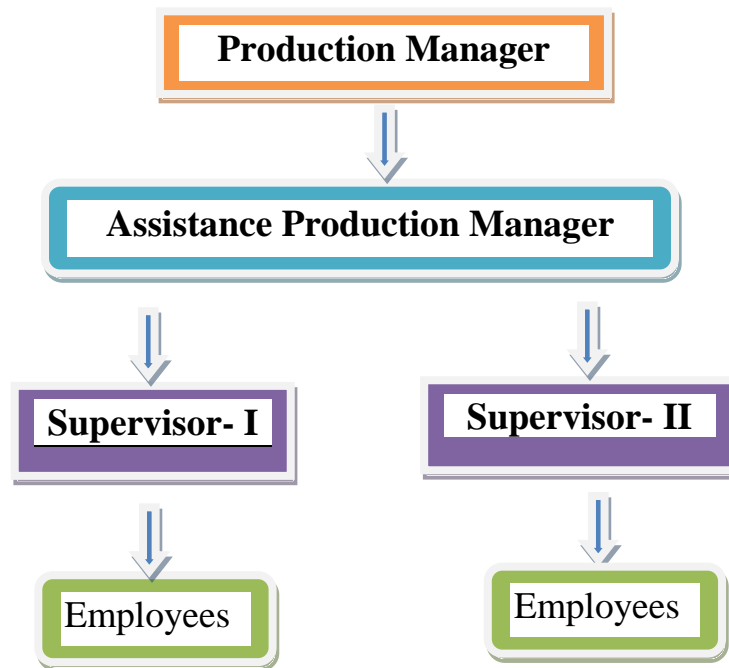
### Inspection:

- ✓ Here inspection is generally concerned with the inspection activities during production, but a separate quality control department does the

quality inspection, which is not under the control of Production Management.

- ✓ This is true because, if the quality inspection is given to production Management, then there is a chance of qualifying the defective products also.

# Working Process in Production Department





# MARKETING DEPARTMENT

- Ascent circuits Company growing in the market size and in its product exports in both the national level and international level.
- The company having many competitors in the inner and outer of the nation.
- The market position of the Ascent Company growing day to day in a systematic order.
- Some of the companies that are in the competition view towards Ascent Company are stated below.

## Role of Marketing Department

- The marketing department will research customer needs to develop strategy and product to satisfy that customer need.
- In its research, the marketing department will investigate the market they are aiming at; the type of consumer making up the market (age, background sex etc.) and the preferences of the consumer within that market.
- The marketing department will then need to marry consumer preferences with producing a product that is profitable.

- Once the product has been designed by the production department marketing will then need to package, advertise, and promote the product.
- Sales are responsible for persuading the consumer to purchase the end product, manufactured through marketing's research.
- The Sales Department's selling strategy could involve mail shots, travelling sales representatives, telephone sales and devising the sales interview.

## Overview

- ❖ Small companies may consist of one or two marketing employees, and larger organizations may have dozens of marketing employees.
- ❖ The organizational structure of the marketing department of a company can vary according to the individual company

## Marketing Manager

- ❖ Marketing manager and marketing director are often interchangeable in the world of marketing.
- ❖ A marketing manager typically has the responsibility of carrying out the marketing strategy for the company.
- ❖ This includes creating marketing messages, choosing mediums such as website advertising and print advertising, and carrying out other

marketing campaigns and programs to reach the target audience of the company.

- ❖ The marketing manager reports to the vice president and generally manages the rest of the marketing employees.
- ❖ In product-based companies that have different product lines, a marketing manager may exist for each product line.

## Market Researchers

- ❖ Market researchers can employ tools, such as surveys and focus groups to help them uncover information and statistic or use publications, such as the U.S. Census to obtain information.
- ❖ The research, information and statistics found by the market researchers are used by the marketing manager to create the programs and messaging.
- ❖ Small- to medium-size companies tend to hire a third-party source for market research rather than have a full-time market research staff. Large organizations employ its own market researchers.

# PURCHASE DEPARTMENT

## Role of Purchase Department

- ❖ It is policy to maintain a reputation for fairness and integrity in its dealings with legitimate and reliable firms and to promote sound relationships with such firms.
- ❖ By maximizing competition among reputable firms, an impartial selection of qualified sources for materials, equipment, supplies and services can be attained and still merit the continuing confidence of suppliers, customers and the public while maintaining high ethical standards.
- ❖ The expenditures for materials, equipment, goods and services
- ❖ Each Strategic Business Unit and facility shall establish a written purchasing policy and procedure to insure that adequate controls are in effect to assure that purchases are properly authorized before orders are placed with vendors.
- ❖ Also, such policy must insure that adequate documentation is requested from vendors to describe goods and/or services rendered. Purchasing, in the broadest sense, involves every organizational unit which participates in the planning, design or use of materials, equipment, supplies and services required in ERL operations.

## Activities of Purchase Department

- ❖ Through coordination of purchasing activities in all of these organizational units, and cooperation between such units, the Company will receive the desired value of needed materials, equipment, supplies and services at the lowest possible cost.
- ❖ Supply Chain Management personnel of each major operating business unit have the primary responsibility for
- ❖ Purchasing all materials, equipment, supplies and services at the best possible prices,
- ❖ Maintaining confidence of suppliers and the public.

## Functions of Purchase Department

- ❖ Procurement of stores through indigenous and foreign sources as required in accordance with the rules in force.
- ❖ Checking of requisitions/purchase indents.
- ❖ Selection of suppliers for issue of enquiries.
- ❖ Issuing enquiries/tenders and obtaining quotations.
- ❖ Negotiating contracts.
- ❖ Checking legal conditions of contracts.
- ❖ Issue of Purchase Orders.
- ❖ Follow-up of purchase orders for delivery in due time
- ❖ Maintenance of purchase records.

- ❖ Maintenance of progressive expenditure statement, sub-head wise.
- ❖ Maintenance of vendor performance records/data.
- ❖ Arrangement for Insurance Surveys, as and when necessary.
- ❖ Clearance of foreign consignments.

# MANUFACTURING PROCESS

For more than 50 years, PVC has been very successful throughout the world. Today, this versatile material is one of the most important plastic materials recognised internationally and proven on the market.

## **PLASTIC PIPES**

Plastic pipes are produced by extrusion process followed by calibration to ensure maintenance of accurate internal die with smooth internal boxes. These pipes generally come in lengths of 6 meters. A wide range of injection moulded fittings, including tees, elbows, reducers, caps, pipes saddles, inserts and threaded adaptors for pipe sizes 15-150mm are available.

**PVC Pipes** The chief advantage of PVC are:

- Resistance to corrosion

- Light weight

- Toughness

- Rigidity

- Economical in laying, jointing and maintenance

- Ease of fabrication

The PVC pipes are much lighter than cast iron or A.C pipes. Because of their light weight

PVC pipes are easy to handle, transport, and install. Solvent cementing techniques for jointing

PVC pipe lengths are cheaper, more efficient and far simpler. PVC pipes do not become pitted or tuberculate and are unaffected by fungi and bacteria and are resistant to a wide range of chemicals. They are immune to galvanic and electrolytic attack, a problem frequently encountered in metal pipes especially when buried in corrosive soils or near brackish waters.

PVC pipes have elastic properties and their resistance to deformation resulting from earth movements is superior compared to conventional pipe materials especially asbestos. Thermal conductivity of PVC is very low compared to metals. Consequently water transported in these pipes remain at a more uniform.

Rigid PVC pipes weighs only 1/5 of conventional steel pipes of comparable sizes. PVC pipes are available in sizes of outer dia 20, 25, 32, 50, 63, 75, 90, 110, 140, 160, 250, 290, 315 mm at working pressure of 2, 5, 4, 6, 10 Kg/cm<sup>2</sup>. Since deterioration and decomposition of plastics are accelerated by ultraviolet light and frequent changes in temperature which are particularly severe in our country it is not advisable to use PVC pipes above ground.

The deterioration starts with Discolouration, surface cracking and ultimately ends with brittleness and the life of the pipe may be reduced to 15-20 years.



## Precautions in Handling and storage

Because of their light weight, there may be a tendency for a PVC pipes to be thrown much more than their metal counterparts. This should be discouraged and reasonable care should be taken in handling and storage to prevent damage to the pipes. On no account should pipes be dragged along the ground pipes should be given adequate support at all times. These pipes should not be stacked in large piles, especially under warm temperature conditions, as the bottom pipes may be distorted thus giving rise to difficulty in pipe alignment and jointing.

For temporary storage in the field, where racks are not provided, care should be taken that ground is level, free from loose stones. Pipes stored thus should not exceed three layers and should be stacked as to prevent movement. It is also recommended not to store one pipe inside another.

## Laying and Jointing Procedures

### Trench Preparation:

The trench bed must be free from any rock projections. The trench bottom where it is rocky and uneven a layer of sand or alluvial earth equal to  $\frac{1}{3}$  dia of pipe or 100mm whichever is less should be provided under the pipes.

The trench bottom should be carefully examined for the presence of hard objects such as flints, rock, projections or tree roots. In uniform, relatively soft fine grained soils found to be free of such objects and where the trench bottom can readily be brought to an even finish providing a uniform support for the pipes over their lengths, the pipes may normally directly on the trench bottom. In other cases the trench should be cut correspondingly deeper and the pipes laid on a prepared under biding, which may be drawn from the excavated material if suitable.

### **Laying and Jointing:**

As a rule trenching should not be carried out too far ahead of pipe laying. The trench should be as narrow as practicable. This may be kept from 0.30m over the outside diameter of pipe and depth may be kept at 0.60 - 1.0m depending upon traffic conditions. Pipe lengths are placed end to end along the trench. The glued spigot and socket jointing technique as mentioned later is adopted. The jointed lengths are then lowered in the trench and when sufficient length has been laid the trench is filled.

If trucks, Lorries, or other heavy traffic will pass across the pipe line, concrete tiles 600 x 600mm of suitable thickness and reinforcement should be laid about 2m above the pipe to distribute the load. If the pipe line crosses a river the pipe should be buried at least 2m below bed level to protect the pipe.

For bending, the cleaned pipe is filled with sand and compacted by tapping with wooden stick and pipe ends plugged. The pipe section is heated with flame and the portion bent as required. The bend is then cooled with water, the plug removed, the sand poured out and the pipe (bend) cooled again. Heating in hot air over hot oil bath, hot gas or other heating devices are also practiced. Joints may be jet welded, or flamed or with rubber gaskets or made with solvent cement. Threaded joints are also feasible but are not recommended. Socket and spigot joint is usually preferred for all PVC pipes up to 150mm in dia. The socket length should at least be one and half times the outer dia for sizes up to 100mm dia and equal to the outer dia for larger sizes.

For pipe installation, solvent gluing is preferable to welding. The glued spigot socket connection has greater strength than can ever be achieved by welding. The surfaces to be glued are thoroughly scoured with dry cloth and preferably chamfered to 30°. If the pipes have become heavily contaminated by grease or oil, methylene cement is applied with a brush evenly to the outside of the socket on the other. The spigot is then inserted immediately in the socket up to the shoulder and thereafter a quarter (90°) turn is given to evenly distribute the cement over the treated surface. The excess cement which is pushed out of the socket must be removed at once with a clean cloth. Jointing must be carried out in minimum possible time, time of making complete joint not being more than one minute. Joints should not be disturbed for at least 5 minutes. Half strength is attained in 30 minutes and full in 24 hours.

## **Pre-fabricated connections**

In laying, long lengths of pipe, prefabricated double socketed connections are frequently used to join successive pipe lengths of either the same or one size different. The socket in this case must be formed over a steel mandrel. A short length of pipe is flared at both ends and used as a socket connection. The mandrel used is sized such that the internal dia of the flared socket matches the outer dia of the spigot to be connected. By proper sizing of the two ends of a connector, it is possible to achieve reduction (or expansion) of pipe size across the connector.

## **Standard threaded connections**

Normally PVC pipes should not be threaded for the connections of PVC pipes to metal pipes, a piece of a special thick wall PVC connecting tube threaded at one end is used. The other end is connected to the normal PVC pipe by means of a glued spigot and socket joint. Before installation the condition of the threads should be carefully examined for cracks and impurities. Glue can be used for making joints leak proof. Yarn and other materials generally used with metal pipe and fittings should not be used. Generally, it is advisable to use PVC as the spigot portion of the joint.

## Pressure Testing

The method which is commonly in use is filling the pipe with water, taking care to evacuate any entrapped air and slowly raising the system to appropriate test pressure. The pressure testing may be followed as in 6.4.4.2.

After the specified test time has elapsed, usually one hour, measured quantity of water is pumped into the line to bring it to the original test pressure, if there has been loss of pressure during the test. The pipe shall be judged to have passed the test satisfactorily if the quantity of water required to restore the test pressure of 30 m for 24 hours does not exceed 1.5 litres per 10 mm of nominal bore for a length of 1 Km.

## FINDINGS

1. Workers have been provided with aprons, gloves, shoes, head covers and ID cards.
2. 75% of work is done manually and 25% of work is done through automated machines.
3. Hygienic lunches for the employees are provided.
4. Refreshments like tea, coffee, biscuits are also provided.
5. Production processes are highly ECO-FRIENDLY.

6. They recycle 95% of their waste materials.
7. Solar powered generators are being effectively used.

# CONCLUSION

The In-Plant Training was in fact an eye opening movement for the Trainee. It helped the Trainee to co-relate the theory into practical aspects. At certain situation Trainee found a wide gap between Theory & Practical knowledge. This becomes a great challenge for the trainee to understand deeply. But as a whole, In-Plant Training immensely helped the Trainee to know the history, working structure, production process, its products, sales and total management of that particular company.

AutoCAD

Report Submitted in Partial Fulfilment of the Requirements for the Degree of

**Bachelor of Engineering**  
*in*  
**Production and Industrial Engineering**

*Submitted by*

DHEERAJ SOLANKI: (Roll No. 18UPIE1304)



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**2020-2021**

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# CERTIFICATE

This is to certify that the work contained in this report entitled “**AutoCAD**” is submitted by Mr. **Dheeraj Solanki**, (Roll. No: 18UPIE1304) to the Department of production and Industrial Engineering, M.B.M. Engineering College, Jodhpur, for the partial fulfilment of the requirements for the degree of **Bachelor of Engineering in Production and Industrial Engineering**.

He has carried out his work under my supervision. This work has not been submitted else-where for the award of any other degree or diploma.

The project work in my opinion, has reached the standard fulfilling of the requirements for the degree of Bachelor of Engineering in Production and Industrial Engineering in accordance with the regulations of the Institute.

**Dr.Milind Kumar Sharma**  
**(Head Of Department)**

Production and Industrial Engg.  
M.B.M. Engineering College, Jodhpur

# DECLARATION

I, Dheeraj Solanki, declare that this seminar/project titled “**AutoCAD**” is a record of original work done.

I, further certify that this work has not formed the basis for the award of the Degree/Diploma/Associateship/Fellowship or similar recognition to any candidate of any university and no part of this report is reproduced as it is from any other source without appropriate reference and permission.

**Dheeraj Solanki**  
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# 1.Introduction

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Internshala is an internship platform, based out of Gurgaon, India.

Founded by Servesh Agarwal, an IIT Madras alumnus, in 2010.

The website helps students find internships with organisations in India.

## 2. Vision

---

Internshala is a dot com business with the heat of dot org.

At the core of the idea is the belief that internship, if managed well, can make a positive difference to the student to the employer, and to the society at large.

ad-hoc culture surrounding internships in India should and would change, Internshala aims to be the driver of this change.

## 3. HISTORY

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The platform started as a WordPress blog which aggregated internships across India and articles on education, technology and skill gap in 2010. The website was launched in 2013. Internshala launched its online trainings in 2014. The platform is used by 2.0 Mn + students and 70000+ companies.

## 4. PARTNERSHIPS

In August 2016, Telangana's not-for-profit organisation, Telangana Academy for Skill and Knowledge (TASK) partnered with Internshala to help students with internship resources and career services. > In September 2016, Team Indus, Google XPRIZE shortlisted entity has partnered with Internshala for college outreach for its initiative, Lab2Moon.

## 5. AWARDS AND RECOGNITION

In 2011, the website became a part of NASSCOM 10K Startups. In 2015, Internshala was a finalist in People Matters TechHR 2015 Spotlight Awards under 'Futurism in Recruitment' category.

## 6. PRODUCTS & SERVICES

Internshala offers following products & services to its users:

1. Internship posting: Organizations & individuals looking to hire interns can post their internship requirement on Internshala. Currently this service is offered free of charge.

2 Internship search and application: Students from all over India can search and apply for internships and trainings relevant to their coursework and interest free of cost.

3. Internshala Trainings: Internshala offers a variety of online training programs across multiple disciplines (Web development, Java, Hacking) which students can join from the comfort of their homes and learn the skills needed in today's industry.

4. Advertisement: Internshala enjoys a very strong reach among students in campuses all over India and organizations looking to advertise their products, services, events and competitions to college students can avail of customized advertising solutions on various Internshala channels (Website, Newsletter, and Social Media).

# CHAPTER – 2

---

## AUTODESK

### 1. INTRODUCTION

Autodesk, Inc. is an American multinational software corporation that makes software for the architecture, engineering, construction, manufacturing, media, and entertainment industries. Autodesk is headquartered in San Rafael, California, and features a gallery of its customers' work in its San Francisco building. The company has offices worldwide, with U.S. locations in Northern California Oregon, Colorado, Texas and in New England in New Hampshire and Massachusetts, and Canada locations in Ontario, Quebec, and Alberta.

The company was founded in 1982 by John Walker, a coauthor of the first versions of AutoCAD, the company's flagship computer-aided design (CAD) software. It's AutoCAD and Revit software is primarily used by architects, engineers, and structural designers to design, draft, and model buildings and other structures, Autodesk software has been used in many fields, from the New York Freedom Tower to Tesla electric cars.

Autodesk became best known for AutoCAD but now develops a broad range of software for design, engineering, and entertainment as well as a line of software for consumers, including Sketchbook, Homestyler, and Pixlr. The company makes educational versions of its software available at no cost to qualified students and faculty through the Autodesk Education Community, and also as a donation to eligible nonprofits through TechSoup Global. Autodesk's digital prototyping software, including Autodesk Inventor, Fusion 360, and the Autodesk Product Design Suite, are used in the manufacturing industry to visualize, simulate, and analyze real-world performance using a digital model during the design process. The company's Revit line of software for building information modeling is designed to let users explore the planning, construction, and management of a building virtually before it is built.

" Autodesk's Media and Entertainment division creates software for visual effects, color grading, and editing as well as animation, game development, and design visualization. 3ds Max and Maya are both 3D animation software used in film visual effects and game development.

## HISTORY

Autodesk's first notable product was AutoCAD, a computer-aided design application designed to run on the systems known as "microcomputers" at the time, including those running the 8-bit CPM operating system and two of the new 16-bit systems, the Victor 9000 and the IBM Personal Computer (PC). This tool allowed users to create detailed technical drawings, and was affordable to many smaller design, engineering, and architecture companies.

Release 2.1 of AutoCAD, released in 1986, included AutoLISP, a built-in Lisp programming language interpreter initially based on XLISP. This opened the door for third party developers to extend AutoCAD's functionality. to address a wide range of vertical markets, strengthening AutoCAD's market penetration.

AutoCAD Release 13, the company stopped supporting Subsequent to the Unix environment and the Apple Macintosh platform. After AutoCAD Release 14 (R13 was last DOS & Unix release), first shipped in 1997, Autodesk discontinued development under DOS, and focused exclusively on Microsoft Windows,

AutoCAD has grown to become the most widely used CAD program for 2D non- specialized applications. The native file formats written by AutoCAD, DXF and DWG. are also widely used for CAD data interoperability. In 1989, Autodesk's sales grew to over \$100,000.000 after just four operational years.

In the 1990s, with the purchase of Softdesk in 1997, Autodesk started to develop specialty versions of AutoCAD. targeted to broad industry segments, including architecture, civil engineering. and manufacturing. Since the late 1990s, the company has added a number of significant non-AutoCAD-based products, including Revit, a parametric building modeling application (acquired in 2002 from Massachusetts-based Revit Technologies for \$133 million), and Inventor, an internally developed parametric mechanical design CAD application.

Autodesk introduced its current logo at the TED conference in Long Beach, California on February 26, 2013

## **2.PRODUCTS**

### **Architecture, engineering and construction-**

- AutoCAD Architecture
- AutoCAD MEP
- AutoCAD Civil 3D
- AutoCAD Map3D AutoCAD P&ID
- AutoCAD Plant 3D

**Manufacturing** - The Company's manufacturing software is used in various manufacturing segments, including industrial machinery, electro-mechanical, tool and die, industrial equipment, automotive components, and consumer products

- Fusion 360 Autodesk Product Design Suite
- Autodesk Factory Design Suite
- Autodesk Inventor Suite
- Autodesk Inventor Professional Suite
- AutoCAD Mechanical
- Autodesk Vault
- Simulation Mechanical

### **Media and entertainment –**

Autodesk Media and Entertainment products are designed for digital media creation, management, and delivery, from film and television visual effects, color grading, and editing to animation, game development, and design visualization.

- Maya
- Softimage
- 3ds Max
- Mudbox
- Smoke
- Flame
- Lustre

# CHAPTER - 3

---

## AUTOCAD

### 1. INTRODUCTION

AutoCAD is a commercial computer-aided design (CAD) and drafting software application. Developed and marketed by Autodesk, AutoCAD was first released in December 1982 as a desktop app running on microcomputers with internal graphics controllers. Prior to the introduction of AutoCAD, most commercial CAD programs ran on mainframe computers or minicomputers, with each CAD operator (user) working at a separate graphics terminal. Since 2010, AutoCAD was released as a mobile- and web app as well, marketed as AutoCAD 360.

AutoCAD is used across a wide range of industries, by architects, project managers, engineers, graphic designers, and many other professionals.

AutoCAD is available for English, German, French, Italian, Spanish, Korean, Chinese Simplified, Chinese Traditional, Brazilian, Portuguese, Russian, Czech, Polish and Hungarian, Albanian (also through additional Language Packs).

