Unlocking Atmanirbhar Bharat Through NEP-2020

Proceedings of 1st National Conference

November 27, 2020

Chief Editor: Prof. Shyam Sundar Pattnaik

Editors: Prof. Rupinder Singh
Dr. Balwinder Singh
Dr. Balwinder Raj

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National Institute of Technical Teachers Training and Research
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Proceedings of 1st National Conference on Unlocking Atmanirbhar Bharat Through NEP-2020

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Proceedings of the National Conference at National Institute of Technical Teachers Training and Research, Chandigarh, India-160019

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Prof. S S Pattnaik
Director, NITTTR Chandigarh

From the Desk of Chief Editor

National Education Policy (NEP)-2020 has come as a boom for the education system of the country more specifically the higher education system which was looking for fresh oxygen to go through a complete transformation. Emerging technologies like Artificial Intelligence, Block chain, IOT, IIOT, Quantum Computing, Augmented Reality, Virtual Reality, 3D Printing etc are evolving very fast leading to an accelerated transformation of industry as industry 4.0 or beyond. Academic institutions were desperately looking forward to new avenues , I will say new Disha, to come out of the suffocated system which was failing to meet the fast changing expectations of the industries. NEP-2020 is not a simple policy document but it is a gateway to limitless opportunities. The flexibility, multidisciplinarity, academic bank of credits, autonomy to faculty and institutions, categorisation of institutions/universities based on strength, mentoring, lifelong learning, training the trainers and internationalization etc. discussed in NEP-2020 on successful implementations will make our country again the Global Guru and our Universities and Institutions will have flow of students from all part of the globe which once was with us as our past glory in the names of Takshila and Nalanda. The call of Honourable Prime minister of the country on Atmanirbhar Bharat is not only a necessity but also for regaining our position in the global competitive scenario for sustainability. The role of higher education, specifically the higher technical education system of the country in Atmanirbhar Bharat is pivotal. The steering of the contributions of nearly 11000 technical institutions of the country in true sense can create the ecosystem for Atmanirbhar Bharat. The initiative of National Institute of Technical Teachers Training and Research (NITTTR) Chandigarh by conducting its first National Conference on Unlocking Atmanirbhar Bharat through NEP-2020 on 27th November, 2020 is an attempt to make the academic community aware of the potential of NEP-2020 and how the academic community can leverage the opportunities of NEP-2020 to contribute towards the nation building by playing a pivotal role in Atmanirbhar Bharat. The organising team left no stone unturned to see that the participants' all queries are met. Experts, well versed with NEP-2020, and Atmanirbhar Bharat were invited to deliver their expertise views and guidance. The selection of only limited papers shows the high quality benchmark set by the organising team to ensure that only relevant, realistic and implementable aspects are presented before the participants. The NITTTR, Chandigarh has already initiated action to have an industry meet with a theme “Vocal for local for Ludhiana Industries through NEP-2020".

National Institute of Technical Teachers Training and Research
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Observations of Conference Chairs

Prof. Pankaj Sharma
Conference Chair

Prof. Rupinder Singh
Conference Chair

It is a matter of great pleasure that National Institute of Technical Teachers Training and Research, Chandigarh is organizing a National Conference on UNLOCKING ATMANIRBHAR BHARAT THROUGH NEP-2020. National Education Policy – 2020 will play a key role for making our country self-reliant. Atmanirbhar Bharat is a key to self-sustainability and is one of driving force for the progress of society through innovation. I hope this conference will be a platform to deliberate the issues pertaining to the theme of conference. I encourage the participants of this conference to consider the idea of making India self-reliant through interdisciplinary collaborations. I am sure that this conference would provide an opportunity to the participants to enrich themselves while interacting with the distinguished educationists, scientists and researchers.

***I extend my best wishes for a grand success of this conference*.**

Editorial Column

Welcome to the Proceedings of the one day National Conference on "Unlocking Atmanirbhar Bharat through NEP-2020", organized by NITTTR Chandigarh, India. Ensuring a quality conference requires accepting papers that pass a rigorous review process. A large number of papers were submitted for this conference from different states and the papers included in the proceedings are papers selected for oral presentation from various papers received for the conference after peer review process. In this conference, we have 4 technical tracks and 2 keynote speeches.

The areas covered in the conference were: Paradigm shift of curriculum design for institution integration to boost Atmanirbhar Bharat in light of National Education Policy (NEP) 2020, Inter/Multi-disciplinary programs to boost the research requirements of Atmanirbhar Bharat, Integration of different engineering disciplines for Atmanirbhar Bharat, Rural Atmanirbharta: Role of engineering colleges through NEP, Role of NEP in growth of MSME/Digital manufacturing to boost Atmanirbhar Bharat, NEP inspired entrepreneurship approach in student/institution level mind change to boost Atmanirbhar Bharat

We would like to express our deepest appreciation to the authors whose technical contributions are being presented in these proceedings. It is because of their excellent contributions and hard work that we have been able to prepare these proceedings. The significance of the work presented in this conference represents a step further towards Unlocking Atmanirbhar Bharat through NEP-2020.

We would like to thank all our keynote speakers who made all the efforts to synthesize the materials and their wide and rich experiences to deliver distinguished talks. We would also like to thank the Director NITTTR Chandigarh for his sincere efforts in delivering excellent inaugural address that focus on the implementation of NEP-2020. We are very grateful to the conference technical program committee members, session chairs and the designated reviewers. Finally, we hope that the participants shall enjoy the conference program and their new learning through online mode.

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1st National Conference on
UNLOCKING ATMANIRBHAR BHARAT THROUGH NEP-2020
27th November, 2020
NITTTR, CHANDIGARH 160019

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Summary of Papers for National Conference ANB-NEP-2020

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Summary of Papers for National Conference ANB-NEP-2020

ANB-NEP-2020P1

Curriculum Development for Autonomous Technical Institutions under NEP 2020 to Accelerate Multidisciplinary Research: A Step towards Atmanirbhar Bharat

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Abstract: In this paper, a curriculum development model emphasizing Multidisciplinary courses is proposed. Features of NEP 2020 and pillars of Atmanirbhar Bharat are linked together in terms of curriculum development and implementation in autonomous technical institutions. This type of curriculum comprising multidisciplinary courses will definitely strengthen the product development capabilities and skills of technocrats which will definitely boost the Atmanirbharta in Bharat. Important factors that are supportive to curriculum implementation are also discussed.

Keywords: National Education Policy (NEP), curriculum development model, Multidisciplinary courses, Atmanirbhar Bharat

1. Introduction: National Education Policy (NEP) 2020 focuses on strategies needed to promote research and innovation across all disciplines, promote inter-disciplinary research and make India a global hub of R and D and innovation. Under NEP 2020 Part III, Chapter 20, Professional Education under Point No. 20.6 special centre of attention is directed towards Technical education and its various streams which are the key factors for developing India. Various factors for systematic and synchronized implementation of NEP 2020 are listed in NEP 2020, Part IV, Chapter 27, Point No. 27.2 and 27.3. These factors are important for experts and authorities of ministries, regulatory authorities, various bodies, and educational institutions for effectiveness of NEP 2020. Under NEP 2020 Part II Chapter 9 point no.9.3 indicates the key changes (a), (b), (c) and (d) are important. The proposed changes are defined for multidisciplinary undergraduate education, revamping of curriculum, moving towards institute autonomy etc.

In NEP 2020, Part I Chapter 4, point no.4.6 of holistic and integrated flexible approach is mentioned for curriculum and pedagogy in school education. In this section, adoption of experiential learning and its types are emphasised. This approach is also useful for curriculum design, development and its effective implementation for technical education.

In NEP 2019, point no. 9.2 it is stated that in 21 century holistic and multidisciplinary education is becoming necessary for knowledge development of students as well as becoming essential to enhance the skills required by industries. It is emphasised in NEP 2019 that through institutional autonomy cutting-edge programmes can be run which is useful for industry and society. Particularly in NEP 2020, centre of attention is holistic and

multidisciplinary learning. Basically, learning is correlated with Curriculum. Curriculum design, development and its effective implementation. It is an important prime objective and strong pillar of autonomous institutions to produce manpower with technical innovativeness and research capabilities. This will be transformed to design of product/system which is key factor of Atmanirbhar Bharat.

This paper is divided into four sections as follows. Section 2 presents linkage between NEP 2020 and Pillars of Atmanirbhar Bharat. Technology driven basic needs of multidisciplinary programmes/courses are also listed in this section. Curriculum development model for autonomous technical institutions like Degree and Diploma in Engineering and Technology to accelerate the multidisciplinary research is presented and explained in Section3. Essential important aspects to be newly started and reoriented in autonomous institutes are discussed in Section 4. Finally, the paper is concluded.

2. Linkage Between NEP 2020 and Pillars of Atmanirbhar Bharat (Self-Reliant India)

Fig.1 shows the linkage between two important elements NEP 2020 with Atmanirbhar Bharat. Further, both elements are linked with the subcomponent of Technical Education. Autonomous Polytechnics and Engineering (Degree) institutions have Curriculum Development as their one of the major pillars along-with others.

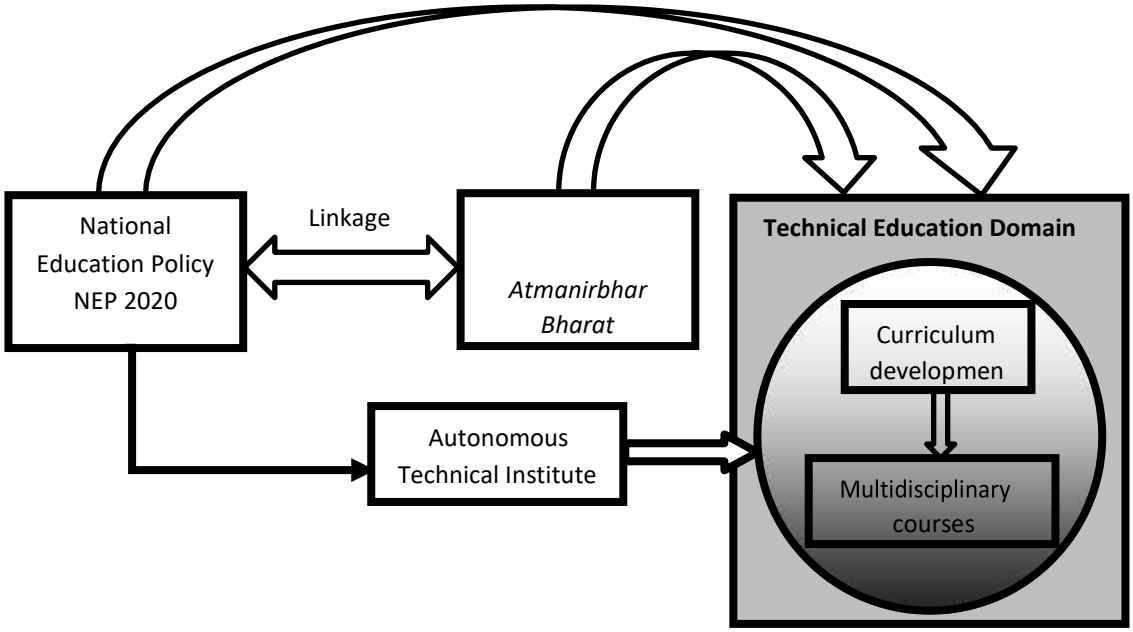

Fig.1 Linkage between NEP 2020 and Atmanirbhar Bharat with Technical Education.

(1) Technical education encompassing autonomous technical institutes is important component of NEP 2020 (2) There are five pillars of Atmanirbhar Bharat. Out of them (a) Pillar No.1 that is economy, (b) Pillar No.3 that is system- Technology Driven (c) Pillar No. 5 is Demand. Technical education policies, development and implementation methodologies described in NEP 2020 are more matching and in hand-to-hand with these Atmanirbhar

Bharat Pillars. Pillar No. 3 is technology driven under which interdisciplinary courses and researches are to be introduced and taught so that technocrats/engineers/researchers can opt start-up of a new production/business.

2.1 Basic Needs of Multidisciplinary or Technology driven Courses

1) Identify and realize needs of society, stake holders and common man.

2) Minutely sort out complex, tedious and serious problems amongst society, agriculture, environment (Ecosystems) and industries.

3) To provide effective, economically feasible, optimistic and intelligent solution in terms of hardware (product) or software.

4) To increase user friendliness in old systems or upcoming systems/products.

5) More focus should be given from product design to product development and marketing.

6) Repairing and Maintenance of existing systems is essential.

3. Proposed Curriculum Development Model for Autonomous Technical Institutes

Fig.2 depicts the proposed curriculum development model for autonomous technical institutes under NEP 2020. This model is useful to accelerate the multidisciplinary research. This model is developed according to different parameters suggested in NEP 2020. This will lead to create technical manpower/technocrats to develop Atmanirbhar Bharat. Details of this model is as follows. Research is nothing but identification or determination of issues (problems) or needs in societal and industrial sectors. For this, any product/system is to be developed either by innovation, research, or adopting continuous improvements in existing systems. A product or system is an integration or combination of different traditional engineering/technology, fundamentals/principles of science and mathematics as well as economics. This indicates that during learning phase the student/researcher should learn core technology courses as well as various important courses belonging to other engineering disciplines. Here, courses indicate subjects. Technical education covers Diploma, Degree, Post-Graduate and Doctoral studies in engineering and technology. In autonomous institutes, need based Curriculum development and its effective implementation is the key function. Till date only industry needs were considered but it is need of time to consider societal needs/problems to develop curriculum. Now, it is necessary for technocrats to come to certain product level to provide better solution to a problem. Therefore, during curriculum development multidisciplinary research approach is proposed in the model. Traditional or core courses should be taught in addition to hands-on-skill based courses should be incorporated. Further, courses on data analysis in various fields should be added. Ecosystems development is an important aspect that should be introduced in the curriculum. Development of Sensor based systems should be added in the curriculum. For Doctoral

research work the course work should comprise interdisciplinary courses related to research topic. This model will help to inculcate various skills amongst the students/researchers.

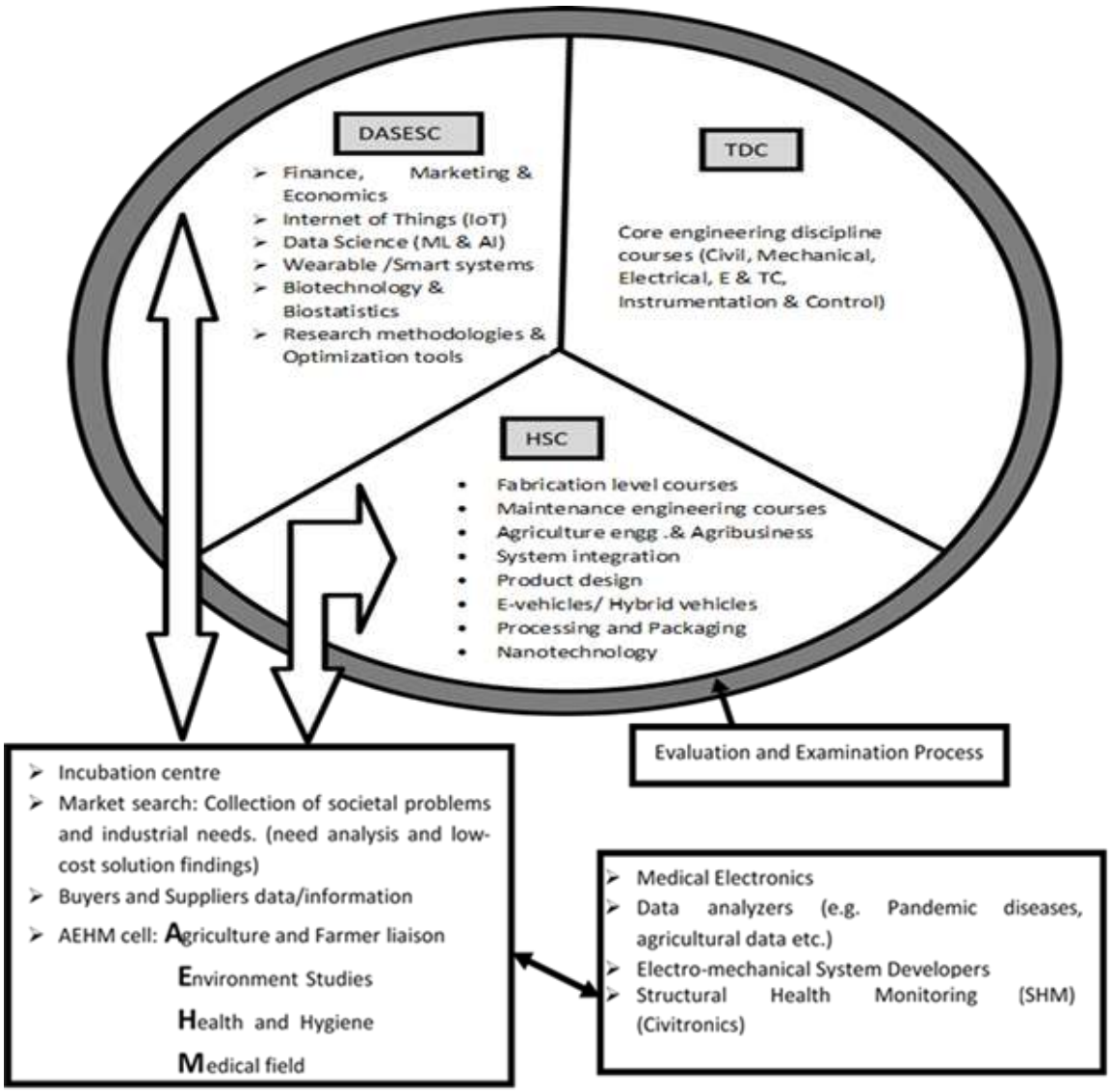

Fig.2 Proposed Curriculum Development Model for Autonomous Technical Institutes

TDC: Traditional Core Courses; HSC: Hands-on-Skill based Courses; DASESC: Data Analysis Smart & Eco Systems based courses. HSC+DASEC = Multidisciplinary courses

4. Important aspects: Some other important aspects (A1 to A4) that are to be considered for autonomous technical institutes are presented below.

A1: Reorientation of Board of Governance (GB)/Programmewise Board of Studies (PBoS).

A1: Industrial experts are members of these bodies like GB and PBOS. These are curriculum approval and institutional development monitoring bodies. In addition, it is suggested that (1) Farmer(s) from local kisan manch (2) Medical doctor(s)/physician(s) from local Indian Medical Association (IMA) should be the members of GB and PBOS to know their problems and

difficulties during their regular practices. These problems should be addressed to respective departments through incubation center. Farmer(s) may discuss their different problems/technical difficulties about agriculture e.g. water and fertilizer delivery systems, transportation of vegetables and grains etc. Doctor will put problems occurred in patient bedside monitoring, drug delivery systems, sensor arrangements, health care systems and sensors etc. Because both of the experts will discuss the real time difficulties which are very much pertaining to human life.

A2: Develop Institutional networking at State level and National level

A2: It is necessary to have better networking amongst autonomous technical institutions. There should be strong association and networking between state level autonomous institutes. Afterwards, this network should be upgraded to National level. This will help to effectively utilize technical manpower and resources. Also, different projects/needs, design ideas, data and concepts can be shared i.e. technology transfer phenomenon. This will save the efforts of duplication and related hard-work.

A3: Motivation to multidisciplinary/ cross- disciplinary research.

A3: Multidisciplinary centres should be formed in the institute(s) with necessary technical manpower, finance and funding proposals should be submitted appropriate agencies. Necessary trainings/workshops by scientists, innovators, economist should be arranged for students, research scholars and faculty members. Innovative problems and cross - disciplinary projects should be assigned to group of students (e.g. Mechatronics, Civitronics, Medical Electronics, Automotive electronics, Wearable computing etc.). More focus should be given on final product which may be useful for society. Efforts of experts like physicists, biologists, bio-technologists, farmers, statisticians, mathematicians' medical doctors, economists etc. should be taken and appropriate appreciation should be given to them as co- authors in research papers, projects and patents. There are two types of research problems

(1) Basic research problems related to core or traditional discipline (2) For multidisciplinary courses the societal problems/community problems should be well-thought-out. It is a combination of more than one traditional discipline.

A4: Formation of Start-up Support Cell (SSC) to guide and help students

A4 : Functions of Start-up Support Cell are- (1) Lectures/Workshops should be arranged for Graduating students/researchers by inviting authorities of Govt. Offices, MSME, and Bank officers to discuss State and Central Govt. schemes, proposals and policies to start up a new business/industry. Support should be given to freshers in various activities like product design, testing, certification and marketing etc. The culture of Innovators to product developers and up to global supplier should be developed. This cell should have better linkage with Incubation centre.

Conclusion: This paper provides insight vision for relation between NEP 2020 and Atmanirbhar Bharat through multidisciplinary courses in curriculum implementation process. This leads to accelerate the development of product/system and selling it at India and global level. Apex bodies in India like UGC, AICTE and institutes of national importance like IITs, NITs, NITTTRs should consider this approach as a step towards Atmanirbhar Bharat.

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ANB-NEP-2020P2

Perspective of NEP 2020 for integration of different engineering disciplines – A Step towards Atmanirbhar Bharat.

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Abstract: Education plays a vital role in our lives for complete development of human skills and potential and to make human respectable in society, and to elevate development of resources in country. Everyone has right to learn and get education in India, and thereafter acquire leadership skills at international level in terms of growth of economy, social equity, gender equality, advancement of technology, national assimilation, and to protect culture. To achieve this globally, high-graded education is the best path to advance skills and talent of the youngsters in the whole world. In next decade, we can say that India will be the country with maximum population of youngsters in the whole world [1]. Our potential to provide high graded educational opportunities and in particular technical education to them will decide the potential of our country. This paper is an attempt to study Interdisciplinary & multidisciplinary programs and integrating different engineering disciplines to boost the requirements of Atmanirbhar Bharat- vision of our worthy Prime Minister. Further, it is observed that NEP 2020 will help to step forward in establishing Atmanirbhar Bharat and fulfilling its requirement by improving quality of education for all sections of society at very early age/stage of learning.

Keywords: NEP: New education policy, ABC: Academic Bank of Credit

1. Introduction

As we all know that now a day's engineering has found its applications in each and every field of society, be it a automobile industry, medical field, share market , home automation, ecommerce , agriculture, remote sensing, space exploration etc to name a few . Further, recent outbreak of pandemic- COVID 19 has changed the life of all members of the society. School and college education has gone online; work from home culture has flourished. This was possible only because of availability of resources and high speed internet connectivity at the last mile, which is a boon to society due to technological advancements. This technological advancement could happen only because of major technologies like computer networks, optical fibre a broadband transmission media and high end processors.

In this direction, to cope with the requirements of mankind from 10 years or so from now, there is a dying need to reform the education sector at grass route level so that young students of middle grade and higher should be educated to be technological savvy. In this direction, the New Education Policy 2020 is a step forward to achieve Indian goal of Atmanirbhar Bharat. As our prime minster said "We all grasp that information has no boundaries. The New Education Policy 2020 can open up the country's education sector. The intention is to open campuses of foreign universities in Asian country and our students get

world exposure. Likewise, analysis collaboration and student exchange programmes between Indian and foreign universities are becoming to be promoted. The credit non inheritable by our students goes to be counted in Indian establishments. The NEP can establish Asian country as a worldwide education destination." [2]. thus this shows that the New Education Policy (NEP 2020) is terribly useful for the gifted youth.

In this direction, Atmanirbhar Bharat is a step forward, which is a Self-Reliant Indian Mission to make India a major and more important part of the world economy by stressing on make in India and by following policies that are systematic, logical, competitive and organised, and being self-encouraging and self-supporting. The main 5 pillars of Atmanirbhar Bharat are:

1. Economy: An economy that makes quantum jumps rather incremental.

2. Infrastructure: Infrastructure which will modern and sufficient India.

3. System: its technology driven and doesn't support the principles of the past life however offers the dreams which may be consummated by technology of the twenty first century. This technique supports in achieving all C of twenty first century skills.

4. Democracy: India is world's biggest democratic country and is its strength that becomes the energy source and help India to become self-reliant. There is a requirement to educate them in right direction.

5. Demand: Demand is power utilisation in full manner and this will act as an asset for Indian economy. We have to utilise it powerfully due to India's large population. [3]

Out of all these pillars system is a very important pillar and plays a key role in education and in engineering fields. System engineering: It is an interdisciplinary approach of engineering which emphasis on method of designing, combining, and how to manage complex situations in their lives (Fig 1.1). In essence, system engineering focuses on how system thinking rules help to arrange the data. The particular outcome of these efforts can be, an engineered and technologic system, it is defined as mixture of skills that collectively help to perform a useful task or functions.

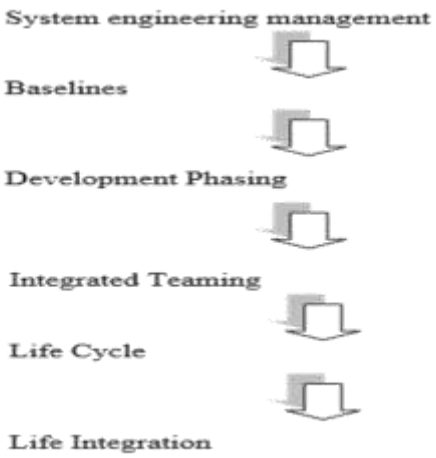

Fig 1.1 System Engineering

21ST CENTURY SKILLS: The 21st century skill focuses on quality education which aims to evolve good, thoughtful, all-rounded, and artistic people. It will make a people to review more than one interesting fields of their curiosity at higher state, and also helps to build up good character, logical interest, ethical values, scientific thinking, innovative mind, and 21st century abilities over a spread of regulations including environmental science, technological sciences, humanities, different languages and also as scientific and professional subjects.

A top graded-education must focus on personal achievement and understanding, productive public meeting, and fruitful contribution to the society. It should plan students for a lot of substantive and fulfilling lives and work role and alter economic freedom. It is necessary to identify that different skills and values are integrated at every stage of education, from pre-learning to higher learning. 21st Century skills are 12 abilities that are necessary for children to realize their careers during the training Age. Each of the twenty first century skill is splited into three classes as follows: Learning skills, Literacy skills and Life skills.

a) Learning skills (four C's) helps students to boost their psychological process that square measure needed to boost their skills for work.

b) Literacy skills specialise in how students can learn different skills and therefore know the technology related to that skill. This prevents from fake information and provides trustworthy sources in digital comprehension. They are also called as IMT skills.

c) Life skills also known as FLIPS and take a look at personal lifestyle of a student. Sometimes it focuses on both personal as well as professional qualities of a student.

The twelve skills of 21st Century are: Critical thinking which means to find solutions to own problems; Creativity: think something different and unique; Collaboration: to figure with others; Communication: communicate with others and discuss; data literacy: Understanding data, diagrams, and data; Media literacy: to know the knowledge that ought to be published; Technology literacy: to know the educational of machines; Flexibility: to form plans versatile

as needed by situation; Leadership: Prompting a team to achieving a goal; Initiative: beginning comes, associate degreed plans on one's individual; Productivity: Sustaining potency in an age of disturbance; Social skills: Contacting with others for communal profit. [5]

Above abilities are important and intended to assist students continue with the lightning-pace of existing trade. Every talent is completely different in its own thanks to facilitate students, but on the other hand all of them have some common qualities. At the community level, learning must enable the event of skilled nation which will help to seek out solutions to their own issues. Education can develop the thought for understanding imaginative and innovative thus causative to a growing market.

2. Multidisciplinary and Interdisciplinary Approach

The aim of quality education is to produce higher opportunities for personage employment. it is the key to create a personal extra energetic, social gathering, auxiliary community and a better off, constant, civilized, creative, new and progressive, and blooming for world. The motive of the NEP 2020 is to finish the fragmentation of higher education by process education establishments into massive multidisciplinary universities, and HEI clusters/Knowledge Hubs, every of which could aim to possess 3000 or further students. this might be ready to facilitate build spirited communities of scholars and peers, break down harmful silos, modify students to become comprehensive across disciplines still as ingenious, creative, and analytic subjects additionally as sports, develop active analysis communities across disciplines still as cross-disciplinary analysis, and increase resource potency, each material and human, across education . Moving to huge multidisciplinary universities and HEI clusters is therefore completely the foremost effective proposal of this policy regarding the structure of higher education. Let's take Associate in Nursing example of the quality Indian universities like Takshashila, Nalanda, Vallabhi, and Vikramshila, [1] within that thousands of scholars from Republic of Asian country unit learning and then most of the scholars unit learning in spirited multidisciplinary environments, sufficiently established the large multidisciplinary analysis and teaching universities may bring around Republic of Republic of Asian country and Asian nation desperately wants multidisciplinary approach to induce back this Brobdingnagian Indian tradition to form comprehensive and innovative of us, that is already process wholly completely different countries educationally and economically. the overall education market, still as technical and education, would request to be Associate in Nursing integrated education system. NEP 2020 and its methodology will apply equally to all or any or any or any of the HEIs across all existing streams, which might become Associate in Nursing integrated pedagogy system. Worldwide Universities, that gives collegian, graduate, and Ph.D programmes and participates in high-quality education and analysis, is also a multidisciplinary institution of higher learning. This advanced word of HEIs among the country like 'deemed to be university', 'affiliating university', 'affiliating technical university', 'unitary university' shall get replaced simply by 'UNIVERSITY'. [1].