The latest version was released on 25 March 2020 as AutoCAD 2021.

Autodesk has also developed a few vertical programs:

- AutoCAD Architecture
  - AutoCAD Civil
  - AutoCAD Electrical
  - AutoCAD eescad
  - AutoCAD Map 3D
  - AutoCAD Mechanical
  - AutoCAD MEP
  - AutoCAD Structural Detailing
  - AutoCAD Utility Design
  - AutoCAD P&ID
  - AutoCAD Plant 3D
- for discipline-specific enhancements

### 2. AUTOCAD WINDOW

Once the AutoCAD 2014 window is active, it should appear as shown on the image shown below. However if you look at the upper left hand corner there is a button with the letter (A) written in red. That is called the application menu of the AutoCAD software. At the right of this button, there is the phrase "3D modeling". This means that the active workspace is 3D modeling.

#### Application Menu

This provides the user with file options like save, open, print.

#### Menu bar



The menu bar appears just below the title bar of the AutoCAD 2014 window, It has Such tabs as home, solid. surface. mesh and view among others for the case of 3D work space. If you switch to 2D Drafting & Annotation you find other tabs relevant to that workspace. Depending on which tab you are on, you will see a collection of tool icons just below it which are organized into panels. The entire collection of tool icons is referred to as the ribbon. As a result the tabs on the menu bar are called ribbon

### **3. Ribbon**

This is a collection of tool panels representing groups of tools and features where you will be selecting tools to draw, edit, or perform other functions. It occurs immediately below the menu bar. Clicking on any of the tabs on the menu bar will give you a different ribbon.

### **4.Drawing Area**

This is a virtual sheet or modeling environment where your designs appear. It boundless area on which your designs are created on a 1:1 scale regardless of their actual life size. The drawing area is also called the canvas. In the default condition, the drawing area will have three icons on display:

- i. The user coordinate system icon at the bottom left corner.
- ii. The cross hairs or drawing cursor which may be at any position on the screen depending on whether the user has touched the mouse or not.
- iii. The view cube at the top right corner. This is very useful in 3D drawing because it facilitates viewing the object from multiple directions.

### **5. Quick Access toolbar**

This includes the basic file-handling functions that you find in virtually all windows application programs. It occurs at the immediate right of the application menu. It carries such functions as workspace switching and title, new file, open file, save and undo among others.

### **Info Center**

This is AutoCAD's online help facility. If you are online type a query there in case you get stuck.

### **UCS**

UCS stands for User CoodinateSystemm. In the low er left comer of the draw ing area. you see L shaped arow. This is the UCS icon. which tells you vourorientation in the drawing This icon becomes helpful as vou start to work wath complex 2D draw ings and 3D models. The X and Y anows indicate the X and Y axes of vourdr awing The liule square at the hase of the anows tells vou that you re an w hat Is called the WorldCoordinate System (WCS). Whenever you launch AutoCAD you will be in the world coordinate system (WCS).

### **Command Window.**

It's located just below the drawing area. As you type in commands on the command line, or pick commands on the ribbon panels, a message is displayed on the command window telling you what to do next. When you issue any command it may also display a list of options related to that command. By so doing it prompts you on your next move. Thus it is also known as the command prompt. The command window and the ribbon complement each other i.e. you can type commands on the command line or click on the ribbon icons. However the command prompts that appear on the command window prevent the user from getting confused.

### **Status Bar**

The status bar is a thin strip of the AutoCAD window found between the command window and the taskbar. To the extreme left it carries the coordinate readout which indicates to the user the curent position of the cursor. Towards the right next to the coordinate readout is the drawing aids panel which carries such tools as object snap, object snap tracking, dynamic UCS and polar tracking among others. These aids assist the user in managing snap and tracking actions. They are activated or

deactivated by switching them on or off respectively. To the extreme right of the status bar we find another panel which contains the model and layout tabs, annotation scale and workspace switching tool (gear wheel icon) among others.

### **3. SELECTING THE WORKSPACE**

A workspace is a task-oriented drawing environment oriented in such a way as to provide you with only the tools and interface elements necessary to accomplish the tasks relevant to that environment. You can switch between workspaces by using the Workspace Switching Tool. You can also customize the workspace the way you want and then save it. It will be appearing on the list of workspaces during switching and you can select it as an option. Work space switching tool takes the form of a gear wheel O located at the bottom right hand corner of the active window. Clicking on it produces a drop down list of other alternative workspaces. Clicking on either changes the workspace to the selected choice. Alternatively you can switch the workspace by clicking on the downward arrow besides the name of the current workspace on the quick access toolbar.

### **4. FILING AND DATA INPUT**

AutoCAD 2014 file operations are similar to the file operations in any other Windows program. The general file handling commands include file saving, file opening, file closing and printing of drawings.

#### **I. OPENING FILES**

There are three ways to open a drawing in AutoCAD.

##### **➤ Using Application Menu**

- Click on Application Menu > Open
- On the select file dialogue box that appears, browse through the folders the Look in slot. This enables you to navigate to the folder where you've saved your drawing.
- Clicking on a file allows you to look at a preview of the drawing.
- Select OPEN.

##### **➤ Using the Quick Access Toolbar**

- Click on File pull down menu > Open
- At the Select file dialogue box, browse through to the folder in the Look in slot. Clicking on a file allows you to look at a preview of the drawing.
- Now you can click Open in the select file dialogue box.

##### **➤ Using the command line**

- At the command prompt on the command line, type Open and enter.
- At the Select file dialogue box, browse through to the folder in the Look in slot. Clicking on a file allows you to look at a preview of the drawing.
- Select open

### **II. FILE SAVING**

#### **➤ To save a drawing for the first time**

The Save Drawing dialogue box appears when you are saving a drawing for the first time. You are required to navigate through the folders in the save in slot to select the folder in which you want to save your drawing. Type in the file name and then click save.

If you modify a drawing you may wish to save it again but retaining the original template. In this case select save as from the file pull down or the application menu. Give it a name that signifies its current status ie, taking into account the changes. Click save.

#### **➤ Saving a File as You Work**

It's a good idea to save your file periodically as you work on it. As with any Windows program, you can save it under its original name by click on the Save tool on the Quick Access toolbar or under a different name by choosing Save As from the Application menu, thereby creating a new file. –

### ➤ **Making Changes**

Coming up with certain drawings may not take place in one pass. Some will require modifications at virtually every stage. Others involve a series of iterative stages before settling on the final copy. In these circumstances, AutoCAD offers the required flexibility as opposed to manual drawing. To keep track of all the modifications, the Save As tool is very essential

## **II. CLOSING A FILE**

Simply click on the X button on the top right corner of the AutoCAD window to close a drawing. A dialogue box appears asking whether to save the changes on the drawing. Select yes to save the changes and no if you don't want to effect the changes. How ever it's usually a goiklpracuce to save your files before closing them.

# **5. COORDINATES ENTRY**

## **1. OVERVIEW**

When a command prompts you for a point, you can use the mouse to specify a point, or you can enter a coordinate value at the command prompt. If the dynamic input is switched you can enter coordinate values in tooltips near the cursor. Two-dimensional coordinates can be entered as either Cartesian (X, Y) or Polar coordinates

### ➤ **Cartesian Coordinate System**

A Cartesian coordinate system has three axes, X, Y, and Z when you enter coordinate values, you indicate a point's distance in units and its direction (+ or -) along the X, Y, and Z axes relative to the coordinate system origin (0,0,0). In 2D, you specify points on the XY plane, also called the work plane. The X value of Cartesian coordinate specifies the horizontal distance, and the Y value specifies the vertical distance. The origin point (0, 0) indicates where the two axes meet.

### ➤ **Polar Coordinate System**

Polar coordinates use a distance and an angle to locate a point.

- **Absolute and Relative Coordinates**
  - **Absolute coordinates**

Represents a specific point in the current work plane relative to the origin point (0,0). To enter an absolute coordinate, type the values as a Cartesian coordinate (X,Y) or Polar coordinate (distance, angle).

- **Relative coordinate**

A relative coordinate is a point specified with reference to the last point specified. We emphasize that it is with reference to your last specified point and not to the origin. This is the distinguishing aspect between relative and absolute coordinates.

## **IV. Dynamic Input**

When dynamic input is on, tooltips display information near the cursor as it moves. It is called dynamic input because the information moving with the cursor is updated with the motion of the cursor. If you type the X value and press tab, the X field (box) displays a lock icon. The Y field is active and you can enter its value. If you type the X value and press enter, the Y value is ignored and AutoCAD interprets it as direct

# **6 NAVIGATION TOOLS OBJECT DISPLAY**

## **I. Overview**

When drawing in both 2D and 3D, you may wish to:

- a. Get a closer look (magnify your drawing).
- b. View hidden details
- c. Bring the whole drawing into focus.
- d. View the hidden details of your 3D drawing.

For a, b and c use the zoom and pan tools as follows:

- i. Zoom in to magnify and zoom out to minimize the size. Zooming out enables you to see the details that are currently spilt out of the screen or make the object smaller in readiness to add details.
- ii. The pan tool allows you to drag your drawing to a convenient location on the screen.
- iii. For d use the orbit tool. It is the tool that enables you to view the objects in your drawing from different angles. It is very essential, when drawing in 3D.

## **II. Accessing the tools**

### **A. Zoom**

- a. To zoom a view with a single click.
  - i. Display a wheel.
  - ii. Right-click the wheel and click Steering Wheel Settings.
  - iii. In the Steering Wheels Settings dialog box, under Zoom Tool, select Enable Single Click Incremental Zoom.
  - iv. Click OK.
  - v. Display one of the Full Navigation Wheels or the mini View Object Wheel.
  - vi. Click the Zoom wedge. The magnification of the model is increased and you are Zoomed in closer to the model. If you hold down the Shift key while clicking the Zoom wedge, the model is zoomed out or you can hold down the Ctrl key to zoom in.
  - vii. Click Close to exit the wheel.
- b. To zoom a view in and out by dragging.
  - i. Display the 2D Navigation wheel, one of the Full Navigation wheels, or the mini View Object wheel.
  - ii. Click and hold down the Zoom wedge. The cursor changes to the Zoom cursor.
  - iii. Drag vertically to zoom in or out.
  - iv. Release the button on your mouse to return to the wheel.

NB: The mouse wheel is a very convenient way of zooming in and out.

### **B. Pan**

- a. To pan the drawing with the pan tool.
  - i. Display the 2D Navigation wheel, one of the Full Navigation wheels, or the mini View Object wheel.
  - ii. Click and hold the Pan wedge. The cursor changes to the Pan cursor.

- iii. Drag to reposition the model.
- iv. Release the button on your pointing device to return to the wheel.
- b. To pan using the middle mouse button or the mouse wheel.
- i. Press and hold down the scroll wheel or middle button. The cursor changes to the Pan cursor.
- ii. Drag to reposition the model.
- iii. Release the wheel or button on your mouse.

## **C. Orbit**

- i. Display one of the View Object or Full Navigation wheels.
- ii. Click and hold down the Orbit wedge The cursor changes to the Orbit cursor.
- iii. Drag to rotate the model
- iv. Release the button on your mouse.

**NE:** To navigate to the zoom, pan or orbit tools, go to:

- a. View tab > navigate panel > zoom or
- b. View tab > navigate panel > pan or
- c. View tab > navigate panel > orbit.

## **7. DRAWING UNITS & LIMITS**

### **• UNITS**

The format, precision, and other settings used to display coordinates, distances, and angles are set through this dialog box, and are saved in the current drawing. It is recommended that you save these settings to your drawing template files to reduce your setup time when you start a new drawing. The Drawing Units dialog box is displayed. Enter -units at the Command prompt to display options.

### **• Limits:**

When you start a new drawing, and then decide how much space I need for my drawing. Think of it as the size of your drawing area. Then you can define drawing limits correctly. Type LIMITS enter. Type 0,0 as lower left corner then type or click the coordinate for upper right corner based on the units which is in Inches or mm.

### **• Command: LIMITS**

Reset Model space limits:

Specify lower left corner or (ON/OFF) <0.0000, 0.0000>: 0,0

Specify upper right corner <100.0000, 100.0000>: 300,200

## **8. COMMANDS**

# **1. OVERVIEW AND DEFINITIONS.**

You communicate with AutoCAD by using tools and Menu options. These devices invoke AutoCAD commands.

## **I. What is a command?**

It's a single-word instruction you give to AutoCAD telling it to do something such as draw a line (the line tool in the Draw Ribbon Panel) or erase an object (the Erase tool in the Modify Ribbon Panel). Whenever you invoke a command, by either typing it or selecting a menu option or tool, AutoCAD responds by presenting messages to you in the Command Window and the Dynamic Input display or by displaying a dialogue box. By right clicking during the drawing process, a context-sensitive short cut menu is displayed; i.e. if you are in the middle of a command, this menu displays a list of options specifically related to that command.

## **II. Command tools.**

Move the arrow cursor to the Line tool and rest it there. Do not click yet. Hold it there for a little while and then for a longer while. You will see two tool tips. The first tip gives you the tool tip name and the keyboard command associated with the tool. The second tip gives a brief explanation of how to use the tool. This happens to all other tools on the ribbon. To be able to draw effectively with AutoCAD, you must learn how to tell AutoCAD what you want, and even more important, understand what AutoCAD wants from you.

## **III. Methods of Accessing/Activating Commands.**

- i. Clicking on the command tool/icon on the Ribbon Panels
- ii. Typing the command on the Key board.
- iii. Use of Accelerator Keys. These are special keystrokes that open and activate drop down menu options. Example is Ctrl+S for save and Ctr+C for copy.
- iv. Use of Aliases; (one, two or three letter abbreviations of a ocommand name). These are also typed on the key board.

# **3. Draw Command Tools**

## **i.Line:**

With the Line command you can draw a simple line from one point to another.

**ii. Construction Line:** The construction line commands creates a line of infinite length which passes through two picked point

**iii. Polyline:** The Polyline command is similar to the line command except that the resulting object may be composed of a number of segments which form a single object.

**iv Rectangle:** The Rectangle command is used to dr aw a rectangle whose sides are vertical and horizontal. The posinon and size of the rectangle are defined by picking two diagonal comers.

## **v Polygon:**

The Polygon command can be used to draw any regular polygon V. from 3 sides up to 1024 sides. This command requires four inputs from the user, the number of sides, a pick point for the centre of the polygon, whether you want polygon inscribed or circumscribed and then a pick point which determines both the radius of this imaginary circle and the orientation of the polygon. The polygon command creates a closed polyline in the shape of the required polygon.

## vi.Circle:

The Circle command is used to draw circles. There are a number of ways you can define the circle. The default method is to pick the centre point and then to either pick a second point on the circumference of the circle or enter the circle radius at the keyboard.

## vii. Arc:

The Arc command allows you to draw an arc of a circle. There are numerous ways to define an arc: the default method uses three pick points, a start point, a second point and an end point.

## vii. Spline:

**viii. spline** is a smooth curve that is fitted along a number of control points. The Fit Tolerance option can be used to control how closely the spline conforms to the control points. A low tolerance value causes the spline to form close to the control points.

**ix. Ellipse:** The Ellipse command gives you a number of different creation options. The default option is to pick the two end points of an axis and then a third point to define the eccentricity of the ellipse

**x.Hatch:** Hatch is used to add shaded patterns to objects and shapes. You can pick: Pattern, Scale, Angle, Points

## 4. MODIFY COMMANDS

**Offset:** Create a duplicate object parallel with the original object. If this object is a Polyline or a Circle, the duplicate shape will be transformed inwards or outwards.

**Copy:** Copy's one or more objects.

**Mirror:** Create a mirror image of an object. It is useful for creating symmetrical objects because you can quickly draw half the object and then mirror it instead of drawing the entire object.

**Array:** Create copies of objects in a rectangular or polar pattern. This is especially useful when you need to duplicate several objects at the same distance from each other.

**For rectangular arrays,** you control the number of rows and columns and the distance between each. For polar arrays, you control the number of copies of the object and whether the copies are rotated.

**Move:** Moves one or more objects.

**Rotate:** You can rotate objects with an absolute or relative angle. When using an absolute angle: Specify the base point and then specify the rotation angle.

**Scale:** A scale factor greater than 1 enlarges the object. It is also possible to scale an object using a reference object. This method scales the object equally in all directions.

**Trim:** With the trim option objects can be shortened or lengthened with the edges of other objects. Objects can exactly be fitted between these objects.

**Extend:** With the extend option you can shorten or lengthen objects to meet the edges of other objects. For example a line can be exactly fitted between objects. Extending an object works in the same way as trimming.

**Fillet:** You can use the fillet tool to connect two objects with an arc with a specified radius. The inside corner is called a fillet and an outside corner is called a round. Chamfer is almost identical to fillet, but it will make a straight line instead of an arc.

**Join:** You can use the join option to combine similar objects into one single object. It is also possible to create complete circles from arcs.

**Explode:** Polylines, hatches or blocks can be converted into individual elements with the explode option. If you explode a polyline every segment will become a separate line.

## **9. DIMENSION TOOLBAR**

You can create several types of dimensions for a variety of object types in many orientations and alignments. The basic types of dimensioning are linear, radial, angular, ordinate, and arc length. Use the DIM command to create dimensions automatically according to the object type that you want to dimension. You can control the appearance of dimensions by setting up dimension styles, or by editing individual dimensions in special cases. Dimension styles allow you to specify your conventions quickly and maintain industry or project dimensioning standards.

- 1. Linear Dimensions** - Linear dimensions can be horizontal, vertical, or aligned. You can create an aligned, horizontal, or vertical dimension with the DIM command depending on how you move the cursor when placing the text.
- 2. Radial Dimensions** - A radial dimension measures the radius or diameter of arcs and circles with an optional centreline or center mark.
- 3. Angular Dimensions** - Angular dimensions measure the angle between two selected geometric objects or three points.
- 4. Ordinate Dimensions** - Ordinate dimensions measure the perpendicular distances from an origin point called the datum, such as a hole in a part. These dimensions prevent escalating errors by maintaining accurate offsets of the features from the datum.
- 5. Arc Length Dimensions** - Arc length dimensions measure the distance along an arc or polyline arc segment. Typical uses of arc length dimensions include measuring the travel distance around a cam or indicating the length of a cable.
- 6. Baseline and Continued Dimensions** Continued dimensions, also called chained dimensions, are multiple dimensions placed end to end.

## **10. TEXT COMMAND**

- 1. Multiline Text** For longer notes and labels with internal formatting, use multiline text.
- 2. Single-line Text** - For short, simple notes and labels, use single-line text.

## **11. TABLE**

A table is a compound object that contains data in rows and columns. It can be created from an empty table or a table style. A table can also be linked to data in a Microsoft Excel spreadsheet.

## **12. LAYER**

Layers are the primary method for organizing the objects in a drawing by function or purpose. Layers can reduce the visual complexity of a drawing and improve display performance by hiding information that you don't need to see at the moment. You gain this level of control by organizing the objects in your drawing on layers that are associated with a specific function or a purpose. It might be helpful to think of layers as clear plastic sheets.



## **13. BLOCK In AutoCAD,**

a block is a collection of objects that are combined into a single named object. The following are some sample blocks at various scales. Some of these blocks are realistic representations of objects, some are symbols, and one of them is an architectural title block for a D-size drawing.

### **INSERT A BLOCK**

Typically, each of these blocks is an individual drawing file, perhaps saved in a folder with similar drawing files. When you need to insert one into your current drawing file, you use the INSERT command (or enter I in the Command window). The first time you insert the drawing as a block, you need to click Browse to locate the drawing file. Make sure you organize your blocks into easy to find folders

## **CREATE A BLOCK DEFINITION**

Instead of creating a drawing file to be inserted as a block, you might want to create block definition directly in your current drawing. Use this method if you do not plan to insert the block into any other drawing. In that case, use the BLOCK command to create the block definition.

## **14. ISOMETRIC DRAWINGS**

A 2D isometric drawing is a flat representation of a 3D isometric projection. This method of drawing provides a fast way to create an isometric view of a simple design. Distances measured along an isometric axis are correct to scale, but because you are drawing in 2D, you cannot expect to extract other 3D distances and areas, display objects from different viewpoints, or remove hidden lines automatically. By using the ISODRAFT command, several system variables and settings are automatically changed to values that facilitate isometric angles. The standard isometric planes, called isoplanes, are as follows:

**Right.** Aligns snap and grid along 30- and 90-degree axes.

**Left.** Aligns snap and grid along 90- and 150-degree axes.

**Top.** Aligns snap and grid along 30- and 150-degree axes.

Choosing one of the three isoplanes automatically causes the crosshairs cursor, and precision drawing and tracking tools to be aligned along the corresponding isometric axes. Therefore, you can draw the top plane, switch to the left plane to draw a side, and switch to the right plane to complete the drawing.

## **15. 3D MODELING**

3D solid primitives are standard shapes which are provided among the ribbon options on the 3D modeling workspace. They include box, wedge, cone, cylinder, sphere, pyramid and torus. The principles of drawing them are similar.

**Box:** Box command on the toolbar modeling is used to draw 3D models such as cubes and block. Creates a box with sides of equal length.

**Cylinder:** The cylinder was created using a center point (1), a point on the radius (2), and a point for the height (3). The base of the cylinder is always on a plane parallel with the workplane.

**Sphere:** Specifies the center point of the sphere. When you specify the center point, the sphere is positioned so that its central axis is parallel to the Z axis of the current user coordinate system (UCS). Defines the radius or diameter of the sphere.

**Wedge:** The direction of the taper is always in the positive X-axis direction of the UCS.

**Torus:** Specifies the center point of the torus. When you specify the center point, the torus is positioned so that its central axis is parallel to the Z axis of the current user coordinate system (UCS). Defines the radius of the torus and then defines the radius of the tube.

**Poly solid:** You can create a 3D solid with polysolid just as you would polyline. You can also convert existing 2D objects such as lines, 2D polylines, arcs, and circles to 3D solids with a default height, width, and justification.

**Extrude:** Objects can be extruded orthogonally from the plane of the source object, in a specified direction, or along a selected path. You can also specify a taper angle.