Educational approaches in pupil education that mix humanities with science, technology, humanities, engineering and arithmetic have consistently achieved constructive learning

results and hyperbolic power and innovation, necessary and higher-order thinking skills, PSA skills, joint effort, communication skills, further very well learning. to boot, learning is dilated and strong by a comprehensive and multidisciplinary approach to education. Multidisciplinary education can obtain to boost all citizens' capacities in Associate in Nursing integrated manner: tutorial, aesthetic, social, physical, emotional and ethical. Multidisciplinary education will build comprehensive individuals at intervals the humanities, languages, sciences, environmental studies, and virtuoso, technological, job fields WHO acquire all the essential capacities of the twenty first century; Associate in Nursing ethic of social engagement; soft skills like communication, discussion Associate in Nursing debate; and intense specialisation in an passing chosen house. The methodology of all students programmes, still as those at intervals the virtuoso, technical and job disciplines, is such a comprehensive education.

The structure and lengths of the degree programmes unit tailored consequently in multidisciplinary education. With several exit selections within this era, the pupil degree becomes either 3 or 4-year-long, with applicable certificates, for e.g. certificate once finishing one year throughout a discipline or field alongside line and technical areas, or a certificate once 2 years of study, or a degree once a 3-years of study. However the 4-year multidisciplinary Bachelor's programme would be the favoured various as a result of it provides the flexibleness to explore the entire spectrum of multidisciplinary education. To boot, in line with the student's preferences, a student is absolve to want major and minors.

A tutorial Bank of Credit (ABC) are developed for the scholar that may digitally save the tutorial credit earned from completely different famous HEIs that the degrees from a HEI are also award winning credits earned through thoughts. If the scholar completes rigorous analysis in their key area(s) of study as printed by the HEI, the 4-year programme also can activate a degree 'through Research'. So, all new rules of latest Education Policy 2020 will facilitate students to explore further.

3. Some Interdisciplinary Fields

Medicine and health treatment, biocompatible prostheses, diagnostic and therapeutic devices starting from hospital instrumentation to micro-implants, imaging instrumentation like MRIs and EEGs, tissue regeneration and prescription drugs are enclosed within the knowledge base methodology of bio-medical engineering. The hyperbolic use of engineering has light- emitting diode to the specialisation in bio-medical nano-engineering within the dominant fields of this branch. [6]

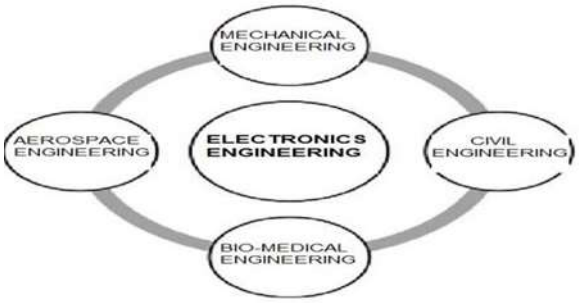

Fig 1.2: Interconnection of Engineering fields

Now a day's electronics engineering is widely used in each form of engineering. Let's take an example of this: Australian researchers are ready to accurately establish the amount of sea turtles at the most important nesting site of its kind world for the first time with the help of drones [7].

Another example of electronics engineering is that mines can be found by using drones and which is under civil engineering.

Also in medical science electronics is very useful and used to operate machines used by doctors. So in that way electronics engineering is playing its vital role in other fields of engineering. The interdependence of engineering fields is shown in Fig 1.2

The most necessary factor regarding the accomplishment of on top of education system is that the standard and commitment of its college. Accepting the criticality of school to achieve the target of higher studies, varied steps square measure introduced among the past few years to order career progression and accomplishment of the teachers, and to make sure honest illustration from varied groups among the recruiting of teachers. Recompensation levels of eternal college, publicly institutions have put together been raised considerably. Various strategies have put together to provide colleges with good improvement skills. However, despite these varied enhancements within the standing of the tutorial profession, school motivation in terms of teaching, research, and repair in HEIs remains most beneath the desired level. The various steps taken to encourage low school and can be address to create positive that every and each member of school is happy, evangelical, engaged, and supposed towards advancing her/his students, establishment, and profession. to the present finish, the policy recommends consecutive initiatives to understand the best, motivated, and capable school in HEIs school can have the freedom to vogue their own information and approaches among the approved framework, conjointly as textbook and reading choices, assignments, and assessments. Empowering the universities to conduct innovative teaching, research, as they're progressing to offer their best, unit about to be a key inducement and enabler for them to undertake truly exceptional and artistic work.

In disciplines ranging from knowledge & arithmetic to humanities and creative writing to acoustic and language to medication and cultivation, country contains an extended historical history of study and knowledge production. This has got to be additional exaggerated to make country, as a durable, progressive and informative society and one in each of the world's three

major and bigger economies, the pioneer in science and innovation inside the twenty 1st century. This Strategy therefore envisages a scientific approach to remodelling India's quality and quantity of science. This entails definitive enhancements to a further frolicking and discovery-based style of learning at school education; with specialize in methodology and necessary thought. This includes career guidance in schools to recognise student preferences and skills, to plug university study, to plug the multidisciplinary nature of all HEIs, and then to deem comprehensive learning, addition of study and internships inside collegian programme, college future organization structures that provide analysis the right age, and enhancements in governance and laws that foster a research and innovation climate. Those entire aspects square measure terribly necessary for the creation of a research mind-set inside the region.

4. Conclusion

In this article we can conclude that "NEP2020 is necessary for developing a bright and successful future for the youth of our country if implemented in phased manner. In anticipation of the less obvious future challenges of education and particularly the role of inter- disciplinary and multi-disciplinary curricula, we'd like to debate and mark all the clear policies and directions for smooth transitions and timely resolutions of such unexpected conundrums. Hence, to attain the goal; of Atmanirbhar Bharat, the reforms such as multidisciplinary approach suggested in NEP 2020 will play a crucial role.

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ANB-NEP-2020P3

Empowering India's MSME's through start-up opportunities under NEP-2020

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Abstract: In past four decades the applicable national education policy (NEP) in India has focussed on development of technological and medical facilities but lacked some key features essential for making the nation self-reliant. But after introduction of NEP-2020 new ray of hope has emerged for making India self-sufficient by empowering micro, small and medium enterprises (MSME's). One aspect of Atmanirbhar Bharat i.e. making India self-sufficient for manufacturing and NEP-2020 is on use of in-house developed consumables for modern technologies such as additive manufacturing (AM) at commercial level through start-up interventions. To achieve the goals of sustainable development, there is a need for techno-economic analysis so that small scale industries can be empowered for producing international standard products in India. The industry 4.0 concept has clearly outlined the research gaps where MSME's can assist in production of low cost consumables for energy efficient AM processes. Since the whole world is witnessing alarming environmental issues, the secondary (2°) and tertiary (3°) level recycling of plastic solid waste (PSW) can be proved very useful for increasing the usage of recycled plastic waste for industrial applications. This article shows the road map to use recycled material for various structural and non-structural applications using 3D/4D printing as a start-up in line with Government of India (GoI) initiatives (Make in India, Atmanirbhar Bharat and NEP 2020). The in house developed consumables will boost MSME's to integrate manufacturing processes of Indian industries with world class technology to provide long term benefits to the coming generations.

Keywords: NEP2020; Atma Nirbhar Bharat, MSME, start-ups, 3D printer, solid plastic waste, recycling, feedstock filament, in house development

1. Introduction

In past four decades, India's national policy on education was dedicated to upliftment of literacy level of average Indians. Government policies were focused on higher and secondary education level upgrade. It has been reported that educational attainment and its distributional pattern improved the education quality but the attainment remained slow as compared to many other countries around the globe [1]. In order to align the modern technology and education along with future goals of progress and development, there is a need to join technology with economical processes. Such policies would guide us towards the sustainable model of national growth and development. The visualization of scientific (VOS) research carried on techno-economical areas (shown in Fig. 1) highlights that this approach is very useful for almost every sector of Indian economy like agriculture, electronics, medical,

manufacturing and innovation of industrial goods [2]. The studies focussed on over viewing education policies and outcomes of primary education sector has been reported that India developed/ upgraded the infrastructure of schools to a new level along with the target of providing education free of cost. The surveys of past 15 years showed that reading skills and numerical solving capabilities of students decreased due to lack of providing skills to teachers. Knowledge management, skill development and training of teachers with modern tools and software could change the course of learning outcomes of the children [3].

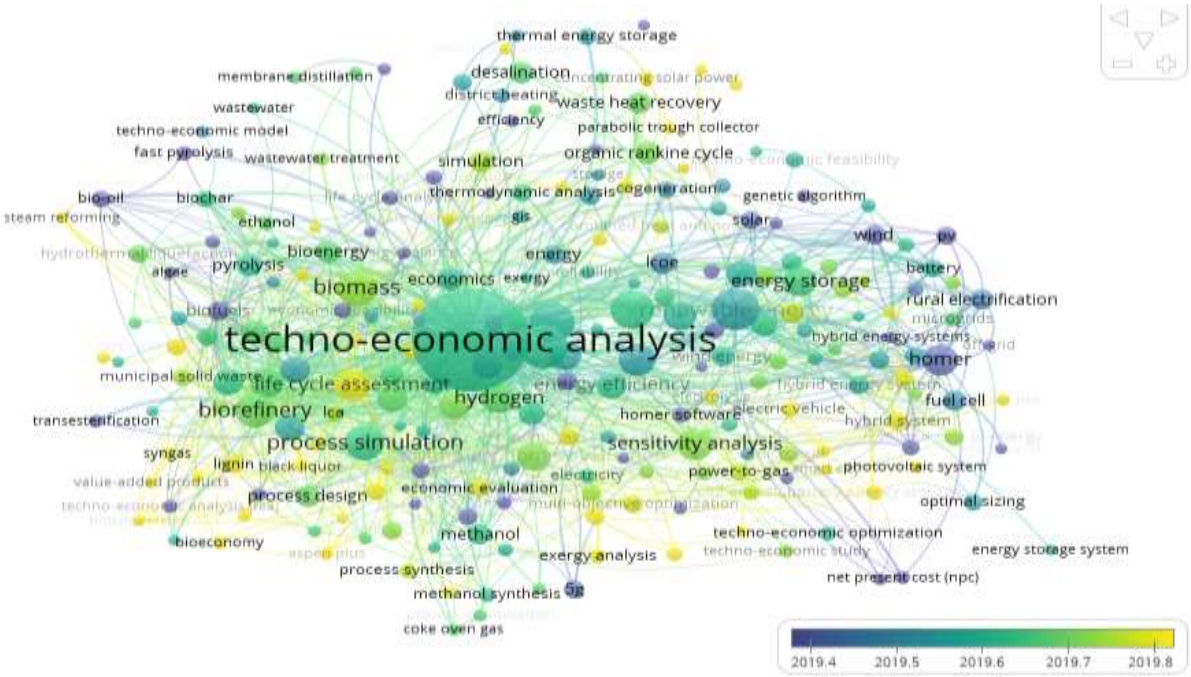

Fig. 1 VOS image of various areas under techno-economic analysis and evaluation

The vision of Indian governance to implement NEP-2020 is closely linked with Atma Nirbhar Bharat plan to make Indian sub-continent a self-reliant nation in terms of technological advancement, space research, manufacturing leader etc. This can be made possible by transferring technology into the research and development schemes. By promoting MSME's under NEP2020 and Atma Nirbhar Bharat plans to take up in-house product development projects, a large number of start-ups can be initiated to boost economic growth of the country [4, 5]. Fig. 2 indicates the absence of steps taken in direction of performing techno-economic testing on comparison between acquired and in house developed products related to various fields. Doing so can be useful to improve the present status of MSME's and lifestyle of new generations of working class Indian professionals [6, 7].

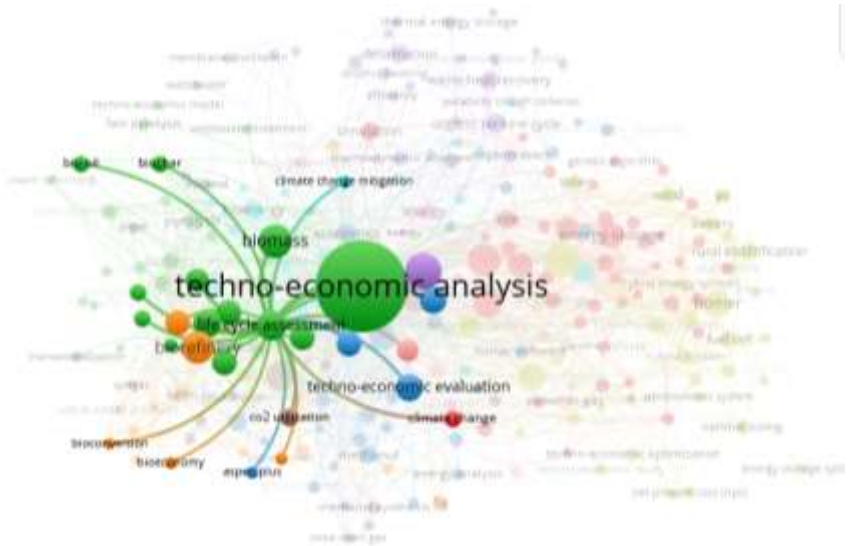

Fig. 2: Explored (highlighted) and unexplored (dim) zones for techno-economic analysis

2. Research Gap: Promoting MSME's for new start-ups under NEP-2020

It is a well-known fact that mass scale production of industrial goods and manufacturing of heavy machinery largely depends upon MSME's as these industries has been providing spare parts to bigger manufacturers. Millions of people working in MSME's makes this sector the backbone of industrial production. Weaker knowledge management activities in Indian MSME's had slowed down their growth. With increase in awareness and interaction between MSME's and research institutes, more opportunities can be given to emerging industrial enterprises [8]. New business ideas and start-up plans can be generated by promoting competencies in business mind people. There is always a need to create new business idea so that the existing plan can be improved. Young minds can be promoted towards new start-ups and work as an entrepreneur by providing the advantages under NEP-2020 and Atma Nirbhar Bharat like initiatives. Financial supports have been reported as an important factor in performance and empowerment of MSME's [9]. It has been reported that there are a lot of uncertainties in entrepreneurship environment in Indian MSME's due to lack of self-confidence or ability of decision making. The support in terms of finance and knowledge plays key role in it. The first industrial revolution known as IR 1.0 taken place in year 1945-60 when Second World War diverted the mind of people towards technological advancements like introduction of special mechanisms in industrial wok. Similarly second and third industrial revolution (IR 2.0 in year 1965-80 and IR 3.0 in year 1980-91) focussed on numeric control of manufacturing processes using computer numeric control (CNC) and direct numeric control (DNC) techniques respectively. The latest industrial revolution i.e. Industry 4.0 has introduced the internet of things (IOT) concept in manufacturing [10-14]. The gap in literature studies revealed that 4th industrial revolution with IOT concept can be explored at a broad level. Modern AM processes can be focussed to boost MSME's by manufacturing low cost products as compared to produce the products that involves high running cost. A novel step can be taken to integrate NEP-2020 and Atma Nirbhar Bharat program with MSME's to empower existing industries and bring more start-ups in MSME sector. For this the focus must be laid

on technological developments in training and research institutes of India and finally implementing those technical refinements in manufacturing practices to manufacture in-house developed at commercial level. For e.g. very less has been reported on analysing in-house developed techniques for extrusion of recycled polymer composite for 3D printing applications (Fig. 2) from technical and economical point of view.

3. Case study: Techno-economic analysis of in-house developed low cost consumable for 3D printers

The AM processes are very time saving for manufacturing of engineering products. Functional prototypes manufactured using this technique improves the properties of castings. Complex and difficult to machined automobile parts can 3D printed using metal printers. 3D printed parts of plastic based materials are made using fused deposition modelling (FDM) based 3D printers. A shifting of manufacturing trend from subtractive to additive manufacturing at large scale can be considered as another revolution in manufacturing [15]. The techno-economical analysis is the backbones of industrial manufacturing processes. No business activity is successful for micro scale industry if the proposed analysis failed. So, we came up with the idea of circular economy. In the present scenario, world is focussing on circular economy because every developed and developing nation is paving way to shun pollution levels by exploring all the possible ways of recycling solid plastic waste. The concept of circular economy is also gaining the popularity due to its effective perspective on economy and ecology of big nations. The basic pillars of circular economy are 3R's, recycling sectors, manufacturers, retailers and consumers [16-19]. Based on the above concept, recycled solid plastic waste material can be put to useful work by reusing in modern engineering practices like 3D printing. Fig. 3 shows the graphical methodology or the road map of developing in-house feedstock filament of recycled plastic based composite material for manufacturing different structural and non structural products of industrial/commercial grade. The waste plastic in form of wrapers and chip can be melted to get grains. These grains can be processed further for secondary (2°) and tertiary (3°) recycling process by reinforcement of different material and chemical treatment respectively. Once reinforced with powders like iron or aluminium etc., a polymer matrix based composite can be obtained that is capable of being drawn into uniform feedstock filament wires by extrusion process. Various properties like rheology, viscosity, thermal stability and mechanical strength are taken into account to ascertain the reinforcement in polymers. After processing through screw extruders, filament wire can be directly inroduced to 3D printers based on FDM techniques to manufacture complex parts that are difficult to cast or forge through subtractive manufacturing [20-22].

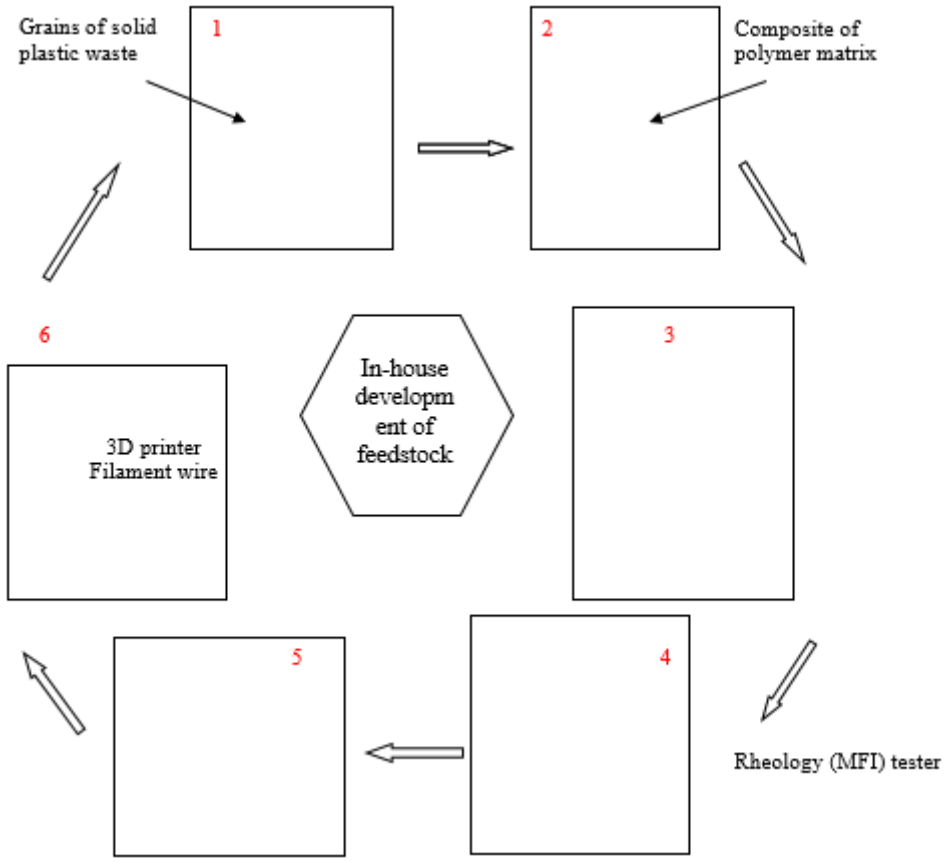

Fig. 3 Road map for the processing of plastic solid waste to do in-house development of 3D printing filament wire

Stages 1-6 shown in Fig. 3 were studied to perform techno-economic analysis of the whole process. In order to manufacture a feedstock filament of 3D printer at lab scale, very less cost is involved as compared to commercially available filament. The wire obtained at stage 6 showed good mechanical, thermal and rheological properties [23-24]. Hence the proposed 6 step process may be employed as successful start-up in terms of techno-economical and environmental concerns in light with GoI initiatives.

4. Summary

It can be concluded from the present article that small technical interventions under Atmanirbhar Bharat abhiyan may be made through researchers at University/ Institute levels for better implementation of NEP-2020. This may be useful for addressing environmental issues through circular economy, providing better job opportunities to coming generations by enhancing entrepreneurial qualities and may contribute in nation building (by developing useful and economic technical solutions) for bridging the gap between industries and research/ academic institutes.

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ANB-NEP-2020P4

Digital Manufacturing to Boost Circular Economy under Atmanirbhar Bharat Initiatives

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Abstract: The circular economy targets for better sustainability of the resources and product to maintain supply chain. As per the Government of India (GoI) initiatives of self-reliant India; micro, small and medium enterprises (MSME) is one of the key area on which success of 'Atmanirbhar Bharat' depends. In the present digital age, the success of MSME depends upon the in-house and digitally manufactured products. The present study highlights a review on digital manufacturing (DM) assisted circular economy based initiatives for managing product life cycle, value chain management and smart factory. Overall, this study provides the framework on manufacturing strategy to boost the circular economy of the product prepared with DM approach.

Keywords: Atmanirbhar Bharat, Digital manufacturing, MSME, digital factory, circular economy

1. Introduction

The manufacturing system is one of the most important parts of the manufacturing and industrial sectors [1, 2]. At this time, due to the high demand for a product with improved quality, manufacturing environment has radically changed over the last two decades [3,4].Conventional manufacturing systems intended for large-scale manufacturing of indistinguishable items are work concentrated, involves high time, and cost [5]. The need for less manufacturing time together with the increased demand for high consumer need-based product variants have forced to move or collaborate the next generation of digitalization or information technology (IT) systems in the manufacturing system [6,7]. As compared to previous manufacturing system new manufacturing system are moving towards automation, smart and DM system due to better or higher productivity by using; internet, sensor, actuators, software etc. [8,9].

DM is a manufacturing process in which by using of Internet of Things (IoT) or with the support of newly developed technology such as rapid prototyping, virtual reality, computer networks, and database final product are prepared. DM system is many advantages such as rapid production to meet the consumer demand with product quality standards [10-12]. Manufacturing organizations endeavor to incorporate their business capacities and divisions with new frameworks in an undertaking information base, following a bound together enterprise view [13]. These frameworks depend on the digital plant/manufacturing idea, as

per which production data management systems and reenactment innovations are together utilized for optimizing manufacturing prior to beginning the production and supporting the increase stages [14, 15].

DM is one of the most indispensable parts of this computerized world. In a traditional manufacturing system, the informational data represents as a 2D drawing whereas in DM it is to represent in 3D advanced models to affirm the data transmission [16]. This idea has redesigned the mechanization and digitalization of the plan, creation and executives. Therefore, the items work, structure, quality, execution, value proportion, advancement time, customization, benefits, etc., have changed subjectively along with the developing interest for client-based items [17-19]. Subsequently, DM innovation has become the most indispensable device for organizations to upgrade the seriousness of their items [14, 16, 20].

The digital/advanced innovation in the manufacturing system is breaking the dividers of manufacturing because of the ongoing improvements in zones, for example, artificial intelligence, 3D printing, human-machine association, computerization and mechanical technology alongside a blast in information and new registering capacities [20-22]. The disruptive and beneficial effects of advanced on the activities of associations; for example, IT, broadcast communications, fabricating, amusement, media, and distributing and so on are materialized [20]. Additive manufacturing (AM) a 3D printing innovation that makes parts through the option of materials have changed the engineering and manufacturing industries from large scale manufacturing of indistinguishable items to low-volume creation of imaginative, customized, and economical items [22,23]. The exceptional abilities of AM processes to create many-sided shapes with multi-material properties and complex designs has discovered its applications in different territories like car aviation, guard, clinical, shopper items, engineering, food and so forth the reason for this article is to discuss the main thrusts for change to advanced and the improvement of assembling to keen assembling. Utilizations of AM measures end concerning the current points of view [24].

MSME has created as a dynamic and dynamic area adding to the social and monetary upliftment of the country's economy through advancing business and producing bigger work openings [25]. MSMEs are adding to the comprehensive modern improvement of the nation, they are presently present in all areas over the economy, producing a different scope of merchandise and administrations to fulfill the need of the public and worldwide market [26].

Past investigation accentuates that the digital transformation of MSMEs will be a one-stop solution for all difficulties looked by them. The Launch of "Digital MSME" was an Initiative by Government to defeat obstacles in computerized change. Digital MSME Scheme is dispatched for promoting Information and Communication Technology (ICT) in MSME Sector by receiving ICT devices and applications in their creation and business measure [27].

India is a developing country, so DM scopes are very big due to the very high demands of the product. MSME or Manufacturing sector plays the most important role in the Indian economy as per 2019-20 data it contributes 18.32% in GDP of India. The "Make in India" initiatives targets for achieving manufacturing sector to 25% of Indian GDP. Under the GoI initiative,

many steps have been taken to improve this contribution in which smart and DM is one of the major steps for making India self reliant.

2. Components of DM

DM is an application of information technology for fabrication, product development, manufacturing processes, and supply chain management. DM technologies connect the manufacturing system and processes during all parts of production to create an integrated approach to fabricate from design to manufacture and serve the final product with less time and less cost [28]. By using simulation and product modeling, it is very much possible to quality improvement of the manufacturing process or techniques [29]. DM can be divided into three main parts; value chain management, smart/intelligent factory and product life cycle [30]. Three aspects of DM system are shown in Fig. 1. All the three aspects of DM system are applied to the fabrication of product from designing and innovation to the improvement of manufacturing lines and the maximum utilization of resources for quality product and consumer satisfaction. Engineering design is the most important part of the product life cycle. For fabrication of product before going on production line engineering design are apply as per requirement, comfort, flexibility, and service life. Each progression utilizes computerized information to permit amendments to plan particulars during the assembling cycle [31].

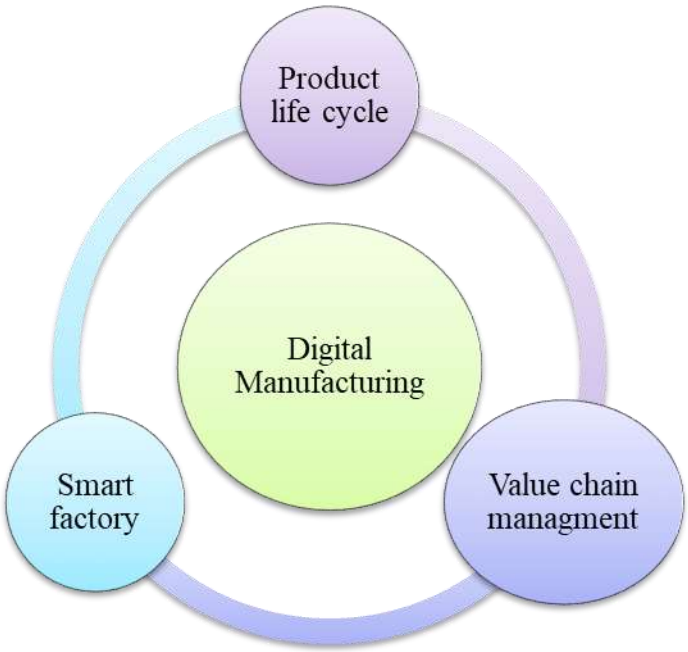

Fig. 1. Three aspects of Digital/Intelligent Manufacturing system

The smart factory facility includes the utilization of keen machines, sensors and tooling to give continuous feedback about the manufacturing techniques and assembling innovation. By joining activities innovation and data innovation, this digital transformation takes into consideration more prominent perceivability of industrial facility cycles, control, and advancement to improve execution [32]. Lastly, in the value chain management mainly focused on to reducing the waste or maximum utilization of raw materials with also included less inventories when product quality are to be maintained with consumer satisfaction [33]. Smart manufacturing is connected with MSMEs sector because of MSMEs are the second

biggest employment sector, it adds to about 32% of the nation's GDP [34]. The advancement of MSMEs will give a strong structure for the nation's improvement and to accomplish the 5.5 trillion dollar economy mark by 2024. Digitalization and innovation up-degree fills in as a device for making MSMEs to be competitive enough to coordinate the worldwide prerequisites [26, 35]. Fig. 2 shows components of DM for MSME's sector.

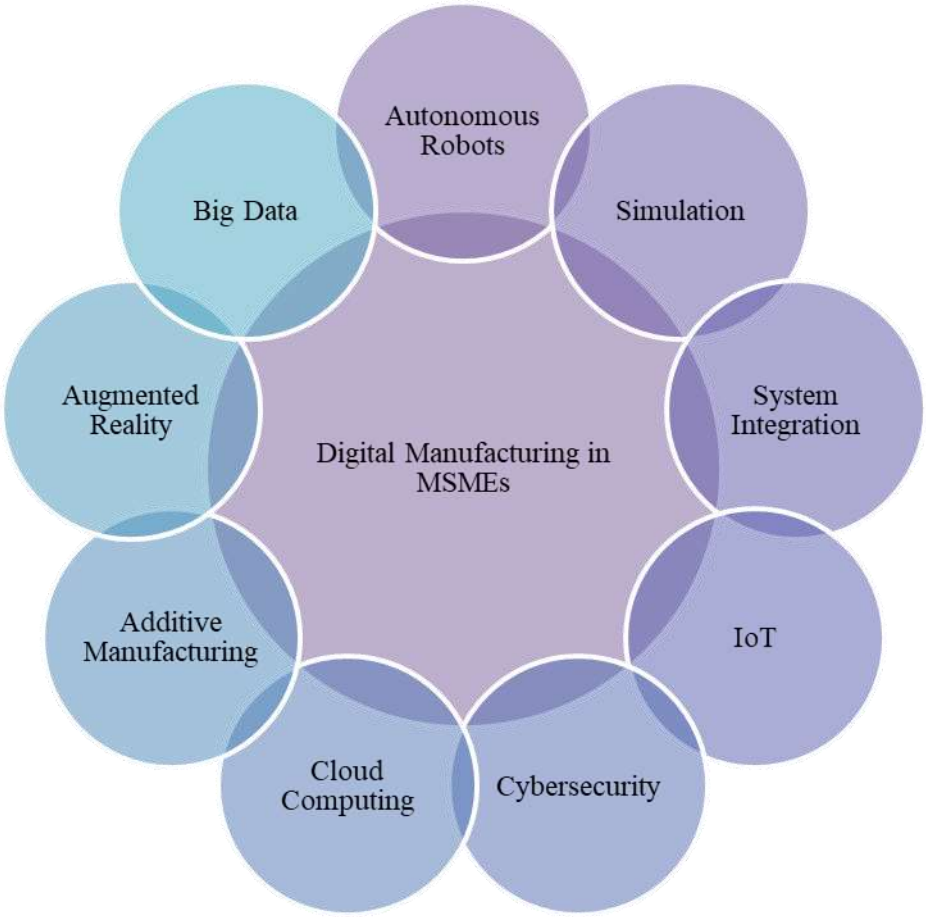

Fig. 2 DM and its components for MSMEs sector

3. Gap in DM and its implementation in Atmanirbhar Bharat initiative

The fruitful implementation of the 'Atmanirbhar Bharat' initiative largely depends upon the outcomes of the DM. The value of resources and products are highly determined by the circular economy. The success of DM has the direct relation with the circular economy of the products. To know the implementation of DM and to meet the gap a bibliometric analysis has been conducted using 'Web of Science' database. The VOSviwer software package has been used for this study. Putting the keywords, 'DM' and 'additive manufacturing' total of 1477 studies have been found and out of those first 500 papers have been selected for analysis. A total of 21584 terms have been found in the study, and selecting the occurrence of 10 minimum no. of terms 292 terms have been met the threshold. Out of those, a total of 50 terms have been presented in Fig. 3. Four different clusters have been formed and is shown in different color mode.

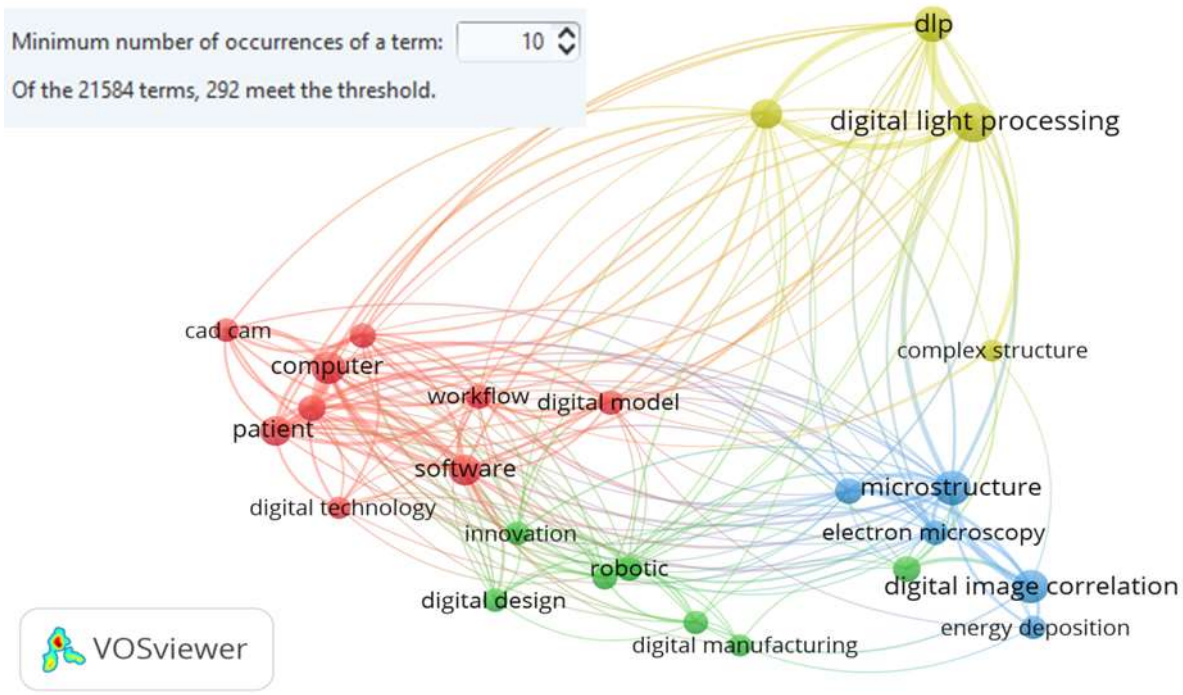

Fig. 3 Bibliographic analysis for additive manufacturing as DM

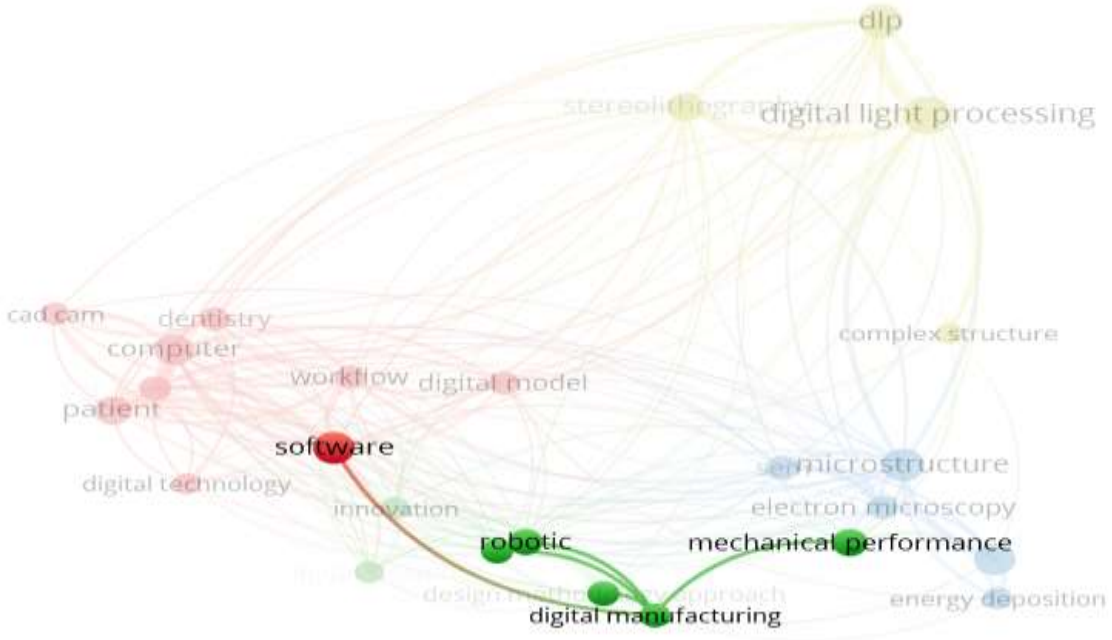

Fig. 4 Bibliographic analysis for gap in additive manufacturing as DM

Fig. 4 shows the gap in the additive manufacturing as DM. It shows that, with additive manufacturing, the studies have been reported for integration with robotics, mechanical performances and software. The studies can be extended for applications in dentistry, digital technology development, preparations of complex structures etc. Under 'Atmanirbhar Bharat' Initiatives, the additive manufacturing as DM techniques can be used for start-ups related to preparation of dental crowns, biomedical implants, scaffolds, organs, daily essential products etc.

4. Case study

Ranjan et al. (2020) fabricated a biocompatible and biodegradable grade of feedstock filament of polylactic acid polymer reinforced with biocompatible fillers chitosan (CS) and hydroxyapatite (HAp) using extrusion process for fabrication of scaffolds using 3D printing technology by suitable composition as per mechanical, thermal and morphological properties [36]. 3D printing techniques are a part of DM technology. Fig. 5 explain step by step fabrication system of biocompatible scaffolds using twin-screw extrusion and AM technology which comes under DM.

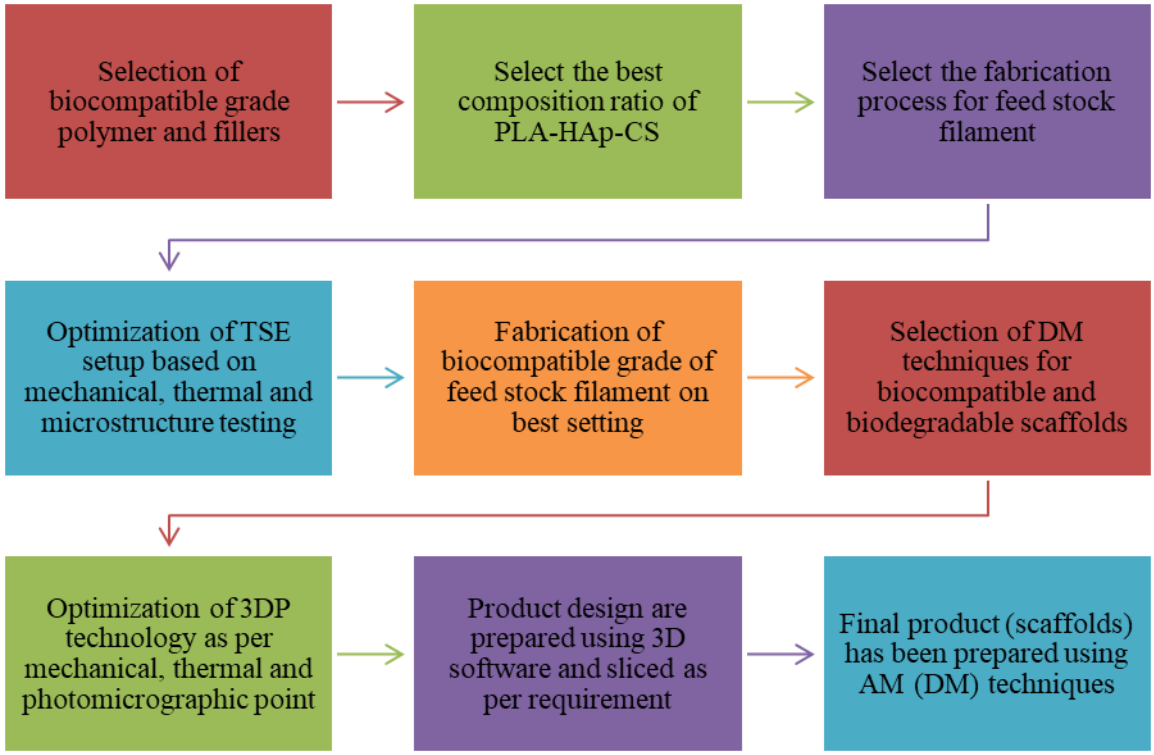

Fig. 5 Step by step fabrication process of biocompatible and biodegradable grade of scaffolds

In first step bio-compatible and biodegradable feedstock filament has been prepared using the TSE process after TSE optimization. In the final step biocompatible scaffolds were manufactured using DM by 3D printing technology. Similar initiatives may be taken by different startups to boost circular economy at Institute level for supporting self reliant India concept.

5. Conclusions

Following are the conclusions of present study:

• DM can be divided into three main parts; value chain management, smart/intelligent factory and product life cycle. All the three aspects of DM system are applied to the fabrication of product from designing and innovation to the improvement of manufacturing lines and the

maximum utilization of resources for quality product and consumer satisfaction. These may be a back bone for supporting self reliant India mission.

• The digital/advanced innovation in the manufacturing system is breaking the dividers of manufacturing because of the ongoing improvements in zones, for example, artificial intelligence, 3D printing, human-machine association, computerization and mechanical technology alongside a blast in information and new registering capacities. Under 'Atmanirbhar Bharat' Initiatives, the additive manufacturing as DM techniques can be used for start-ups related to preparation of dental crowns, biomedical implants, scaffolds, organs, daily essential products etc. especially for job/ batch production.

Acknowledgement

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POST PROCESSING OF 3D PRINTED REPLICAS TO REDUCE REWORK UNDER SELF RELIANT INDIA MISSION

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Abstract: The role of 3d printing in modern manufacturing industries are increasing day-by-day due to design customization and material flexibility. Fused Deposition Modeling (FDM) technology, due to lower installation cost and pollution free operation, is widely accepted which has reduced the product lead time and production time. The most widely used material for FDM is acrylonitrile butadiene styrene (ABS) due to higher heat resistance, impact resistance and toughness. But, the major limitation of this technique is poor surface roughness which occurs due to layer-by-layer deposition behaviour. These challenges of rework and part rejection can be tackled by providing surface enhancement services for 3d printed parts. A comprehensive literature review has been performed to select appropriate finishing technique for ABS parts manufactured by FDM technology. It has been found that vapour smoothing technique using acetone vapours can be extended to create entrepreneurship. In Indian manufacturing environment. The proposed business model can be promoted under "Self-reliant India Mission" by providing innovative technology based services for manufacturing industry.

Keywords: 3d printing, Fused Deposition Modeling, ABS, surface finishing, Atmanirbhar Bharat Abhiyan

1. Introduction

3d printing is presently utilized broadly, replacing conventional ways to deal with manufacturing customized prototypes and models. For the most part, it has been utilized in enterprises, for example, automotive, jewellery, electronics, medicinal and aviation to quicken their product delivery to the market. Exploiting adaptability,3d printing is utilized widely by industries from various fields. The capability of these techniques apparently is boundless, as it improves the product quality, lowers manufacturing time and cost [1].

FDM is plastic processing technologywhich uses semi-liquefied material as a medium which is deposited through movable nozzle on numeric controlled platform. After cooling, the plastic material solidifies quickly once it achieves room temperature [2]. In FDM, the major componentscomprise of a base table which is computer controlled. This table moves in Zdirection while nozzle moves in X and Y direction. The another significant part is a nozzle which is heated to convert the filament wire into semi-molten thick plastic bead. The expelled material is supplied by means of fiber spool as demonstrated in Fig. 1. The motion is controlled by servo motors which receive signals from microcontroller based upon CAD

drawing. The X, Y and Z movement of base table and nozzle leads to complete fabrication of product within few hours [3, 4].

Before analyzing the scopes and challenges of business on providing services for 3d printing industry, the broad applications of this technology are studied as shown in Table 1. Extensive range of material such as metals, thermoplastics, composites, ceramics with wide range of melting temperature are employed.

Table 1 Scope of recent activities in 3d printing

S. No.	Area	First article published in Year	Total Publications	Progress
1	Medical and dentistry	2000	989	Used to manufacture customized implants, surgical planning, Used in complicated cases to easily replace teeth, braces, crown, dentures and alignment
2	Design	1993	5918	Creates greater geometric independence and physical test model before beginning a full production process Capacity to rapidly create a unique product with fullest success AM is used for the development of prototypes and various engineering components
3	Manufacturing and Engineering	1995	2617	The ability to easily and effectively create a unique brand AM is used for the development of models and various engineering components
4	Aerospace	2000	881	Now there is availability for the design and manufacture of indoor aircraft parts, composite tooling, rocket engine components, combustion liners and fuel tank components

5	Automobile	2003	190	It can create unique automotive parts with highly rigid geometries at the lowest cost, something traditional manufacturing technologies cannot perform easily.
6	Architecture	2008	646	Used to develop construction services in which models showing textures, colors and shapes are constructed
7	Food and Agriculture	2016	137	The new rising innovation will create physical agricultural equipment models that easily manufacture a functional prototype.

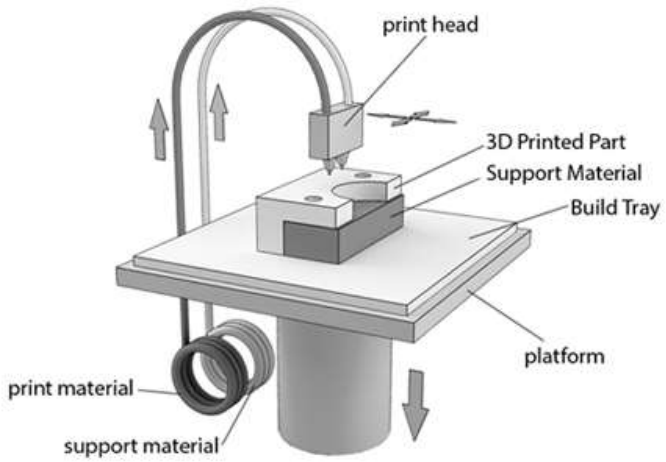

Fig. 1: Schematic of FDM Process

A requirement of accuracy and surface finish employing various materials is paramount in medical field during development of prosthetics, customized dental implants [4, 5]. Computer Aided Design (CAD) model created by software is converted into standard triangulate language, which produces considerable surface roughness in FDM parts [6, 7] as shown in Fig. 2. Nowadays, FDM advances with enormous advantages in contrast with other techniques have been included in additive manufacturing [8,9]. This increases requirement of post processing techniques which lead to wastage of time and money [10, 11]. The geometric and complex shapes are difficult to finish especially implants used for biomedical applications [12-14].

2. Surface Finish of FDM Parts

In spite of the fact that this technology is broadly utilized,low surface quality[15]is major limitation which is inherent defect as shown in Fig. 2. Besides, they are portrayed by anisotropy because of the layered manufacture procedure [9]. The quality and texture must be examined and improved to achieve desired characteristics on target surface [10]. Additionally, FDM manufactured parts are primarily begun in the setting period of the procedure parameters that have a direct effect on numerous part properties, for example, mechanical conduct or geometrical exactness [11]. Be that as it may, one of the most down to earth way to deal with control the integrity of an AM procedure is to assess the surface harshness of the manufactured segments [12]. In this manner, concentration should be put on the procedure parameters affect the surface quality is pivotal and the advancement of beyond medicines for harshness decrease could prompt a significant improvement of FDM applications [13]. Many researched the influence of FDM process parameters on the manufactured parts surface quality. In specific, it was discovered that layer thickness and part direction are the most influencing factors in the surface finish of FDM slices [16, 17].

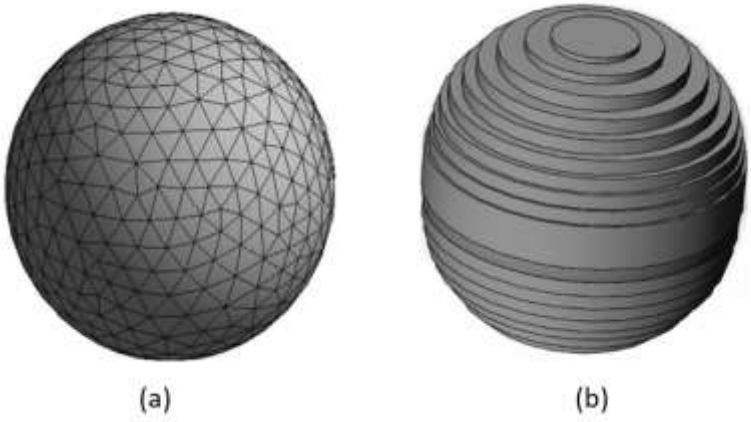

Fig. 2: (a) CAD model (b) Surface roughness on FDM part

Regardless of conceivable procedure enhancements, post-handlingfor FDM printed parts must be directed with the point of expanding the surface execution [18].Mechanical techniques can be characterized by exceeding procedure cost, by difficult to reach areas during the procedure and furthermore by the danger of harming the soft highlights of the printed parts. Additionally, they frequently don't fulfill the prerequisites of a completely functional and efficient post-preparing technique, which needs to decrease the harshness of the whole surface at the most minimal conceivable expense, with no change in properties and in a perfect shape rather than the requirement to easy parts [19]. Compound assistance used to great outcomes other than the confinement of the mechanical methodologies. Specifically, dimethyl ketone is across the board in this field, especially to treat acrylonitrile butadiene styrene (ABS) parts [5]. Dimethyl ketone treatment may significantly decrease the base harshness of ABS segments with no significant change in the part measurements [6].Two types of fumes treatment are conceivable. In hot fume treatment, the holder is warmed so as to quicken the energy of the response on the ABS segments. In cool fume treatment, no warmth is applied and the smoothing is progressively slow. Hot fume smoothing is quicker

however more difficult to control, and a non-uniform fume dissipation can bring about a non-uniform surface treatment [20, 21].

From Scopus information, we have examined that added substance fabricating applications are highly developing. In the following years it will turn out to be useful in various fields in huge way. AM has interest to different fields, and a great deal of work is carried out through this, as it appeared in Table 1. By getting this information, we examined that added substance fabricating is making an incredible commitment to the field of assembling and plan. This innovation is available because of its assembling ability of any modified item and furthermore effectively producing imaginative planning of the part. Less work is taken out in farming by adding substance manufacturing.

3. Mechanical Finishing Techniques

These methods focused on mechanical trimming or squeezing the top of surface profiles. For the most part, the methods are imitated from ordinary metal completing strategies, however their reaction on ABS plastics is radically extraordinary when contrasted with metals effectively endeavored different grating completing procedures on stereo lithography parts utilizing rough impacting, vibratory bowl and ultrasonic scraped area. The grating completing brought about expulsion of undesirable material from sides because of effect of scraped area media in these mass completing procedures [22]. The keyword and co-authorship analysis (country wise analysis) of FDM and surface finishing has been shown in Fig. 3 and Fig. 4 respectively.

3.1 Manual Sanding

Stratasys [23] prescribed different manual grating techniques utilizing sandpaper (120 and 320 coarseness), steel fleece and recording for evacuation of little support, burrs and fur like threads. Hot blade may evacuate creases and utilized for filling holes with crude material physically. Practically, the handmade strategies are not controlled, estimated, steady and exact, as such techniques endless supply of administrator. Additionally, when managing parts having many-sided shapes, physically completing techniques needs loyalty to the use of fast tools and throwing [23].

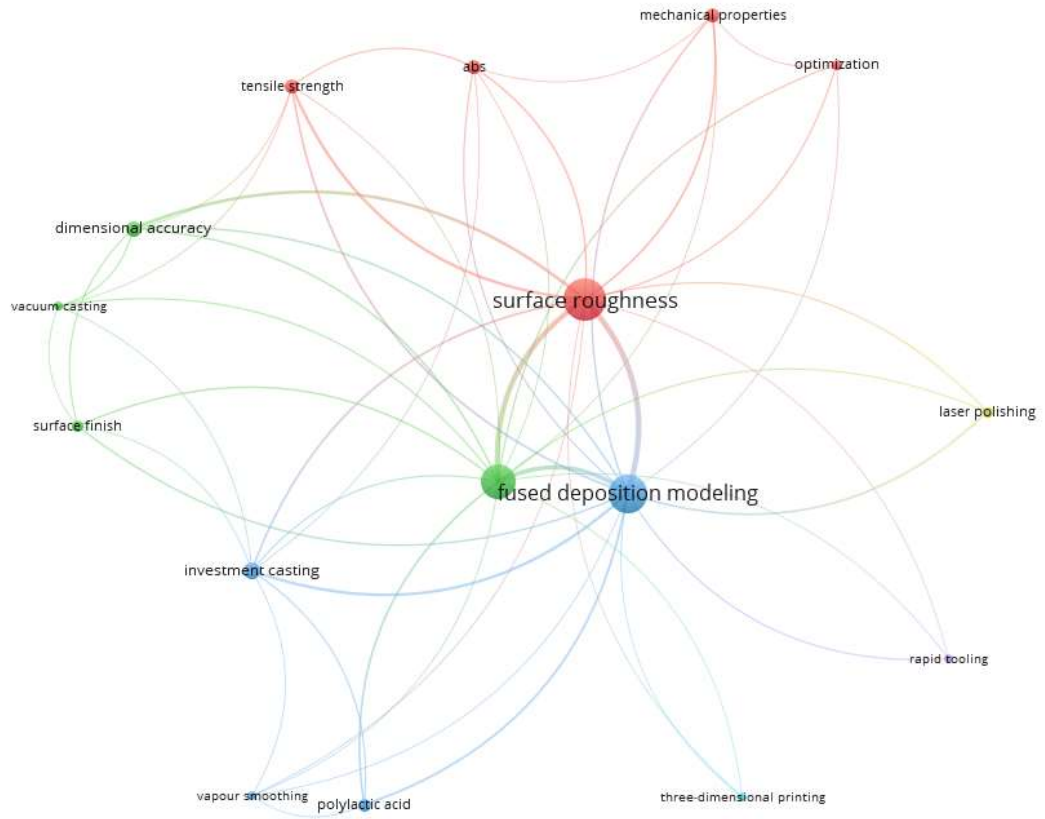

Fig. 3 Keyword analysis of FDM and surface finishing processes

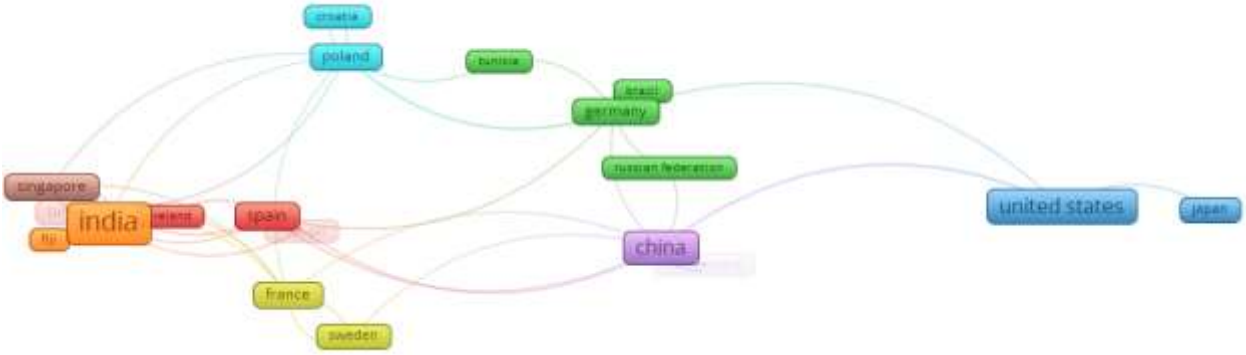

Fig. 4 Co-authorship analysis (country wise analysis) of FDM and surface finishing processes

3.2 Abrasive Milling

Blair [11] utilized rough machining activity of sandpapers of various coarseness dimensions turned on wheel like material expulsion procedure with the help of chip arrangement. Quicker feed, speeds, littler media expanded matter evacuation rate and upgraded surface hardness. Galantucci et al. [17] actualized rough processing utilizing mass lamellar grating paper to

accomplish 90 percent betterment of surface completion without any deviation in measurements. Grating processing pursued by physical fume testimony indicated minimal dimensional varieties when contrasted with miniaturized scale sandblasting and electroplating reported by Galantucci et al. [17]. CNC processing proposed by Kulkarni and Dutta [18] where a program is created by geometry utilizing versatile cutting. The highlights of those parts which have perplexing shapes cannot be accessed by subtractive machining strategy

3.3 Abrasive flow machining

In this process, a rough loaded flexible media is utilized for completing and cleanliness of the slices. A extreme speed fly of abrasives encroached on unpleasant outward and burrs till they are not get smoothened. It is founded by Williams and Melton [24] that the media pressure, coarseness size and impacting time assumed significant job in controlling the last surface unpleasantness, while little dimensional amendments happened because of material evacuation. Leong et al. [19] revealed 70 percent upliftment in surface unpleasantness of plastic pieces via rough stream deburring utilizing bald air as transporter and glass globules as grating media. Lopsided substance evacuation is a significant weakness because of failure to maintain pressure among media causing weight reduction and max of 5.85 percent decrease in thickness. The exteriors indicated the most noteworthy reaction during process was arbitrary and forceful as the edges and corners get harmed.

3.4 Sand Blasting

It has been actualized by a few scientists Galantucci et al. [17] and uplifted outward unpleasantness up to 96 percent. Sand impacting, prescribed by Stratasys that is to be utilized following fume smoothing and demonstrated to be ultra-fine completing procedure reported by Zinniel [18]. It is equipped for providing matte completion among parts since fume and substance introduction radiated gleaming surface

3.5 Vibratory bowl finishing

In this, mass completing of parts is finished by grating activity media and fine rough mixes blended in with water through vibrating spring-mass framework. Two restricting arrangements of unpredictable loads connected at end of shaft driven by belt. Distinctive matter expulsion ranges are accomplished relying on schedule, media length, shape, weight and mixes. Schmid et al. [6] explored extended job of rough media shape and type in exterior completion by note down the fact that unpredictable molded media get stuck among parts. Trivedi [25] announced 31.67 and 4.59 percent expansion in slices unpleasantness and harshness, individually, utilizing pyramid media shape for lengthy machining occasions (3 to 4 h). There was a discovery that machining for lengthy hours and utilizing lesser media weight yielded better dimensional solidness for ABS parts.

4. Chemical Finishing Techniques

The reaction of ABS plastics to the synthetic compounds, fumes and coatings has examined under this area, as plastics have vulnerable surface which could be effectively altered by concoction activity. The significant priority of synthetic completing over mechanical completing procedures is that there is no contact of apparatuses with surface which could guarantee better dimensional and geometrical dependable qualities.