**Loft:** Creates a 3D solid or surface in the space between several cross sections. The cross sections define the shape of the resulting solid or surface. You must specify at least two cross sections.

**Sweep:** Creates a 3D solid or 3D surface by sweeping a 2D object or subobject along an open or closed path.

**Revolve:** Creates a 3D solid or surface by sweeping an object around an axis. You cannot revolve objects contained within a block or objects that will self-intersect. REVOLVE ignores the width of a polyline and revolves from the center of the path of the polyline.

## **BOOLEAN OPERATIONS:**

**Union:** Combines two or more 3D solids, surfaces, or regions into a single, composite 3D solid, surface, or region. Select two or more objects of the same type to combine.

**Subtract:** Creates a new object by subtracting one overlapping region or 3D solid from another. Objects in the second selection set are subtracted from objects in the first selection set. A single new 3D solid or surface is created.

**Intersect:** With INTERSECT, you can create a 3D solid from the common volume of two or more existing 3D solids, surfaces, or regions. If you select a mesh, you can convert it to a solid or surface before completing the operation. You can extrude 2D profiles and then intersect them to create a complex model efficiently. Select the intersect command. Select the two objects which intersect and then tap enter.

## **16. PRINTING AND PLOTTING**

Output a drawing layout to a printer, a plotter, or a file. Save and restore the printer settings for each layout. Originally, people printed text from printers and plotted drawings from plotters. Now, you can do both with either.

# CHAPTER - 4

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## **CONCLUSION**

Internshala has a very good market in the internship program. The company is offering good services, which is reflected on the satisfaction of the customer. Majority of the interns are satisfied with the service. This is the only company which provide internship in India. It guides us to help to set up and manage a large project. It makes feel free to adjust the recommendations to suit the way we work.

This report covered the preview of our learning path and study materials. The use of AutoCAD has many advantages. It can help to reduce the time it takes to produce the drawing needed in the work environment. AutoCAD software is the most amazing range of mechanical computer aided design tool. It is now considered to be the best according to industry standards that can be obtained for a wide array of designing, Mechanical Engineering Services and other industrial purposes.

The use of AutoCAD may also be relied on heavily in order to create efficiencies within the industries. We explored different materials ranging from text, tutorials and Youtube videos so as get to grips with the finer details of mastering AutoCAD. We were guided by the fact that there is more to learning AutoCAD than drawing simple figures and lines. It has very vast application in the field of manufacturing, architecture, electrical, and many more. The company Autodesk provides wide range of application and software which reduces the effort to create complex drawing and easy to maintain. With the help of AutoCAD, we can create design very quickly. It improves the quality of the drawing which we can't get by hand drafting. With the help of this software, drawing can be easily modified whenever wanted which reduces the human effort. We can easily transfer files from one place to another in no time which reduces the time.

This software is utilized to provide some useful and practical designing software that will allow users to visualize as well as create prototypes of a product in reality and quick time. AutoCAD software allows developers to give form to their out of the box ideas.

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## CERTIFICATE

This is to Certify that Mr./ Miss Pawan Meena Student of  
Class III<sup>rd</sup> year (P&I) of M.B.M. Engineering College has undergone  
Practical Training at Kota Super Thermal Power Station, JNVU, Jodhpur Kota  
w.e.f. 15<sup>th</sup> July 2021 to 30<sup>th</sup> Aug 2021 in various fields of this Power Station.  
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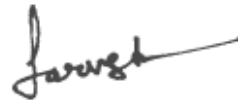
**Prakash Prajapat**

from M.B.M ENGINEERING COLLEGE, has successfully completed a six weeks online training on **SOLIDWORKS**.

The training consisted of SolidWorks- Introduction, Interface and Sketching, Applying Features and Material, SolidWorks Assembly, SolidWorks Drawing and Portfolio Building and Final Project- Air Piston-Cylinder Assembly modules.

In the final assessment, Prakash scored 50% marks.

We wish Prakash all the best for the future endeavours.

A handwritten signature in black ink, appearing to read "Sarvesh".

**Sarvesh Agarwal**

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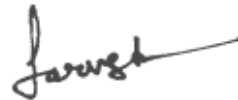
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**Prateek Panwar**

from MBM Engineering College, Jodhpur, Rajasthan, has successfully completed a six weeks online training on **3D Printing**. The training consisted of Introduction to 3D Printing, Principles, Technologies, and Materials, The Printing Journey, Applications of 3D Printing, Merits, Advancements, and Scope and Final Project modules.

We wish Prateek all the best for the future endeavours.

A handwritten signature in black ink, appearing to read "Sarvesh".

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Date: 03/09/2021

## TO WHOM IT MAY CONCERN

This is to certify that Mr. Pushpender Bajaj, student of Production and Industrial Engineering 3<sup>rd</sup> Year, MBM Engineering College, Jodhpur has successfully completed 45 days of summer internship from 01.07.2021 to 14.08.2021.

During this period of his internship program, he had been exposed to different processes and was found diligent, hardworking and inquisitive.

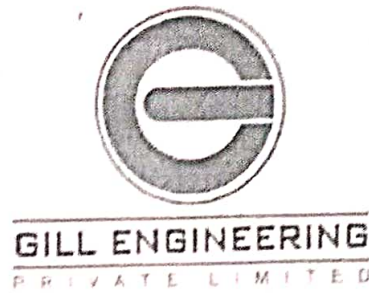
We wish him every success in his life and career.

(Authorised Signatory)

For BORANA INDUSTRIES

Authorised Signatory





Ref;-GEPL/SSCTPP/WEXP./18

Date- 11<sup>th</sup> Aug 2021

### To whom it may concern

This is certify that Mr. Rahul Choudhary S/o Mr. Kishan Lal Choudhary Student of B.E. in Production & Industrial from M.B.M. Engineering Collage, Jodhpur has under gone industrial training at M/s Gill Engineering Pvt. Ltd., RRVUNL, SSCTPP, Suratgarh from 28 June 2021 to 11 August 2021 as a part of his course curriculum. He has successfully completed his training of 45 days at our workplace following covid guidelines. During this period his conduct was satisfactory and result oriented.



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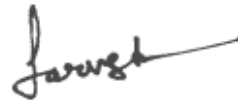
E mail : gill.engineering@yahoo.in

# Certificate of Training

---

**Rishabh Sankhla**

from M.B.M. Engineering College, has successfully completed a six weeks online training on **3D Printing**. The training consisted of Introduction to 3D Printing, Principles, Technologies, and Materials, The Printing Journey, Applications of 3D Printing, Merits, Advancements, and Scope and Final Project modules. Rishabh scored 100% marks in the final assessment and is a top performer in the training. We wish Rishabh all the best for the future endeavours.

A handwritten signature in black ink, appearing to read "Sarvesh".

**Sarvesh Agarwal**  
FOUNDER & CEO, INTERNSHALA

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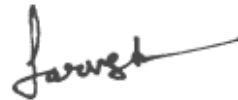
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**Seema Suthar**

from MBM ENG.COLLEGE, Jodhpur, has successfully completed a six weeks online training on **3D Printing**. The training consisted of Introduction to 3D Printing, Principles, Technologies, and Materials, The Printing Journey, Applications of 3D Printing, Merits, Advancements, and Scope and Final Project modules.

We wish Seema all the best for the future endeavours.

A handwritten signature in black ink, appearing to read "Sarvesh".

**Sarvesh Agarwal**  
FOUNDER & CEO, INTERNSHALA

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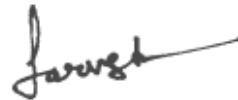
**Shivani Singhal**

from M. B. M ENGINEERING COLLEGE, has successfully completed a six weeks online training on **3D Printing**.

The training consisted of Introduction to 3D Printing, Principles, Technologies, and Materials, The Printing Journey, Applications of 3D Printing, Merits, Advancements, and Scope and Final Project modules.

In the final assessment, Shivani scored 44% marks.

We wish Shivani all the best for the future endeavours.

A handwritten signature in black ink, appearing to read "Sarvesh".

**Sarvesh Agarwal**

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**A Training Report on**

# **3-D PRINTING**



Shubham Kumawat  
(19UPIE1317)

Third Year (6<sup>th</sup> Semester)  
B.E. (Production and  
Industrial Engineering)  
Session 2020-21



## CERTIFICATE

This is to certify that the work contained in this report entitled “**3-D PRINTING**” is submitted by Mr. **Shubham Kumawat**, (Roll. No: 19UPIE1317) to the Department of production and Industrial Engineering, M.B.M. Engineering College, Jodhpur, for the partial fulfilment of the requirements for the degree of Bachelor of Engineering in Production and Industrial Engineering.

He has carried out his work under my supervision. This work has not been submitted else-where for the award of any other degree or diploma.

The project work in my opinion, has reached the standard fulfilling of the requirements for the degree of Bachelor of Engineering in Production and Industrial Engineering in accordance with the regulations of the Institute.

**Dr.Milind Kumar Sharma**  
(Head Of Department)  
Production and Industrial Engineering

## **DECLARATION**

I, **Shubham Kumawat** hereby declare that this seminar/project titled **“3-D PRINTING”** is a record of original work done.

I, further certify that this work has not formed the basis for the award of the Degree/Diploma/Associate ship/Fellowship or similar recognition to any candidate of any university and no part of this report is reproduced as it is from any other source without appropriate reference and permission.

**Shubham  
Kumawat  
6<sup>TH</sup> Semester,  
Roll No. –  
19UPIE1317**

## **ACKNOWLEDGEMENT**

The internship opportunity I had with INTERNSHALA was a great chance for learning and professional development. Therefore, I consider myself as a very lucky individual as I was provided with an opportunity to be a part of it. I am also grateful for having a chance to meet so many wonderful people and professionals who led me through this internship period. I express my deepest thanks to Tayseer Almattar, 3D Printing specialist, founder of TforDesign and Ideabee Design co-chair for taking part in useful decision & giving necessary advices and guidance and arranged all facilities to make learning experience easy. I choose this moment to acknowledge his contribution gratefully, for their careful and precious guidance on 3D printing which was extremely valuable for my study both theoretically and practically.



# **INTRODUCTION**

**3D printing**, is the construction of a 3- dimensional object from a CAD model or a digital 3D model. Deposited, joined or solidified under computer control to create a three- dimensional object, with material being added together (such as plastics, liquids or powder grains being fused together), typically layer by layer.

Our interaction with 3d printing:-

- ☐ As an operator > operating industrial 3d printers (specific training)
- ☐ As a maker
- ☐ As a designer (making 3d designs)
- ☐ As a manager (3d printing can add value to an organization)

History of 3D printing:-

- ☐ Earliest model by Dr hideo kadama (Japan).
- ☐ First patent for 3d printing in 1986 for SLA (Stereolithography) to 3d modelling.
- ☐ SLS (Selection Laser Sintering) manufacturing at 1986 to university of Texas.
- ☐ Fused deposition modelling (FDM) at 1992 to Stratesis.
- ☐ 3d printing techniques at 1995 to MIT.

# **Principles and Technologies:**

## **Preparing 3d models:-**

- Print Journey:-

1. Preparing model in a 3d CAD software.
2. Exporting the 3d model from the CAD software.
3. Importing our CAD file into the slicer software and generating g-code.
4. Watching then extracting the print.
5. Post printing processing.
6. Additional topics.

## **Printing-**

Before printing a 3D model from an [STL](#) file, it must first be examined for errors. Most CAD applications produce errors in output STL files, of the following types: A step in the STL generation known as "repair" fixes such problems in the original model. Generally STLs that have been produced from a model obtained through 3D scanning often have more of these errors as 3D scanning is often achieved by point to point acquisition/mapping. 3D reconstruction often includes error.

## **Finishing-**

Though the printer-produced resolution is sufficient for many applications, greater accuracy can be achieved by printing a slightly oversized version of the desired object in standard resolution and then removing material using a higher-resolution subtractive process.

## **Materials-**

Traditionally, 3D printing focused on polymers for printing, due to the ease of manufacturing and handling polymeric materials. However, the method has rapidly evolved to not only print various polymers but also metals and ceramics, making 3D printing a versatile option for manufacturing. Layer-by-layer fabrication of three-dimensional physical models is a modern concept that "stems from the ever-growing CAD industry, more specifically the solid modeling side of CAD.

### 3D Scanning:-

- It is process of analyzing and collecting data from an object in the real world and turning those into digital 3d model.
- 3d scanning with 2d printing is used in Archaeology, Reverse engineering and Medicine.
- Archaeology:- 3d scanned and printed artefacts can be used for education, restoration and research.
- Reverse engineering:- it is the process of reconstructing existing object. This could be for educational purposes, design improvement purposes or archiving.
- Medicine:- 3D human replicas are used for teaching and research. Making better fitting prosthetics, hearing aids and teeth alignment support.
- Difference between 3d scanning and 3d printing:-

3d scanning converts Physical object -----> Digital object 3d printing converts Digital object -----> Physical object

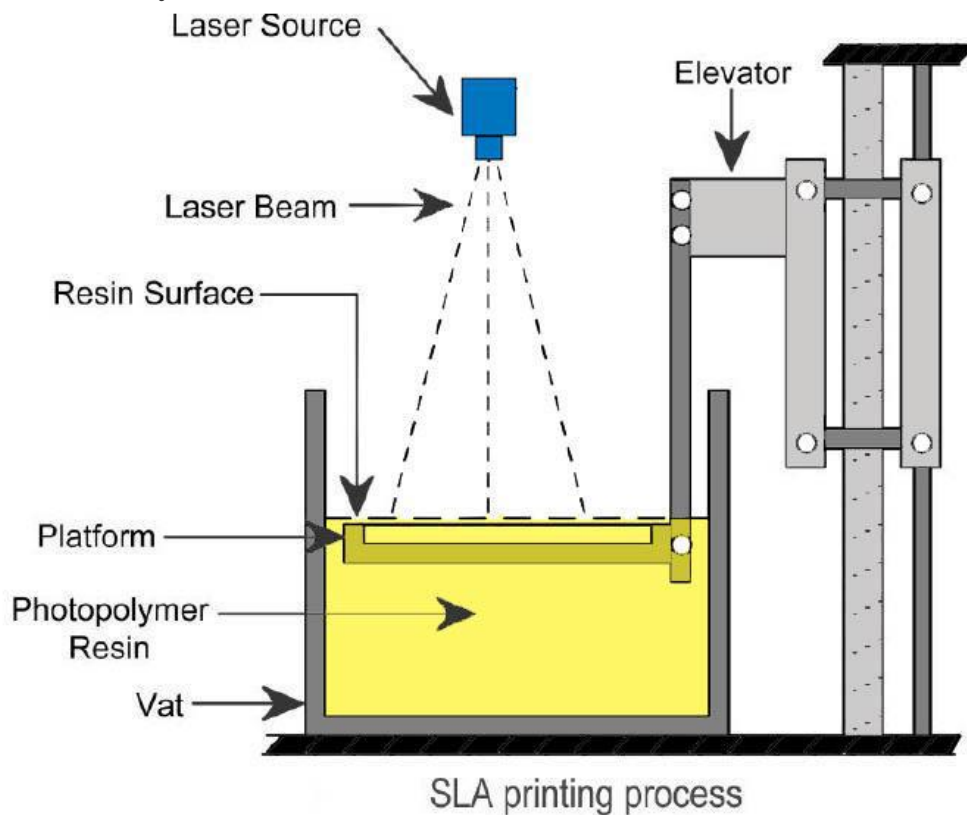
- Can also be used in Virtual Reality, Education and architecture

## 3-D PRINTING Processes :

*There are many different branded additive manufacturing processes, that can be grouped into seven categories:*

### 1. VAT Photopolymerisation

Vat polymerisation uses a vat of liquid photopolymer resin, out of which the model is constructed layer by layer. An ultraviolet (UV) light is used to cure or harden the resin where required, whilst a platform moves the object being made downwards after each new layer is cured.



## **2. Material Jetting**

Material jetting creates objects in a similar method to a two dimensional ink jet printer. Material is jetted onto a build platform using either a continuous or Drop on Demand (DOD) approach.

Material is jetted onto the build surface or platform, where it solidifies and the model is built layer by layer. Material is deposited from a nozzle which moves horizontally across the build platform. Machines vary in complexity and in their methods of controlling the deposition of material. The material layers are then cured or hardened using ultraviolet (UV) light.

As material must be deposited in drops, the number of materials available to use is limited. Polymers and waxes are suitable and commonly used materials, due to their viscous nature and ability to form drops.

## **3. Binder Jetting**

The binder jetting process uses two materials; a powder based material and a binder. The binder acts as an adhesive between powder layers. The binder is usually in liquid form and the build material in powder form. A print head moves horizontally along the x and y axes of the machine and deposits alternating layers of the build material and the binding material. After each layer, the object being printed is lowered on its build platform.

Due to the method of binding, the material characteristics are not always suitable for structural parts and despite the relative speed of printing, additional post processing (see below) can add significant time to the overall process.

As with other powder based manufacturing methods, the object being printed is self-supported within the powder bed and is removed from the unbound powder once completed. The technology is often referred to as 3DP technology and is copyrighted under this name.

## 4. Powder Bed Fusion

The Powder Bed Fusion process includes the following commonly used printing techniques: Direct metal laser sintering (DMLS), Electron beam melting (EBM), Selective heat sintering (SHS), Selective laser melting (SLM) and Selective laser sintering (SLS).

Powder bed fusion (PBF) methods use either a laser or electron beam to melt and fuse material powder together. Electron beam melting (EBM), methods require a vacuum but can be used with metals and alloys in the creation of functional parts. All PBF processes involve the spreading of the powder material over previous layers. There are different mechanisms to enable this, including a roller or a blade. A hopper or a reservoir below of aside the bed provides fresh material supply. Direct metal laser sintering (DMLS) is the same as SLS, but with the use of metals and not plastics. The process sinters the powder, layer by layer. Selective Heat Sintering differs from other processes by way of using a heated thermal print head to fuse powder material together. As before, layers are added with a roller in between fusion of layers. A platform lowers the model accordingly.

## 5. Metal Extrusion

**Metal Extrusion** is a **metal forming** manufacturing process in which a cylindrical billet inside a closed cavity is forced to flow through a die of a desired cross-section. These fixed cross-sectional profile extruded parts are called “**Extrudates**” and pushed out using either a mechanical or hydraulic press. The process which was first patented by Joseph Bramah was first used to extrude lead pipes by Thomas Burr. Most commonly extruded materials are Aluminium, Copper, Steel, Magnesium, and Lead. Plastics and ceramics are also extruded extensively but not discussed in this article. Extrusion is a metal forming process in which metal or work piece is forced to flow through a die to reduce its cross section or convert it into desire shape. This process is extensively used in **pipes and steel rods manufacturing**. The force used to extrude the work piece is compressive in nature

## 6. Directed Energy Deposition (DED)

It is a 3D printing method which uses a focused energy source, such as a plasma arc, laser or electron beam to melt a material which is simultaneously deposited by a nozzle. As with other additive manufacturing processes, DED systems can be used to add material to existing components, for repairs, or occasionally to build new parts.

The DED process is known by other names, including Laser Engineered Net Shaping (LENS), Direct Metal Deposition (DMD), Electron Beam Additive Manufacturing (EBAM), Directed Light Fabrication, and 3D Laser Cladding, depending on the exact application or method used.

## 7. Sheet lamination 3D printing

Sheet lamination is one of the **seven recognized** 3D Printing methods. The process uses sheets of building material which are cut through laser or knife and the sheets are joined one after the other either by using an adhesive or by welding the laser cut sheets together to form the 3D object. The process is also called ultrasonic additive manufacturing (UAM) in case the building material used is metal sheets. The variation of the process in which paper is used for making the 3D models is known by the name – Laminated Object Manufacturing (LOM).

The apparatus for UAM variation of the sheet lamination process has a cylindrical sonotrode to which the material sheet is coiled. The sonotrode is rotated to feed the material sheet onto a building platform. If metal sheets are used as building material they are welded together before coiling over the sonotrode. Similarly in LOM variation of the process, paper sheets are glued together using an adhesive. The feed material sheet is cut by laser or knife on a layer by layer basis and passed to CNC machining for separating each model/part. Each layer is laser cut and joined to the preceding layer by welding (in case of UAM) or applying adhesive (in case of LOM). The Laminated Object Manufacturing involves an additional cross hatching process to remove the extra build ups.

# **“Fused Deposition Modelling”**

## **What is FDM printing?**

FDM 3D printing is a technology that works both horizontally and vertically, where an extrusion nozzle moves over a build platform. The process involves the use of thermoplastic material that reaches melting point and is then forced out, to create a 3D object layer by layer. As the design takes shape, it is clear to see each layer as a horizontal cross section. Following the completion of one layer, the nozzle of the printer is lowered in order for the next layer of plastic to be added to the design. Once the object has been created, the materials that are used to support the object can then be removed.

## **How does FDM 3D printing work?**

In the same way as other forms of 3D printing, FDM uses a digital design that is uploaded to the 3D printer. There are a lot of different polymers used, such as ABS, PETG, PEI and PEEK. These take the shape of plastic threads that are fed from a coil and through a nozzle. The filaments are melted and fed onto the base, known as a build platform or table with the base and the nozzle, both of which are controlled by a computer. The computer works by translating the object and its dimension into co-ordinates that make it possible for the nozzle and base to follow.



As the nozzle moves across the base, the plastic cools and becomes solid, forming a hard bond with the previous layer. At this point the printhead goes up in order for the next layer of plastic to be laid. As always, 3D printing is efficient and fast but the time it takes to create an object does depend on its size. Smaller objects that are around several cubic inches can be created quickly but larger, more complex object will take longer

## **What is FDM 3D printing used for?**

The use of 3D printing is highly publicised but what is FDM 3D Printing or FFF 3D printing used for? Many different industries choose to use FDM 3D printing. Industries including automotive and a wide range of consumer goods manufacturers. They use FDM because it helps to aid their product development, their prototyping and their manufacturing process. Manufacturers of certain products use FDM 3D printing because of the thermoplastic that is used during development is perfect for anything ranging from Children's toys or even sports equipment.

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## **Prototyping**

Prior to a product being taken to the mass market, it is important that objects are tested vigorously. Therefore, the use of thermoplastics is ideal for creating prototypes because they can endure heat, chemicals and mechanical stress. Along with this, as FDM printing has the ability to create extremely detailed objects, it makes it the ideal choice for those industries that use need to create parts that need to be tested for fit and form.

However, it is not just about prototyping because FDM is also used to create end-use parts, especially small parts that have a lot of details. In fact, it is common for thermoplastics to be used for food packaging and drug packaging and so, it is a popular technology in the medical industry. Here you can find some case studies about the use of 3D printing.

For businesses looking for a viable option that can deliver results, FDM 3d printing offers the perfect solution. It is competitively priced and the best FDM 3D printers can deliver results efficiently and effectively.

## **What are the advantages of FDM 3D printing?**

### **1. Easy handling**

The 3D printing industry is constantly evolving. There is no doubt that it will become the main way to create parts and objects in the future. It simplifies the manufacturing process and enables manufacturers to test, alter and finally produce a final product in timeframe that is faster than traditional methods. Easy handling is one of the great benefits of FDM or FFF 3D printing, make sure you have the best FDM 3D printer for your company goals.

## **2. Cost efficient**

For any business, cost is everything because it eats into the bottom line and affects profits and so, keeping costs low is vital. Therefore, FDM 3D printing, provides a viable solution that is designed to help keep manufacturing costs low. Of course, there is the prototype development costs to keep down, the testing costs and the final production costs. Through a comparison with other types of 3D printing techniques, FDM 3D printing is also cheaper than other methods. The materials used are cheaper than the ones used in SLS and SLA 3D printing.

## **3. Flexibility in material choice**

Often, many businesses are governed by the materials they use during the manufacturing process. However, when it comes to FDM or FFF 3D printing, there is a broad range of materials available and all are accessible and economical. It is also possible for a selection of materials to be used at the same time which helps to create complex objects while it is also possible to print using a wide range of colours offering versatility and flexibility.

## **4. Less post-processing**

Time is money but FDM 3D printing is an option that optimises production times and that saves money. As there is less post-processing required, it means that there is no need to think about how you use expensive liquids used in other methods, it simply creates a product that is ready to use.

Accessibility is vital for businesses if they are to take advantage of FDM 3D printing. Whether a business is looking for a 3D printing solution for the first time or simply looking for a feasible printing option that is readily-available, FDM 3D printing is a great option. The technique is efficient, easy to understand and the best FDM 3D printers deliver readily-available results with very little fuss. So after comparing technologies you can start comparing printers to find your best FDM 3D printer, meeting your requirements.

## Anatomy of an FDM 3d printer:-

- The common parts that make an FDM desktop 3D printer:

1. Print bed: Heated or non-heated, detachable or non-detachable, moving (make z-axis) or non-moving and bed adhesion extras (blue painters tape, glue, etc). The print bed should be levelled with the extruder if not print will fail.
2. The filament: -Rolls of plastic used by printer as to print (thin wire of plastic is known as spool). Standard diameters are 1.75 or 2.85 mm.
3. Material: Commonly used are PLA and ABS, less common materials are nylon and composites; once we know the material to be used we must know recommended bed temperature, extruder temp and bed adhesion.
4. The extruder: It is the part which takes raw material from filament, and melts and arranges it to form an object. Its Parts are-
  - Motor (which drive, drive gears),
  - Drive gears (pushes the material towards the hot end commonly used are hobbled gears),
  - Heating block,
  - Thermostat (control temp) and
  - Nozzle (melted material comes out common 0.4 mm) and
  - Cooling fans (first fan cools heat from heat sink to prevent heat to travel backward and second fan cools the extruded material to solidify on print).

4. The mechanical moving parts: - stepper motors, rods and bearings
5. The electronic and electrical components- power supply, controller board and drivers.
6. The frame
7. User interface additions: communicate with printer with small screen.

## Uniqueness in mass scale:-

Mass Customization:-

- Much of industrial design influenced by mass production. Automation integrated with conventional manufacturing.
- Making parts with 3d printing requires more manual work compared to conventional methods. There are automated 3d printing FDM machines.
- In future more technologies will integrate with 3d printing like artificial intelligence, Internet of things and flexible manufacturing to product mass production of 3d prints.

Faster Cheaper bigger:- Bigger:-

- one of the biggest announced 3d printer have a working volume of about 14 meters long, 7 meters wide(23ft.) and 3 meters in height (10ft.).
- In aerospace, construction and architecture there is use of bigger printed objects.

Faster:-

- Till date 3d printing is generally slow compared to traditional manufacturing.
- In future emerging new technologies will be faster than present.

Cheaper:-

- SLA 3D printing is becoming rapidly cheaper.
- In future improvements in Materials will bring ease of use and print quality.

## Advancements in 3d printing: -

4D printing:-

- It is concept a 3d printed object will deform based on the external condition.
- There is a self-folding 3d printed strand by the self-assembly lab, MIT & Stratasys.
- It requires development of Smart Materials.
- It can enable smart pipes with imbedded safety features.
- Smart material can enable making smart, shifting sport shoes.
- Smart implants in medical field can be used.

# Certificate of Training

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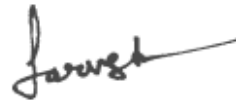
**Sikandar**

from MBM Engineering College, Jodhpur, has successfully completed a six weeks online training on **3D Printing**.

The training consisted of Introduction to 3D Printing, Principles, Technologies, and Materials, The Printing Journey, Applications of 3D Printing, Merits, Advancements, and Scope and Final Project modules.

In the final assessment, Sikandar scored 88% marks.

We wish Sikandar all the best for the future endeavours.

A handwritten signature in black ink, appearing to read "Sarvesh".

**Sarvesh Agarwal**

FOUNDER & CEO, INTERNSHALA

Date of certification: 2021-08-02

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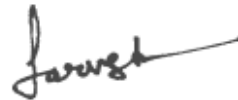
# Certificate of Training

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**Sourav Mazumdar,**

has successfully completed a eight weeks online training on **Ansys**. The training consisted of Introduction to Finite Element Analysis (FEA), Understanding Concepts at Work & Installing Ansys, Introduction to Ansys Software, Static Structural Analysis, Modal, Thermal, & Buckling Analysis, Case Studies and Final Project modules. In the final assessment, Sourav scored 57% marks.

We wish Sourav all the best for the future.

A handwritten signature in black ink, appearing to read "Sarvesh".

**Sarvesh Agarwal**

FOUNDER & CEO, INTERNSHALA

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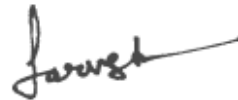
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**Teekam Singh**

from MBM ENGINEERING COLLEGE, has successfully completed a six weeks online training on **3D Printing**. The training consisted of Introduction to 3D Printing, Principles, Technologies, and Materials, The Printing Journey, Applications of 3D Printing, Merits, Advancements, and Scope and Final Project modules.

In the final assessment, Teekam scored 80% marks.

We wish Teekam all the best for the future endeavours.

A handwritten signature in black ink, appearing to read "Sarvesh".

**Sarvesh Agarwal**

FOUNDER & CEO, INTERNSHALA

Date of certification: 2021-09-01

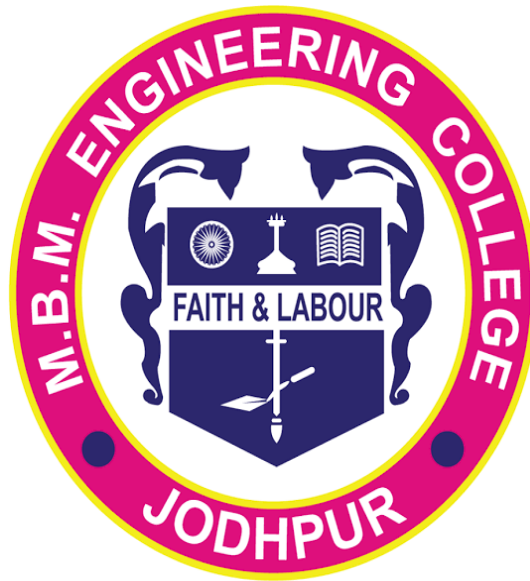
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SUMMER TRAINING  
REPORT ON

# 3D PRINTING

At  
**INTERNSHALA**  
Submitted  
In the partial fulfillment of  
**Bachelor of Engineering**



Department of  
**Production and Industrial  
Engineering**  
***2021-2022***

***Submitted by : SUKHA RAM***

***Roll number : 19UPIE1320***

**6th semester (3rd year)**

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NAME:-SUKHA RAM

ROLL NO. :- 19UPIE1320

*6th semester (3rd year)*

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## INTRODUCTION

A 3D printer uses a virtual, mathematical model to construct a physical artifact. For example, a designer in the process of creating a new laptop can use a software package to create a three-dimensional model of her creation, that can be manipulated and viewed on the computer screen. The 3D printer can take the symbolic representation of this new object and use it to build a full-size, physical model that can be held and manipulated, helping the designer to better understand the strengths and limitations of her design.

An architect can turn the plans for a building into a three-dimensional model and then “print” a scale model to help him understand and communicate his design. An archaeologist can print duplicates of an important, but fragile, tool so that her students can hold it in their hands and better understand how it might have been used by an ancient civilization. A biochemist can print accurate models of DNA molecules, enlarged by many orders of magnitude, to help students and researchers better understand nature by engaging their hands as well as their eyes in comprehending the geometry of nature. And a student of the arts can create a unique object that would be difficult or impossible to build by hand.

We will not here consider other types of computer-controlled manufacturing, such as subtractive machines, which work by cutting away from a larger piece of material in order to build a part. Additive rapid prototyping machines were first introduced twenty years ago, when 3D Systems introduced the Stereo lithography, or SLA machine. While these machines were remarkable for their ability to create complex parts, they were large, expensive, and difficult to operate.

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## 1. History Of 3d Printing

Early AM equipment and materials were developed in the 1980s. In 1984, Chuck Hull of 3D Systems Corporation, invented a process known as stereo lithography, in which layers are added by curing photopolymers with UV lasers. Hull defined the process as a "system for generating three-dimensional objects by creating a cross-sectional pattern of the object to be formed. He also developed the STL (Stereo Lithography) file format widely accepted by 3D printing software as well as the digital slicing and infill strategies common to many processes today. The term *3D printing* originally referred to a process employing standard and custom inkjet print heads. The technology used by most 3D printers to date—especially hobbyist and consumer-oriented models—is fused deposition modeling, a special application of plastic extrusion.



**Chuck Hull the father of 3D printing**

AM processes for metal sintering or melting usually went by their own individual names in the 1980s and 1990s. Nearly all metalworking production at the time was by casting, fabrication, stamping, and machining; even though plenty of automation was applied to those technologies (such as by robot welding and CNC), the idea of a tool or head moving through a 3D work envelope transforming a mass of raw material into a desired shape layer by layer was associated by most people only with processes that removed metal (rather than adding it), such as CNC milling, CNC EDM, and many others. The umbrella term additive manufacturing gained wider currency in the decade of the 2000s as the various additive processes

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matured and it became clear that soon metal removal would no longer be the sole occupant of the aforementioned paradigm. It was during this decade that the term subtractive manufacturing appeared for the large family of machining processes with metal removal as their common theme. However, at the time, the term 3D printing still referred only to the polymer technologies in most minds, and the term AM was likelier to be used in metalworking contexts than among polymer/inkjet/stereo lithography enthusiasts.

By the early 2010s, the terms 3D printing and additive manufacturing developed senses in which they were synonymous umbrella terms for all AM technologies. Although this was a departure from their earlier technically narrower senses, it reflects the simple fact that the technologies all share the common theme of sequential-layer material addition/joining throughout a 3D work envelope under automated control. (Other terms that have appeared, which are usually used as AM synonyms have been desktop manufacturing, rapid manufacturing [as the logical production-level successor to rapid prototyping], and on-demand manufacturing [which echoes on-demand printing in the 2D sense of printing].) The 2010s were the first decade in which metal parts such as engine brackets and large nuts would be grown (either before or instead of machining) in job production rather than obligatory being machined from bar stock or plate. The term subtractive has not replaced the term machining, instead complementing it when a term that covers any removal method is needed.

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## 2. General Principles

### 2.1 Modeling

3D printable models may be created with a computer aided design package or via 3D scanner. The manual modeling process of preparing geometric data for 3D computer graphics is similar to plastic arts such as sculpting. 3D scanning is a process of analyzing and collecting digital data on the shape and appearance of a real object. Based on this data, three-dimensional models of the scanned object can then be produced.

Both manual and automatic creation of 3D printable models is difficult for average consumers. This is why several marketplaces have emerged over the last years. Among the most popular are Shape ways, Thingiverse, MyMiniFactory and Threading

### Printing

Before printing a 3D model from an STL file, it must first be processed by a piece of software called a "slicer" which converts the model into a series of thin layers and produces a G-code file containing instructions tailored to a specific printer. Several open source slicer programs exist, including Skeinforge, Slic3r, KISSlicer, and Cura.

The 3D printer follows the G-code instructions to lay down successive layers of liquid, powder, paper or sheet material to build the model from a series of cross sections. These layers, which correspond to the virtual cross sections from the CAD model, are joined or automatically fused to create the final shape. The primary advantage of this technique is its ability to create almost any shape or geometric feature.

Printer resolution describes layer thickness and X-Y resolution in dots per inch (dpi) or micrometers ( $\mu\text{m}$ ). Typical layer thickness is around 100  $\mu\text{m}$  (250 DPI), although some machines such as the Objet Convex series and 3D Systems' ProJet series can print layers as thin as 16  $\mu\text{m}$  (1,600 DPI). X-Y resolution is comparable to that of laser printers. The particles (3D dots) are around 50 to 100  $\mu\text{m}$  (510 to 250 DPI) in diameter.

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Construction of a model with contemporary methods can take anywhere from several hours to several days, depending on the method used and the size and complexity of the model. Additive systems can typically reduce this time to a few hours, although it varies widely depending on the type of machine used and the size and number of models being produced simultaneously.

Traditional techniques like injection moldings can be less expensive for manufacturing polymer products in high quantities, but additive manufacturing can be faster, more flexible and less expensive when producing relatively small quantities of parts. 3D printers give designers and concept development teams the ability to produce parts and concept models using a desktop size printer.

## **Finishing**

Though the printer-produced resolution is sufficient for many applications, printing a slightly oversized version of the desired object in standard resolution and then removing material with a higher-resolution subtractive process can achieve greater precision. As with the LUMEX Avance-25 and other machines slated for IMTS 2014 [IMTS Press Release | International Manufacturing Technology Show](#)

Some additive manufacturing techniques are capable of using multiple materials in the course of constructing parts. Some are able to print in multiple colors and color combinations simultaneously. Some also utilise supports when building. Supports are removable or dissolvable upon completion of the print, and are used to support overhanging features during construction.



### **3. Current 3d Printing Technologies**

#### **Stereo lithography**

Stereo lithographic 3D printers (known as SLAs or stereo lithography apparatus) position a perforated platform just below the surface of a vat of liquid photo curable polymer. A UV laser beam then traces the first slice of an object on the surface of this liquid, causing a very thin layer of photopolymer to harden. The perforated platform is then lowered very slightly and another slice is traced out and hardened by the laser. Another slice is then created, and then another, until a complete object has been printed and can be removed from the vat of photopolymer, drained of excess liquid, and cured. Fused deposition modeling - Here a hot thermoplastic is extruded from a temperature-controlled print head to produce fairly robust objects to a high degree of accuracy.

#### **Selective laser sintering (SLS)**

This builds objects by using a laser to selectively fuse together successive layers of a cocktail of powdered wax, ceramic, metal, nylon or one of a range of other materials.

#### **Multi-jet modeling (MJM)**

This again builds up objects from successive layers of powder, with an inkjet-like print head used to spray on a binder solution that glues only the required granules together. The V-Flash printer, manufactured by Canon, is low-cost 3D printer. It's known to build layers with a light-curable film. Unlike other printers, the VFlash builds its parts from the top down. Desktop Factory is a startup launched by the Idea lab incubator in Pasadena, California.

#### **Inkjet 3D printing**

It creates the model one layer at a time by spreading a layer of powder (plaster, or resins) and inkjet printing binder in the cross-section of the part. It is the most widely used 3-D Printing technology these days and the reasons beyond that are stated below.

This technology is the only one that

- Allows for the printing of full color prototypes.

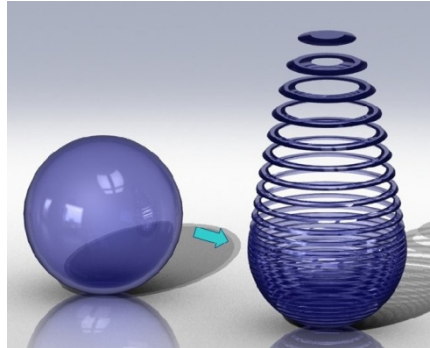
Unlike stereo lithography, inkjet 3D printing is optimized for speed, low cost, and ease-of-use.

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## 4. There is two major type Manufacturing

### Additive Manufacturing

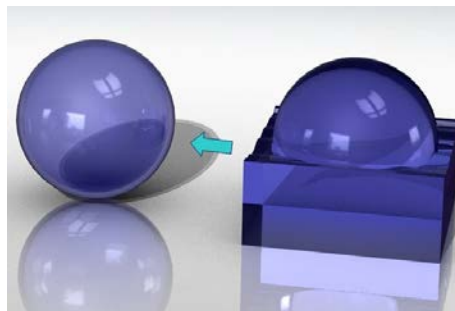
- Creating A Form
- Conserves Resources
- Efficient
- 3D Printing



Additive manufacturing

### Subtractive Manufacturing

- Uncovering A Form
  - Carving A Sculpture
  - Chiseling A Statue
- Wasteful
- Time Consuming



Subtractive Manufacturing



## 5. Processes

Several different 3D printing processes have been invented since the late 1970s. The printers were originally large, expensive, and highly limited in what they could produce.

A large number of additive processes are now available. The main differences between processes are in the way layers are deposited to create parts and in the materials that are used. Some methods melt or soften material to produce the layers, e.g. selective laser melting (SLM) or direct metal laser sintering (DMLS), selective laser sintering (SLS), fused deposition modeling (FDM), while others cure liquid materials using different sophisticated technologies, e.g. stereo lithography (SLA). With laminated object manufacturing (LOM), thin layers are cut to shape and joined together (e.g. paper, polymer, metal). Each method has its own advantages and drawbacks, which is why some companies consequently offer a choice between powder and polymer for the material used to build the object. Other companies sometimes use standard, off-the-shelf business paper as the build material to produce a durable prototype. The main considerations in choosing a machine are generally speed, cost of the 3D printer, cost of the printed prototype, cost and choice of materials, and color capabilities.

Printers that work directly with metals are expensive. In some cases, however, less expensive printers can be used to make a mould, which is then used to make metal parts.

Table 1 materials and technologies

Type	Technologies	Materials
Extrusion	Fused deposition modeling (FDM)	Thermoplastics (e.g. PLA, ABS), HDPE, eutectic metals, edible materials, Rubber (Sugru), Modeling clay, Plasticine, RTV silicone, Porcelain, Metal clay (including Precious Metal Clay)
Wire	Electron Beam Freeform Fabrication (EBF)	Almost any metal alloy
Granular	Direct metal laser	Almost any metal alloy

	sintering (DMLS)	
	Electron-beam melting (EBM)	Almost any metal alloy including Titanium alloys
	Selective laser melting (SLM)	Titanium alloys, Cobalt Chrome alloys, Stainless Steel, Aluminium
	Selective heat sintering (SHS)	Thermoplastic powder
	Selective laser sintering (SLS)	Thermoplastics, metal powders, ceramic powders
Powder bed and inkjet head 3D printing	Plaster-based 3D printing (PP)	Plaster
Laminated	Laminated object manufacturing (LOM)	Paper, metal foil, plastic film
Light polymerised	Stereo lithography(SLA)	photopolymer
	Digital Light Processing (DLP)	photopolymer

## Extrusion deposition

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Fused deposition modeling (FDM) was developed by S. Scott Crump in the late 1980s and was commercialized in 1990 by Stratasys. After the patent on this technology expired, a large open-source development community developed and both commercial and DIY variants utilizing this type of 3D printer appeared. As a result, the price of this technology has dropped by two orders of magnitude since its creation.

In fused deposition modeling the model or part is produced by extruding small beads of material which harden immediately to form layers. A thermoplastic filament or metal wire that is wound on a coil is unreeled to supply material to an extrusion nozzle head. The nozzle head heats the material and turns the flow on and off. Typically stepper motors or servo motors are employed to move the extrusion head and adjust the flow. The head can be moved in both horizontal and vertical directions, and control of the mechanism is typically done by a computer-aided manufacturing (CAM) software package running on a microcontroller.

Various polymers are used, including acrylonitrile butadiene styrene (ABS), polycarbonate (PC), polylactic acid (PLA), high density polyethylene (HDPE), PC/ABS, polyphenylsulfone (PPSU) and high impact polystyrene (HIPS). In general, the polymer is in the form of a filament fabricated from virgin resins. There are multiple projects in the open-sourced community aimed at processing post-consumer plastic waste into filament. These involve machines used to shred and extrude the plastic material into filament.

FDM is somewhat restricted in the variation of shapes that may be fabricated. For example, FDM usually cannot produce stalactite-like structures, since they would be unsupported during the build. Otherwise, a thin support must be designed into the structure which can be broken away during finishing.

## **Granular materials binding**

Another 3D printing approach is the selective fusing of materials in a granular bed. The technique fuses parts of the layer and then moves downward in the working area, adding another layer of granules and repeating the process until the piece has built up. This process uses the unfused media to support overhangs and thin walls in the part being produced, which reduces the need for temporary auxiliary supports for the piece. A laser is typically used to sinter the media into a solid. Examples include selective laser sintering (SLS), with both metals and polymers (e.g. PA, PA-GF, Rigid GF, PEEK, PS, Alomide, Carbonmide, elastomers), and direct metal laser sintering (DMLS).