4.1 Manual Painting

Not many synthetic substances smoothen the outside of the ABS parts by artificially dissolving the harsh edges and holding the layers together. Stratasys[23] proposed the utilization of a few paints for washing the prototypes [23]. Albeit manual use of these concoction and paints spares time and cost, manual techniques are non-uniform and in this manner convey lopsided surface completion

4.2 Acetone Dipping

$CH_3)_2CO$, being an essential part of cleaning specialists, has a decent surface stripping qualities and broadly utilized for cleaning and completing the items. The FDM parts are plunged in $CH3_2CO$ for explicit time referenced by Galantucci et al. [17] for wrapping up the surface. Schmid et al. [6] additionally utilized CH3)2CO plunging as a after handling system where bits are dunked in CH3)2CO shower for five minutes to get wanted bits completion. The expansion in weight, flexibility, flexural quality and compressive quality has been seen in the wake of dunking in CH3)2CO, while 1 percent abatement was noted down by Percoco et al. [26]. Rao et al. [27] stretched out the investigation to streamline the procedure factors, for example arrangement fixation, time, beginning harshness and temperature of synthetic compounds utilizing structure of investigation and ANOVA. The outcomes showed that the fixation, focus temperature association and focus time cooperation have most noteworthy effect on surface harshness. McCullough and Yadavalli [20] utilized CH3)2CO plunging for fixing and surface completing of the ABS parts for biomedical miniaturized scale gadget applications. The sublime circumstances were presentation of 1-8 h with 60 percent watery answer for best surface execution and includes the protecting part. Mireles et al. [21] expanded the utilization of FDM slices including liquid weight applications by diminishing porosity of ABS parts by concoction treatment. Eleven sealants with differing concoction properties were applied to FDM parts through brushing and vacuum invasion. FDM parts were made proficient to withstand liquid weight up to weight of 276 KPa with minute-dimensional changes. In addition, parts experienced substance treatment demonstrated less dimensional changes when contrasted with precisely brushed parts. Kuo and Mao [28] built up a test arrangement with arrangement of fan for constrained course of CH3)2CO fumes in shut surface finishing the chamber of FDM parts. The surface completion is upgraded with an expansion in rpm of fan, though longer presentation is required to complete ABS leaves behind bigger surface.

Garg et al. enhanced the utilization of cold fumes (at 20°C in shut holder) to control the quick fume plastic cooperation. The surface parts standard is upgraded with least modifications in measurements up to a presentation of 40 mins. Be that as it may, at longer terms (90 mins), the corners and sharp edges gets adjusted. The post-handling with CH3)2CO demonstrated to be exceptionally powerful, simple, quick and monetary surface completing procedure. In any case, there is danger of disintegrating and dissolving of little highlights of parts for prolonged spans and utilizing undiluted CH3)2CO, while utilization of weaken arrangement can expand the submersion time. In any case, the strategy should be controlled, robotized and motorized to do progressively exact and efficient wrapping up

4.3 Vapor Smoothing

A propelled completing strategy has created where part surface reflows briefly because of presentation of fumes developed by warming of synthetic in managed condition Priedeman and Smith [29]. Fume flattening mechanical assembly has utilized by Espalin et al. [30] for surface completing of ABS parts. At first, slices are permitted to cool for few moments in evaporating chamber and afterward put in flattening chamber for 10 to 30 s. The decided measure of dissolvable is warmed in smoothing chamber, and hence (substance) fumes ascend to get kept on the ABS part which is hanged by appropriate course of action inside. Disintegrated dissolvable exhaust ascends to get dense on ABS part, enters in the base and briefly levels the surface on account of surface pressure Anthamatten et al. [31]. Beyond the completion of three cycles of fume introduction, bits were exposed to preparing soft drink impacting, in Fortus finishing Station Zinniel [32]. Introductory and last readings delineated irrelevant measurements changes with incredibly smooth surface. The SEM image of FDM parts finished by vapour smoothing process as shown in Fig. 5.

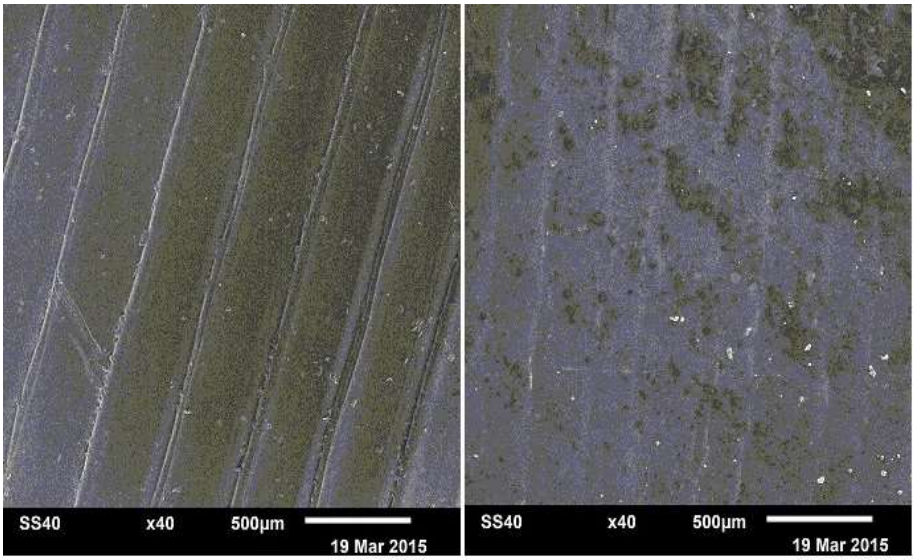

Fig. 5 SEM micrographs of ABS part surface before and after smoothing [22]

5. Future Challenges

The increasing demand of customized product has intensified the production activities through low cost 3d printers using ANS material. However, the commercial vapour smoothing apparatuses are costly and complex during operation; hence these are not used by operators during surface finishing. Generally, surface finishing is done through acetone dipping process as discussed in previous section. The major limitation of this process is over-exposure which further erodes the upper surface and reduces the weight. Moreover, the intricate sections and fin details are dissolved by harsh action of solvent. Hence, vapour smoothing process using mild and cold vapors is recommended which would retain surface integrity and dimensional accuracy of FDM parts.

6. Business Model for surface finishing services

The proposed business model would be dedicated to provide surface finishing services to 3d printing industry through mass finishing machine. The special purpose machine has been designed and tested at Chandigarh University Campus which has provision to control the temperature of vapour along with concentration and smoothing time, Moreover, the finishing apparatus used minimum quantity of vapours which can be reused by condensation through cooling unit attached. The power consumption is minimum which leads to cost-effective services for 3d printing industry.

The dedicated apparatus (Fig. 6) has capacity to finish fifteen parts of nominal size in ten minutes. The finishing apparatus can be utilized to develop a business model where FDM parts are received and finished as per requirement. The dimensional accuracy and surface roughness of parts can be customized by varying the finishing time. Moreover, the business model can be beneficial to reduce rework and rejection rate during 3d printing.

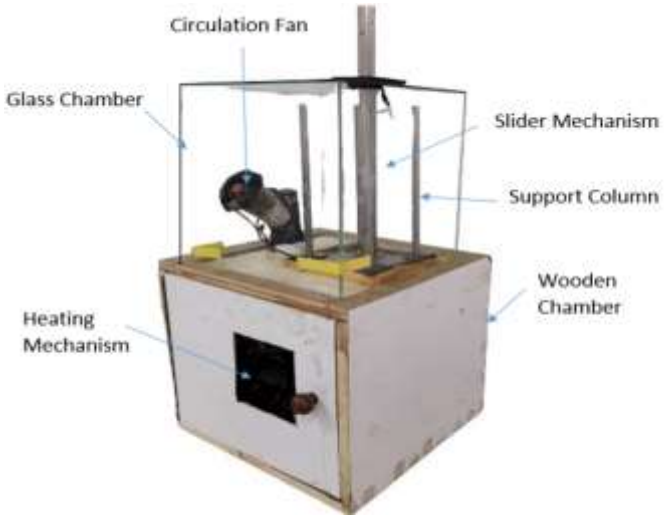

Fig. 6 Vapour smoothing designed for commercial finishing of FDM parts

7. Conclusions

3d printing plays pivotal role in the designing of product and evolution by decreasing the lead time of product development, expenses and increased end product performance. Compared to another conventional machining process, the design and production of the material is carried out efficiently. The issues related to surface roughness of FDM parts are surveyed and remedial methods are studied. It was concluded that vapour smoothing through acetone vapour is most efficient process which can be commercialized.Furthermore, the research areas including optimization of parameters for improving surface characteristics such as surface roughness, post-cooling time, orientation angle and size have been discussed in extensive literature review. The research findings can be expanded to provide surface finishing services through a business model by improving dimensional stability and surface quality of FDM parts through vapor smoothing process.

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ANB-NEP-2020P6

SCOPE AND CHALLENGES OF ELECTRIC VEHICLES IN INDIA UNDER SELF RELIANT NATION MISSION

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Abstract: The development and research work in industrial and academic sector always lead us to Sustainable environment represented technology as EVT. An American inventor was the first one to make the first practical electric car in late 1800's. Hybrid cars were also created to solve the issue of electric vehicles at that time. The rising of Electric Vehicles from the last decade to till now made the car manufactures go electric for the sake of environment and advantages over internal combustion engines. Comparing to other vehicles less time for refueling, less weight of battery and air conditioning system reducing battery ranges. Implementation of V2G (Vehicle-to-Grid) concept between vehicle and electricity system. In present work, an attempt has been made to present the scenario of Electric Vehicles in developing countries such as India which indicates that India is leading in research and innovation in this domain. The scope and challenges faced during development and commercialization of electric vehicle under self-reliant Nation mission have also been presented.

Keywords: Electric Vehicles, Non-conventional energy resources, Battery issues, vehicle cost, atmanirbharbharat

1. Introduction

The demand for electric vehicle (EV) is rising and can be definite replacement of conventional vehicles with advancements in existing technologies. Many countries providing free parking, free facilities for charging and with low taxes (Dai et al., 2016). EVs which are environment friendly and can provide reliable outcomes. The Vehicle powered by the energy stored in the battery to the motor by the use of controller which acts as brain of an EV and providing power for each wheels by using a differential (Juan et al., 2016). The main components including electric motor, the controller and rechargeable battery cells with regenerative braking system as shown in Fig. 1. The advantages over conventional IC engines, when it comes to lowering of local emissions mostly exhaust, giving higher energy efficiency and mainly decreasing the demand of fuel that we were depending on. Drivelines for Electric Vehicles of hybrid types of different combinations for both electrical system and IC engines consists of parallel , series or both which completes the EV for their demand in market (Singh et al., 2019). There are still some barrier and challenges for the adoption of Electric Vehicles that we will be discussing in

this paper including battery technologies limitations, needs for all type of Vehicles and its recharging infrastructure (Shen et al., 2016).

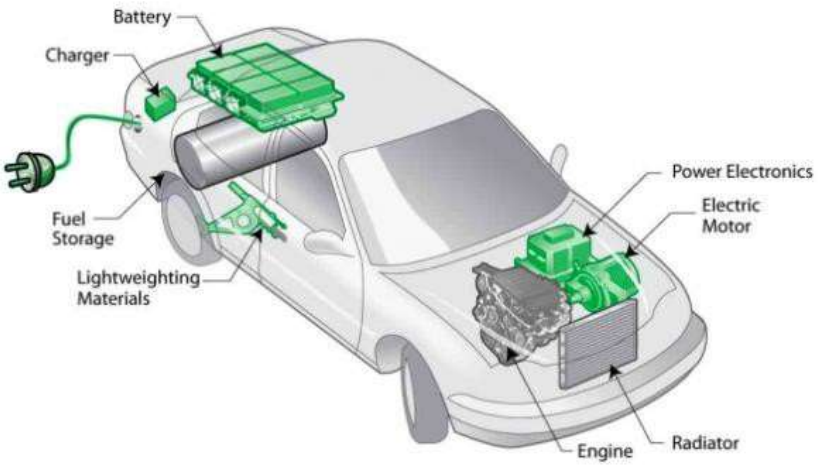

Fig. 1 Major components of electric vehicle

There are four categories that defines Electric Vehicles with different approaches as follows (Noor et al., 2017):

1) Full EV- Full Electric Vehicle uses only electricity for its power from rechargeable batteries which is driven by one or more than one electric motor. Battery charged by an electric power source by plugging it to high power charging station or low power house station and can also be charged through regenerative braking system. There are number of fully electric cars like Tesla all models, Nissan Leaf, Chevrolet Bolt EV and Jaguar I-Pace.

2) Plug-In Hybrid EV-These are very much similar to Hybrid EV but having a larger battery pack that can be plugged in to an external electric source for charging and also can be charged through regenerative braking, providing more distance plus than in Hybrid EVs. BMW i series are the most demanding in this sector.

3) Fuel Cell EV- This uses combination of hydrogen and oxygen for creating a chemical reaction that generate electricity which powers an electric motor. As fuel cell system used which includes Proton Exchange Membrane for the production via electrochemical process.

4) Hybrid EV-This is the combination of electric motor on one side and a conventional IC engine on the other which can be placed in series or parallel. The battery can only be charged through regenerative braking. Toyota Prius and Camry Hybrid are best Hybrid cars in the market.

2. Background of Electric Vehicle Technology

Electric motor which is used in EV was created way back in early 1800s by Anyos Jedlik till 1828 which was to move small model car. Then to drive a carriage a larger motor was used which was created by Robert Anderson before 1840. In the same years first electric car was also made to run on batteries with non-rechargeable facility and very short range (Chan, 2013). There were many inventors from the Europe side like Netherlands, French which was

working on better batteries performance. As the birth of electric vehicles was 200 years ago can be seen not an invention of the modern times. It has taken land speed record before the times of 1900's, but still it lacks some parameters when compared to Internal Combustion engines which led to decline of electric era. The keyword analysis of electric vehicle suggests that total 72672 articles have been published whereas 68311 (almost 94 %) articles have been published since year 2000. Fig. 2 and Fig. 3 shown the year wise and country wise distribution of research articles respectively as per Scopus database.

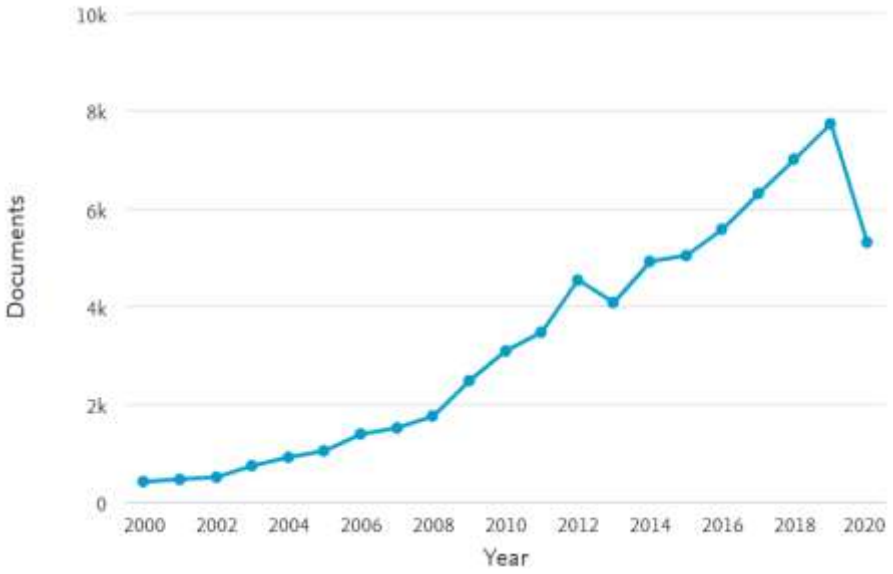

Fig. 2 Year wise research articles published in referred journals

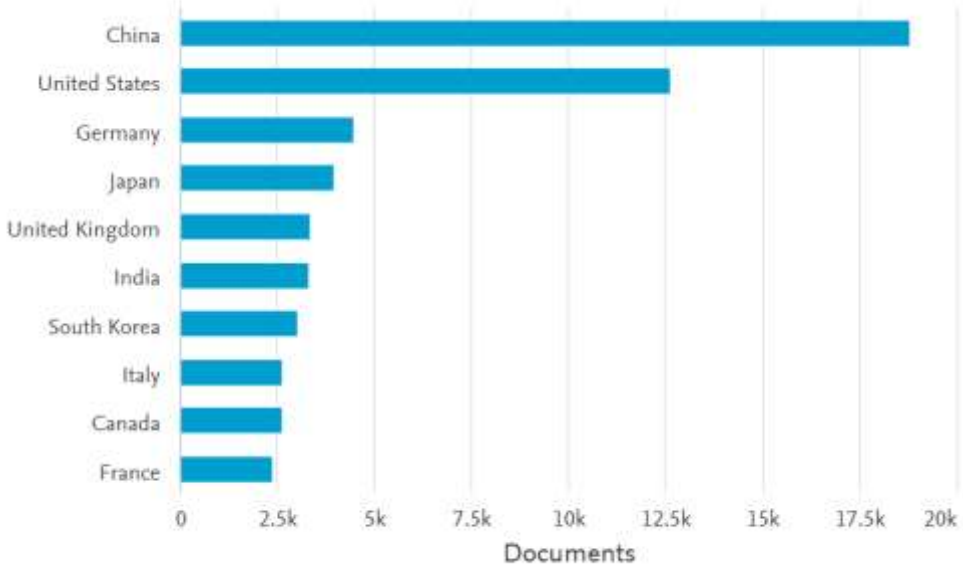

Fig. 3: Country wise distribution of research articles

3. Need of Electric Vehicle in Developing Countries

In terms of growing concern the one is for the conservation of energy and the other is for the protection of environment, as for the fulfilment of these needs the development of Electric

vehicle technology has taken. It can provides emissions free transportation, as per environment concern and reducing pollution caused by noise and on air which was increased fuel dependence vehicles (Mwasilu et al., 2014). EV offers a secure and very balanced energy alternative that is effective and environmental friendly, using renewable energies of various kinds by recycling batteries from the energy aspects. Furthermore, very much impact can be seen on environment, energy and transportation and also new technologies development, new industrial and economic development (Yan and Kezunovic, 2012). The technologies providing a clean and safe environment thus improving human health. The reasons why people are going electric including: fast & smooth for driving, no fumes smell or no harmful gases, cool & innovative, maintain cost very less as compared to other vehicles, high torque and very responsive. Vehicle emitting exhaust emissions which include CO,CO2,NOx and particulate matters causing the increase in global warming and also leading towards serious diseases and other forms of cancer.

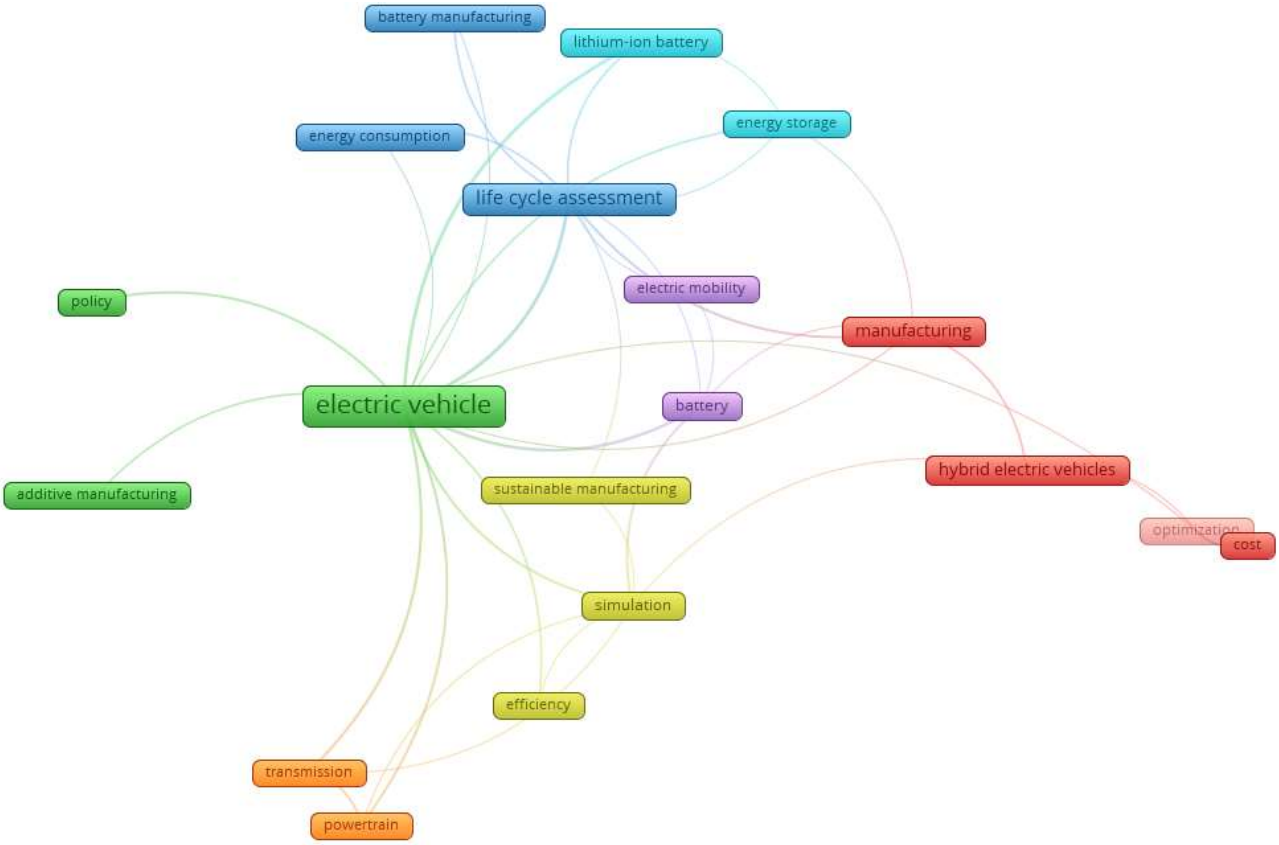

Fig. 4 Keyword analysis ofelectric vehicle manufacturing

Electric drivelines are simple and mechanically more efficient than IC engines. As EV from its name it's been driven by the power of electricity which is stored in battery with rechargeable facility and also can generate power from IC engine named as Hybrid Vehicle. The keyword and co-authorship analysis (country wise analysis) of electric vehicle manufacturing has been shown in Fig. 4 and Fig. 5 respectively.

Fig. 5 Co-authorship analysis (country wise analysis) of electric vehicle manufacturing

Also can be seen almost all manufactures across the world have at least one hybrid vehicle offering half electric and giving high economy. The technology of electric vehicle keeps better and better with improved battery performance, higher economy and better power drivelines (Dai et al., 2016).

4. Major Barriers in Electric Vehicle Technology

For the adoption of Electric Vehicles, we have overcome the barriers even like including vehicle cost, low driving range, long charging times and the need of infrastructure for charging. However their always been some economic, technical and social barriers to accept. There are only light duty Electric vehicles models available from various car manufactures. Mostly consumer acceptance because they tend to resist new technologies that been considered unproved, thus for higher level of success the policies decisions should be considered as their critical concern. As the largest barrier is battery technology for the rapid increase of electric vehicles (Pandey and Bansal, 2014). Even for the conventional vehicles the Lithium ion batteries were also having less energy density when compared to electric vehicles. Heavy and large batteries also have a limited range. Further research is definitely needed for its long life and may be more compact size as shown in Fig. 6.

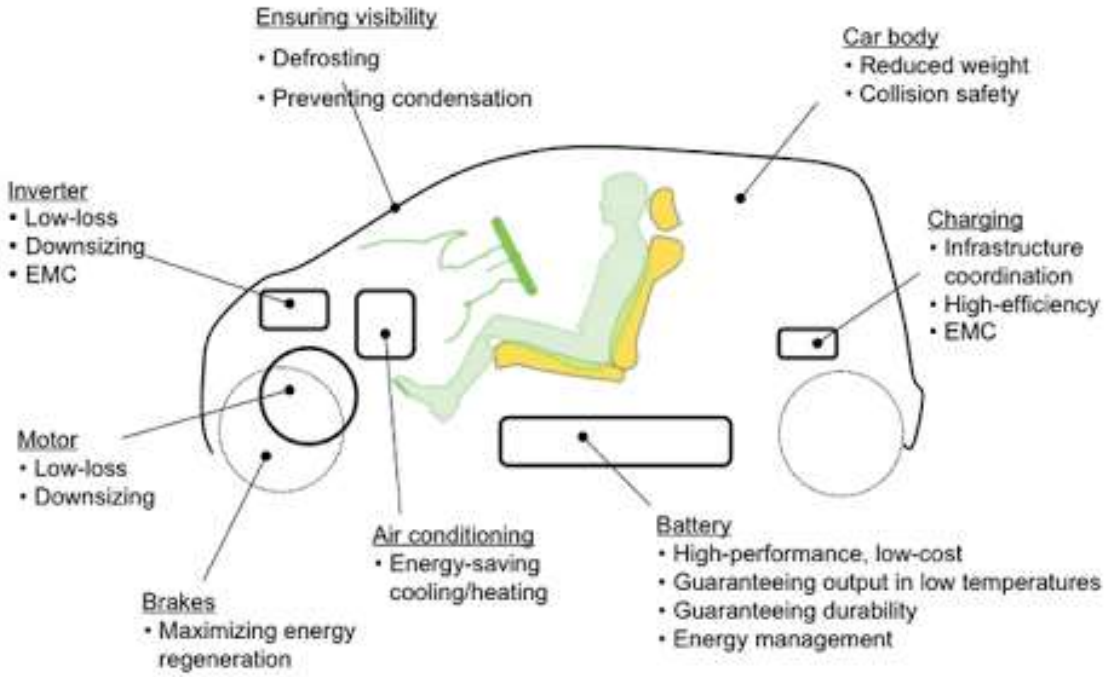

Fig. 6 Major challenges in designing of electric vehicle

The need of sufficient numbers of charging stations and also with considering protection otherwise leads to misuse. Mostly for that household power connectors are available but having low power output. Another problem regarding the standardization of charging connectors and paying methods on national and international level.

Demand for electricity will increase as electric vehicles run on it. EV charging process need many hours for complete charge (Sarbi et al., 2016). For social barrier consideration the

acceptance of electric vehicles for its low range and longer charging time when compared to conventional vehicle. When compared to worldwide less than 1% people own electric vehicles, numbers are increasing, but slowly. In India, big car companies like Tata and Mahindra have also their one electric vehicle. As the government is started to take action against pollution producing vehicles as the diesel engines is banned after 2040, not for heavy duties vehicle which only run on diesel engines. For the protection of environment and lowering the level of pollution. Their also been having limited models released for gasoline as most of the statement is favor of producing either hybrid or electric. The new policies across some countries are changing numbers of going electric within 20 years. Most of the European countries are has taken these steps including banned the sale of diesel and petrol cars till 2030 because due to the level of increase of nitrogen oxide in air defining public health risk.

5. Future Challenges in Commercialization of EVT

The different types Electric Vehicle are having different techniques for the approach of development in different stages like for hybrid vehicles which consisting of both IC engines and electric motor making it heavy and its high cost. For full electric vehicles the battery is more of a concern because of its low range, thus suitable for small EVs. Fuel Cell EV is in its early stage of development as powered H2 directly or directly, the technology can be used for the future rather than having its refuelling and production cost (Yilmaz and P. T. Krein, 2013). Generally Electric driven vehicles are more expensive than conventional vehicles. However, high torque output from the start, noise free and the ease of power to the whole vehicle without any fuel expenses. As the technologies advancing in battery sector thus reducing the cost electric vehicles is expected. The need of battery standards and safety features that deactivate the electric system when meeting a short circuit. To enable plug-in electric vehicles whether fully electric or plug-in hybrid or fuel cell EVs to communicate with the electricity network called Grid as to feed back by returning electricity to the grid at times of peak demands. This would also increase the connected load of the grid. Future development for other storage methods including super capacitors and Flywheel Energy storage. Improved batteries whether lithium polymer or cobalt metal oxides (Morrowa, 2008).

6. Conclusions

The rapid increase in number of vehicles and continuous depletion of fossil fuels has intensified the research and development activities in the field of electric vehicle technology. In recent years, an enormous innovation has been reported regarding improvement in battery life, light weight chassis, material strength and low cost charging stations. The developing countries are relying on development of energy efficient vehicles due to huge demand of fuels and energy. Hence, there is need to intensify the research activities in electric vehicle. Moreover, the future challenges faced would be tackled by introducing low cost hybrid electric vehicles. The research has been carried to analyse the quantity of research article along with challenges and scope of electric vehicle. As per Vosviewer analysis, the research

activities in India are intensive and rapidly growing which would lead to set-up electric vehicle manufacturing industry under self-reliant Nation mission.

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ANB-NEP-2020P7

A framework for the resilience and sustainable additive manufacturing process for self-reliant India

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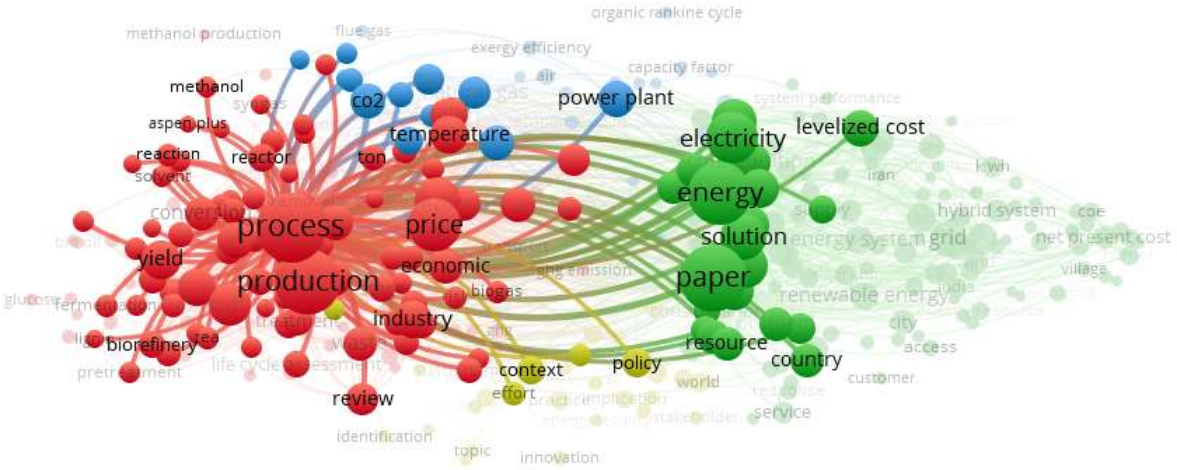
Abstract- This article proposesa framework for the resilience and sustainable additive manufacturing processwith fused deposition modeling system (FDM) in order to cater various issues experienced with standard feedstock filament. The feedstock filament development process has been briefed and the critical factors are highlighted for the successful 3D printing on FDM. The in house developed feedstock filament is cost effective and increases the application range of FDM, which is a step toward the mission “Atmanirbhar Bharat”. Further, the determinant effects of plastic may also be addressed with the adoption of proposed procedure.