Selective Laser Sintering (SLS) was developed and patented by Dr. Carl Deckard and Dr. Joseph Beaman at the University of Texas at Austin in the mid-1980s, under sponsorship of DARPA. A similar process was patented without being commercialized by R. F. Housholder in 1979.

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Selective Laser Melting (SLM) does not use sintering for the fusion of powder granules but will completely melt the powder using a high-energy laser to create fully dense materials in a layer-wise method that has mechanical properties similar to those of conventional manufactured metals.

Electron beam melting (EBM) is a similar type of additive manufacturing technology for metal parts (e.g. titanium alloys). EBM manufactures parts by melting metal powder layer by layer with an electron beam in a high vacuum. Unlike metal sintering techniques that operate below melting point, EBM parts are fully dense, void-free, and very strong.

Another method consists of an inkjet 3D printing system. The printer creates the model one layer at a time by spreading a layer of powder (plaster, or resins) and printing a binder in the cross-section of the part using an inkjet-like process. This is repeated until every layer has been printed. This technology allows the printing of full color prototypes, overhangs, and elastomer parts. The strength of bonded powder prints can be enhanced with wax or thermoset polymer impregnation.

## **Lamination**

In some printers, paper can be used as the build material, resulting in a lower cost to print. During the 1990s some companies marketed printers that cut cross sections out of special adhesive coated paper using a carbon dioxide laser and then laminated them together.

In 2005, Mcor Technologies Ltd developed a different process using ordinary sheets of office paper, a Tungsten carbide blade to cut the shape, and selective deposition of adhesive and pressure to bond the prototype.<sup>[36]</sup>

There are also a number of companies selling printers that print laminated objects using thin plastic and metal sheets

## **Photo polymerization**

Stereo lithography was patented in 1986 by Chuck Hull. Photo polymerization is primarily used in stereo lithography (SLA) to produce a solid part from a liquid. This process dramatically redefined previous efforts, from the "photosculpture" method of François Willème (1830–1905) in 1860 through the photopolymerization of Mitsubishi's Matsubara in 1974. The "photosculpture" method consisted of photographing a subject from a variety of equidistant angles and projecting each photograph onto a screen, where a pantagraph was used to trace the outline onto modeling clay)

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In photo-polymerization, a vat of liquid polymer is exposed to controlled lighting under safelight conditions. The exposed liquid polymer hardens. The build plate then moves down in small increments and the liquid polymer is again exposed to light. The process repeats until the model has been built. The liquid polymer is then drained from the vat, leaving the solid model. The EnvisionTEC Perfactory is an example of a DLP rapid prototyping system.

Inkjet printer systems like the Objet PolyJet system spray photopolymer materials onto a build tray in ultra-thin layers (between 16 and 30  $\mu\text{m}$ ) until the part is completed. Each photopolymer layer is cured with UV light after it is jetted, producing fully cured models that can be handled and used immediately, without post-curing. The gel-like support material, which is designed to support complicated geometries, is removed by hand and water jetting. It is also suitable for elastomers.

Ultra-small features can be made with the 3D micro-fabrication technique used in multiphoton photopolymerisation. This approach uses a focused laser to trace the desired 3D object into a block of gel. Due to the nonlinear nature of photo excitation, the gel is cured to a solid only in the places where the laser was focused while the remaining gel is then washed away. Feature sizes of under 100 nm are easily produced, as well as complex structures with moving and interlocked parts.

Yet another approach uses a synthetic resin that is solidified using LEDs.

### **Mask-image-projection-based stereolithography**

In this technique a 3D digital model is sliced by a set of horizontal planes. Each slice is converted into a two-dimensional mask image. The mask image is then projected onto a photocurable liquid resin surface and light is projected onto the resin to cure it in the shape of the layer. The technique has been used to create objects composed of multiple materials that cure at different rates. In research systems, the light is projected from below, allowing the resin to be quickly spread into uniform thin layers, reducing production time from hours to minutes. Commercially available devices such as Objet Connex apply the resin via small nozzles.

### **Bio printing**

The medical applications of 3D bioprinting are numerous, and are thus the subject of intensive research at academic institutions such as Cornell University and companies such as Organovo.

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Researchers in the Jonathan Butcher Laboratory at Cornell University have been developing methods to bioprint living aortic heart valves. Poly(ethylene glycol)-diacrylate (PEGDA) is used as a base polymer, because of its biocompatibility and easily tunable mechanical properties. Two different solutions of PEGDA were created with different mechanical stiffness's when cross-linked, with the stiffer polymer to be used as the aortic root wall and the compliant polymer to be used as the valve leaflets. Using these solutions, a valve exhibiting mechanical heterogeneity and cytocompatibility was bio printed, which will serve as a base for future development of the aortic valve printing process.

The Lawrence Bonassar Laboratory at Cornell University has been working on 3D bio printing cartilaginous geometries. One focus of their research involves the replacement of intervertebral disks with Tissue Engineered-Total Disk Replacement constructs. Tissue engineered intervertebral disks were bio printed with cell-seeded hydrogel constructs, and implanted into male rats.

Commercially, Printerinks, a UK company, and Organovo, a U.S. company, have worked together to develop human tissue through 3D printing. Printer cartridges are adapted to use stem cells obtained from biopsies and grown in cultures. The resulting substance is called Bioink.

## **6. Advantage Of 3d Printing**

### **Cheap Manufacturing**

As discussed in the first post of this series, 3D printing is increasingly being used by large companies such as Converse or Alessi to replace some of their traditional manufacturing methods with cost savings of up to 70%. This is achieved through lower shipping and packaging costs related to overseas parts suppliers, less human resource involved and cheaper and sometimes more reliable raw materials.

Although currently 3D home-printed objects are not necessarily cheaper than their mass-manufactured counter parts, printing your own object a priceless experience for many (at least until its novelty wears off). 3D printed objects are only expected to get cheaper with improved additive manufacturing techniques, cheaper consumables, main stream adoption and self-replicating practices.

### **Quick Production**

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The speed of 3D printing compared to traditional methods is similar to comparing a sports car's top speed to a horse cart's. They both take you where you want to go but the journey time differs considerably. With industrial 3D printers being able to 'manufacture' most objects in a matter of hours, the classical manufacturing methods, taking up to several days or even weeks (from prototype to end product), are slowly becoming obsolete.

This leads to massive cost savings and to an on-demand manufacturing model. Why should you have warehouses filled up with stocks of your products if you can create them according to demand? Even if this model might not work with the big offline manufacturers due to their dependence on offline retailers that usually buy in bulk, it can prove extremely efficient for an online business.

### **Less waste**

Manufacturing metal and plastic objects in particular is usually a wasteful process with chunky parts and a lot of surplus material. For some aircraft makers, up to 90% of the material is being cut away and no longer useful. Making a similar object using additive manufacturing not only uses less energy but also reduces waste to a minimum. And sometimes, the finished 3D printed product can be up to 60% lighter compared to the machined part but still as sturdy according to the Economist. Significant cost savings can be achieved in this way and less waste also means a lower impact on the environment.

### **Better quality**

Think about 3D printing as cake baking. You can make a cake by whisking some cake mix, pouring it in an oven tray and baking everything. The result may taste amazing but it can have unwanted air bubbles inside, different thickness and all nuts or fruits could be grouped to one side. However, if you could assemble the cake layer by layer similar to additive manufacturing, you could achieve perfection through a full control of where each layer is going and how it fits with the rest.

Avoiding most of the mass manufacturing faults does not only make better products but it also extends their life as they will break less often. This is not necessarily a great benefit for manufacturers who need the product life cycle to be profitable, but it is certainly a major benefit for the end consumer.

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## **Accessibility**

With more people getting access to 3D printing, it may not be long until we will all have our own multi-purpose contraption (with additive manufacturing being only one of the many functionalities) capable of creating the products we need, when we need them. This can seriously shake up the current consumerism culture built on the contemporary industrial supply chain nevertheless, it remains to be seen if this is only an ideology or a possible transitional period in human evolution.

Less waste compared to traditional manufacturing methods is not only a cost saving feature of 3D printing but also a possible eco-friendly attribute. Add to this the multi-purpose characteristic of a 3D printer (can build different objects without the need of using specialised machines for each part) and their digital ecosystem (all 3D models are transmitted electronically so in theory they can be printed out where they are needed, minimising therefore transport costs) and you get a sustainable manufacturing process. Integrating additive manufacturing with more classic production methods – as is the case with 3D printed textiles in the clothing industry – adds another layer (excuse the pun) to the sustainability case.

## **New shapes and structures**

Traditional manufacturing methods rely on moulds and cutting technologies to produce a finite number of shapes and structures, with more complex hollow ones having to be created from several parts and assembled together. But 3D printing changes this altogether – the 3D printer's nozzle can build an infinite number of complex figures, being limited only by human imagination. This method gives them more durability and higher structural integrity. From medical implants that resemble bone to aerodynamic parts for the space industry and from unique-shaped furniture to 3D printed jewellery, the opportunities are endless.

## **New combinations of materials**

Mixing different raw materials is not always possible with mass-manufacturing methods due to the sometimes high costs involved and to their physical & chemical properties that make them difficult to combine through traditional methods. 3D printing has removed many of these boundaries not only because of the initial dependency on plastic (being one of the few raw

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materials that melt at lower temperatures) but also because of a continuous innovation fed by enthusiasts believing that additive manufacturing's potential has not been reached yet. As a result, many companies now offer tens of different materials with different finishes giving the look and feel of metal, ceramics or glass with various strengths and temperature resistance.

### **New business models**

With 3D printing gaining popularity fast, entrepreneurs have not lost any opportunity to get their foot into an industry deemed by many as potentially very lucrative. This is how 3D printing 'shops' were born. Imagine going shopping in a supermarket where you decide how your products will look and feel, and where everything can be personalised to fit your demanding tastes.

## **7 Disadvantage Of 3d Printing**

### **Fewer Manufacturing Jobs:**

As with all new technologies, manufacturing jobs will decrease. This disadvantage can and will have a large impact to the economies of third world countries, especially China, that depend on a large number of low skill jobs.

### **Limited Materials:**

Currently, 3D printers only manufacture products out of plastic, resin, certain metals, and ceramics. 3D printing of products in mixed materials and technology, such as circuit boards, are still under development.

### **Copyright:**

With 3D printing becoming more common, the printing of copyrighted products to create counterfeit items will become more common and nearly impossible to determine.

### **Dangerous Items:**

3D printers can create dangerous items, such as guns and knives, with very little or no oversight.

### **More Useless Stuff:**

One of the dangers of 3D printers is that they will be used to create more useless stuff that is bad for the environment and wallets. Fortunately, there are new methods of automatically recycling objects made by 3D printers that hold promise of better recycling in the future.

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## Size:

Currently, 3D printers are limited with the size of the products that they can create. Ultimately, large items, such as houses and building, could be created using 3D printers.

## 8. Application

### **Medical :-** A New Way to Heal Broken Bones

In the near future, having a broken arm could look way cooler thanks to a new, black, lightweight 3-D printed cast that's patterned like latticework and which uses an ultrasound device to make bones heal more quickly.

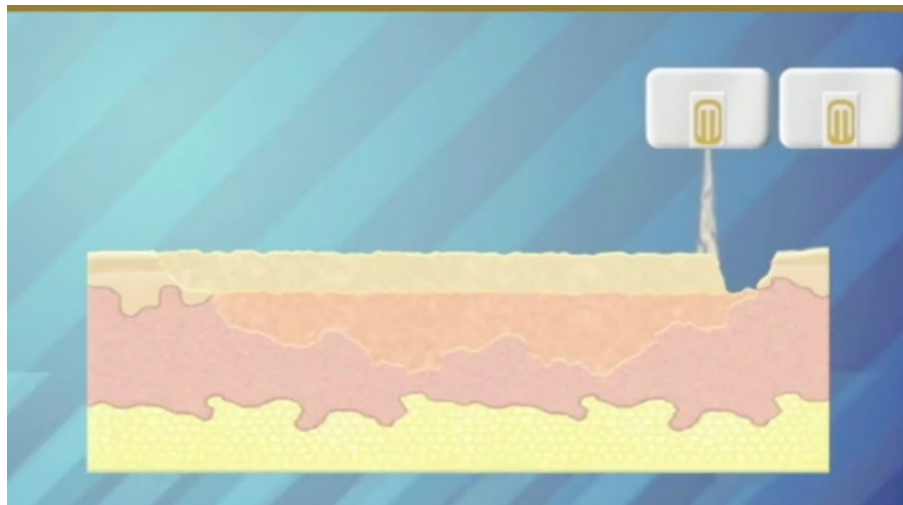


a new way to heal broken bones by 3d printing

### **.3d printed wound hill process**



**Scanning the wound**



**Filling the wound**

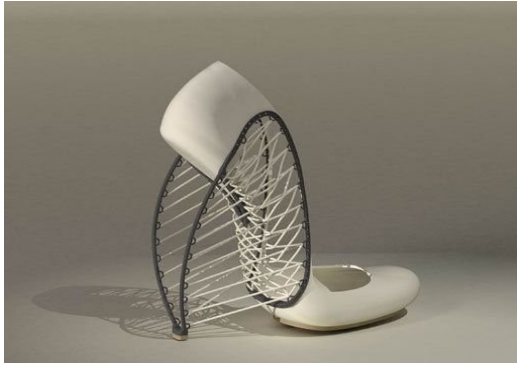
### **3.Jewellery**



**different type of rings and jewellery**



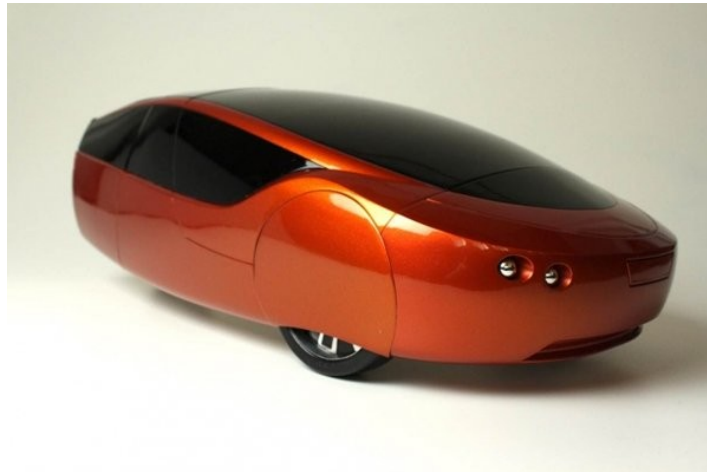
## 8.4. footwear



different type of footwear made by 3d printing

## 8.5 .3d printed car

Urbee II, a 3D-printed electric car about to go into production, boasts an ultrastrong, ultralight chassis that can take on highway rigors with ease.



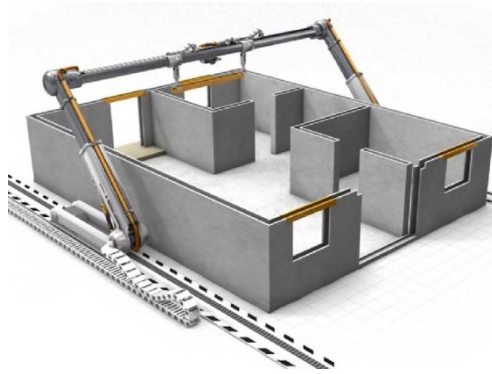
Urbee II 3D printed car

## 8.6.bulding construction:

Building printing refers to various technology that use 3D printing as a way to construct buildings. The advantages of this would be quicker construction, lower labor costs, and less waste produced. It is also a potential way of building extraterrestrial structures on the Moon or other planets where environmental conditions are less conducive to human labor-intensive building practices.

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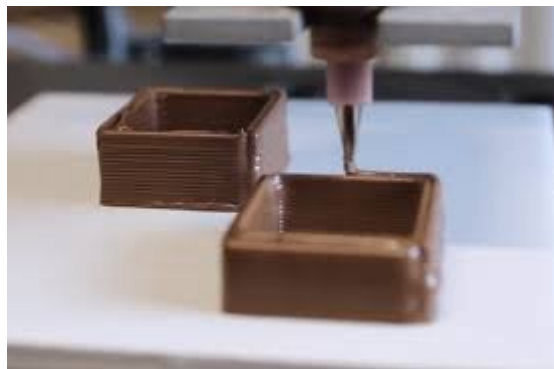
**3d printed home**

## **8.7.Toys**



**Different type of toys**

## **8.8.Food**



**Different type of food**

## **Mobile covers**

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different type of mobile covers

## Guns



Gun made by 3d printing

## 8.11. human organs:-



different type of human organs using 3d printing

## Conclusion

3D printing can offer benefits across the entire creation process from initial concept design to final manufacturing and all steps in between. Different applications have unique needs and understanding those application requirements is critical when choosing a 3D printer. Multiple systems may offer broader use opportunities than a single system, so identifying your unique requirements to apply 3D printing across your entire design-to-manufacture process can shorten time-to-market, improve product performance, streamline and cost-reduce manufacturing, and improve product quality and customer satisfaction will help you define the ideal 3D printing capability for your organization.



SUMMER TRAINING  
REPORT ON

# 3D PRINTING

At  
**INTERNSHALA**  
Submitted  
In the partial fulfillment of  
**Bachelor of Engineering**



Department of  
**Production and Industrial  
Engineering**  
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**Submitted by: NIRMA PRAJAPAT**

**Roll number: 19UPIE1325**

**6th semester (3rd year)**

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6th semester (3rd year)

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## INTRODUCTION

A 3D printer uses a virtual, mathematical model to construct a physical artifact. For example, a designer in the process of creating a new laptop can use a software package to create a three-dimensional model of her creation, that can be manipulated and viewed on the computer screen. The 3D printer can take the symbolic representation of this new object and use it to build a full-size, physical model that can be held and manipulated, helping the designer to better understand the strengths and limitations of her design.

An architect can turn the plans for a building into a three-dimensional model and then “print” a scale model to help him understand and communicate his design. An archaeologist can print duplicates of an important, but fragile, tool so that her students can hold it in their hands and better understand how it might have been used by an ancient civilization. A biochemist can print accurate models of DNA molecules, enlarged by many orders of magnitude, to help students and researchers better understand nature by engaging their hands as well as their eyes in comprehending the geometry of nature. And a student of the arts can create a unique object that would be difficult or impossible to build by hand.

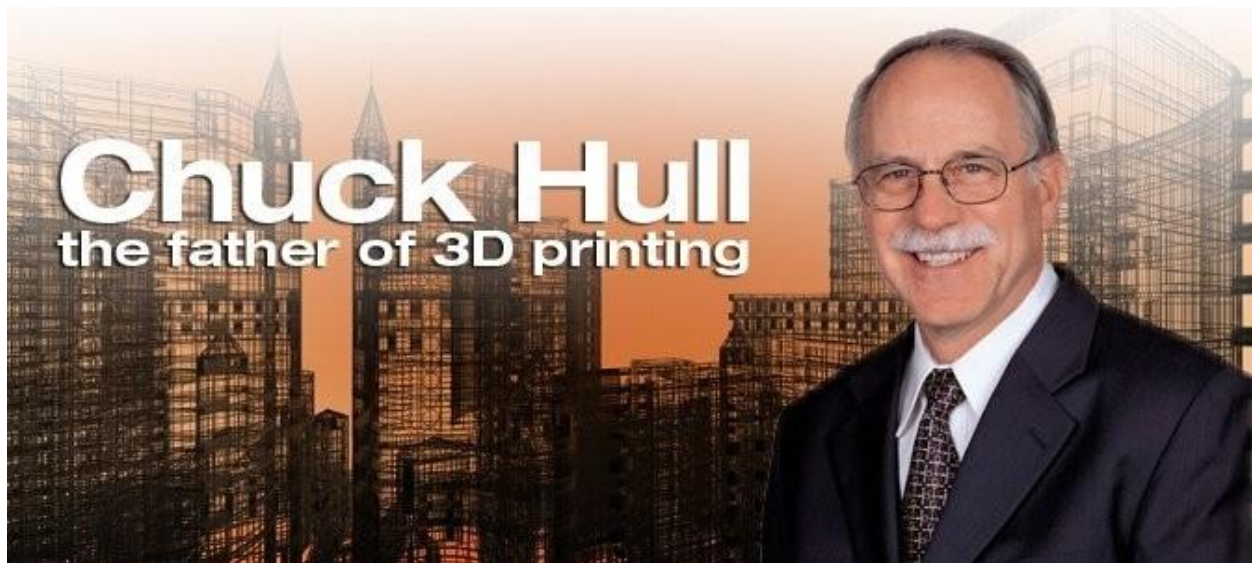
We will not here consider other types of computer-controlled manufacturing, such as subtractive machines, which work by cutting away from a larger piece of material in order to build a part. Additive rapid prototyping machines were first introduced twenty years ago, when 3D Systems introduced the Stereo lithography, or SLA machine. While these machines were remarkable for their ability to create complex parts, they were large, expensive, and difficult to operate.

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## 1. History Of 3d Printing

Early AM equipment and materials were developed in the 1980s. In 1984, Chuck Hull of 3D Systems Corporation, invented a process known as stereo lithography, in which layers are added by curing photopolymers with UV lasers. Hull defined the process as a "system for generating three-dimensional objects by creating a cross-sectional pattern of the object to be formed. He also developed the STL (Stereo Lithography) file format widely accepted by 3D printing software as well as the digital slicing and infill strategies common to many processes today. The term *3D printing* originally referred to a process employing standard and custom inkjet print heads. The technology used by most 3D printers to date—especially hobbyist and consumer-oriented models—is fused deposition modeling, a special application of plastic extrusion.



**Chuck Hull the father of 3D printing**

AM processes for metal sintering or melting usually went by their own individual names in the 1980s and 1990s. Nearly all metalworking production at the time was by casting, fabrication, stamping, and machining; even though plenty of automation was applied to those technologies (such as by robot welding and CNC), the idea of a tool or head moving through a 3D work envelope transforming a mass of raw material into a desired shape layer by layer was associated by most people only with processes that removed metal (rather than adding it), such as CNC milling, CNC EDM, and many others. The umbrella term additive manufacturing gained wider currency in the decade of the 2000s as the various additive processes

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matured and it became clear that soon metal removal would no longer be the sole occupant of the aforementioned paradigm. It was during this decade that the term subtractive manufacturing appeared for the large family of machining processes with metal removal as their common theme. However, at the time, the term 3D printing still referred only to the polymer technologies in most minds, and the term AM was likelier to be used in metalworking contexts than among polymer/inkjet/stereo lithography enthusiasts.

By the early 2010s, the terms 3D printing and additive manufacturing developed senses in which they were synonymous umbrella terms for all AM technologies. Although this was a departure from their earlier technically narrower senses, it reflects the simple fact that the technologies all share the common theme of sequential-layer material addition/joining throughout a 3D work envelope under automated control. (Other terms that have appeared, which are usually used as AM synonyms have been desktop manufacturing, rapid manufacturing [as the logical production-level successor to rapid prototyping], and on-demand manufacturing [which echoes on-demand printing in the 2D sense of printing].) The 2010s were the first decade in which metal parts such as engine brackets and large nuts would be grown (either before or instead of machining) in job production rather than obligatory being machined from bar stock or plate. The term subtractive has not replaced the term machining, instead complementing it when a term that covers any removal method is needed.

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## 2. General Principles

### 2.1 Modeling

3D printable models may be created with a computer aided design package or via 3D scanner. The manual modeling process of preparing geometric data for 3D computer graphics is similar to plastic arts such as sculpting. 3D scanning is a process of analyzing and collecting digital data on the shape and appearance of a real object. Based on this data, three-dimensional models of the scanned object can then be produced.

Both manual and automatic creation of 3D printable models is difficult for average consumers. This is why several marketplaces have emerged over the last years. Among the most popular are Shape ways, Thingiverse, MyMiniFactory and Threading

### Printing

Before printing a 3D model from an STL file, it must first be processed by a piece of software called a "slicer" which converts the model into a series of thin layers and produces a G-code file containing instructions tailored to a specific printer. Several open source slicer programs exist, including Skeinforge, Slic3r, KISSlicer, and Cura.

The 3D printer follows the G-code instructions to lay down successive layers of liquid, powder, paper or sheet material to build the model from a series of cross sections. These layers, which correspond to the virtual cross sections from the CAD model, are joined or automatically fused to create the final shape. The primary advantage of this technique is its ability to create almost any shape or geometric feature.

Printer resolution describes layer thickness and X-Y resolution in dots per inch (dpi) or micrometers ( $\mu\text{m}$ ). Typical layer thickness is around 100  $\mu\text{m}$  (250 DPI), although some machines such as the Objet Convex series and 3D Systems' ProJet series can print layers as thin as 16  $\mu\text{m}$  (1,600 DPI). X-Y resolution is comparable to that of laser printers. The particles (3D dots) are around 50 to 100  $\mu\text{m}$  (510 to 250 DPI) in diameter.

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Construction of a model with contemporary methods can take anywhere from several hours to several days, depending on the method used and the size and complexity of the model. Additive systems can typically reduce this time to a few hours, although it varies widely depending on the type of machine used and the size and number of models being produced simultaneously.

Traditional techniques like injection moldings can be less expensive for manufacturing polymer products in high quantities, but additive manufacturing can be faster, more flexible and less expensive when producing relatively small quantities of parts. 3D printers give designers and concept development teams the ability to produce parts and concept models using a desktop size printer.

## **Finishing**

Though the printer-produced resolution is sufficient for many applications, printing a slightly oversized version of the desired object in standard resolution and then removing material with a higher-resolution subtractive process can achieve greater precision. As with the LUMEX Avance-25 and other machines slated for IMTS 2014 [IMTS Press Release | International Manufacturing Technology Show](#)

Some additive manufacturing techniques are capable of using multiple materials in the course of constructing parts. Some are able to print in multiple colors and color combinations simultaneously. Some also utilise supports when building. Supports are removable or dissolvable upon completion of the print, and are used to support overhanging features during construction.



### **3. Current 3d Printing Technologies**

#### **Stereo lithography**

Stereo lithographic 3D printers (known as SLAs or stereo lithography apparatus) position a perforated platform just below the surface of a vat of liquid photo curable polymer. A UV laser beam then traces the first slice of an object on the surface of this liquid, causing a very thin layer of photopolymer to harden. The perforated platform is then lowered very slightly and another slice is traced out and hardened by the laser. Another slice is then created, and then another, until a complete object has been printed and can be removed from the vat of photopolymer, drained of excess liquid, and cured. Fused deposition modeling - Here a hot thermoplastic is extruded from a temperature-controlled print head to produce fairly robust objects to a high degree of accuracy.

#### **Selective laser sintering (SLS)**

This builds objects by using a laser to selectively fuse together successive layers of a cocktail of powdered wax, ceramic, metal, nylon or one of a range of other materials.

#### **Multi-jet modeling (MJM)**

This again builds up objects from successive layers of powder, with an inkjet-like print head used to spray on a binder solution that glues only the required granules together. The V-Flash printer, manufactured by Canon, is a low-cost 3D printer. It's known to build layers with a light-curable film. Unlike other printers, the VFlash builds its parts from the top down. Desktop Factory is a startup launched by the Idea lab incubator in Pasadena, California.

#### **Inkjet 3D printing**

It creates the model one layer at a time by spreading a layer of powder (plaster, or resins) and inkjet printing binder in the cross-section of the part. It is the most widely used 3-D Printing technology these days and the reasons beyond that are stated below.

This technology is the only one that

- Allows for the printing of full color prototypes.

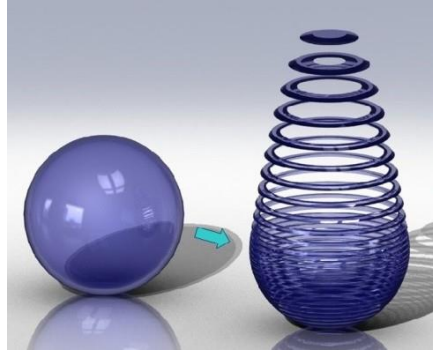
Unlike stereo lithography, inkjet 3D printing is optimized for speed, low cost, and ease-of-use.

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## 4. There is two major type Manufacturing

### Additive Manufacturing

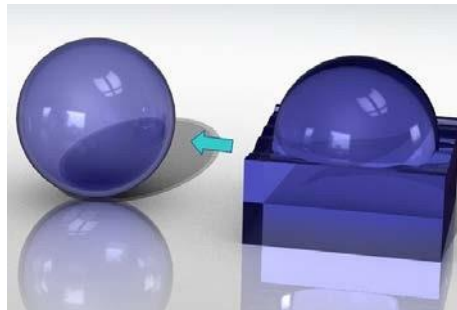
- Creating A Form
- Conserves Resources
- Efficient
- 3D Printing



Additive manufacturing

### Subtractive Manufacturing

- Uncovering A Form
- Carving A Sculpture
- Chiseling A Statue
- Wasteful
- Time Consuming



Subtractive Manufacturing



## 5. Processes

Several different 3D printing processes have been invented since the late 1970s. The printers were originally large, expensive, and highly limited in what they could produce.

A large number of additive processes are now available. The main differences between processes are in the way layers are deposited to create parts and in the materials that are used. Some methods melt or soften material to produce the layers, e.g. selective laser melting (SLM) or direct metal laser sintering (DMLS), selective laser sintering (SLS), fused deposition modeling (FDM), while others cure liquid materials using different sophisticated technologies, e.g. stereo lithography (SLA). With laminated object manufacturing (LOM), thin layers are cut to shape and joined together (e.g. paper, polymer, metal). Each method has its own advantages and drawbacks, which is why some companies consequently offer a choice between powder and polymer for the material used to build the object. Other companies sometimes use standard, off-the-shelf business paper as the build material to produce a durable prototype. The main considerations in choosing a machine are generally speed, cost of the 3D printer, cost of the printed prototype, cost and choice of materials, and color capabilities.

Printers that work directly with metals are expensive. In some cases, however, less expensive printers can be used to make a mould, which is then used to make metal parts.

Table 1 materials and technologies

Type	Technologies	Materials
Extrusion	Fused deposition modeling (FDM)	Thermoplastics (e.g. PLA, ABS), HDPE, eutectic metals, edible materials, Rubber (Sugru), Modeling clay, Plasticine, RTV silicone, Porcelain, Metal clay (including Precious Metal Clay)
Wire	Electron Beam Freeform Fabrication (EBF)	Almost any metal alloy
Granular	Direct metal laser	Almost any metal alloy

	sintering (DMLS)	
	Electron-beam melting (EBM)	Almost any metal alloy including Titanium alloys
	Selective laser melting (SLM)	Titanium alloys, Cobalt Chrome alloys, Stainless Steel, Aluminium
	Selective heat sintering (SHS)	Thermoplastic powder
	Selective laser sintering (SLS)	Thermoplastics, metal powders, ceramic powders
Powder bed and inkjet head 3D printing	Plaster-based 3D printing (PP)	Plaster
Laminated	Laminated object manufacturing (LOM)	Paper, metal foil, plastic film
Light polymerised	Stereo lithography(SLA)	photopolymer
	Digital Light Processing (DLP)	photopolymer

## Extrusion deposition

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Fused deposition modeling (FDM) was developed by S. Scott Crump in the late 1980s and was commercialized in 1990 by Stratasys. After the patent on this technology expired, a large open-source development community developed and both commercial and DIY variants utilizing this type of 3D printer appeared. As a result, the price of this technology has dropped by two orders of magnitude since its creation.

In fused deposition modeling the model or part is produced by extruding small beads of material which harden immediately to form layers. A thermoplastic filament or metal wire that is wound on a coil is unreeled to supply material to an extrusion nozzle head. The nozzle head heats the material and turns the flow on and off. Typically stepper motors or servo motors are employed to move the extrusion head and adjust the flow. The head can be moved in both horizontal and vertical directions, and control of the mechanism is typically done by a computer-aided manufacturing (CAM) software package running on a microcontroller.

Various polymers are used, including acrylonitrile butadiene styrene (ABS), polycarbonate (PC), polylactic acid (PLA), high density polyethylene (HDPE), PC/ABS, polyphenylsulfone (PPSU) and high impact polystyrene (HIPS). In general, the polymer is in the form of a filament fabricated from virgin resins. There are multiple projects in the open-sourced community aimed at processing post-consumer plastic waste into filament. These involve machines used to shred and extrude the plastic material into filament.

FDM is somewhat restricted in the variation of shapes that may be fabricated. For example, FDM usually cannot produce stalactite-like structures, since they would be unsupported during the build. Otherwise, a thin support must be designed into the structure which can be broken away during finishing.

## **Granular materials binding**

Another 3D printing approach is the selective fusing of materials in a granular bed. The technique fuses parts of the layer and then moves downward in the working area, adding another layer of granules and repeating the process until the piece has built up. This process uses the unfused media to support overhangs and thin walls in the part being produced, which reduces the need for temporary auxiliary supports for the piece. A laser is typically used to sinter the media into a solid. Examples include selective laser sintering (SLS), with both metals and polymers (e.g. PA, PA-GF, Rigid GF, PEEK, PS, Alumide, Carbonmide, elastomers), and direct metal laser sintering (DMLS).

Selective Laser Sintering (SLS) was developed and patented by Dr. Carl Deckard and Dr. Joseph Beaman at the University of Texas at Austin in the mid-1980s, under sponsorship of DARPA. A similar process was patented without being commercialized by R. F. Housholder in 1979.

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Selective Laser Melting (SLM) does not use sintering for the fusion of powder granules but will completely melt the powder using a high-energy laser to create fully dense materials in a layer-wise method that has mechanical properties similar to those of conventional manufactured metals.

Electron beam melting (EBM) is a similar type of additive manufacturing technology for metal parts (e.g. titanium alloys). EBM manufactures parts by melting metal powder layer by layer with an electron beam in a high vacuum. Unlike metal sintering techniques that operate below melting point, EBM parts are fully dense, void-free, and very strong.

Another method consists of an inkjet 3D printing system. The printer creates the model one layer at a time by spreading a layer of powder (plaster, or resins) and printing a binder in the cross-section of the part using an inkjet-like process. This is repeated until every layer has been printed. This technology allows the printing of full color prototypes, overhangs, and elastomer parts. The strength of bonded powder prints can be enhanced with wax or thermoset polymer impregnation.

## **Lamination**

In some printers, paper can be used as the build material, resulting in a lower cost to print. During the 1990s some companies marketed printers that cut cross sections out of special adhesive coated paper using a carbon dioxide laser and then laminated them together.

In 2005, Mcor Technologies Ltd developed a different process using ordinary sheets of office paper, a Tungsten carbide blade to cut the shape, and selective deposition of adhesive and pressure to bond the prototype.<sup>[36]</sup>

There are also a number of companies selling printers that print laminated objects using thin plastic and metal sheets

## **Photo polymerization**

Stereo lithography was patented in 1986 by Chuck Hull. Photo polymerization is primarily used in stereo lithography (SLA) to produce a solid part from a liquid. This process dramatically redefined previous efforts, from the "photosculpture" method of François Willème (1830–1905) in 1860 through the photopolymerization of Mitsubishi's Matsubara in 1974. The "photosculpture" method consisted of photographing a subject from a variety of equidistant angles and projecting each photograph onto a screen, where a pantagraph was used to trace the outline onto modeling clay)

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In photo-polymerization, a vat of liquid polymer is exposed to controlled lighting under safelight conditions. The exposed liquid polymer hardens. The build plate then moves down in small increments and the liquid polymer is again exposed to light. The process repeats until the model has been built. The liquid polymer is then drained from the vat, leaving the solid model. The EnvisionTEC Perfactory is an example of a DLP rapid prototyping system.

Inkjet printer systems like the Objet PolyJet system spray photopolymer materials onto a build tray in ultra-thin layers (between 16 and 30  $\mu\text{m}$ ) until the part is completed. Each photopolymer layer is cured with UV light after it is jetted, producing fully cured models that can be handled and used immediately, without post-curing. The gel-like support material, which is designed to support complicated geometries, is removed by hand and water jetting. It is also suitable for elastomers.

Ultra-small features can be made with the 3D micro-fabrication technique used in multiphoton photopolymerisation. This approach uses a focused laser to trace the desired 3D object into a block of gel. Due to the nonlinear nature of photo excitation, the gel is cured to a solid only in the places where the laser was focused while the remaining gel is then washed away. Feature sizes of under 100 nm are easily produced, as well as complex structures with moving and interlocked parts.

Yet another approach uses a synthetic resin that is solidified using LEDs.

### **Mask-image-projection-based stereolithography**

In this technique a 3D digital model is sliced by a set of horizontal planes. Each slice is converted into a two-dimensional mask image. The mask image is then projected onto a photocurable liquid resin surface and light is projected onto the resin to cure it in the shape of the layer. The technique has been used to create objects composed of multiple materials that cure at different rates. In research systems, the light is projected from below, allowing the resin to be quickly spread into uniform thin layers, reducing production time from hours to minutes. Commercially available devices such as Objet Connex apply the resin via small nozzles.

### **Bio printing**

The medical applications of 3D bioprinting are numerous, and are thus the subject of intensive research at academic institutions such as Cornell University and companies such as Organovo.

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Researchers in the Jonathan Butcher Laboratory at Cornell University have been developing methods to bioprint living aortic heart valves. Poly(ethylene glycol)-diacrylate (PEGDA) is used as a base polymer, because of its biocompatibility and easily tunable mechanical properties. Two different solutions of PEGDA were created with different mechanical stiffness's when cross-linked, with the stiffer polymer to be used as the aortic root wall and the compliant polymer to be used as the valve leaflets. Using these solutions, a valve exhibiting mechanical heterogeneity and cytocompatibility was bio printed, which will serve as a base for future development of the aortic valve printing process.

The Lawrence Bonassar Laboratory at Cornell University has been working on 3D bio printing cartilaginous geometries. One focus of their research involves the replacement of intervertebral disks with Tissue Engineered-Total Disk Replacement constructs. Tissue engineered intervertebral disks were bio printed with cell-seeded hydrogel constructs, and implanted into male rats.

Commercially, Printerinks, a UK company, and Organovo, a U.S. company, have worked together to develop human tissue through 3D printing. Printer cartridges are adapted to use stem cells obtained from biopsies and grown in cultures. The resulting substance is called Bioink.

## **6. Advantage Of 3d Printing**

### **Cheap Manufacturing**

As discussed in the first post of this series, 3D printing is increasingly being used by large companies such as Converse or Alessi to replace some of their traditional manufacturing methods with cost savings of up to 70%. This is achieved through lower shipping and packaging costs related to overseas parts suppliers, less human resource involved and cheaper and sometimes more reliable raw materials.

Although currently 3D home-printed objects are not necessarily cheaper than their mass-manufactured counter parts, printing your own object a priceless experience for many (at least until its novelty wears off). 3D printed objects are only expected to get cheaper with improved additive manufacturing techniques, cheaper consumables, main stream adoption and self-replicating practices.

### **Quick Production**

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The speed of 3D printing compared to traditional methods is similar to comparing a sports car's top speed to a horse cart's. They both take you where you want to go but the journey time differs considerably. With industrial 3D printers being able to 'manufacture' most objects in a matter of hours, the classical manufacturing methods, taking up to several days or even weeks (from prototype to end product), are slowly becoming obsolete.

This leads to massive cost savings and to an on-demand manufacturing model. Why should you have warehouses filled up with stocks of your products if you can create them according to demand? Even if this model might not work with the big offline manufacturers due to their dependence on offline retailers that usually buy in bulk, it can prove extremely efficient for an online business.

### **Less waste**

Manufacturing metal and plastic objects in particular is usually a wasteful process with chunky parts and a lot of surplus material. For some aircraft makers, up to 90% of the material is being cut away and no longer useful. Making a similar object using additive manufacturing not only uses less energy but also reduces waste to a minimum. And sometimes, the finished 3D printed product can be up to 60% lighter compared to the machined part but still as sturdy according to the Economist. Significant cost savings can be achieved in this way and less waste also means a lower impact on the environment.

### **Better quality**

Think about 3D printing as cake baking. You can make a cake by whisking some cake mix, pouring it in an oven tray and baking everything. The result may taste amazing but it can have unwanted air bubbles inside, different thickness and all nuts or fruits could be grouped to one side. However, if you could assemble the cake layer by layer similar to additive manufacturing, you could achieve perfection through a full control of where each layer is going and how it fits with the rest.

Avoiding most of the mass manufacturing faults does not only make better products but it also extends their life as they will break less often. This is not necessarily a great benefit for manufacturers who need the product life cycle to be profitable, but it is certainly a major benefit for the end consumer.

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## **Accessibility**

With more people getting access to 3D printing, it may not be long until we will all have our own multi-purpose contraption (with additive manufacturing being only one of the many functionalities) capable of creating the products we need, when we need them. This can seriously shake up the current consumerism culture built on the contemporary industrial supply chain nevertheless, it remains to be seen if this is only an ideology or a possible transitional period in human evolution.

Less waste compared to traditional manufacturing methods is not only a cost saving feature of 3D printing but also a possible eco-friendly attribute. Add to this the multi-purpose characteristic of a 3D printer (can build different objects without the need of using specialised machines for each part) and their digital ecosystem (all 3D models are transmitted electronically so in theory they can be printed out where they are needed, minimising therefore transport costs) and you get a sustainable manufacturing process. Integrating additive manufacturing with more classic production methods – as is the case with 3D printed textiles in the clothing industry – adds another layer (excuse the pun) to the sustainability case.

## **New shapes and structures**

Traditional manufacturing methods rely on moulds and cutting technologies to produce a finite number of shapes and structures, with more complex hollow ones having to be created from several parts and assembled together. But 3D printing changes this altogether – the 3D printer's nozzle can build an infinite number of complex figures, being limited only by human imagination. This method gives them more durability and higher structural integrity. From medical implants that resemble bone to aerodynamic parts for the space industry and from unique-shaped furniture to 3D printed jewellery, the opportunities are endless.

## **New combinations of materials**

Mixing different raw materials is not always possible with mass-manufacturing methods due to the sometimes high costs involved and to their physical & chemical properties that make them difficult to combine through traditional methods. 3D printing has removed many of these boundaries not only because of the initial dependency on plastic (being one of the few raw

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materials that melt at lower temperatures) but also because of a continuous innovation fed by enthusiasts believing that additive manufacturing's potential has not been reached yet. As a result, many companies now offer tens of different materials with different finishes giving the look and feel of metal, ceramics or glass with various strengths and temperature resistance.

## **New business models**

With 3D printing gaining popularity fast, entrepreneurs have not lost any opportunity to get their foot into an industry deemed by many as potentially very lucrative. This is how 3D printing 'shops' were born. Imagine going shopping in a supermarket where you decide how your products will look and feel, and where everything can be personalised to fit your demanding tastes.

## **7 Disadvantage Of 3d Printing**

### **Fewer Manufacturing Jobs:**

As with all new technologies, manufacturing jobs will decrease. This disadvantage can and will have a large impact to the economies of third world countries, especially China, that depend on a large number of low skill jobs.

### **Limited Materials:**

Currently, 3D printers only manufacture products out of plastic, resin, certain metals, and ceramics. 3D printing of products in mixed materials and technology, such as circuit boards, are still under development.

### **Copyright:**

With 3D printing becoming more common, the printing of copyrighted products to create counterfeit items will become more common and nearly impossible to determine.

### **Dangerous Items:**

3D printers can create dangerous items, such as guns and knives, with very little or no oversight.

### **More Useless Stuff:**

One of the dangers of 3D printers is that they will be used to create more useless stuff that is bad for the environment and wallets. Fortunately, there are new methods of automatically recycling objects made by 3D printers that hold promise of better recycling in the future.