Keywords- Resilience and sustainable manufacturing, fused deposition modeling,feedstock filament, melt flow index, Atamnirbhar Bharat

1. Introduction

The self-reliant India or self-sufficient India namely “Atmanirbhar Bharat” is the vision of Hon’ble Prime Minister of India, Sh. Narendra Modi for building the nation as a self-reliant and it becomes a bigger part of global economy. In this regard, different policies are floated which promote efficient, competitive and resilient. Moreover, these policies are being itself self-sustaining and self-generating. Further, the mission does not have any intension of making the isolation from the rest of world. The first brief of “Atmanirbhar Bharat” was announced during COVID-19 pandemic on May 12, 2020. The five obligations of ‘Atmanirbhar Bharat’ are: economy, technology-driven systems, infrastructure, vibrant demography and demand. As mentioned above that the mission is to achieve a large share of the global economy. Prime Minister welcomes the foreign direct investment (FDI) and advanced technology to boost up the nation’s economy. It has been realized that, the technology is only one among the several inter related components which propel the performance of organization[1]. There are two possibilities for the occurrence of successful innovations in technology, first the technology will be designed according to organization’s current structure/culture, secondly, the organizational structure/culture will be modified as per the requirement of new technology. Therefore, it is necessary to understand the desired effects of new technologies so that the additional changes can be realized for maintaining the overall fit. For making such type of understanding, this paper presents a case study on a technology driven change in the area of additive manufacturing. In this case, attention has been given on

reusing the polymeric based material which not only cater the environmental issues but also causes low cost manufacturing with FDM process [2]. Fig. 1 (a and b) shows gap analysis based upon Scopus data for past 20 years related to 3D printing and sustainable manufacturing by using VOS viewer open source processing software. As illustrated in Fig. 1(a and b), various studies have been reported on process development and optimization, sustainable manufacturing but little has been mentioned on use of digital manufacturing especially with in house developed feed stock filaments to reduce the process cost under techno-economic analysis. The same may be one of the game changer for self reliant India mission under National education policy 2020.



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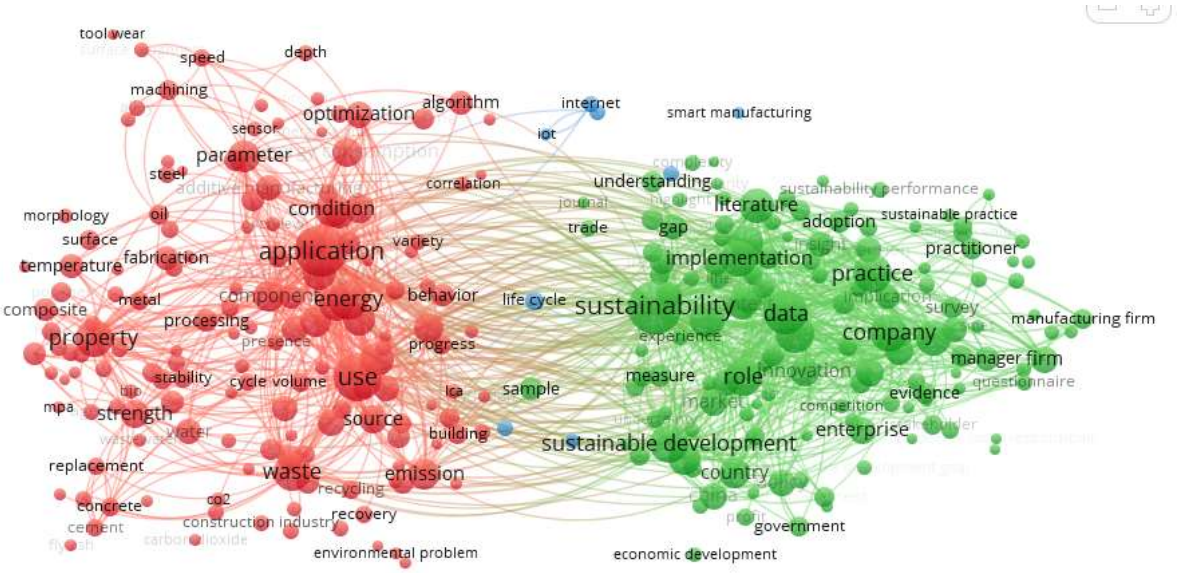

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Fig. 1: VOS viewer bibliographic analysis (a) 3D printing, (b) Sustainable manufacturing

2. Research Background

3D printing is a technology which can make a three-dimensional object based on layer-by-layer deposition. The technique is based upon additive manufacturing (AM) principle for the fabricating a wide range of structures and intricated geometries from 3D model data [3,4].3DP is a robotic construction process in digitally-controlled manner, which can construct up complex solid forms in layers and apply chemical reactions or phase transitions to bind the layers together. The application of AM model has been ferociously used in many fields of industry such as fashion design, architecture, medical and automotive. The commonly used 3D printing techniques have been classified into four categories as shown in Fig.2.

3. Feedstock Filament Materials

Number of processes working on AM principle and among these processes, Fused deposition modelling (FDM) is most widely used for the production of prototypes and functional parts [4-6]. Presently, various types of polymeric materials (virgin as well as reinforced) are used as a standard feedstock filament such as ABS, PLA, Nylon, glass filled PLA, fibre reinforced PLA etc.The FDM system is designed as per the processing conditions required for the extrusion of these standard materials [5]. Although the processing of these standard materials in FDM system very good but there are some challenges associated with them.

i. The selective choice of materials limits the application range of FDM platform.

ii. The standard materials labelled a high price tag.

iii. Availability and shipment issues as these materials are exported.

iv. Damaged/waste FDM prints and similar polymer material may cause environmental issue.

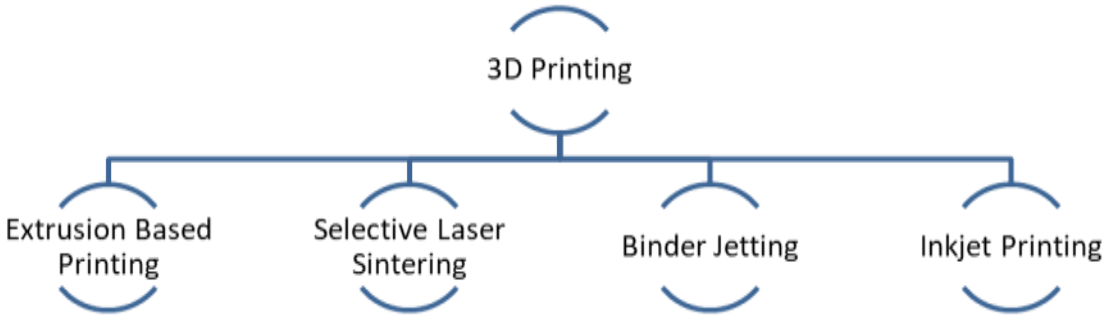

Fig 2: 3D printing techniques

4. Case Study

In order to address the above-mentioned issues, a case study is presented for the inhouse production of feedstock filament materials. This study is a guide map toward the resilient and sustainable manufacturing.

4.1 Fabrication Process of Feedstock Filament

The flow chart of feedstock filament development process is shown in Fig. 3. Based upon the application, material is selected. The material should be polymeric material that can be reinforced by metal, ceramic, carbon nanotubes, fibres etc. as per the requirement. The extend of reinforcement is depend upon two factors, first is the application intended for which it is developed and second is the estimation of processing conditions. The approach is to process the developed feedstock material on FDM system without any software and hardware changes. Therefore, the processing conditions of the newly developed material in FDM system should match with the processing conditions set for standard materials. In this regard the preliminary test is melt flow index (MFI) measurements.

This is the estimation of rheological behaviour of the developed material and it should be equal to the standard material. In other words, one can do the reinforcement in polymeric matrix up to limit such that the flow behaviour at the set processing condition is similar to standard material. As an example, the standard ABS material has 2.41 MFI value. If we are using nylon6 as an alternative material, its MFI value is 10.6. Now we can make the reinforcement up to a level, so that its MFI become equivalent to ABS. It should be noted that, the reinforcement is only possible if the MFI of an alternative material is higher than standard material. The selected polymeric and reinforced material has to crushed to powder size, (450-550 µm for polymers and <325 mesh size for metal/ ceramics) in order to make uniform composition. The materials should be free from moisture content and it can be attained by vacuum heating. As the composition has been prepared, the single screw extruder (SSE) is used for the fabrication of feedstock filament. During the production, the care should be taken for the dimensional accuracy of feedstock filament (filament diameter and ovality), otherwise it may cause chock in the FDM system. After the successful fabrication of filament, its tensile strength should be tested before loading in FDM. The required strength is necessary for feeding the material in liquefier head. Finally, the part can be printed on FDM platform (Fig. 4).

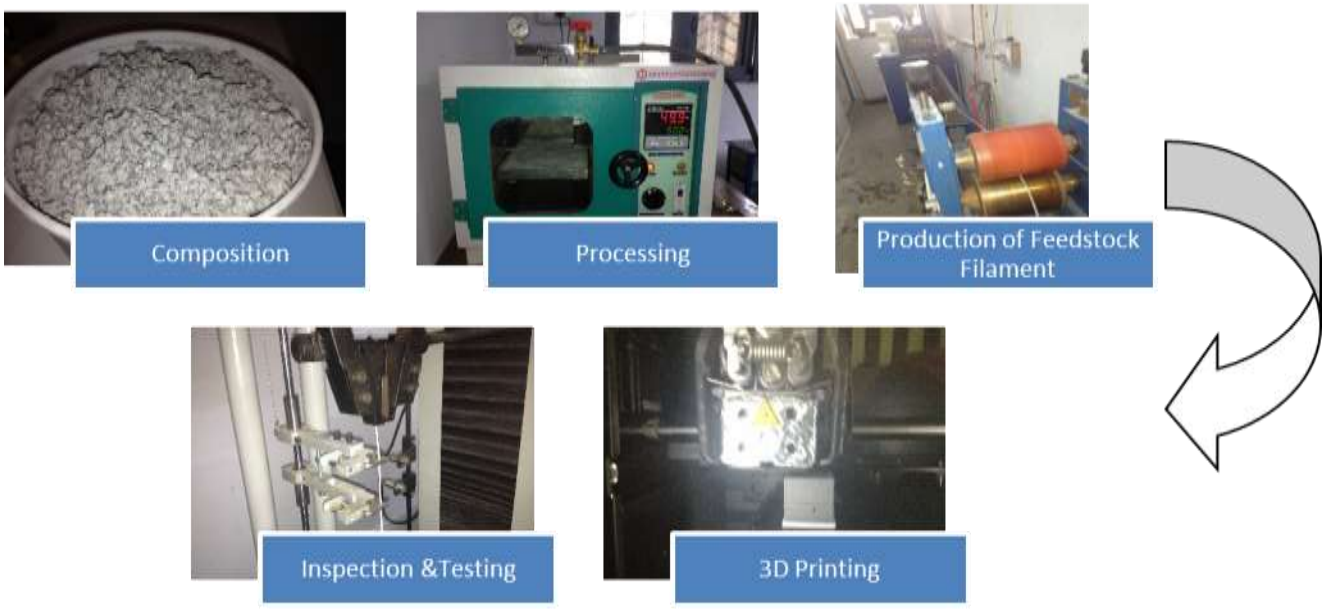

Fig. 3: Feedstock filament development chart [6].

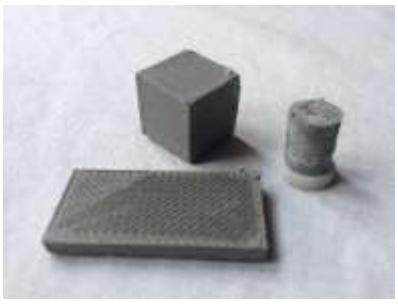

Fig. 4: 3D prints with alternative feedstock filament material.

5. Discussion

Based upon the above said case study, a Nylon6 +Al+ Al_2O_3 based feedstock filament has been developed and run successfully on FDM system. The whole process has been carried out without making any modification in the FDM system. The developed feedstock filament shows less tensile strength and large elongation but its tribological [3] and thermal properties such as DSC, DMA, TGA[7] are enhanced and even more than the standard material. Although some challenges are faced during the production of 3D prints on FDM such as uneven size of the developed feedstock filament and liquefier head nozzle chocking but this frame work is a directional tool for exploring more possibilities with FDM system.

5.1 Techno-economic Analysis

During investigations it was observed that the tensile strength, tensile modulus of composition A (Nylon6 60% +Al 26%+ $Al_2O_3$14%), B(Nylon6 60% +Al 28%+ $Al_2O_3$12%) and C(Nylon6 60% +Al30%+ $Al_2O_3$10%) are 64%, 53%, 28% and 2.7%, 2.1%, 1.5% respectively less than ABS material[8]. The results shown that, elongation at break increases as the filler content and particle size increases. On the other hand,the wear testing was performed with pin on disk arrangement (as per ASTM G99), by applyinga contact load (5N, 10N, 15N, 20N) for the duration of 5min, 10min respectively at constant sliding velocity (1.36 m/s). The testshave beencarried out at room temperature, by pasting abrasive paper on the steel surface and dry sliding on abrasive surface.The composition “A” material has less friction coefficient, friction force, wear, and material loss as compared to composition “B” and “C” materials at all selected operating parameters [3]. Further, the DMA, DSC and TGA analysis also indicated that the alternative materials have higher thermal stability than standard ABS material.

The another most important factor is the cost associated with this method. It is cleared that, the total development cost is the combination of material cost andoverhead cost associated with production. It is cleared that, the part fabrication time depends upon its orientation and infill ratio [2, 9,10]. Table 1 shows the material cost for the fabricating one spool of composite material filament (1 Kg) for FDM.

Table 1 Material cost of the alternative feedstock filament

Composition	**Weight (g)**	**Cost (Rs)**
Nylon 6 E 35	600	30.00
Al	280	40.28
Al_2O_3	120	10.40

Total Production cost = Material cost + overhead cost

= 80.68+20.00=100.68Rs/kg

The cost alternative material filament spool cost is 100.68Rs, which is approximately10 times less than standard material cost (Rs 1000).

6. Conclusions

The frame work for the development of Nylon 6+ Al +Al2O3based alternative feedstock filament for FDM have been presented with the experimental results of tensile testing, thermal analysis (TGA, DSC, DMA) and wear studies.The development cost associated with alternative material filament spool cost is 100.68 (Rs), which is 10 times less than standard material cost. The proposed research work promotes the inhouse developments with a critical

goal of self-sustainability and is a step towards the vision set for self-reliant India (Atmanirbhar Bharat).

7. Acknowledgements

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ANB-NEP-2020P8

Nanoscience and Nanotechnology for Interdisciplinary Teaching and Research:NEP-2020

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Abstract- Nanoscience and nanotechnology is vital to prepare science and engineering students to work in a highly technological industry and research which also align very well with multidisciplinary teaching learning approach inherited in National Education Policy (NEP-2020). Nanoscience and nanotechnology has been projected as the next 'industrial revolution' of our modern age technologies. Itcan serve as a channel to support science education goals and contribute toward making India self-reliant. The advancements that have been made in nanoscience and nanotechnology, and the challenges and opportunities that exist to educate students about critical areas of nanoscience and technology have been discussed here. The ability to succeed rests on the contemporary teaching and training of students, academicians, researchers, engineers, professionals, and other skilled personnel in variety of the emerging areas including Nanoscience and nanotechnology. Finally, we discuss multidisciplinary research in the areas of nanoelectronics, artificial intelligence, internet of things, Robotics, 3D/4D printing, nano-sensors etc. which require nanoscience and nanotechnology interventions.

Keywords- Nanoscience, nanotechnology, interdisciplinary teaching and research, national education policy 2020

1. Introduction

Almost each generation undergoes larger adversities. These adversities witnessed major devastations, but simultaneously provided an opportunity for the hard-working nations to transform these into instruments to become architects for new generations. During this Covid-19 pandemic when Indian trade was diminishing, a concept of self-reliant India was envisioned in some industry sectors and to establish India as a global supplier. Being self-reliant is a trait that demands years of continual work and perseverance. The idea of self-reliant India is inspired from the great Indian thinkers like Swami Vivekanand's remarks, "This is your century right now, but 21st century is India's century" during his visit to University of Michigan around 125 years back [1]. On May 12, 2020 Shri Narendra Modi, the Prime Minister of India, has envisioned to make Bharat a self-reliant (Atmanirbhar Bharat) nation on the basis of five verticals which involves Economy, Infrastructure, System, Demography and Demand.

Each vertical has its own importance to achieve the self-reliant goal, but here this article is focussed on the vertical 'system' i.e. technology driven arrangements and the most important components of technology are led by Nanotechnology. The new frontiers of the century include nanoscience and nanotechnology. The word nano describes the one billionth of a unit for a physical quantity and in nanotechnology the physical quantity is length. There is no question that nanoscience in this century will rule the technology, and this science will affect our lives to an unimaginable degree. In all scientific and technological disciplines, the manipulation of materials at nano level will stimulate new perspectives. By becoming a path-breaker in nanotechnology India can become self-reliant in sectors like clean drinking water, food processing, energy, security, pharma, transportation, electronics, agro-chemicals, etc. (Fig. 1).

The current advancement in technology is rising around the idea of nanotechnology, which is timely for industrial product development. Many nanotechnology products are being utilized in our day to day activities, often without customer knowledge about the technology being used. The field of nanotechnology, which is a multidisciplinary domain having physics, chemistry, biology, electrical, electronics, computer and other engineering domains are attracting a great deal of attention. There is a possibility that the scaling of electronic, optical, and mechanical systems that have had such a marvelous economic impact in industry can be extended with nanotechnology. The researcher, scientists and professionals believe that nanotechnology will lead industry to a new and interesting phase of product development that has cheat technologies with advanced features. The size of products can be minimized with nanotechnology and the parts used to make such devices will be as per Moore's Law, i.e., in the same area double the number of transistors can be integrated in every two year. As the number of transistors doubled in the same area products can have more applications integrated in small areas.

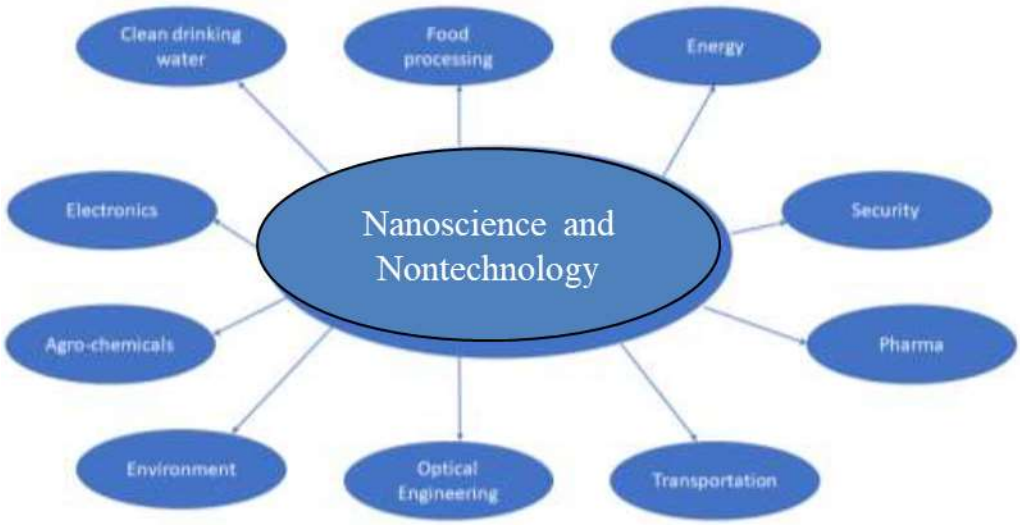

Fig. 1: Major sectors where nanoscience and nanotechnology play a vital role.

2. Importance of Teaching and Research in Inter/ Multi- Disciplinary Areas as per NEP 2020

Inter- / multi- disciplinary teaching and research finds strategic focus in NEP 2020 to make India self-reliant and a global hub for research and development. The NEP 2020 specially focuses to develop a strong research culture among the universities/ institutes at national level. The current GDP expenditure toward education is 4.43% and NEP 2020 envisions it to be increased to 6%. The national education policy 2020 suggests following changes to research and innovation in the country [2].

- Promote and expand research and innovation along with funding and seeding research in universities and colleges across the country by establishing National Research Foundation (NRF)
- The Model Multidisciplinary Education and Research University (MERU) approach to education will provide greater leverage and academic freedom to researchers in higher institutions at different levels of research, including Masters and PhD.
- Aligning Research with Academic Programmes
- Mission Nalanda and Mission Takshashila- Institute of Liberal Arts and MERU will be set up as part of these missions.

3. Importance of Nanoscience and Nanotechnology in Various Areas

Following are various areas where nanoscience and nanotechnology interventions are promising for research and innovations

3.1 Electrical Engineering

Nanotechnology has a key role in many electrical equipments and the industry has taken huge benefit of nanotechnology and nanoscience in its components, such as in insulation materials for wires, transformers that are the main unit in the electrical engineering. The use of nanotechnology in transformers, particularly investigations associated to isolation and insulating materials, oil for transformers, monitoring systems and other electrical components.

3.2 Nanoelectronics

Nanoelectronics deals with the design of electronic circuits and systems with nano semiconductor devices. Its subfields include multi gate devices, hybrid inorganic-organic electronics, nanowires, III-V compound semiconductors, spin electronics, quantum dots and quantum electronics. The Demand for low power and high-performance systems has increased many folds with technology scaling due to several factors like increasing leakage currents, power dissipation, heat removal requirement and stability/reliability issues etc. According to the International Technology Roadmap for Semiconductor Devices the printed gate length will scale down to 10 nm until 2015 and 6 nm till 2020 [3, 4]. Scaling of conventional single gate MOSFET much below 50 nm is difficult due to high Short Chanel Effects (SCE) and leakage currents. Control of leakage currents requires gate dielectrics so thick and bodies doped so heavily that degrades the carriers' mobility and hence reduces the

driving current of the device. All these concerns motivated the designers to explore various alternative device structures such as multi-gate MOSFETs (DG-MOSFET, FinFET, Tunnel-FET, CNT-FET, SET) i.e., nanoscale semiconductor devices and circuits.To mitigate the single gate MOSFET scaling problems, new Silicon on Insulators (SOI) and Ultra-Thin Body (UTB) devices with multi-gate structure required [3].

3.3 Artificial Intelligence

Artificial Intelligence (AI) is a multidisciplinary research area increasingly finding its way in Engineering Design, Analysis and Manufacturing. Advances in AI, combined many technologies such as Internet of Things (IoT), 3D/4D printing, cognitive computing, robotics, human-machine interface, nanoscience, nanotechnology, nanoelectronics, quantum computing, smart grid etc. together for products design, manufacturing, assembled, distributed and serviced tasks. Recently, Artificial Intelligence (AI) has demonstrated huge potential for industry development and provides design at low power that leads to highly energy efficient computing systems. Artificial Intelligence (AI) has become a very important technology in modern design & manufacturing processes, exploding speeds & smart programmable devices. Next revolution in the industry will take place with the development of artificial intelligence.

3.4 Internet of Nano things (IoNT)

We are surprised at the revolution of technology that brings us by the concept called- Internet of Things (IoT). This intelligent technology is able to change our traditional home to a smart home by the involvement of technology with the internet and control the home appliances by giving a simple command from a device at a remote location. This IoT based smart watch that not only trails all our activities but also prepares us when the limits are exceeded. The IoNT is the combination of nano-sensors and nano-devices with Internet with various types of information, chains high speed of communication network which leads to “Internet of Nano Things” (IoNT) [5]. Since last decade, the number of IoT devices available in the market has increased radically. The total is approaching a amazing 15 billion, meaning that there are currently roughly two connected devices per living human. This development is probable to continue at a fast pace, with an expected 50 billion linked devices by the year 2030.

3.5 Nanorobotics

Nanorobotics is a multidisciplinary area that requires involvement of researchers, scientific and medical doctors, pharmaceutical, engineering as well as other applied sciences expertise. Nanorobotics, from time to time reported literature also known as molecular robotics, which is a budding research field. This has two main domains. The first domain study the design, implementation, timing control, and coordination of robots with nanoscale dimensions (i.e., nanorobots). The second domain deals with the treatment and assembly of nanoscale components with macroscale instruments or robots.

3.6 3D/4D Printing

3D printing is also known as adaptive manufacturing that has evolved quickly in many applications. The past decade has coined a new term known as four-dimensional (4D) printing, that utilizes additive manufacturing methods to print stimulus-responsive products subjected to specific stimuli. The 4D printing is usually regarded as the advancement of 3D printing [6-9]. 3D printing has speedily garnered wide focus and developed as an emerging manufacturing technology. 3D printing has been extensively used in many areas, some of them are jewelry design, textiles printing, tissue, nanoelectronics layout design, and healthcare products etc. 3D printing has boosted the application areas according to its various characteristics, i.e., less process time, economic product, customization possibilities, and less material requirement. To mitigate the issues regarding 3D printing, an advanced printing technology has evolved well known '4D printing'. The concept of 4D printing was firstly introduced by Tibbit that involved its innovation and applications for new product development. 4D printing adds the fourth coordinates of time in addition to the conventional 3D coordinates. The 4D printing is an innovative idea for design of a smart 3D object with a material that can change its shape over time if exposed to environment changes and other factors are water, magnetic field, heat and light.

3.7 Nano-sensors

Nano-sensors are expected to be a vital part of the success story of Industry 4.0. Improving medical diagnostics and enhancing performance of energy devices such as fuel cells and batteries is possible by using nano-sensors. Sensors have potential in improving health, safety and security, and have a crucial role from environmental monitoring to space exploration. There are many research areas in sensors which needs nanotechnology intervention such as Advanced materials for sensor application, Challenges and strategies towards the development of ultrasensitive and highly selective electrochemical biosensors, Nanostructured based gas sensors towards health monitoring, Flexible and smart sensors in building indigenous ecosystem, Water quality sustainability, Real world sensor applications for food quality and robotics, and Enabling sensor technology using artificial intelligence, etc.

3.8 Other Areas of Nanotechnology

The scarcity of clean drinking water is a major concern not only in India but worldwide and this has opened the way to develop new water purification technologies which are reliable and cost effective. Heavy metals (arsenic, lead, cadmium, mercury etc.), pathogens (bacteria, viruses, protozoan, and parasites), Organic chemicals (phenolic compounds, dyes, drugs etc.), Radioactive contaminants (cesium, plutonium, and uranium) etc. appear among the main pollutants in water [10]. These pollutants pose serious health hazards despite their very low concentrations in water.

Using nanotechnology these problems can be overcome by developing novel nano-adsorbents (e.g. carbon based, Metal-Based,nanocomposites as nano-adsorbents), nano-enhanced membranes, and nano-photocatalysts. The performance of membrane systems is largely decided by the membrane material, but the key challenge for membranes lies in the fundamental trade-off among selectivity and permeability. Nano-enhanced membranes, like aligned carbon nanotubes, biomimetic membranes, and thin film nanocomposite membranes, have shown promise to get over such challenges. In photocatalysis mass transfer limitations and higher consumption of photons are the key challenges and can be solved by developing nano-photocatalysts, e.g. nanocomposites for solving electron hole pair recombination problems [11].

The demand of energy is soaring exponentially and we need to look at non-conventional energy resources. The role of nanotechnology is vital in reducing the cost and enhancing the performance of energy harvesting and energy storage devices, e.g. nanotechnology cuts the cost of catalysts employed to generate the hydrogen ions from fuel (e.g. methanol), as well as it improves the effectiveness of membranes in segregating H+ ions from other gases, for example oxygen.

4 Conclusions

Nanoscience and nanotechnology can serve as a channel to reconsider science and technology education and public policy in support of science education goals. The opportunities exist to educate students about critical areas of nanoscience and technology. The multidisciplinary research in the areas of nanoelectronics, artificial intelligence (AI), internet of things (IoT), Robotics, 3D/4D printing, nano-sensors etc. require nanoscience and nanotechnology interventions. The National Education Policy 2020 has potential to change the research and innovation culture and make India a self-reliant nation by developing it as a global research and development hub.

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Atmanirbhar Bharat: A Review on Chaotic Automobile Sector of India

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ABSTRACT: Atmanirbhar Bharat is an ambitious vision by the Prime Minister of India Shri Narendra Modi of making India "a bigger and more important part of the global economy" (self-reliant India). With the announcement of 20 trillion economic package under this vision in response towards devastating blow caused by COVID-19 Pandemic and aid the country out of the corona virus crisis. However this vision is not only limited to aid country from the damage done by corona virus pandemic but also to encourage and accelerate the policies that are self-resilient and self-sustaining. Economy, infrastructure, technology-driven systems, vibrant demography and demand are the five pillars of Atmanirbhar Bharat according to the vision statement. However there is one huge sector that is in its continuous chaotic state and largely affected by economic fallout which is the automobile sector needs to be addressed more frequently under the Atmanirbhar Bharat program as it is one of the driving factor in the economy and contributes 49% of the Indian manufacturing sector. This paper aims to bring the clarity in current scenario of automobile industry and the need of finding a one stop solution while considering Atmanirbhar Bharat as an opportunity to implement such solution.

1. Introduction

Automotive sector is always been a chaotic experience for both industry and common people sincemid 2019 as Indian automotive industry saw its biggest recession in history resulting in decline of sales upto 30% as of august 2019 and the worst being 35% as of December 2019. Further seeing the climate conditions it was confirmed that Bharat Stage (BS 6) norms will be implemented soon in 2020 which is going to be successor of BS4 norms and features more advanced emission control systems however increasing the cost of the vehicle. Later in 2020 as the industry was settling with new standards but was about to hit by the COVID-19 Pandemic[1]. In 1991 India moved to a more open economy and since then new innovations and modern much simplified solutions in automotive industry are having tricky time trying to adapt local atmosphere in India either for setting up manufacturing plants or providing services etc.

2. Background of Indian Automotive Industry

Indian automotive industry sector was always under frequent policy changes from decades now. Back in 1980's important changes in de-regulation of licensing frame work, capacity re-

endorsement etc and liberalization of controls and restrictionsof controls and restrictions on clearances for foreign collaborations and imports of capital goods and components were introduced in India [2]. Later this move resulted in a technological advancements and introduction and attraction of new foreign automotive brands from Japanese market and including some western manufacturers.But it was suggested that policies environment between late 80's and early 90's only seem to permit a limited increase in technology inflow [3]. However without loosening up things on the imports and foreign exchange did increase the dependency in imports. On the other hand according to a report due to liberalization and other positive policies there was a significant growth in auto industry [4].

Table 1 Data of 10 Years

Years / Company	1981	1983	1985	1986	1998	1990
BAJAJ	36.00	34.47	41.09	35.11	33.94	30.73
H.MOTOR	11.51	6.40	4.57	4.89	2.21	1.37
MAHINDRA	29.03	36.84	32.25	27.91	11.70	9.12
PREMIER	5.00	2.81	0.58	0.14	0.00	0.00
SWARAJ MAZDA	0.00	0.00	0.00	4.42	4.67	6.31
MAHNISSAN	0.00	0.00	3.23	3.56	4.88	5.54
TELCO	0.00	0.00	0.00	8.24	24.71	30.69

Source: ACMA, Automotive Industry of India: Facts and figures, various issues.

Thus industry saw new entry of imported technology and new firms. This entry of new technology forced existing firms to bring technological upgrades as entry of Japanese firms altered while most of the firms were struggling to stay in the market as new technology was taking over the market [5]. The new firms bought modern engineering practices and introduction of CAD/CAM in their manufacturing processes while existing firms also showed adoption of much simplified and innovative manufacturing practices. During the early 90's era there was overall significant growth of automobile sector according to data it increased around 14% compared to 8.5% before 1991 [6].

3. Post-Pandemic and Automotive Industry

Atmnirbharbharat is already focusing on some major topic like increasing coal usage. India has one of the world's largest coal production and once it is opened for private sector that could be used to create immense profit. Talking about abandoned fuel resources however India does not have emerging demanding fuels like Lithium Mines which means we still have to rely on other countries for Lithium as source for manufacturing latest Battery Electric

Vehicle [7]. Fig. 1 and 2 shows keyword and country wise analysis respectively related to research in automobile production in India.

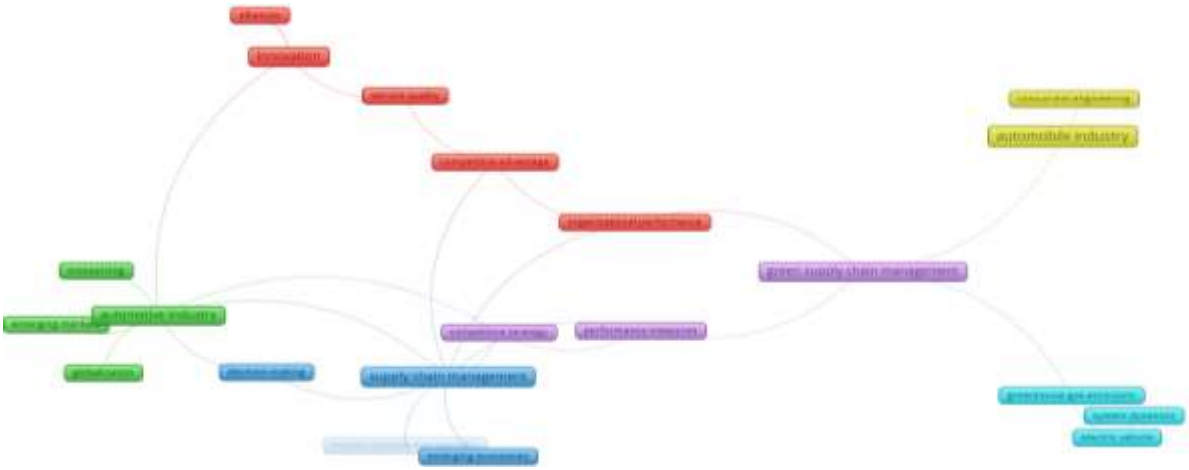

Fig. 1 Keyword analysis of automobile production in India

Due to this COVID-19 outbreak the world has seen a tremendous decline in atmospheric pollution and the world is taking more initiative towards manufacturing cleaner or zero emission vehicles. This means there will be new technological advancements in coming future and existing firms need to press the accelerator towards it too. As said by Industrial Automation India "Indian Automotive Industry, unfortunately, is going through a rough time just like any other automotive market". So the reason we have already discussed that how Indian automotive industry was already suffering from a recession then the new emission norms came out making vehicles slightly more expensive and then the COVID-19 Pandemic hit it even badly and could prove a long lasting effect. According to the GDP forecast there will be absolute drop of in financial year 2021 [8]. Until and unless we follow a new path out of this situation and that is getting more into green vehicle manufacturing market.

In mean time the stress in automotive market is affecting job opportunities for young aspirants according to a data Maruti has cut over 6% of workforce since early 2019, slow rate of car sales has also affected the side businesses. "The automotive industry is facing an unprecedented slowdown," Ram Venkatramani, president of ACMA said in the statement. "If the trend continues, an estimated 10 lakh [1 million] people could be laid off," he added. But PM Modi says "The slowdown is transient. I believe that both demand and the industry will bounce back strongly and soon," told to India's The Economic Times newspaper [9].

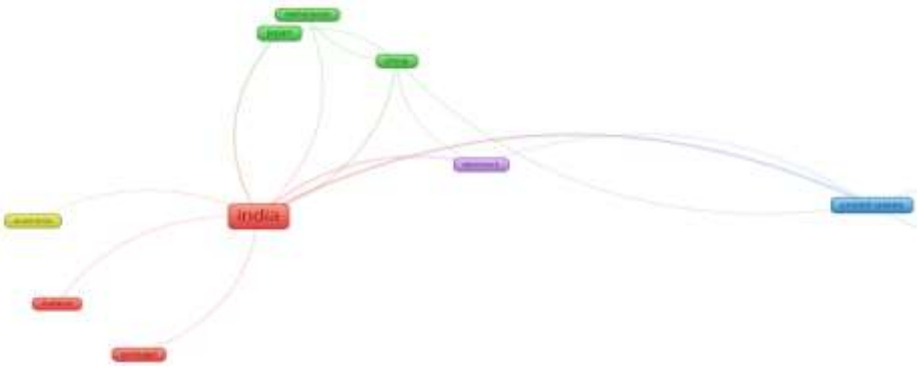

Fig. 2 Country wise analysis of research on automobile production in India

Pandemic year 2020 is about to end as soon and firms are looking forward to new fuel type vehicles that are Battery Electric Vehicles[10]. It is not a new concept and took many years to be practically implemented on road for general public because the initiative was huge and very few companies came forward to commit[11]. As every new technology does came with some challenges and in case of BEV (Battery Electric Vehicles) the challenge is to setup a huge network of charging station available for the public who owns an BEV can make use of this facility of charging his/her vehicle in remote location, because even though BEV technology came a long way still budget electric cars don't provide that much of travel range[12].

This type of network basically could be of two types:-

- Government Charging Station
- Private Charging Station

To accelerate the penetration of BEV technology in India one need to first facilitate the charging station and other side needs of a BEV. Here government could take an initiative or support the firms towards setting up this network. But this setup also has some complication and needs to be projected as a challenge[13].

The charging station that are used are basically either home charging station or public charging station out of which there are fast charging station and normal charging station. The fast charging station as set by Tesla cost around $0.06-$0.26 per KWh in United States. While other charging station ranges from $0.39 to $0.69 per kWh for members and $0.49 to $0.79 per kWh for non-members, depending on location. However there are various technologies that help in framing a better infrastructure for these upcoming electric vehicle technologies [14]

The Indian government is committed to solve the pollution issues in Delhi capital of India, and as more and more initiatives are being taken and worked on but no solution is practically coming handy [15].Seeing the air quality before and after Covid-19 Pandemic world has realised that the greener vehicles shall reduce pollution if a high percentage of the electricity mix comes from renewable sources and also if the battery manufacturing takes place at outskirts of city [16].

4. Conclusion

Atmnirbhar Bharat is not being self-contained or being closed to the world it's about self-sustaining and self-generating. Indian automotive industry has always been in a swing and now the adaptation of more clean and green vehicle infrastructure is being adopted worldwide and seeing the current condition of automotive industry it would be beneficial to introduce new automotive practices creating a new sector of interest. The green and cleaner vehicles will slowly show demand in automobile sector, practicing and implementation of new technical structure will benefit industry also encouraging younger aspirants from engineering background to innovate and contribute to the automobile sector could aid the situation in coming years. With the new education policy 2020 we shall expect students getting more and more skill based learning and adaptation of entrepreneur mindset. There were many

challenges discussed above mostly are either dealt by government or any private firm which sometimes leaves an un-discussed issue behind. Through the NEP-2020 education and entrepreneurshipwill be strengthened resulting in decrease in un-employability in near future.

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ANB-NEP-2020P10

Smart Irrigation System with Wireless Control and Notification

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Abstract: This paper describes the design analysis of Smart Irrigation System based on Global-System- for-Mobile-Communication (GSM) and automatic plant watering for the wastage of electricity and water through remotely control. The designed system can be initialized through Short Message Service (SMS) and automatic plant watering takes place. The switching of water pump is depends on the water level detector. If the water plant area is full, microcontroller automatically turns OFF the water pump as well as notifies the status of water pump and water level on the GSM based handset through SMS. The smartness is performed by providing remotely controlled environment and as well as automatic plant watering. The system consists of an 8-bit ATMEL microcontroller (AT89S52), GSM module (SIM300), Relay Driver Unit (Darlington Pair), Water Pump and water level selector (transistors or soil moisture sensor). The software is designed in KEIL and circuit in Proteous designing tools. The designed system is automatic start the water pump until the plant area will full and the status of the water level is shown on Indicators as well as sent to user's handset through GSM module.

Keywords- Microcontroller, GS M Module, Water Pump, Water-Le vel-Detector and Relays

1. Introduction

Today, the most important problem is facing misuse of electricity and wastage of water due to carelessness of the authorities, water operators or unawareness of the farmers which results in wastage of electricity as well as the water [1-3]. The Indian farmers are mostly uses the traditional manual method for plant watering, switching of water pumps which consumes a lot of manpower and time [4-6]. To overcome all these problems we have designed a system which provides a wireless control for the switching of water pump and automatic plant watering through low cost water level detector circuit or soil moisture sensor. In the present time most of the peoples are using GSM based mobile phones. With the advancement of technology in last decades, a new concept called wireless switching has become established and through this concept people have been trying to control and secure their devices remotely by using GSM technique [7]. The automatic irrigation system is performs the control the water wastage through various methods and techniques all over the world [8-12].

So it gives motivation to us for designing a system for smart irrigation system which control through SMS and provides the automatic plant watering to agriculture land. Fig. 1 illustrates the Structure of Smart Irrigation System.

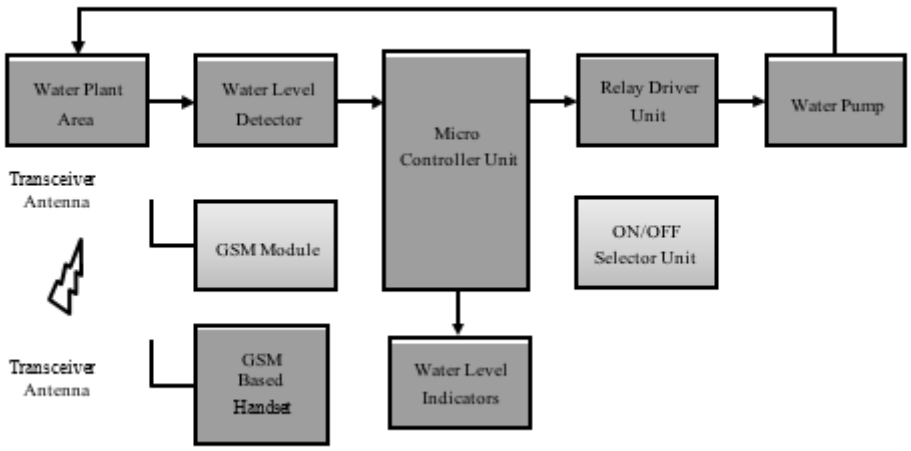

Fig. 1 Structure of Smart Irrigation System.

2. System Design and Implementation

The complete system is divides into hardware and software section. The hardware section consists of embedded system that is based on microcontroller (AT89S52), a GSM module (SIM300), GSM Mobile Phone, Relay Driver Unit (Darlington Pair), Water Level Detector Circuit or Soil Moisture Sensor and switching device (Relay). The GSM module provides the communication media between farmers and designed system through SMS. The GSM modules uses the AT commands to send or receives the SMS message. The format of the message is predefined as per the datasheet of GSM (SIM300). As GSM module receives the message, microcontroller extracts the command automatically and turns ON/OFF water pump. The water level detector is used to detect the water level of plant area and sends the signal to microcontroller for further action. The microcontroller will automatically turn OFF the water pump if the water plant area is full which indicates by the Red Light Emitting Diode (LED). The relay driver unit contains a PNP and NPN transistor which acts as darlington pair and generates LOW output if it receives LOW input and HIGH output if receives HIGH input. The relay is switching device which turns ON or OFF the water pump as per given instructions by the microcontroller. The microcontroller is automatically generating a SMS to the farmer's handset through GSM module to notify the status of water pump and current level of water plant area. The detailed configuration of the designed system is given as:

2.1 Schematic Design

The hardware components are virtually connected in the schematic design with the help of professional ISIS 7 Proteus designing and verification software. The circuit of hardware prototype was designed in Proteus. The components properties can be varied in according the requirement which is available in the software. After the completion of circuit designing, simulation is performed and virtually verified the circuit performance on Proteus with embedded C code. The schematic design of Smart Irrigation System is shown in Fig. 2.

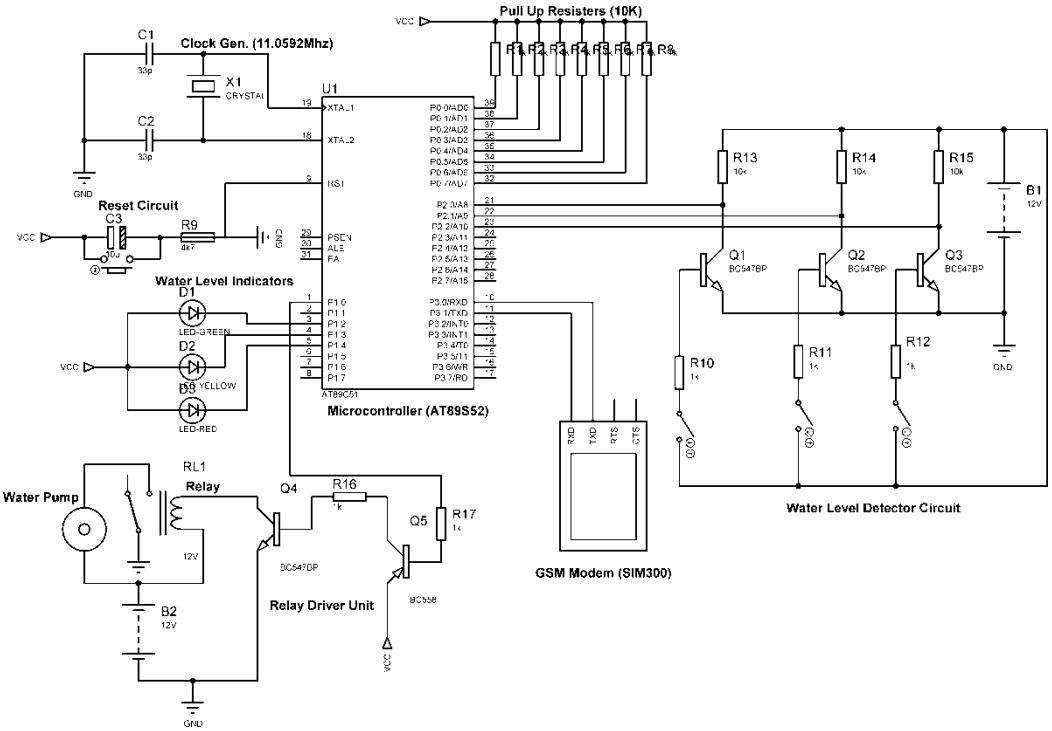

Fig. 2 Schematic design of Smart Irrigation System.

2.2 Microcontroller (AT89S52)

This system is designed with the Atmel 8-bits micro-controller (AT89S52) and a clock/timeout generator circuit having 11.0592 MHz (~=12MHz) frequency and it operates on +5V dc supply.

It consists of four input/output (I/O) ports and every I/O port contains eight pins, so the total numbers of I/O pins of microcontroller are 32 pins which either used as input pin or output pin. It also contains 128bytes of Random- Access-Memory (RAM), 4Kbyte of Read-Only-Memory (ROM) and one Serial COM port. Microcontroller is the heart of the system and it initialized through received message from farmer's handset and overall operation is controlled by it by receiving signal from water level detector circuit. These function is performed are based on stored embedded C code in the ROM and it also passes the signal to corresponding components as per received input signal.

2.3 Water Level Detector

The water level detector circuit contains the transistors, resisters and jumpers. The circuit is designed as per Fig. 2. It circuits detects the three water levels and send the corresponding signal to microcontroller through Pin no. 21, 22 and 23. We have designed water detector circuit to reduce the cost of the system; we can also use soil moisture sensor instead of this circuit. There are three water levels Low, Medium and High level and corresponding output indicators are Green, Yellow and Red LED respectively.

2.4 GSM Module (SIM300)

GSM Module can either send or receive short text messages through Universal-Asynchronous- Receiver/Transmitter (UART. The module is connected to microcontroller through voltage level converter (MAX232) which maintains the voltage level between microcontroller and GSM module. The serial baud rate of SIM300 is adjustable with 1200 to 115200 bits per sec (bps) and default baud rate of SIM300 is 9600 bps. Its operating voltage is 7-15V, 1.5-2.0A DC. The operation of GSM module is performed by AT commands. Table I. shows the AT commands of GSM Module (SIM300).

Table 1 AT Commands of GSM Module (SIM 300).

AT Command	Uses
AT+CM GF	Message Mode
AT+CM GS	Message Send
AT+CM GR	Message Receive
AT+CNMI	Set Baud Rate
AT+CPOWD	Power down

2.5 Relay Driver Unit

The switching action is performed relay driver unit, which contains relay and its drivers. The relay driver performs as D flip flop through transistors (PNP and NPN) and biasing resisters. The relay is a switching device which operates automatically by receiving signal from microcontroller through its driver circuit and turn ON or OFF the water pumps. The operating voltage of the relay is +12V DC supply.

3. Software Development

In the software development section source code of the system are designed. The source code is written in Embedded C language on Keil4 Compiler which converts it into HEX File. The HEX file is stored into microcontroller using Flash Magic. Fig. 3 illustrates the flow chart of Smart Home Automation.

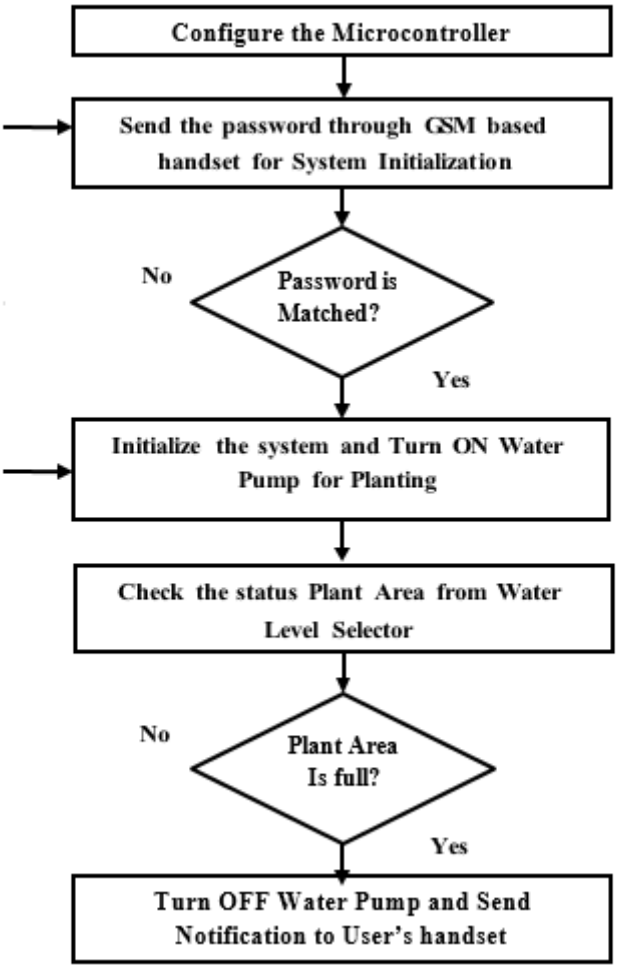

Fig. 3. Flow Chart of Smart Irrigation System.

4. Conclusion

The Smart Irrigation System is successfully able to remotely control through wireless technique from any location of the world where GSM service is available and Automatic Plant Watering takes place through water detector circuit. The designed system is very low cost, automatic operated and remotely controlled solution for wastage of electricity and water in agriculture lands. The remotely controlled and automatic operating capabilities of this system are make it so interesting.

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ANB-NEP-2020P11

A SCIENTOMETRIC ANALYSIS OF DIFFERENT ASPECTS OF EDUCATION POLICY

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Abstract: It is a common practice to do amendments in existing education policy for sustainable development of a country. In present research, a bibliometric analysis on education policy is presented to explore the various aspects of education policy. The study is more inclined to discuss the various research concepts investigated by Indian authors. The VOSviewer software is used to visualize keyword network and co-authorship network. The outcomes of this paper would provide future research directions for analyzing national Education Policy (NEP-2020).

Keywords: Education policy, Keywords Network, NEP-2020

1. Introduction

For every nation to create world class institutions, there should be an extremely regulatory framework as well as great policy [1]. This particular policy articulates precisely which framework type, and also it is going to enable us to create today a world class institution. The holistic method of training is stressed by the policy. It examines modern science, contemporary understanding methods as well as conventional wisdom that allows the intersection of the disciplines being analyzed. Additionally, it allows pupils to seamlessly learn different areas which make for a well-rounded education making for amazing people of India as well as the world. Training policy evaluation is definitely the scholarly research of education policy [2]. It seeks to answer questions about the goal of training, the goals (personal and societal) that it's created to achieve, the means of following them as well as the resources for measuring their failure or success. Education reform would be the title given on the aim of changing public education. Historically, reforms have taken various forms as the motivations of reformers have differed [3].

Modifications might be applied by specific educators or by broad based schooling business or by curriculum switches with performance evaluations. At present, there are numerous initiatives targeted at coping with these issues including revolutionary cooperation between federal and state governments, educators, as well as the business market [4]. Education Policy focuses on the improvement of policy in the level of the nation state along with the person institution [5]. Policy should be viewed as a dialectic practice where all those impacted by the policy are going to be engaged in shaping the development of it. Policy development is thus equally a consistent and a contested process in that individuals with fighting values as well as

differential entry to power find to develop as well as shape policy in their own individual interests [6-7].

Union Cabinet of India on 29th July 2020 has approved the National Education Policy 2020 (NEP 2020) by replacing the prior National Policy on Education, 1986. The policy is an extensive framework for elementary education to advanced schooling and vocational instruction in each urban and rural India. The policy seeks to change India's education system by 2040 [8]. The language policy of NEP is an extensive tip as well as advisory in nature; and also it's as much as schools, institutions, and the states to select the implementation. The next section provides the quantitative measure of existing research on education policy. Section 3 is focused to explore the research concepts of education policy. The last section provides the conclusion.

2. Global Research Trends on Education Policy

The present research provides quantified data based on the published documents on education policy. The flow chart of present work is shown in Fig. 1.

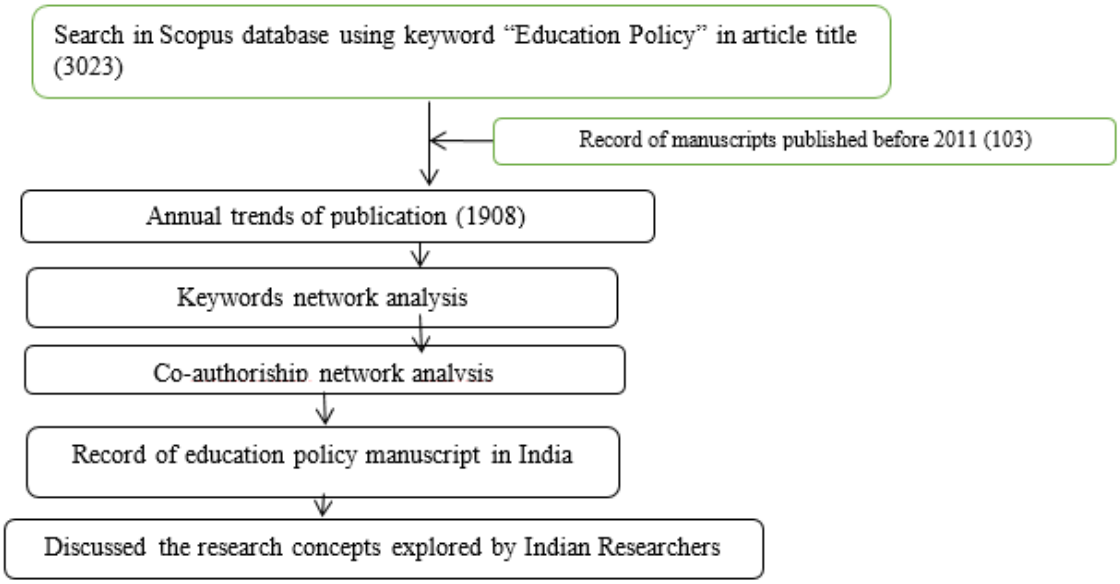

Fig. 1 Flow chart of present work

2.1 Annual Trends of Publication

It has been observed that a total 1908 manuscripts have been published 2011 onwards as per Scopus database. The highest documents have been published in the year of 2019 and followed by publication in 2017. United States, United Kingdom and Australia are the top three countries who have published more than 150 documents on Education Policy as shown in Fig. 2.

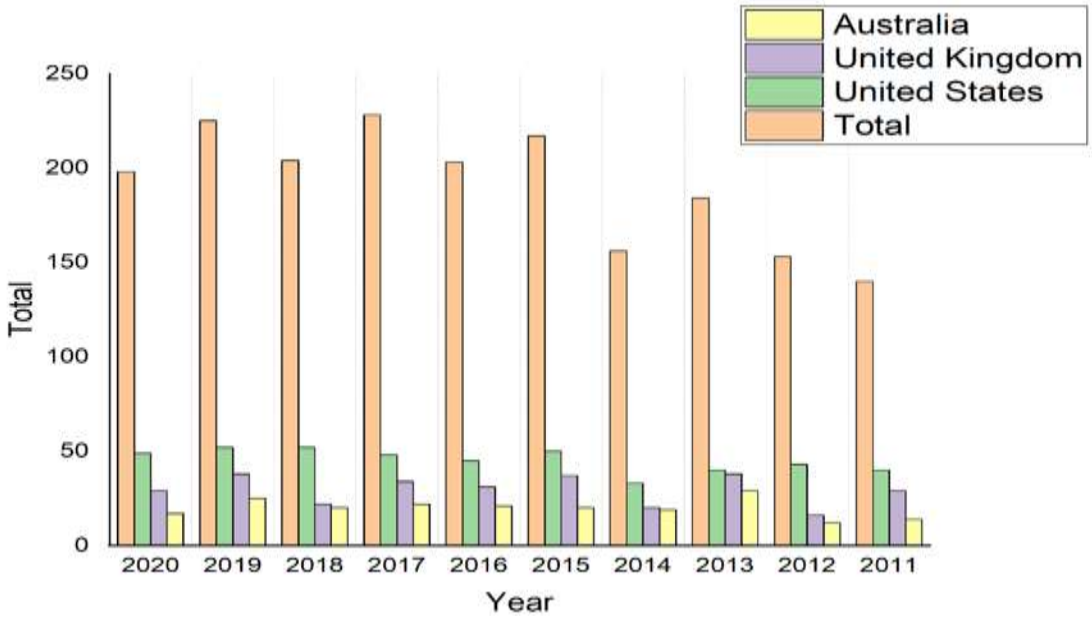

Fig. 2 Annual Trends of document publication

2.2 Keywords Analysis

The keywords analysis is performed using VOSviewer software. Out of 3332 keywords, only 48 keywords with a minimum 10 occurrences are selected. The similar and irrelevant keywords were dropped and finally, the network is developed using 36 keywords and divided into 6 different clusters as shown in Fig. 3. As per global trends, it has been observed that education, curriculum, quality is more relatedness than policy implementation. Researchers have focused more on early childhood education than higher education policy. It has been noticed that researchers have explored more attributes of governance as compared with accountability.