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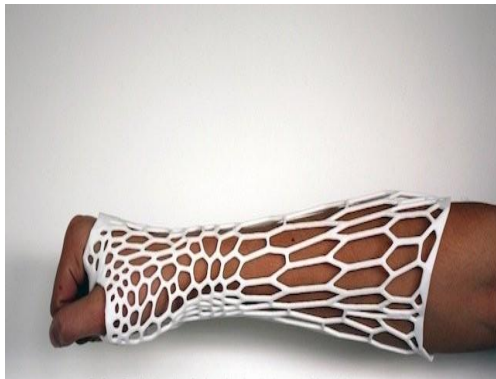
### **Size:**

Currently, 3D printers are limited with the size of the products that they can create. Ultimately, large items, such as houses and building, could be created using 3D printers.

## **8. Application**

### **Medical :- A New Way to Heal Broken Bones**

In the near future, having a broken arm could look way cooler thanks to a new, black, lightweight 3-D printed cast that's patterned like latticework and which uses an ultrasound device to make bones heal more quickly.



**a new way to heal broken bones by 3d printing**



### **.3d printed wound hill process**



Scanning the wound



Filling the wound

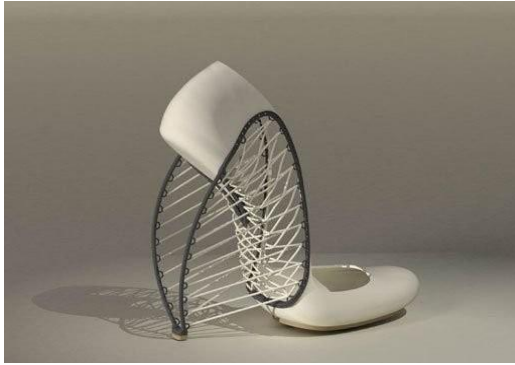
### **3.Jewellery**



different type of rings and jewellery



## 8.4. footwear



different type of footwear made by 3d printing

## 8.5 .3d printed car

Urbee II, a 3D-printed electric car about to go into production, boasts an ultrastrong, ultralight chassis that can take on highway rigors with ease.

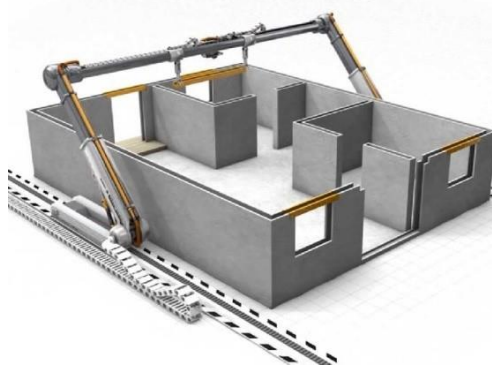


Urbee II 3D printed car

## 8.6. bulding construction:

Building printing refers to various technology that use 3D printing as a way to construct buildings. The advantages of this would be quicker construction, lower labor costs, and less waste produced. It is also a potential way of building extraterrestrial structures on the Moon or other planets where environmental conditions are less conducive to human labor-intensive building practices.





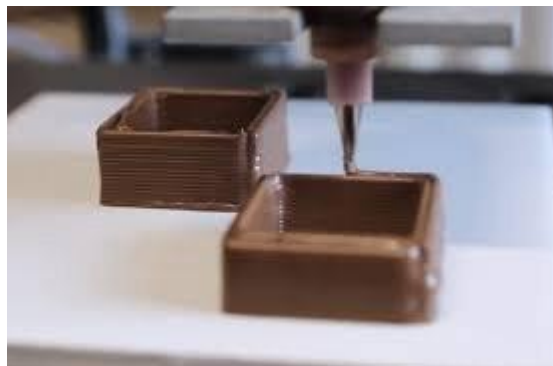
**3d printed home**

## **8.7. Toys**



**Different type of toys**

## **8.8. Food**



**Different type of food**

**Mobile covers**

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different type of mobile covers

## Guns



Gun made by 3d printing

## 8.11. human organs:-



different type of human organs using 3d printing

## Conclusion

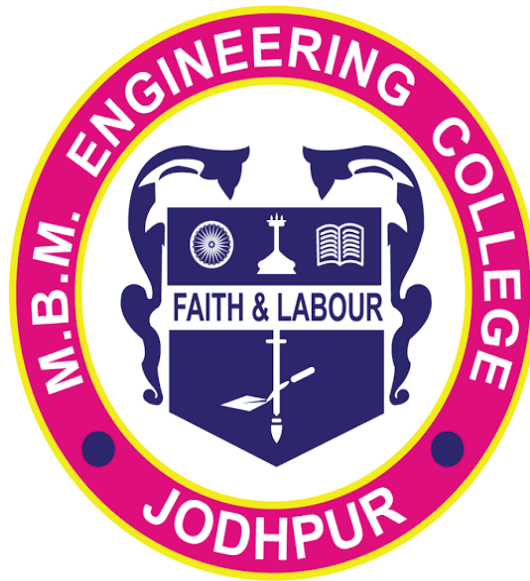
3D printing can offer benefits across the entire creation process from initial concept design to final manufacturing and all steps in between. Different applications have unique needs and understanding those application requirements is critical when choosing a 3D printer. Multiple systems may offer broader use opportunities than a single system, so identifying your unique requirements to apply 3D printing across your entire design-to-manufacture process can shorten time-to-market, improve product performance, streamline and cost-reduce manufacturing, and improve product quality and customer satisfaction will help you define the ideal 3D printing capability for your organization.



SUMMER TRAINING  
REPORT ON

# 3D PRINTING

At  
**INTERNSHALA**  
Submitted  
In the partial fulfillment of  
**Bachelor of Engineering**



Department of  
**Production and Industrial  
Engineering**  
**2021-2022**

**Submitted by: SIDDHI NAGAR**

**Roll number: 19UPIE1328**

**6th semester (3rd year)**

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6th semester (3rd year)



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## INTRODUCTION

A 3D printer uses a virtual, mathematical model to construct a physical artifact. For example, a designer in the process of creating a new laptop can use a software package to create a three-dimensional model of her creation, that can be manipulated and viewed on the computer screen. The 3D printer can take the symbolic representation of this new object and use it to build a full-size, physical model that can be held and manipulated, helping the designer to better understand the strengths and limitations of her design.

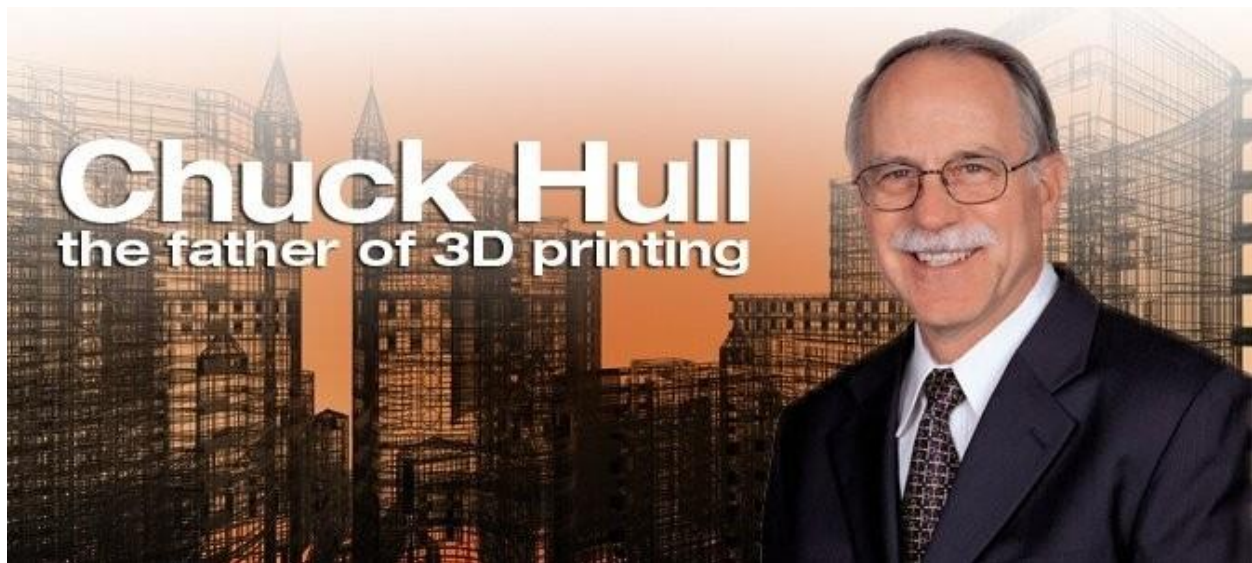
An architect can turn the plans for a building into a three-dimensional model and then “print” a scale model to help him understand and communicate his design. An archaeologist can print duplicates of an important, but fragile, tool so that her students can hold it in their hands and better understand how it might have been used by an ancient civilization. A biochemist can print accurate models of DNA molecules, enlarged by many orders of magnitude, to help students and researchers better understand nature by engaging their hands as well as their eyes in comprehending the geometry of nature. And a student of the arts can create a unique object that would be difficult or impossible to build by hand.

We will not here consider other types of computer-controlled manufacturing, such as subtractive machines, which work by cutting away from a larger piece of material in order to build a part. Additive rapid prototyping machines were first introduced twenty years ago, when 3D Systems introduced the Stereo lithography, or SLA machine. While these machines were remarkable for their ability to create complex parts, they were large, expensive, and difficult to operate.

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## 1. History Of 3d Printing

Early AM equipment and materials were developed in the 1980s. In 1984, Chuck Hull of 3D Systems Corporation, invented a process known as stereo lithography, in which layers are added by curing photopolymers with UV lasers. Hull defined the process as a "system for generating three-dimensional objects by creating a cross-sectional pattern of the object to be formed. He also developed the STL (Stereo Lithography) file format widely accepted by 3D printing software as well as the digital slicing and infill strategies common to many processes today. The term *3D printing* originally referred to a process employing standard and custom inkjet print heads. The technology used by most 3D printers to date—especially hobbyist and consumer-oriented models—is fused deposition modeling, a special application of plastic extrusion.



**Chuck Hull the father of 3D printing**

AM processes for metal sintering or melting usually went by their own individual names in the 1980s and 1990s. Nearly all metalworking production at the time was by casting, fabrication, stamping, and machining; even though plenty of automation was applied to those technologies (such as by robot welding and CNC), the idea of a tool or head moving through a 3D work envelope transforming a mass of raw material into a desired shape layer by layer was associated by most people only with processes that removed metal (rather than adding it), such as CNC milling, CNC EDM, and many others. The umbrella term additive manufacturing gained wider currency in the decade of the 2000s as the various additive processes

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matured and it became clear that soon metal removal would no longer be the sole occupant of the aforementioned paradigm. It was during this decade that the term subtractive manufacturing appeared for the large family of machining processes with metal removal as their common theme. However, at the time, the term 3D printing still referred only to the polymer technologies in most minds, and the term AM was likelier to be used in metalworking contexts than among polymer/inkjet/stereo lithography enthusiasts.

By the early 2010s, the terms 3D printing and additive manufacturing developed senses in which they were synonymous umbrella terms for all AM technologies. Although this was a departure from their earlier technically narrower senses, it reflects the simple fact that the technologies all share the common theme of sequential-layer material addition/joining throughout a 3D work envelope under automated control. (Other terms that have appeared, which are usually used as AM synonyms have been desktop manufacturing, rapid manufacturing [as the logical production-level successor to rapid prototyping], and on-demand manufacturing [which echoes on-demand printing in the 2D sense of printing].) The 2010s were the first decade in which metal parts such as engine brackets and large nuts would be grown (either before or instead of machining) in job production rather than obligatory being machined from bar stock or plate. The term subtractive has not replaced the term machining, instead complementing it when a term that covers any removal method is needed.

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## 2. General Principles

### 2.1 Modeling

3D printable models may be created with a computer aided design package or via 3D scanner. The manual modeling process of preparing geometric data for 3D computer graphics is similar to plastic arts such as sculpting. 3D scanning is a process of analyzing and collecting digital data on the shape and appearance of a real object. Based on this data, three-dimensional models of the scanned object can then be produced.

Both manual and automatic creation of 3D printable models is difficult for average consumers. This is why several marketplaces have emerged over the last years. Among the most popular are Shape ways, Thingiverse, MyMiniFactory and Threading

### Printing

Before printing a 3D model from an STL file, it must first be processed by a piece of software called a "slicer" which converts the model into a series of thin layers and produces a G-code file containing instructions tailored to a specific printer. Several open source slicer programs exist, including Skeinforge, Slic3r, KISSlicer, and Cura.

The 3D printer follows the G-code instructions to lay down successive layers of liquid, powder, paper or sheet material to build the model from a series of cross sections. These layers, which correspond to the virtual cross sections from the CAD model, are joined or automatically fused to create the final shape. The primary advantage of this technique is its ability to create almost any shape or geometric feature.

Printer resolution describes layer thickness and X-Y resolution in dots per inch (dpi) or micrometers ( $\mu\text{m}$ ). Typical layer thickness is around 100  $\mu\text{m}$  (250 DPI), although some machines such as the Objet Convex series and 3D Systems' ProJet series can print layers as thin as 16  $\mu\text{m}$  (1,600 DPI). X-Y resolution is comparable to that of laser printers. The particles (3D dots) are around 50 to 100  $\mu\text{m}$  (510 to 250 DPI) in diameter.

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Construction of a model with contemporary methods can take anywhere from several hours to several days, depending on the method used and the size and complexity of the model. Additive systems can typically reduce this time to a few hours, although it varies widely depending on the type of machine used and the size and number of models being produced simultaneously.

Traditional techniques like injection moldings can be less expensive for manufacturing polymer products in high quantities, but additive manufacturing can be faster, more flexible and less expensive when producing relatively small quantities of parts. 3D printers give designers and concept development teams the ability to produce parts and concept models using a desktop size printer.

## **Finishing**

Though the printer-produced resolution is sufficient for many applications, printing a slightly oversized version of the desired object in standard resolution and then removing material with a higher-resolution subtractive process can achieve greater precision. As with the LUMEX Avance-25 and other machines slated for IMTS 2014 [IMTS Press Release | International Manufacturing Technology Show](#)

Some additive manufacturing techniques are capable of using multiple materials in the course of constructing parts. Some are able to print in multiple colors and color combinations simultaneously. Some also utilise supports when building. Supports are removable or dissolvable upon completion of the print, and are used to support overhanging features during construction.



### **3. Current 3d Printing Technologies**

#### **Stereo lithography**

Stereo lithographic 3D printers (known as SLAs or stereo lithography apparatus) position a perforated platform just below the surface of a vat of liquid photo curable polymer. A UV laser beam then traces the first slice of an object on the surface of this liquid, causing a very thin layer of photopolymer to harden. The perforated platform is then lowered very slightly and another slice is traced out and hardened by the laser. Another slice is then created, and then another, until a complete object has been printed and can be removed from the vat of photopolymer, drained of excess liquid, and cured. Fused deposition modeling - Here a hot thermoplastic is extruded from a temperature-controlled print head to produce fairly robust objects to a high degree of accuracy.

#### **Selective laser sintering (SLS)**

This builds objects by using a laser to selectively fuse together successive layers of a cocktail of powdered wax, ceramic, metal, nylon or one of a range of other materials.

#### **Multi-jet modeling (MJM)**

This again builds up objects from successive layers of powder, with an inkjet-like print head used to spray on a binder solution that glues only the required granules together. The V-Flash printer, manufactured by Canon, is a low-cost 3D printer. It's known to build layers with a light-curable film. Unlike other printers, the VFlash builds its parts from the top down. Desktop Factory is a startup launched by the Idea lab incubator in Pasadena, California.

#### **Inkjet 3D printing**

It creates the model one layer at a time by spreading a layer of powder (plaster, or resins) and inkjet printing binder in the cross-section of the part. It is the most widely used 3-D Printing technology these days and the reasons beyond that are stated below.

This technology is the only one that

- Allows for the printing of full color prototypes.

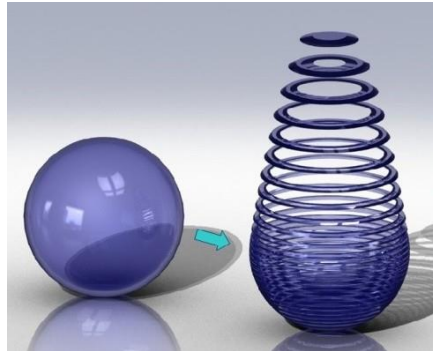
Unlike stereo lithography, inkjet 3D printing is optimized for speed, low cost, and ease-of-use.

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## 4. There is two major type Manufacturing

### Additive Manufacturing

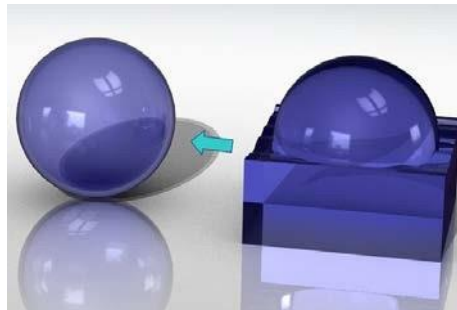
- Creating A Form
- Conserves Resources
- Efficient
- 3D Printing



Additive manufacturing

### Subtractive Manufacturing

- Uncovering A Form
- Carving A Sculpture
- Chiseling A Statue
- Wasteful
- Time Consuming



Subtractive Manufacturing





## 5. Processes

Several different 3D printing processes have been invented since the late 1970s. The printers were originally large, expensive, and highly limited in what they could produce.

A large number of additive processes are now available. The main differences between processes are in the way layers are deposited to create parts and in the materials that are used. Some methods melt or soften material to produce the layers, e.g. selective laser melting (SLM) or direct metal laser sintering (DMLS), selective laser sintering (SLS), fused deposition modeling (FDM), while others cure liquid materials using different sophisticated technologies, e.g. stereo lithography (SLA). With laminated object manufacturing (LOM), thin layers are cut to shape and joined together (e.g. paper, polymer, metal). Each method has its own advantages and drawbacks, which is why some companies consequently offer a choice between powder and polymer for the material used to build the object. Other companies sometimes use standard, off-the-shelf business paper as the build material to produce a durable prototype. The main considerations in choosing a machine are generally speed, cost of the 3D printer, cost of the printed prototype, cost and choice of materials, and color capabilities.

Printers that work directly with metals are expensive. In some cases, however, less expensive printers can be used to make a mould, which is then used to make metal parts.

Table 1 materials and technologies

Type	Technologies	Materials
Extrusion	Fused deposition modeling (FDM)	Thermoplastics (e.g. PLA, ABS), HDPE, eutectic metals, edible materials, Rubber (Sugru), Modeling clay, Plasticine, RTV silicone, Porcelain, Metal clay (including Precious Metal Clay)
Wire	Electron Beam Freeform Fabrication (EBF)	Almost any metal alloy
Granular	Direct metal laser	Almost any metal alloy

	sintering (DMLS)	
	Electron-beam melting (EBM)	Almost any metal alloy including Titanium alloys
	Selective laser melting (SLM)	Titanium alloys, Cobalt Chrome alloys, Stainless Steel, Aluminium
	Selective heat sintering (SHS)	Thermoplastic powder
	Selective laser sintering (SLS)	Thermoplastics, metal powders, ceramic powders
Powder bed and inkjet head 3D printing	Plaster-based 3D printing (PP)	Plaster
Laminated	Laminated object manufacturing (LOM)	Paper, metal foil, plastic film
Light polymerised	Stereo lithography(SLA)	photopolymer
	Digital Light Processing (DLP)	photopolymer

## Extrusion deposition

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Fused deposition modeling (FDM) was developed by S. Scott Crump in the late 1980s and was commercialized in 1990 by Stratasys. After the patent on this technology expired, a large open-source development community developed and both commercial and DIY variants utilizing this type of 3D printer appeared. As a result, the price of this technology has dropped by two orders of magnitude since its creation.

In fused deposition modeling the model or part is produced by extruding small beads of material which harden immediately to form layers. A thermoplastic filament or metal wire that is wound on a coil is unreeled to supply material to an extrusion nozzle head. The nozzle head heats the material and turns the flow on and off. Typically stepper motors or servo motors are employed to move the extrusion head and adjust the flow. The head can be moved in both horizontal and vertical directions, and control of the mechanism is typically done by a computer-aided manufacturing (CAM) software package running on a microcontroller.

Various polymers are used, including acrylonitrile butadiene styrene (ABS), polycarbonate (PC), polylactic acid (PLA), high density polyethylene (HDPE), PC/ABS, polyphenylsulfone (PPSU) and high impact polystyrene (HIPS). In general, the polymer is in the form of a filament fabricated from virgin resins. There are multiple projects in the open-sourced community aimed at processing post-consumer plastic waste into filament. These involve machines used to shred and extrude the plastic material into filament.

FDM is somewhat restricted in the variation of shapes that may be fabricated. For example, FDM usually cannot produce stalactite-like structures, since they would be unsupported during the build. Otherwise, a thin support must be designed into the structure which can be broken away during finishing.

## **Granular materials binding**

Another 3D printing approach is the selective fusing of materials in a granular bed. The technique fuses parts of the layer and then moves downward in the working area, adding another layer of granules and repeating the process until the piece has built up. This process uses the unfused media to support overhangs and thin walls in the part being produced, which reduces the need for temporary auxiliary supports for the piece. A laser is typically used to sinter the media into a solid. Examples include selective laser sintering (SLS), with both metals and polymers (e.g. PA, PA-GF, Rigid GF, PEEK, PS, Alumide, Carbonmide, elastomers), and direct metal laser sintering (DMLS).

Selective Laser Sintering (SLS) was developed and patented by Dr. Carl Deckard and Dr. Joseph Beaman at the University of Texas at Austin in the mid-1980s, under sponsorship of DARPA. A similar process was patented without being commercialized by R. F. Housholder in 1979.

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Selective Laser Melting (SLM) does not use sintering for the fusion of powder granules but will completely melt the powder using a high-energy laser to create fully dense materials in a layer-wise method that has mechanical properties similar to those of conventional manufactured metals.

Electron beam melting (EBM) is a similar type of additive manufacturing technology for metal parts (e.g. titanium alloys). EBM manufactures parts by melting metal powder layer by layer with an electron beam in a high vacuum. Unlike metal sintering techniques that operate below melting point, EBM parts are fully dense, void-free, and very strong.