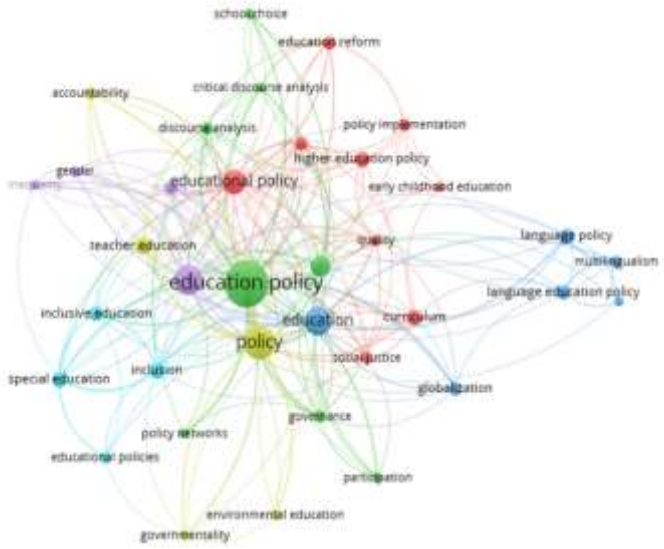

Fig. 3 Keywords Network

2.3 Co-Authorship analysis countries wise

It has been noticed that researchers from Malaysia and Russian Federation have done collaborative research with researchers from Australia and Finland respectively as shown in Fig. 4. There are eight countries viz. Mexico, South Korea, Taiwan, Austria, Hungary, Ireland, Malaysia, Russian Federation have less than 5 values of total link strength.

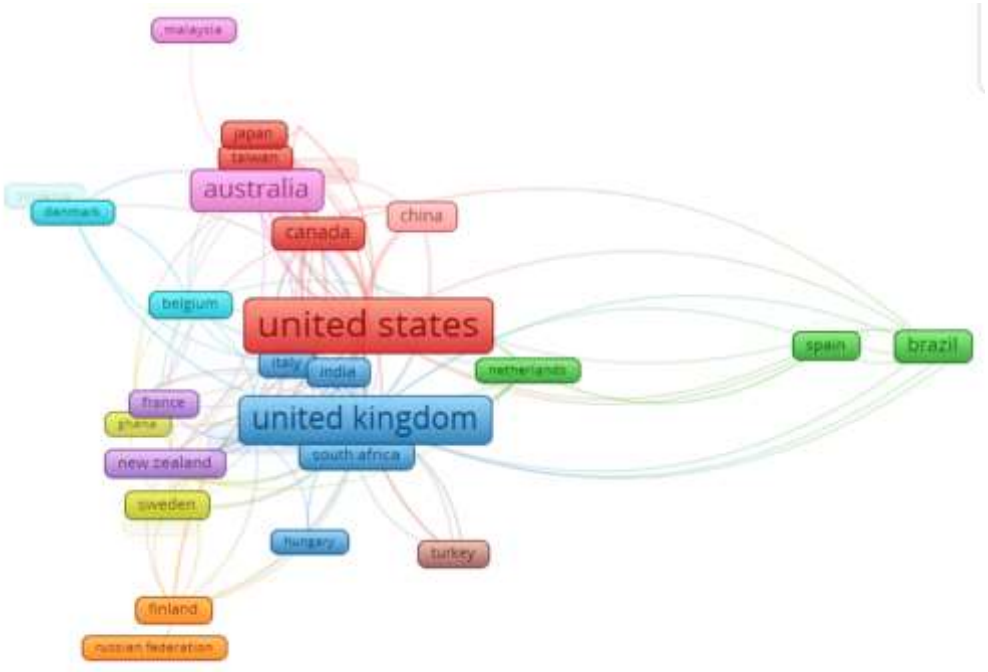

Fig. 4 Co-authorship analysis

3. Research Trends on Education Policy: Indian Scenario

There are only 5 authors who have published 2 documents on education policy and none of authors have published more than two manuscripts. Table 1 shows the top institutes of India on the basis of documents publication on education policy.

Table 1 Top Institutes

Institute	**No of publication**	**Location**
Jawaharlal Nehru University	5	New Delhi
University of Delhi	3	New Delhi
National Institute of Advanced Studies, Bangalore	3	Karnataka
National Institute of Educational Planning and Administration	2	New Delhi
Tata Institute of Social Sciences	2	Maharashtra
Savitribai Phule Pune University	2	Maharashtra

Azim Premji University	2	Karnataka

The highest documents are published by Jawaharlal Nehru University and followed by University of Delhi. It has been noticed that authors of three states only are inclined towards education policy research.

3.1 Research concepts

Table 2 and Fig. 5 showed that research concepts explored by researchers in the domain of education policy. As compared to global research trends, the research concepts such as policy implementation, accountability, governance, early childhood education, discourse analysis are less focused by Indian researchers.

Table 2 Keywords and link strength

Keyword	**Occurrences**	**Total link strength**
Cultural politics of transnational connections	1	17
Education and the construction of skilled workforce	1	17
Education policy in India	2	21
Education reforms in India	1	17
Education-action networks	1	17
Educational bureaucracy	1	17
History of education policy in India	1	17
Higher education	1	17
Multilateral institutions and education reforms in India	1	17
National identity and education	1	17
New interventions in education	1	17
Post-liberalization transformation	1	17
Private schools and globalisation in India	1	17
Role of education in India's modernity project	1	17
Skilled migration from India	1	17
Transnational actors in education policy	1	17
Transnationalised education	1	17

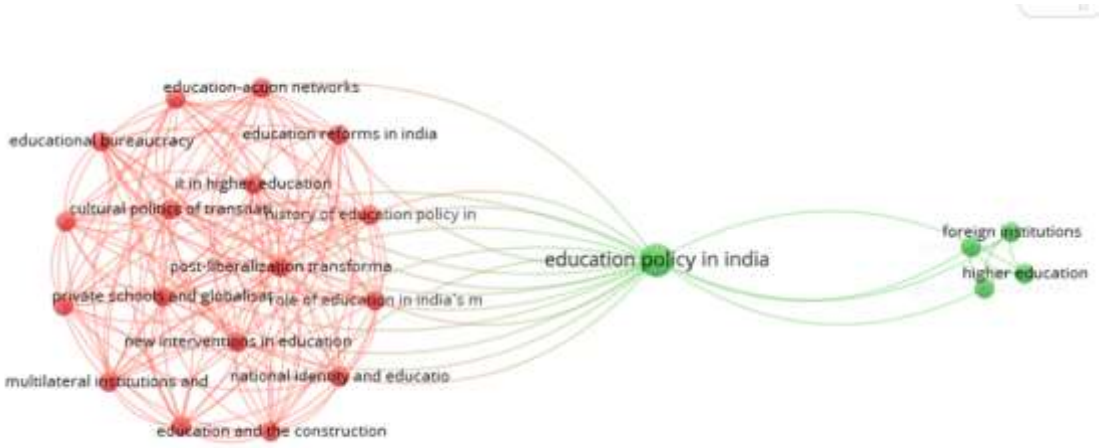

Fig. 5 Keywords network

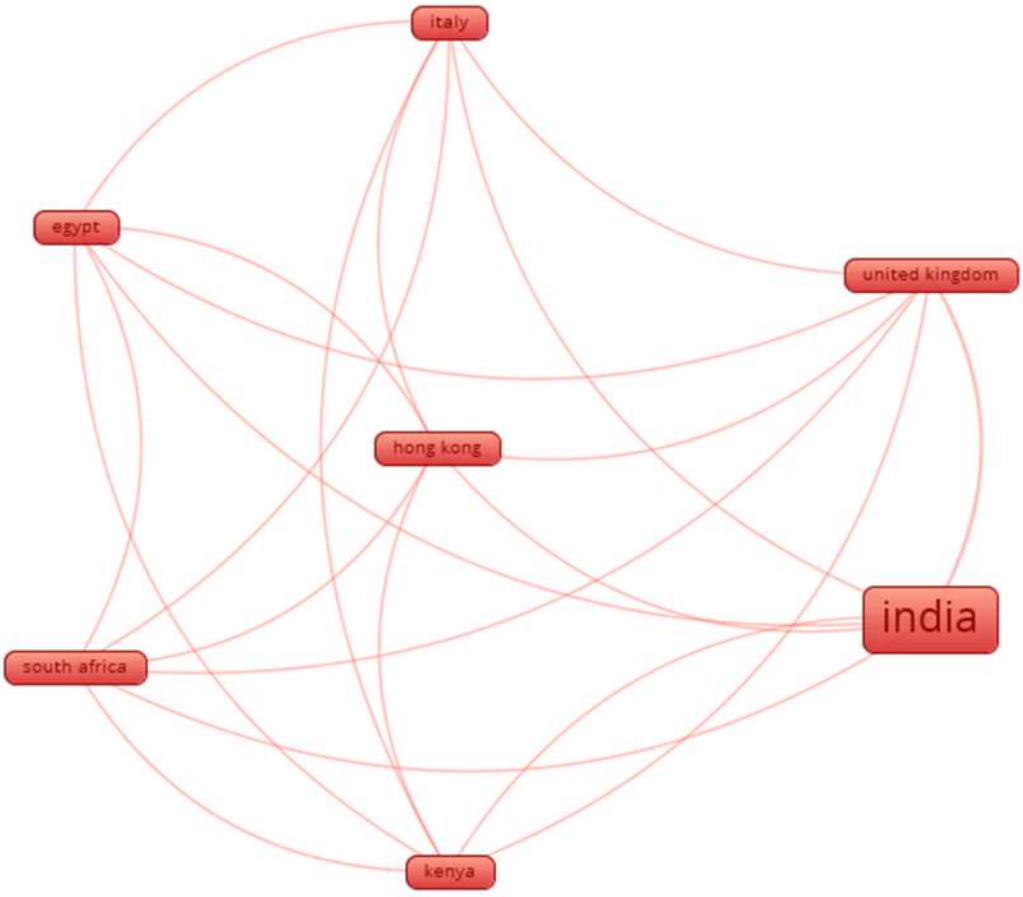

Fig. 6 Co-authorship network

Fig. 6 showed that Indian researchers are doing collaborative research with Hong Kong, Egypt, South Africa, United Kingdom and Italy. It is suggested to do collaborative research with those countries who are doing excellence research in the domain of education policy.

4. Conclusions

The present work showed the quantitative measures of published documents on education policy. United States is a pioneer as they have published the highest documents on education policy. Indian researchers have published few documents, however very less work is focused on policy implementation strategy, governance and accountability. It has been noticed that authors from larger states of India such as Rajasthan, Madhya Pradesh, Uttar Pradesh are not contributing or focusing on education policy. The Indian government must offer research grants to assist the academicians/researchers for performing research on education policy.

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ANB-NEP-2020P12

National Education Policy (NEP-2020): Criticism, Challenges and Opportunities.

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Abstract: In July 2020, the Union cabinet approved the NEP, which was intended to make schooling from pre-school level to high-school level universal. This is an inclusive structure that is based on the primary level of education to higher education in the country, NEP-2020 which replaces the national policy on education 1986. As every education system is designed to support children and ensure that no children sacrifice their opportunities and excellence due to birth or context circumstances, the NEP-2020 target for school education in 2030 is 100 percent GEER. The NEP-2020 target is 100% GEER. The policy reaffirms that bridging social disparities in education access, engagement and educational outcomes is still one of the key priorities of all development initiatives in the education sector.This article involves the criticism faced by NEP, challenges in the way of NEP andopportunities in various fields and sectors created by NEP.

Keywords: NEP, education sector, development.

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1. Introduction

NEP, now recognised as the National Education Policy, is both the State and Centre's guiding text. The NEP assists politicians and educators in influencing their views. Prof. D S Kothari chaired the first NEP-like paper in 1966. It was a highly thought-out paper and still serves as a driving force for many educational programmes, although it cannot be completely enforced. After 20 years in 1986, the second education programme arrived. After a long six-year delay, the action plan for this strategy was laid down in 1992. After 34 years this new NEP also reflects the government's interests and concerns regarding education and educational causes.

Many government and NGO studies in recent years have indicated that the "learning crisis" in India is precarious. Nevertheless it came to light that the National Academic Research and Training Council (NCERT), which was sponsored ably by the Ministry of Education of Union, carried out the National Achievement Survey (NAS). The aim of this survey was to understand how efficient the school system in the country operates based on learning from students. The school was held in government and governmental schools in the country on 13 November 2017 for classes III, V and VIII. It was by far the country's largest appraisal survey and one of the highest in the world.

Results show that the national average in the field of mathematics was slightly lower for students across 12 states. Learning NAS considers Indian education as a major obstacle. The

next few years will be crucial, as India will lose ten or more students because of learning losses and lead to analphabetism unless appropriate steps are taken early. The Union Minister of Education, Ramesh Pokhriyal, said that all graduate students, whom the government is committed to achieving by 2025, have the highest priorities in the NEP concept. The National Initiative for Proficiency (NIP) in Reading With Comprehension and Numeracy (NIPUN— Bharat) shall be launched soon to reflect this particular vision of NEP-2020 under the programme 'Atmanirbhar Bharat.'

In the age groups of 3 to 11 years, this mission will meet the learning needs of almost five Crore children. The mission will also take a holistic approach and actively engage all actors in achieving the objectives.

In order to make education open, equitable, inclusive and only if enforced at all levels, the NEP will change the country's educational sector. The present paper deals with the criticism, challenges and opportunities in regard with NEP.

2. NEP: Criticisms

NEP 2020 has to face a lot of criticism since it is introduced. Some of the major criticisms are listed here:

• Parliamentary monitoring, debate, and review were avoided by the NEP. Given that this is a pretty hasty approach, which seems to target at a political question, when Parliament doesn't work because of COVID-19. This is not the first time, either. In the course of the last 6 years, parliamentarians have consistently been shut out of important debates and excluded from critical or non-critical consideration of policies and from introducing amendments.

• The agenda is a vision paper that is not including the lower strata of society and offers little or no relief to the poor, the women and the caste and religious minorities because it represents key long-standing issues about access to education. To execute this great vision, no comprehensive plan and cohesive strategy are in place.

• There is no specific description of many targets and the financial investment required to implement the strategy. The government cannot keep it responsible for any specific promise.

• Three Language formula is again a matter of criticism and is facing a lot of politics already.

• NEP 2020 does not comply with the RTE Act and universal education is not achieved without legal support: there is no framework for the relation between primary and secondary education and RTE. The center/state is not legally binding.

• The socially and economically marginalized should not devote themselves to affirmative action. It relates heavily to privatizing schooling, but as a way forward for the economically marginalized no solutions are proposed.

• It is argued that the word 'public-spirited philanthropic institutions for higher education' used in private universities which the NEP 2020 does not consider to be fairly handled is furious for those battling education commodification. It is proposed that HEIs should be

formed in each district. Modalities, procedures and service have not been clearly explained, however. NEP 2020 is seen as a direct step toward increased privatisation because these organisations would need land and facilities and administrative services to operate.

3. NEP: Challenges

For the proper implementation the NEP 2020 we need to work upon a few major challenges listed below:

• A curriculum structure of 5+3 +3+4 corresponding to ages 3–8, 8–11, 11–14 and 14-18 respectively should replace the structure of 10+2 school curricula. The new system would provide 12 years of school with an Anganwadi or pre-school education for three years. A comprehensive revision of the curriculum, education and materials in compliance with the NCF (National Curriculum Framework) and content rubrics must be updated to alter the textbooks for the purposes of incorporating improvements at each level.

• In order to use technology for better learning performance, a National Educational Alliance for Technology (NEAT) will be formed as a regulatory body. NEAT aims to make the learning more customised and tailored according to student requirements with artificial intelligence. It also suggests the creation and improvement of a national partnership with EdTech companies. However a major challenge is to build a comprehensive digital infrastructure, which also tackles remote areas.

• Today India has some 1,000 universities throughout the world. One of the stated objectives of the strategy would mean doubling the gross enrolment ratio in higher education before 2035 that one new university must be opened every week for the next 15 years. It is an unquestionably massive challenge to open a university every week on an ongoing basis.

• The National Education Policy 2020 aims at getting back into the school system 2 crore children currently not in classrooms. Regardless of how you look at this it takes about 50 schools per week to be built over 15 years. Since several positions at schools are still unfulfilled, this becomes an especially interesting challenge.

• This is not a challenge to the fainthearted from the funding point of view. Education policy 2020 envisages an increase of 4.6% to 6% of GDP in education expenditure. The trick is that this policy is in existence at a time of lock-downs in the economy, government fiscal collections and a large fiscal deficit even before COVED. This policy is very difficult to achieve.

• The National Education Agenda is a 20-year journey, worrying that in the next 2 to 3 years, we will start with the more urgency of health care and economic recovery needs, as government and budget priorities are claimed.

• The policy provides a welcome step in school education toward a sweeping systemic reform of the curriculum. However, we need teachers who are educated and understand pedagogical needs in order to implement this programme effectively. Many of the changes in education require major changes in thought from teachers and parents.

4. NEP: Opportunities

Since 1986 the government's New Education Policy (NEP) 2020 has been the first step in education to replace the National Economic Policy (NPE). It can be assumed that education has become increasingly required, particularly the need, throughout the country over the past few decades. In NEP2020, education is revolutionized and opportunities in different sectors are created:

- NEP addresses some big holes in the existing school system - developing a more comprehensive approach, spending even more, focusing on gross enrollment and making them perfect in all respects.
- The NEP's targets in the coming years are to build enough jobs for India's youth.
- The strategy is undoubtedly intended to turn India into a global powerhouse of knowledge.
- India is in desperate need of work opportunities and in many respects the highly discussed New Education Policy plays an important role in generating opportunities.
- The importance of vocational training will also increase, due to the growing importance of vocational training. Further, children will now have ample opportunity during their schooling to pursue their own areas of interest and develop their skills accordingly.
- By growing teachers' esteem and efficiency as well as by seeing e-learning as a main form of learning. This can be resolved in itself by providing more opportunities for jobs.
- To make B.Ed., a four-year course, emphasis on holistic teacher growth, encouraging more people to take education as a profession to help shape Indian youth's future. I hope this will improve teachers' chances to have good and growth-orientated careers.
- To provide the ed-tech industry with an enormous opportunity in India, because this could help educational people reach students across the world particularly where physical education is unable to help.

5. Conclusions

Although the NEP has to face many criticism and challenges for its implementation and execution but in the best-case scenario, the NEP will truly revolutionize the education system of the country in the near future. In the field of methods, scope, jobs, chances, and much more, the education and technology industry will experience a great boom. Over all in order to achieve the NEP202020 objectives for the country over the next years the education-tech industry will certainly play a huge role. The bunch of opportunities provided by NEP thus play an immense role in strengthening India in one way or other.

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ANB-NEP-2020P13

Rural Atma Nirbhar Bharta: Role of Engineering Colleges using NEP

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Abstract: This paper presents the hypothesis that rural India can achieve Atma Nirbharta by aggressive participation of Engineering Colleges in solving the problem of rural areas. New Education Policy is providing the required leverage in the curriculum design to achieve the target. The incentives and the development in the sectors that have been linked to Atma Nirbharta will lead to the problem identification at the local level and further networking and solutions implementation. The learnings developed during solution implementation will lead to the capacity building of the institution and strengthen the curriculum under new education policy. It is the continuous updation of the schemes and syllabus that would lead to the effective implementation of essence of New education policy and making Rural Bharat Atma Nirbhar.

Keyword : Rural Bharat, Atma Nirbhar, New Education Policy.

1. Introduction

With the successive launch of Self Reliant India Policy in May 2020 [1] and New Education Policy July 2020 [2], it becomes imperative to explore the role of the Engineering Colleges in making India self-reliant. With these developments, the role of the Engineering Colleges has increased manifold to integrate the societal requirement with the policy benefits and the changes that are desired in the society by the policy maker. Although Bharat has made progress in various spheres related to Civil Engineering discipline comprising infrastructure, road and mode of transportation, or in Electronics and communication system which assisted Bharat in marching ahead to be one of the pioneers in the space and communication system with the support of highly qualified IT Professionals, or in agricultural and horticultural production with the tremendous support from green revolution which led to the self-sufficiency in food grain production and achieving high targets in milk, fruits and vegetable production, or in the development of health facilities with the effort from National Health Rural Mission or the educational facilities with the implementation of Sarv Shiksha Abhiyan [3], Rastriya Madhyamik Shiksha Abhiyan [4] and Rashtriya Uchchatar Shiksha Abhiyan. This paper is focusing on the role of Engineering colleges established in the rural setup from problem identification to the solution implementation as an achievement by taking into account reforms introduced in New Education Policy 2020.

2. Role of Engineering Colleges towards Self-Reliant India

Even though the development across the various dimensions of the Bharat can be observed and it can be said that every corner has been tried to be taken up for development but the

aspect which cannot be ignored is that the societal development had taken in such a way that a large section of rural India had been neglected and the development was more concentrated in terms of urbanized area. Although in the past three decades the higher technology imparting educational institution did start spreading their feet in the rural areas and had been one of the main contributors for development of IT sectors in Bharat. But since the schemes and Syllabus were taken up from the conventional educational system these institutions turned out to be more of a kind of workforce supplier rather than be an institution that would solve the societal problem or at least the problem of the nearby area. The problems of the area with such Higher technological institutions remained more or less as it is, Although the development of the area did took place in the direction that assist in solving the functional smooth operations of the institution such as transportation facility of students and employee or residential facility development. These developments cannot be landmark achievements in making the area self-reliant. The amenities that are available in the urban areas unless do not become part of the rural living, the huge divide of rural and urban will exist unless concentrated effort is made. The efforts that any government wants to give into society is not only associated with development but are also looked into with the return of the investment. But the society can only give in return once the earning in the society is increased. This increase in learning is associated with employability in the society. However the employment generation has always been a big issue to the extent that this aspect is alway one of the major focuses for winning the elections by political parties. It is under this assurance that the Mahatma Gandhi Rural Employment Guarantee Scheme was launched to ensure minimum 100 days job guarantee. But the scheme since focused only on the employment generation, the accountability in terms of development needs to be proven. This scheme focused more on expenditure on human resources with less emphasis on material procurement and processing. The present policy of Atma Nirbhar Bharat is not only focusing on employment generation but also on various other sectoral development. The present form of these sectors is such that they have achieved a maturity level. Hence it is of utmost importance that the innovative approach be adopted by the industries so as to be unique and competitive enough to be able to sustain in the market. Such innovative approaches can only be achieved through the combined efforts of industry and institutions. There are some problems that the industry is already aware off and are working for their solutions But such problems are focused toward solving the problems at a much larger scale. The problems that persist at the local level which do not have scope beyond a particular geographic boundary are normally being left unattended due to the apathy of the local government setup. It is with this presumption it is strongly suggested that the Engineering colleges should get directly involved with the problems of the local area.

3. NEP 2020: A Roadmap towards making 'Atam Nirbhar Bharat'

India's much-awaited New Education Policy (NEP) 2020, a reformatory step by Honorable PMO, is expected to introduce many reformations in India's education sector. The focus on education technology to be introduced in NEP is going to be a game-changer for the face of education system in India. Emphasizing on the blend of modern science, modern knowledge

systems with traditional wisdom, it envisages a holistic system of education. Giving both vocational and professional education an equal status, NEP has a multi-disciplinary, value-based approach along with special focus on honing the life-skills of students. The students will have flexibility to learn the subjects of their choice and the option of multiple entry-exit points will ensure that everyone can complete a college education. The college affiliation system in higher education will be phased out. This will allow curriculum innovations and pave the path for creating industry-linked curriculum based on industry's needs. This will be a win-win situation for both students and industry as it will help the students in placements while the industry will get skilled manpower, thus saving its money and time in training newly inducted staff.

Although much has been said about NEP 2020 and the transformation it is expected to bring in the education system of India, this article focuses on the role of NEP 2020 in making India self-reliant in the direction of Aatm Nirbhar Bharat Abhiyaan by our honourable prime Minister. As the focus of NEP 2020 is introducing technology education in early ages in middle and secondary school it will lay foundation for holistic development of a child, who will have practical exposure at an early age and thus make him ready for the real world. One of the interesting elements of the policy is the option of multiple entry-exit points to the students. This will further boost innovation and startups, encouraging students more freedom and opportunity to pursue the fields they are truly interested leading to more patents and research work. The key focus of NEP is on skills and not just marks, which reminds me of a famous quote by Albert Einstein, who said that "Everybody is a genius. But if you judge a fish by its ability to climb a tree, it will live its whole life believing that it is stupid." Every student is unique and has different skillsets, but the current marks system judges them all on one single parameter. For example, a single exam, which is set at a single bar becomes the basis for judging a student's calibre. However, each student has different potential and capabilities of grasping the concept. It leads in creation of an education system which makes the student's mind the proverbial well's frog whose thinking is confined till its well and has no idea about what is happening in the infinitely large world outside that well. The New Education Policy, replacing the 34 years old National Policy on Education (NPE), 1986 puts focus on holistic development of students with an emphasis on skills development, extracurricular activities, music, arts & sports.

Much has been said till now about NEP and its path-breaking reformations expected in the current education system, it is high time to implement these reforms by strengthening the role of Engineering colleges established in the rural setup from problem identification to the solution implementation as an achievement. With the nation gearing for an Aatm Nirbhar Bharat, the timing of much awaited NEP 2020 couldn't be better. If implemented well, that day is not far away when the NEP 2020 will bring about a new era of Entrepreneurs, artists, researchers innovators, thus paving the way towards making Aatm Nirbhar Bharat.

4. Conclusion

This paper focuses on the role of Engineering Colleges in solving the problem of rural areas by taking into account the policy changes introduced by New Education Policy (NEP) 2020. As the focus of NEP 2020 is introducing technology education in early ages in middle and secondary school, the foundation of the education system leading towards Engineering education becomes stronger. At the same time, aggressive participation of Engineering Colleges in solving the problem of rural areas becomes important for making India self-reliant.

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ANB-NEP-2020P14

Mass Production of Protective Face Shields using Injection Molding Process for CORONA warriors

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Abstract: In the current COVID-19 pandemic duration, the necessity of explicit medical devices, for example, personal protective equipment (PPE) has immediately in excessive demand around the globally. Specifically, basic medical gears for example, clinical gloves, goggles, covers, mask, and visor were shortage in market due to huge requirements. Because of deficiencies in close to PPE kits during the COVID-19 pandemic, government and private foundations, NGOs, local communities and producers around the globe used additive manufacturing to create these things. However additive manufacturing is restricted by its higher manufacturing time when compared with large scale manufacturing process such as injection molding and even the manufacturing cost of 3D printed parts were high.

Key words: CORONA, COVID-19, Personal Protective equipment, Face Shield, 3D Printing, Injection Molding

1. Introduction

The World Health Organization (WHO) was declared the disease brought by corona virus named as Corona virus disease in short COVID-19 and declares the pandemic in March 2020 [1]. Because of this, global and public specialists have been declaring public appeal and setting up lawful guidelines with respect to maintaining social distance and the utilization of personal protective equipment (PPE). Health care institutions have gotten one of the most unsafe conditions to work in, particularly for doctors, nurses and other paramedical staffs who deals with patients infected by Corona virus [2]. Despite the fact that it is perceived that wearing a PPE kit may give insurance not getting infection from patient who has infection of COVID-19. In this manner, numerous global and National Health Service specialists notify the utilization regarding individual PPE for safety while communicating with COVID-19 patients [3]. The WHO likewise published a direction on the prescribed kinds of PPE to be utilized with regards to infection causing COVID-19 [4].

The visor / protective face shield could be planned and delivered for one time use or reusable after fully sterilization. On March 3, 2020, the WHO communicated the worry over the shortage of face shield [5]. On 25 March 2020, the government authority of India requested a cross country lockdown for 21 days as a preventive measure against the COVID-19. Anyway Ministry of MSME circulates the guidelines to manufacturing industry for producing of PPE items. Among the PPE items, the necessities for face shields manufacturing were big challenges. A few arrangements have been made utilizing additive manufacturing, for example3D printing. The injection molding is second option as mass production manufacturing [6].

2. Methodology

The protective face shields were manufacturing using the additive manufacturing (3D printed) supplied by various private and governments' organizations and institutions in collaboration with the staff of Defense Research & Development Organization (DRDO) and National Institute of Technical Teacher Training and Research (NITTTR), Chandigarh to support public hospitals nearby Chandigarh, Haryana and Punjab region. The manufacture of face shields using the injection molding process for mass production was carried out by Modern Manufacturers, Mohali under supervision DRDO.

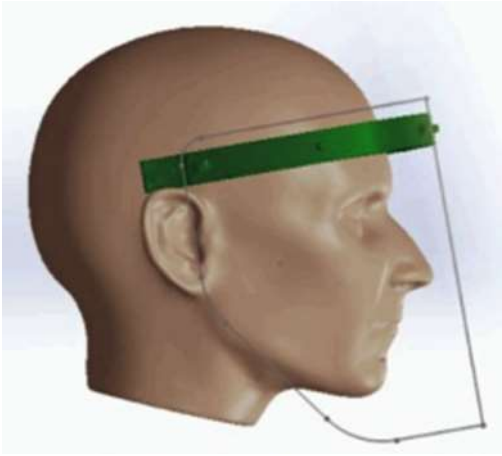

Fig 1: Design of Protective Face Shield

Fig. 1 shows the design of face shields developed by DRDO. Certain factors of the DRDO design were changed to reduce the manufacturing time of Mold. The mold was design by using CAD software. The core, cavity, ejectors and base plates were manufactured by using CNC machines. The mold was manufactured and tested within 3 days; it is possible due to fully integrate flexible manufacturing system based on CAD/CAM/CAE.

Fig 2: Vertical Machines Control at SG Engineering Works, Mohali

The melted plastic material injects through a nozzle in the mold. After solidification, the solidified plastic part is move along with cavity side plate and then ejected by pressure of ejector pins, falling freely inside a collecting container in the machine. After that the protective face shield is assembled delivered to healthcare workers.