Another method consists of an inkjet 3D printing system. The printer creates the model one layer at a time by spreading a layer of powder (plaster, or resins) and printing a binder in the cross-section of the part using an inkjet-like process. This is repeated until every layer has been printed. This technology allows the printing of full color prototypes, overhangs, and elastomer parts. The strength of bonded powder prints can be enhanced with wax or thermoset polymer impregnation.

## **Lamination**

In some printers, paper can be used as the build material, resulting in a lower cost to print. During the 1990s some companies marketed printers that cut cross sections out of special adhesive coated paper using a carbon dioxide laser and then laminated them together.

In 2005, Mcor Technologies Ltd developed a different process using ordinary sheets of office paper, a Tungsten carbide blade to cut the shape, and selective deposition of adhesive and pressure to bond the prototype.<sup>[36]</sup>

There are also a number of companies selling printers that print laminated objects using thin plastic and metal sheets

## **Photo polymerization**

Stereo lithography was patented in 1986 by Chuck Hull. Photo polymerization is primarily used in stereo lithography (SLA) to produce a solid part from a liquid. This process dramatically redefined previous efforts, from the "photosculpture" method of François Willème (1830–1905) in 1860 through the photopolymerization of Mitsubishi's Matsubara in 1974. The "photosculpture" method consisted of photographing a subject from a variety of equidistant angles and projecting each photograph onto a screen, where a pantagraph was used to trace the outline onto modeling clay)

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In photo-polymerization, a vat of liquid polymer is exposed to controlled lighting under safelight conditions. The exposed liquid polymer hardens. The build plate then moves down in small increments and the liquid polymer is again exposed to light. The process repeats until the model has been built. The liquid polymer is then drained from the vat, leaving the solid model. The EnvisionTEC Perfactory is an example of a DLP rapid prototyping system.

Inkjet printer systems like the Objet PolyJet system spray photopolymer materials onto a build tray in ultra-thin layers (between 16 and 30  $\mu\text{m}$ ) until the part is completed. Each photopolymer layer is cured with UV light after it is jetted, producing fully cured models that can be handled and used immediately, without post-curing. The gel-like support material, which is designed to support complicated geometries, is removed by hand and water jetting. It is also suitable for elastomers.

Ultra-small features can be made with the 3D micro-fabrication technique used in multiphoton photopolymerisation. This approach uses a focused laser to trace the desired 3D object into a block of gel. Due to the nonlinear nature of photo excitation, the gel is cured to a solid only in the places where the laser was focused while the remaining gel is then washed away. Feature sizes of under 100 nm are easily produced, as well as complex structures with moving and interlocked parts.

Yet another approach uses a synthetic resin that is solidified using LEDs.

### **Mask-image-projection-based stereolithography**

In this technique a 3D digital model is sliced by a set of horizontal planes. Each slice is converted into a two-dimensional mask image. The mask image is then projected onto a photocurable liquid resin surface and light is projected onto the resin to cure it in the shape of the layer. The technique has been used to create objects composed of multiple materials that cure at different rates. In research systems, the light is projected from below, allowing the resin to be quickly spread into uniform thin layers, reducing production time from hours to minutes. Commercially available devices such as Objet Connex apply the resin via small nozzles.

### **Bio printing**

The medical applications of 3D bioprinting are numerous, and are thus the subject of intensive research at academic institutions such as Cornell University and companies such as Organovo.

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Researchers in the Jonathan Butcher Laboratory at Cornell University have been developing methods to bioprint living aortic heart valves. Poly(ethylene glycol)-diacrylate (PEGDA) is used as a base polymer, because of its biocompatibility and easily tunable mechanical properties. Two different solutions of PEGDA were created with different mechanical stiffness's when cross-linked, with the stiffer polymer to be used as the aortic root wall and the compliant polymer to be used as the valve leaflets. Using these solutions, a valve exhibiting mechanical heterogeneity and cytocompatibility was bio printed, which will serve as a base for future development of the aortic valve printing process.

The Lawrence Bonassar Laboratory at Cornell University has been working on 3D bio printing cartilaginous geometries. One focus of their research involves the replacement of intervertebral disks with Tissue Engineered-Total Disk Replacement constructs. Tissue engineered intervertebral disks were bio printed with cell-seeded hydrogel constructs, and implanted into male rats.

Commercially, Printerinks, a UK company, and Organovo, a U.S. company, have worked together to develop human tissue through 3D printing. Printer cartridges are adapted to use stem cells obtained from biopsies and grown in cultures. The resulting substance is called Bioink.

## **6. Advantage Of 3d Printing**

### **Cheap Manufacturing**

As discussed in the first post of this series, 3D printing is increasingly being used by large companies such as Converse or Alessi to replace some of their traditional manufacturing methods with cost savings of up to 70%. This is achieved through lower shipping and packaging costs related to overseas parts suppliers, less human resource involved and cheaper and sometimes more reliable raw materials.

Although currently 3D home-printed objects are not necessarily cheaper than their mass-manufactured counter parts, printing your own object a priceless experience for many (at least until its novelty wears off). 3D printed objects are only expected to get cheaper with improved additive manufacturing techniques, cheaper consumables, main stream adoption and self-replicating practices.

### **Quick Production**

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The speed of 3D printing compared to traditional methods is similar to comparing a sports car's top speed to a horse cart's. They both take you where you want to go but the journey time differs considerably. With industrial 3D printers being able to 'manufacture' most objects in a matter of hours, the classical manufacturing methods, taking up to several days or even weeks (from prototype to end product), are slowly becoming obsolete.

This leads to massive cost savings and to an on-demand manufacturing model. Why should you have warehouses filled up with stocks of your products if you can create them according to demand? Even if this model might not work with the big offline manufacturers due to their dependence on offline retailers that usually buy in bulk, it can prove extremely efficient for an online business.

### **Less waste**

Manufacturing metal and plastic objects in particular is usually a wasteful process with chunky parts and a lot of surplus material. For some aircraft makers, up to 90% of the material is being cut away and no longer useful. Making a similar object using additive manufacturing not only uses less energy but also reduces waste to a minimum. And sometimes, the finished 3D printed product can be up to 60% lighter compared to the machined part but still as sturdy according to the Economist. Significant cost savings can be achieved in this way and less waste also means a lower impact on the environment.

### **Better quality**

Think about 3D printing as cake baking. You can make a cake by whisking some cake mix, pouring it in an oven tray and baking everything. The result may taste amazing but it can have unwanted air bubbles inside, different thickness and all nuts or fruits could be grouped to one side. However, if you could assemble the cake layer by layer similar to additive manufacturing, you could achieve perfection through a full control of where each layer is going and how it fits with the rest.

Avoiding most of the mass manufacturing faults does not only make better products but it also extends their life as they will break less often. This is not necessarily a great benefit for manufacturers who need the product life cycle to be profitable, but it is certainly a major benefit for the end consumer.

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## **Accessibility**

With more people getting access to 3D printing, it may not be long until we will all have our own multi-purpose contraption (with additive manufacturing being only one of the many functionalities) capable of creating the products we need, when we need them. This can seriously shake up the current consumerism culture built on the contemporary industrial supply chain nevertheless, it remains to be seen if this is only an ideology or a possible transitional period in human evolution.

Less waste compared to traditional manufacturing methods is not only a cost saving feature of 3D printing but also a possible eco-friendly attribute. Add to this the multi-purpose characteristic of a 3D printer (can build different objects without the need of using specialised machines for each part) and their digital ecosystem (all 3D models are transmitted electronically so in theory they can be printed out where they are needed, minimising therefore transport costs) and you get a sustainable manufacturing process. Integrating additive manufacturing with more classic production methods – as is the case with 3D printed textiles in the clothing industry – adds another layer (excuse the pun) to the sustainability case.

## **New shapes and structures**

Traditional manufacturing methods rely on moulds and cutting technologies to produce a finite number of shapes and structures, with more complex hollow ones having to be created from several parts and assembled together. But 3D printing changes this altogether – the 3D printer's nozzle can build an infinite number of complex figures, being limited only by human imagination. This method gives them more durability and higher structural integrity. From medical implants that resemble bone to aerodynamic parts for the space industry and from unique-shaped furniture to 3D printed jewellery, the opportunities are endless.

## **New combinations of materials**

Mixing different raw materials is not always possible with mass-manufacturing methods due to the sometimes high costs involved and to their physical & chemical properties that make them difficult to combine through traditional methods. 3D printing has removed many of these boundaries not only because of the initial dependency on plastic (being one of the few raw

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materials that melt at lower temperatures) but also because of a continuous innovation fed by enthusiasts believing that additive manufacturing's potential has not been reached yet. As a result, many companies now offer tens of different materials with different finishes giving the look and feel of metal, ceramics or glass with various strengths and temperature resistance.

## **New business models**

With 3D printing gaining popularity fast, entrepreneurs have not lost any opportunity to get their foot into an industry deemed by many as potentially very lucrative. This is how 3D printing 'shops' were born. Imagine going shopping in a supermarket where you decide how your products will look and feel, and where everything can be personalised to fit your demanding tastes.

## **7 Disadvantage Of 3d Printing**

### **Fewer Manufacturing Jobs:**

As with all new technologies, manufacturing jobs will decrease. This disadvantage can and will have a large impact to the economies of third world countries, especially China, that depend on a large number of low skill jobs.

### **Limited Materials:**

Currently, 3D printers only manufacture products out of plastic, resin, certain metals, and ceramics. 3D printing of products in mixed materials and technology, such as circuit boards, are still under development.

### **Copyright:**

With 3D printing becoming more common, the printing of copyrighted products to create counterfeit items will become more common and nearly impossible to determine.

### **Dangerous Items:**

3D printers can create dangerous items, such as guns and knives, with very little or no oversight.

### **More Useless Stuff:**

One of the dangers of 3D printers is that they will be used to create more useless stuff that is bad for the environment and wallets. Fortunately, there are new methods of automatically recycling objects made by 3D printers that hold promise of better recycling in the future.

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### **Size:**

Currently, 3D printers are limited with the size of the products that they can create. Ultimately, large items, such as houses and building, could be created using 3D printers.

## **8. Application**

### **Medical :- A New Way to Heal Broken Bones**

In the near future, having a broken arm could look way cooler thanks to a new, black, lightweight 3-D printed cast that's patterned like latticework and which uses an ultrasound device to make bones heal more quickly.



**a new way to heal broken bones by 3d printing**

### **.3d printed wound hill process**



Scanning the wound



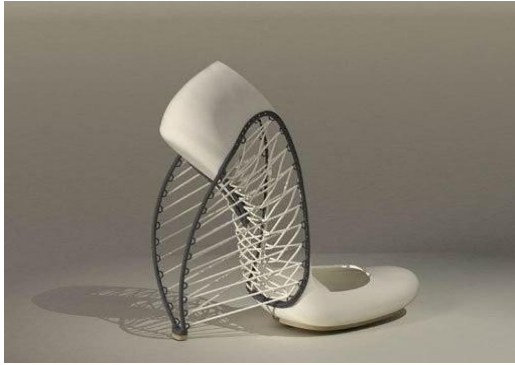
Filling the wound

### **3.Jewellery**



different type of rings and jewellery

## 8.4. footwear



different type of footwear made by 3d printing

## 8.5 .3d printed car

Urbee II, a 3D-printed electric car about to go into production, boasts an ultrastrong, ultralight chassis that can take on highway rigors with ease.

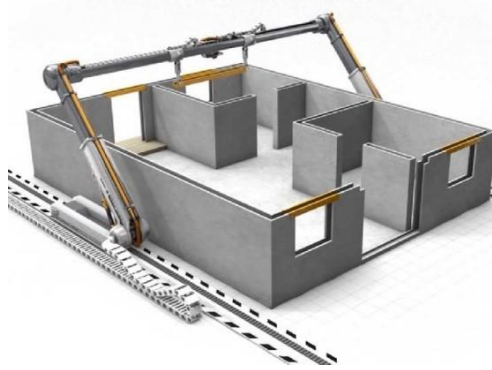


Urbee II 3D printed car

## 8.6. bulding construction:

Building printing refers to various technology that use 3D printing as a way to construct buildings. The advantages of this would be quicker construction, lower labor costs, and less waste produced. It is also a potential way of building extraterrestrial structures on the Moon or other planets where environmental conditions are less conducive to human labor-intensive building practices.

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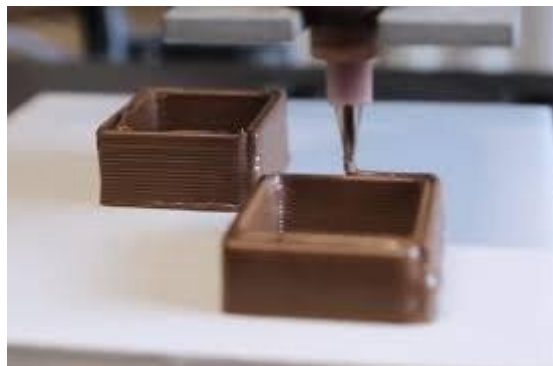
**3d printed home**

## **8.7. Toys**



**Different type of toys**

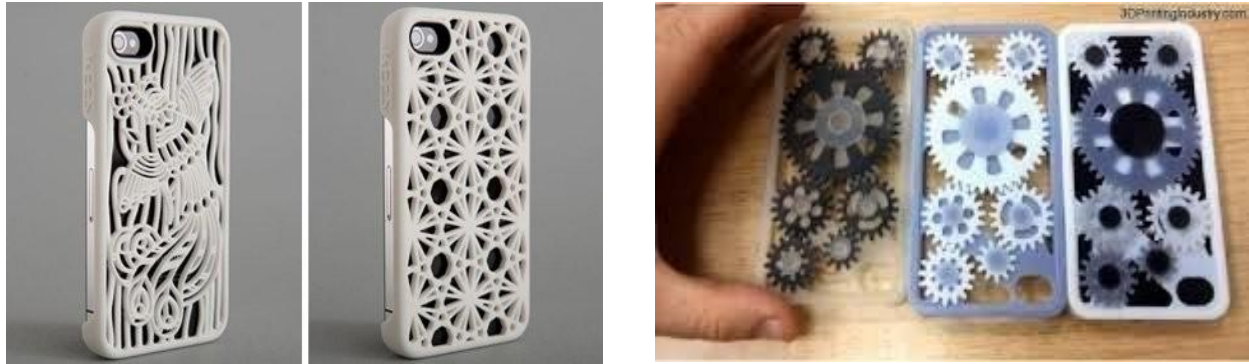
## **8.8. Food**



**Different type of food**

## **Mobile covers**

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different type of mobile covers

## Guns



Gun made by 3d printing

## 8.11. human organs:-



different type of human organs using 3d printing

## Conclusion

3D printing can offer benefits across the entire creation process from initial concept design to final manufacturing and all steps in between. Different applications have unique needs and understanding those application requirements is critical when choosing a 3D printer. Multiple systems may offer broader use opportunities than a single system, so identifying your unique requirements to apply 3D printing across your entire design-to-manufacture process can shorten time-to-market, improve product performance, streamline and cost-reduce manufacturing, and improve product quality and customer satisfaction will help you define the ideal 3D printing capability for your organization.









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Date: 03/09/2021

## TO WHOM IT MAY CONCERN

This is to certify that **Mr. Tushar Soni**, a student of Production and Industrial Engineering 3<sup>rd</sup> Year, MBM Engineering College, Jodhpur has successfully completed 45 days of summer internship from 01.07.2021 to 14.08.2021.

During this period of his internship program, he had been exposed to different processes and was found diligent, hardworking and inquisitive.

We wish him every success in his life and career.



(Authorised Signatory)

For BORANA INDUSTRIES

Authorised Signatory

# Certificate of Training

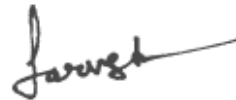
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**Vaibhav Gupta**

from MBM Engineering College , Jodhpur, has successfully completed a six weeks online training on **3D Printing**. The training consisted of Introduction to 3D Printing, Principles, Technologies, and Materials, The Printing Journey, Applications of 3D Printing, Merits, Advancements, and Scope and Final Project modules.

In the final assessment, Vaibhav scored 88% marks.

We wish Vaibhav all the best for the future endeavours.

A handwritten signature in black ink, appearing to read "Sarvesh".

**Sarvesh Agarwal**

FOUNDER & CEO, INTERNSHALA

Date of certification: 2021-08-02

Certificate no. : 71349FB2-0C1D-C7F1-9B52-332E617E28FB

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2020-21

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JAI NARAIN VYAS UNIVERSITY, JODHPUR**

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**NOTICE**

Project allotment list of the final Yr. B.E. Civil students is given below, Students are instructed to contact their Project Supervisor for further action, with immediate effect.

Name of Project Supervisor : **Prof. A. N. Modi**

Project subject /Topic : **New Techniques in Water Treatment**

S.No.	Name of Student
1	Atul Singh
2	Balkrishna Attal
3	Deepak Kumar Labana
4	Hansa Ramawat
5	Hanumana Ram
6	Mahipal Vishnoi
7	Mana Ram
8	Prem Prakash
9	Rahul Kumar Meena
10	Ram Pal
11	Rohit Solanki
12	Roshan Bhagora
13	Sanjay Kumar Saran
14	Sanjay Rathore
15	Sourav Singh
16	Sunil Kumawat
17	Tapendra Singh
18	Vishal Faujdar
19	Yadavendra Sharma
20	Surendra Kumar Vishnoi

  
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Name of Project Supervisor : **Prof. Suresh Kumar Sankhla**

Project subject /Topic : **Performance Study & Design for Retrofitting of an Old RCC Building**

S.No.	Name of Student
1	Pooja Saini
2	Saloni Jagwaral
3	Jeeshan Ali Chouhan
4	Gautam Sharma
5	Ghanshyam Kumpawat
6	Khushwant Singh Rathore
7	Dharmendra Kumar Meena
8	Ankit Mathur
9	Damodar Lal Dhaker
10	Harshvardhan Singh Rajawat
11	Abhishek Gurjar
12	Deena Ram
13	Amit Kumar Meena
14	Bajrang Parihar
15	Anil Yadav
16	Hawa Singh Gurjar
17	Lekhraj Gurjar
18	Gaurav Verma
19	Arvind Mehra
20	Bhawani Singh

  
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Name of Project Supervisor : **Shri Sanu Meena**

Project subject /Topic : **Behavioural travel Modelling**

S.No.	Name of Student
1	Kaluram Meena
2	Jay Kumar Baror
3	Hemant Khatri
4	Jyoti Mittal
5	Jatin Moond
6	Harshita Jain
7	Himani Bahmania
8	Harsh Agarwal
9	Chandra Prakash Gupta
10	Shubham Verma
11	Anchal
12	Mukesh Gahlot
13	Mohit Khajuria
14	Jagrati Panwar
15	Khushbu Garg
16	Pankaj Nagar
17	Anil Kumar Fageria
18	Charu Kain
19	Mahima Dindur
20	Himanshi Saini

  
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Name of Project Supervisor : **Prof. Shailesh Choudhary**

Project subject /Topic : **Multi Storey Building Design**

S.No.	Name of Student
1	Narendra Kumar
2	Pushpa Bhardwaj
93	Monica Bunkar
4	Deepali Mathur
5	Kamal Kishore Rakhecha
6	Jahanvi Vyas
7	Richhpal Singh
8	Ritika Yadav
9	Nand Kishor Maal
10	Deeksha Ahirwar
11	Abhinav Bajal
12	Abhishek Kumar Mundotiya
13	Ravindra Lohiya
14	Jaypal Prajapat
15	Rajkumar Surana
16	Ram Lal Kumawat
17	Anshul Choudhary
18	Manju Choudhary
19	Lokesh Ahir
20	Subal Doyal
21	Jayesh Damor

  
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Name of Project Supervisor : **Prof. Peeyush Choudhary**

Project subject /Topic : **Latest Trends in Highway Engineering**

S.No.	Name of Student
1	Sakshi Choudhary
2	Vijesh Prajapat
3	Manali Panwar
4	Ashish Panchariya
5	Mukesh Dadhich
6	Mukesh Dadhich
7	Vedansh Solanki
8	Ravina Kumari
9	Narsi Ram Gurjar
10	Rohit Saimar
11	Nishant Meena
12	Kapil Rathore
13	Naresh Kumar Pandey
14	Aniruddh Guha
15	Mansi Bhati
16	Manoj Bhadu
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18	Kajal Meena
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20	Ashutosh Sharma
21	Ayush Laddha
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Name of Project Supervisor : **Shri Umesh Kumar**

Project subject /Topic : **Hydrological Analysis in Water Basins**

S.No.	Name of Student
1	Manisha Meena
2	Ayush Surana
3	Kirti Meena
4	Garima Khichar
5	Kanchan
6	Rahul Kumawat
7	Pradeep Singh
8	Pravesh Khandelwal
9	Abhilasha Choudhary
10	Amit Charan
11	Praveen
12	Raina Venposh
13	Puneet Gurjar
14	Ravi Prakash Rajpurohit
15	Hanuman Singh
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**INTERNSHIPS DURING THE YEAR**

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2.	BHARTI PARIHAR	
3.	ESHNA SINGH	
4.	FIRDOUS KHANAM	
5.	GARVIT SHARMA	
6.	HARSH VARDHAN BARCHE	
7.	ISHIKA AGARWAL	
8.	KANIKA GUPTA	
9.	KANISHK SHARMA	
10.	KARTIK KHOKHAR	
11.	KARTIK PARIHAR	
12.	LAKSHYA KUMAWAT	
13.	LAXMAN SINGH BHATI	
14.	LEENA SONI	
15.	NAVIDH PACHAURI	
16.	NIDHI JAIN	
17.	NIRIKSHA VAGHASIYA	
18.	PRAJJWAL TANK	
19.	PRAVEEN SINGH RATHORE	
20.	PUSHPDEEP GEHLOT	
21.	RISHI VIJAY	
22.	RONAK LUHADIA	
23.	SAURABH SUTHAR	
24.	VIDDYUL VIKAS TEOTIA	
25.	YASHASVI SHARMA	
26.		
27.		