3. Conclusion

In a circumstance of COVID-19, both 3D printing and injection molding manufacturing are appropriate for manufacture and supply of protective face shields. At starting stage, the 3D printing utilized to satisfy every day requirements of face shields. The injection molding manufacturing completely integrated with flexible manufacturing system with VMC, CNC and EDM machines is demonstrated to be the most ideal alternative for mass production of any plastic part and fulfill the requirements. The 135,000 delivered protective face shields were given and disseminated to help the paramedical staff, security personal and municipals staff during COVID-19 pandemic in Chandigarh, Haryana and Punjab. This case study gives a best example of Industry 4.0 revolution to design, development, prototype and production of any component in short period of time to serve society.

Acknowledgments

The authors wish to acknowledge the Defence Research & Development Organization (DRDO), Chandigarh for the contribution to the product design and prototyping stages. Post Graduate Institute of Medical Education & Research, Chandigarh for medical product evaluations

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ANB-NEP-2020P15

National Education Policy (NEP)-2020 in the context of Change in Role of Engineers in Industry and Society: A Visionary Sustainable Development in Engineering Education for India

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Abstract: With progression of the technology, the role of engineers has changed in the society and industry around the globe. Since industry 1.0, the advent of mechanisation, the world has reached to industry 4.0, the cyber physical systems and on the threshold of industry 5.0, the era of HMI(Human Machine Interface). This change in technology, society and environment has brought about radical changes in the role of modern-day engineers. All of these changes lead modelling and use to predict the role of future engineers in the society. This paper presents a study on the vision of National Education Policy (NEP), how the same is interlinked with the future model predictive role of engineers, and how relevant and important would be this new education policy to educate the future engineering students of the country.

1. Introduction

In the past four centuries, a radical change has been found in engineering and technology for the creative industrial applications. In the professional world of engineers, all of the changes have been landmarked with a beginning from industry 1.0 to industry 5.0; these four industrial revolutions create an automated society in the world so far. Industry 1.0 started in the middle of 19th century with the invention of utilizing mechanization in steam power systems, waving loom etc. Industry 2.0 started with the invention related to taming of electrical energy in the beginning of 20th century, which is described as the time of mass production and assembly line in the industry circle. In the latter half of 20th century, industry 3.0 began with the revolutionary arrival of the electronics, automation and computers. The industry in the first decade of 21st century came across the innovative utilization of cyber physical system, networks and also internet of things (IoT) technology and entered into the industry 4.0[1].Along with the revolutions in technology, the role of engineers in the society and industry played the witness of subsequent changing. The requirement of skill set, competency and moreover mind set has been subjected to above elementary change [2]. Emphasizing on the value added services, the revolution in freelance industry and arrival of gig economy has changed the prerequisites of engineering professionals around of the globe [3]. The development in sustainable systems is recently more important than building of new machines. Villages are getting converted into the smart villages whereas cities are getting converted to smart cities [4]. Engineers are now-a-days expected to work in diverse teams, and be innovative in solving modern day-to-day industrial problems [5]. With the industry 5.0, the realm of Human Machine Interface (HMI), the field of robotics is knocking at the door; the

role of engineers is to be predicted to undergo yet another non-impervious change in the near future [6]. India, being one of the largest economy, is also enduring these changes. According to Dasand and Rathor[7], the engineers of near future will require new skill sets and competencies in order to work in present interdisciplinary environment governed by demanding entrepreneurs and intrapreneurs. Not only technological development but also the timely economic liberalisation that taking place around the globe and in India, is going to influence the job markets and the role of engineers in their upcoming employments. The economic growth in India according to Krishnan [8], is elementarily changing the requirement of skill level of industry ready or employable engineering graduates. For meeting up this gap between the requirement of engineering industry and the changing role of engineers in present and in future scenario, a visionary National Education Policy (NEP) of 2020 was developed [9]. In the backdrop of this changing role of engineers and their job profile in India and abroad, and to increase the employability of future engineers and students pursuing higher education; the Ministry of Education (formerly known as the Ministry of Human Resource Development), Government of India framed this National Education Policy(NEP) of 2020 [10].The policy in its proposal addresses the major hindrances of unemployment, and focuses on the multidisciplinary graduate education and holistic development of graduate engineers who will fit better in future engineering jobs.

This paper presents a study of how this New Education Policy (NEP) can substantiate the needs of role of the future engineers of the country. In the first part of the paper, the change of engineering industry in India with respect to the global change, the change in role of the engineers and the model predictive prerequisites of engineers have been presented and suggested. In the second part, the highlights of the National Education Policy and how the policy can address the needs of the future engineering graduates, as found in the first part, have been depicted.

2. The Economic Growth of Engineering Industry of India and Key Factors Influencing Job Profile

In the policies of Govt. of India, the scaling up in sectors such as infrastructure, oil and gas, power, steel, automobile, mining, and refinery can be found owing to national policy on capital goods (2016), 100% FDI scheme, Make in India etc. According to the published reports as depicted in Fig. 1 and 2, the capital goods turnover and engineering tools' production is going to increase in India. The investment in research and development, and export is also going to improve in the recent time. Thus, the sectors of engineering which are supposed to get maximum attention are:

Manufacturing, Engineering R&D, Engineering Exports, Make in India (Entrepreneurship Development), Smart City Project, Digital Technology, Agriculture with Smart Technology, Energy Efficiency, Space Technology, Smart Construction, Healthcare for all.

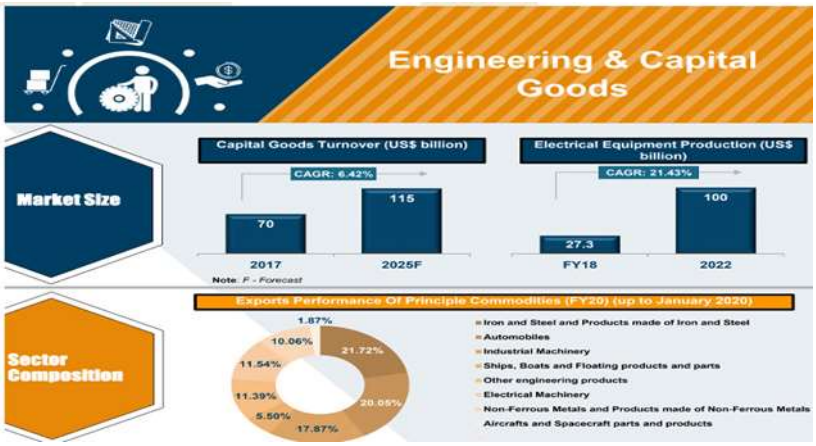

Fig. 1: Growth of Engineering and Capital Goods in India (available at www.ibef.org, India Brand Equity Foundation)

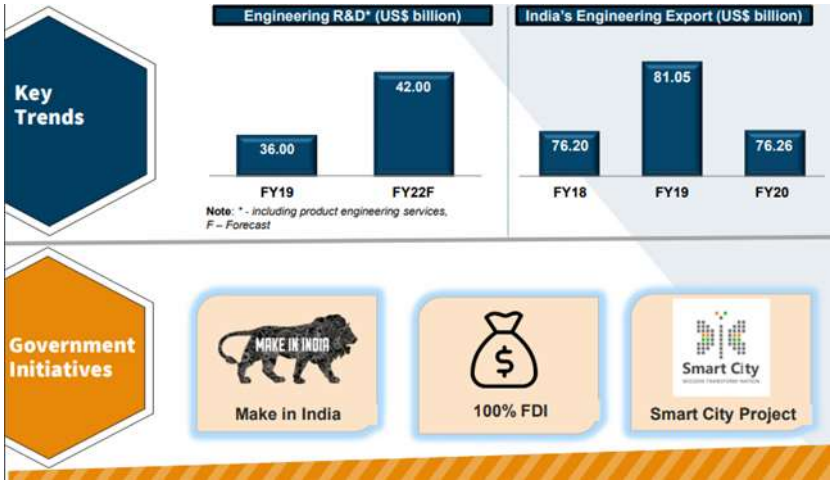

Fig. 2: Growth of Engineering and Capital Goods in India (available at www.ibef.org, India Brand Equity Foundation)

It is quite evident that these sectors will be requiring modern and high level of skill set among the future engineers. Government projects like Smart City, Promotion of Renewable Energy, Smart Agriculture will be requiring engineers with innovative mind-set and patience for sustainable development.

3. Other Factors Influencing the Role of Future Engineers in Industry and Society

The recent changes in work culture can also influence the role of future engineers in industry. The Gig economy that is the freelance sector is expanding uncontrollably. Due to its several advantages like maintaining multiple jobs, work while intended as shown in Fig. 3 (a, b), freelance has achieved high level of popularity. According to one survey, India isone of the biggest market of Gig economy with 10 million people freelancing. Gig economy includes specialised services in digital platform which makes freelancing attractive. Digital applications like paytm, phone pe, google pay do not have any bank, services like Ola, Uber don't have to own a car, service like swiggy, zomato don't own any restaurant. Thus gig economy has given birth to new sectors of job opportunity which may expand in near future. This expansion will

require engineers willing to work round the clock, willing to apply innovative new technology and willing to learn appropriate technology.

The value-added services are getting more importance in Industry for escalation of efficiency through minimisation of losses. The term “Abundant” has been replaced by “Appropriate” in value added services.

Fig. 3(a): The Gig Economy (https://bmogamviewpoints.com/the-gig-economy/)

Fig. 3(b): The Value-Added Service (https://www.indiamart.com/proddetail)

Fig. 4 is showing key factors of value-added services like minimization of overproduction, inventory, transportation, over processing and waiting. The traditional services were quantity and quality dependent, but along with the two-value addition is becoming a prime factor. This may change the role of future graduate engineers and value education will thus become indispensable.

Diversity is another new development in modern working field which may propagate to be one of the key factors of employment in Industry. The future engineers are expected to work in more diverse teams, as per the requirement of output from the industry end. As shown in Fig. 4, diverse working environment industry produces more output and hence the future engineering graduates should be taught to develop themselves to get accustomed.

Fig. 4: Diversity increasing output (https://www.forbes.com/sites/eriklarson/)

In view of the all above, future engineers are expected to be more professional to contribute more to sustainable development. Multidisciplinary knowledge and holistic development of future engineering graduates is thus quite important which the formal Engineering Education can only provide partially. Fig. 5 shows the key concepts of sustainable development, where the core or domain knowledge is superimposed by the environment and the sustainability study.

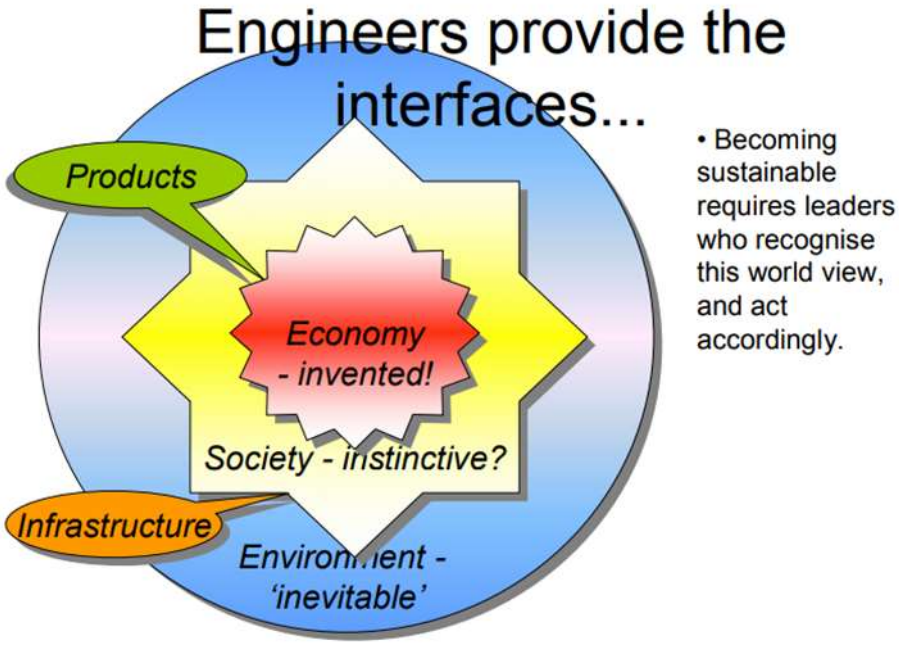

Fig. 5: Change in Role of Engineers for Sustainable Development (Sustainable Development, Role of Engineers, NTUU, KPI,2008)

4. Summary of the Prerequisites of Future Engineering Profession and Possible Transformation Required in Engineering Education

From the study conducted above, it is quite evident that the expected prerequisites of engineering profession is under transformation and the same will continue in near future to cause radical changes in role of engineers in both in industry and society. Table 1 shows a summary of possible transformations in industry and the subsequent change in prerequisites that might be possible for compensating for the change.

Table 1: The Transformation of the Role of Engineers and Subsequent Change in Prerequisites of Engineering Education

Transformation	**Possible Change in Prerequisites of Engineering Profession**
Development→Sustainable Development	participatory learning (1), critical reflection (2), systemic thinking (3), creativity (4), problem solving skills (5), leadership (6)
Uniformity →Diversity	critical thinking and problem solving(7), oral/written communication (8), teamwork/collaboration (9), information technology applications (10), professionalism and work ethic(11), career management(12)
Creativity →Innovation	organized(13), goal-oriented(14), eloquent(15),multilingual(16),learner (17), curious(18), multidisciplinary knowledge(19)
Industry 4.0 →Industry 5.0	technological skills(20), programming skills(21), and digital skills(23)

5. Highlights for National Education Policy (NEP) of 2020: A Visionary Sustainable Development in Engineering Education

The National Education Policy(NEP) of 2020 presents a new progressive vision for India's Higher and Engineering Education. In the preamble of this policy [9], the 21st century requirements of graduates can be found where the objective of Higher Engineering Education is cited as to train the future graduates to be good, able to bring clarity in thinking, all around and imaginative graduates. The policy also depicts that thorough and deep level of study by higher education students should be able to develop stronger character, clear ethical and constitutional understanding, knowledgeable curiosity, scientific attitude, innovativeness, soul of great service, and 21st Century competencies across a wide range of subjects including

science of modern engineering and Technology, humanities and understanding of human history, ability to comprehend languages, social and environmental sciences, Creative arts, as well as specialized, technical knowledge, and expertise in vocational subjects and above all for the holistic development of individuals. Thus, the preface of this New Education Policy (NEP) of 2020 recommendations by the Ministry of Education, Government of India is quite in line with the prerequisites of the future engineers and the transformation of their roles in Industry and in Education, those presented in Table 2. In Table 2, the major reforms proposed in NEP-2020 have been presented and how the same can tune the engineering education to develop future graduate engineers is depicted.

Table 2: The Major reforms proposed in NEP 2020 for Higher Education and its possible outcome (NEP-2020, Ministry of Education, GoI)

Reform of HEIs in NEP-2020	**Possible Outcome**
Institutional Restructuring and Consolidation: The end of fragmentation and creation of multidisciplinary autonomous knowledge hubs for more open and convincing learning	Development of well-rounded and innovative individuals, with multidisciplinary knowledge for transforming education towards excellence for economic growth.
Towards a More Holistic and Multidisciplinary Education: Enforcement inquality education for UG and PG level that assimilate the essence of our humanities and arts subjects with Science and its application to Technology, Engineering and Mathematics (STEM).	Escalation of originality and innovation, critical thinking, problem formulation-solving abilities with feasibility study, collaborative approach, eloquent skills of communication, additional detailed learning as well as command of curricula of other fields, good knowledge of social science and sound moral understanding etc.
Optimal Learning Environments and Support for Students: Revision of curriculum, pedagogy, continuous assessment, and emphasis on student development and support systems that promote student fitness and sound health, psychological	This will make higher education more stimulating and pertinent, and updated to bring into line with the newest requirements of knowledge and to encounter quantified outcomes of learning. This will enable the graduates to meet job/ industry requirement.

understanding of harmony with the nature and also good ethical base.	
Internationalization: India would be endorsed as an International study hub to provide the finest education within reasonable costs which will help to reinstate its role to establish as a Vishwa Guru.	An exchange of knowledge and technology may be initiated with International students perusing higher education in India, Indian students visiting and studying abroad in credit transfer and/or research at institutions of abroad.
Motivated, Energized, and Capable Faculty: Revision in recruitment rules and career advancement schemes, and assurance of reasonable depiction out of various groups in appointing of any faculty, conduction of any faculty training, rewards for performance.	The faculty of HEIs will get an impetus towards performing well as well as achieving the excellence in teaching-learning, also in innovation and Research, and they will be more inclined towards community service outreach programmes.
Catalysing of Quality Academic Research in all of the Fields through a newly National Research Foundation: All-inclusive methodology in altering the quality of research, its value and quantity. This comprises conclusive changes in education for schools to a more interesting and research-based methodology of teaching-learning with an emphasis on the understanding of application of scientific methods and critical thinking.	India's great knowledge and value education heritage needs to be further reinforced to make India the future leader in research and innovation and India will reborn as a robust and free-thinking knowledge hub. With the preferment of excellence in research, engineering graduates can be part of latest technology and in turn will make them updated for job requirement and industry.
Professional Education: All institutions those offering either professional or general education in all	All of the stand-alone agricultural and legal universities, all health science universities, all technical universities, and all stand-alone

fields, will aim to organically evolve into institutions or clusters for offering both seamlessly, and in an integrated manner by the year of 2030.	institutions in other fields, shall be aimed to become as multidisciplinary institutions to offer holistic as well as multidisciplinary education.
Technology Use and Integration: Learning, adoption and application of new technologies such as block chains, artificial intelligence (AI), machine learning, devices for computing, smart boards, and use of other types of educational software and hardware will advance the learning of students in classroom and beyond.	Incorporation of technology will advance multiple features of education, provided these interferences are thoroughly and clearly assessed in pertinent contexts before they are used extensively.

6. Conclusion

This National Education Policy (NEP) of 2020 is a visionary sustainable development of higher and engineering education. The economic liberalization taking place around the globe and India will open new avenues of industrial job opportunity. Factors like gig economy, diversity, necessity of sustainable development, innovation and transition from Industry 4.0 to 5.0 is transforming the role of engineers in industry and society alongside the growth in new sectors of engineering. In this paper, a study of such changes has been presented along with the changes in the prerequisites of engineering profession that may be required to compensate and adopt in the new industrial and job environment. The work also presents how relevant and important of NEP-2020 is in addressing the required prerequisites in near future.

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Mechanical Strength and Surface Finish Enhancement of 3D Printed Electronic Components under Self-reliant India Mission

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Abstract: Fused Deposition Modelling (FDM) is an advanced digital manufacturing technique which has gained extreme popularity among researchers due to its portability, cleanliness and flexibility. This procedure was created by Stratasys Inc., U.S.A in late 1980s and has been adopted by researchers and industry for prototyping and concept development. FDM can fabricate parts using digital CAD file as input within few hours with minimum human intervention and higher accuracy. However, the layer by layer process of polymer extrusion develops considerable surface roughness and mechanical strength. In this paper an effort has been made to identify the significant process parameters of FDM which influence the surface finish and mechanical properties. The results of various optimization techniques such as ANOVA, Taguchi, Response Surface Methodology and Factorial designs have been tabulated and findings have been critically discussed. It was founded that there is minimal work given an amount of research has been reported where metal spray has been used to develop composites. The surface coatings can enhance surface finish as well as mechanical strength of FDM parts along with increasing the aesthetic value. The future research perspective and potential applications include on demand surface enhancement and strength improvement of electronic components which would provide jobs and business opportunities to graduates.

Index Terms— 3D printing, Electronic Applications, Mechanical Strength, Optimization, Process Limitations, Process Parameters, Surface roughness

1. Introduction

Fused Deposition Modeling (FDM) is a common additive rapid manufacturing technique that is used to create prototypes or reference models and is also known by the name of Fused Filament Fabrication (FFF). An FDM is a rapid prototyping system in which 3-D prototype or specimen is made by deposition of material one layer at a time using a Driven assembling process or CAD. FDM is the one of the best known and in most commonly used processes among all Additive Manufacturing techniques for 3-D modelling of the parts [1]. In the fused filament fabrication process, hot molten filament material is extruded from the nozzle and deposited on a bed as shown in Fig. 1. The filament on the plate is referred to as a road. Subsequent roads are deposited side by side and will have a bond with previously discarded road to form a single layer, then the next layer is deposited on the first layer to develop a 3D model. It is used to make clean, quick and cost-efficient 3-D prototype [2]. It is usually based on design diagram in which the design command is send to controller head which is under the control of computer, which releases the melted thermoplastic material (for example ABS, PLA,

highly impact styrene, poly-urethane (PU), nylon) through nozzle as per design command and the material is repeatedly released layer by layer and form 3D object or prototype The head generally move in two dimensions one horizontally to deposit and vertically for new layer [3]. The material solidifies when come in contact with cool environment. Further, coating of nickel, resin, wax, copper, chrome, nylon, etc. is done on FDM part to give surface finish to part. Then study the mechanical properties (strength, hardness, toughness, rigidity etc.) of the part or material. This strategy works with special type 3D printer used for fused modelling and production grade plastic which is used to build strong, dimensionally stable and durable parts with the good accuracy. The FDM innovation was created by a S. Scott Crump (co-founder of Stratasys) over multi- year prior. Stratasys lead the revolution of 3-D printing continued ever since. The FDM technology uses thermoplastic material which are tested and founded in conventional build procedure [4]. For applications that demand true tolerances, toughness durability, natural strength, stability and specific characteristic such as biodegradability, VO combustibility. FDM innovation is quick, office friendly, clean and simple to use, it underpins generation quality thermoplastics that were precisely, mechanically and ecologically stabling. It would be problematic to create complex shapes and cavities, becomes possible practically with the FDM technology. Initially the main focus of Rapid Prototyping is on polymers. Later on, there are replaced by composites, metals and ceramics. Many industries such as model manufacturing, functional model, medical models for the purpose of engineering analysis [5]. The quality of FDM model relies upon the process parameters. So, the study of the process parameter is very important which affects the FDM model quality. The greatest advantage of FDM is its scalability. It can be easily extended to any size. It costs less in proportion to size. FDM printers are consistently larger and less expensive, because of its straight forward structure included and low cost [6]. The main weakness or disadvantage of FDM printing is its quality or detail. Since the material is expelled in layers and has some thickness that is predetermined by the nozzle, high detail prints are difficult to obtain, requiring much post-procedures to achieve an efficient finish. Another disadvantage of FDM printing is that they make a frail point in the print where each layer is added, making the print less rough physical quality and not suitable for certain applications [7].

2. Literature Review

Huang and Singamneni [1] worked on the flat and the curved layer to improve the mechanical properties of the specimen. They demonstrated that variation in layer structure would have considerable effect on intermediate structure, in this manner impacts mechanical characteristics of specimen. They used thermoplastic as a deposition material. They conduct three-point bending test and found that the average compressive load for conventional flat layered component decline by about 140N as related to curved layer component which definitely indicates that curved layer component has best mechanical performance in the curved parts in the three-point bending test. Haidiezul and Bakar [2] worked on outer finish of printed 3-D FDM prototype. The 3D manufactured prototype was assembled layer by layer which cause ‘stair stepping’ impact that has uneven surface finish. They found that stair stepping is the general defect found in 3-D printing item specifically in FDM machine. They

state that by using XTC-3Dimensional covering can significantly improve the outer finish of 3-D printed product. David et al. [3] made an attempt to study the utilization of AM-manufactured model in fluid pressure applications is limited because of part porosity and non-optimized manufactured variables (e.g., direction and material properties).With an attempt to expand the utilization of AM in variable applications including liquid pressure, items made with FDM were fixed with different sealants and were examined under applied pressure. The test results gives a sealing technique utilizing BJB TC-1614 that pressures 2.68896 bar with brushing FDM object and 1.37895 bar with vacuum intrusion make capable. Brushing and vacuum intrusion permitted the test object to over and again hold a liquid pressure for in any event five minutes correctly at stress of 276000 N/m and 137000 N/m, separately. They found that due to the application of BJB TC-1614 the total difference between untreated item and treated object was minimum. The structural variation can be restrained by a client utilization during brushing and vacuum intrusion. Daneshmand [4] worked on wind tunnel model. Most of them are constructed with every single metal component utilizing CNC machines. Building metal tunnel object is highly expensive and consuming time. They found that by utilizing rapid prototype manufacturing system and materials in such a manner considerably decreases time and expense of producing wind tunnel objects. Udayagiri et al.[5] worked on printed 3-dimensional specimens for quick prototyping of miniaturized aerial vehicles. Their examination gives the outcomes for facilitating the immediate utilization of printed 3d model in the composition and advancement of MAV. Traditionally created electrochemical, mechanical procedures were utilized to deposit basic light nickel covering on printed 3-D sand sample test MAV models. The remaining stresses and mechanical stability of experimentally covered printed 3d components were estimated through practical test strategies. Significant increment is seen on impact performance of printed 3Dimensional coating piece and on tensile strength. They saw that MAV models should be worked with fabricated parameter of 100 µm layer thickness to decrease the remaining stresses. Coating methodology are established for the deposition of thin nickel covering on FDM samples. Kohad and Dalu [6] made an attempt on enhancement of procedure parameters in FDM. The study shows that there are variety of procedure parameters that affects the quality of FDM prototypes and the identification of different procedure parameters involving in FDM, which affects part quality and to compare different development techniques and identify the suitable technique for performing optimization of the procedure parameters in Fused Deposit Modelling. They found that there are adequate improvement strategies to make trail structure insensitive towards uncontrollable factors, for example, environmental parameters to foresee responses and enhance the FDM process conditions in precision level. Akande [7] made an attempt to analyse the optimal procedure parameters that can utilized to manufacture prototype with improved surface finish and structural precision. Test samples were created on FDM by taking various levels of covering thickness, speed of deposition and filler thickness. Test outcomes were validated by making samples with acquired optimum procedure parameters. Test outcomes will in general purpose shows that it is possible to create components with optimal outer finish and dimensional precision. The rest of literature review has been presented in tabular form as shown in Table 1.

TABLE 1 PUBLISHED WORK RELATED TO OPTIMIZATION STUDIES ON FUSED DEPOSITION MODELING

S.No.	Authors	Material, Parameters and Coating, method	Findings
1	Kannan and Kumaran[8]	ABS, Electroplating, Nickel, Chromium, Drop Impact Analyser And Rock Well Hardness	Treated ABS samples expand energy consumption by 143% compared to non-treated ABS.
2	Darbar et al.[9]	Tagauchi, Anova, ANN(Artificial Neural Network System)	Tagauchi is best method for experimental design, ANOVA is useful in selection the factor that affects the performance qualities, and ANN is useful to foresee the test results.
3	Narong and Chhabra[10]	Layer Thickness, Raster Angle, Part Orientation, Raster Width, ABS	More layer thickness gives dimensionally accurate and high surface finish, tensile and flexural strength shows inverse relation with layer thickness and directly varies with raster width.
4	Chari et al.[11]	Resolution, Compressive Strength, Temperature, Abs, Tagauchi's L9 Array	Variation in model can be achieved by varying the value of these specific parameters.
5	Kumar et al.[12]	Layer Thickness, Orientation, Raster Angle, Width Of Raster, Bacterial Foraging Method	More no. of layers brings more temperature towards the base of object due to which the diffusion between adjacent raster's increases and quality will increase.
6	Krishna and	Cost, Structural	Structural precision and outer finish of

	Gundeti[13]	Precision, Outer Finish, Injection Modelling And 3d Modelling, ABS	prepared model of abs using 3d modelling is superior to model prepared by injection modelling.
7	Christiyan et al.[14]	ABS +Hydrous Magnesium Silicate Composite, Layer Thickness And Printing Speed	Minimum printing speed of 0.03 m/s with less layer thickness of 0.02 mm allows a superior binding with the past layer because of tat it showed a superior tensile and flexural strength.
8	Abdullah et al.[15]	Raster Angle And Thickness Of Layer, Folger Tech 3d Printer, ABS And PLA, ANOVA	For PLA at raster angle 30/60 degree and layer thickness 0.04cm shows extreme tensile strength and for ABS at raster angle -45/45degree and layer thickness 0.03cm shows extreme tensile strength.
9	Prasanth [16]	Ultem 9085,Manufacturing Orientation, Raster Angle, Air Gap, Factorial Test	Flexural test shows perpendicular direction displays better tensile strength and finish as compared to parallel and compressive test shows that parallel direction displays higher compressive strength as compared to perpendicular.
10	Rajpurohit et al.[17]	PLA, Tensile Test, Raster Angle	For unidirectional high tensile strength obtained at 0 degree raster angle and low at 90degree raster angle and for bidirectional high strength obtained at -45/45degree and low strength at 0/90degree raster angle.
11	Lanzotti et al.[18]	PLA, UTS (Ultimate Tensile Strength),Raster Angle, Layer Thickness, Shell Perimeters	These parameters majorly affects UTS, as raster angle declines, no. of shells expanded and layer thickness expanded with in 2cm the UTS expanded.

12	Dickson et al.[19]	Carbon, Kevlar, Glass Fibre, Markforged Mark One 3d Printing System	By using glass, Kevlar and carbon reinforced fibre composites the tense and flexural strength increases upto 6.3 times as compared to non-reinforced materials. The increasing in strength is as per order given below carbon fibre>glass fibre>Kevlar fibre.
13	Postiglione et al.[20]	PLA, Multi Walled Carbon Nano Tubes, Liquid Deposition Modelling , Commercial Benchtop 3d Printer	With the increase in the concentration of MWCNT the electrical conductivity of Nano composite increases with respect to pristine PLA matrix material. The electrical conductivity in the range 10-100s/m obtained for >5% increase in MWCNT concentrations.

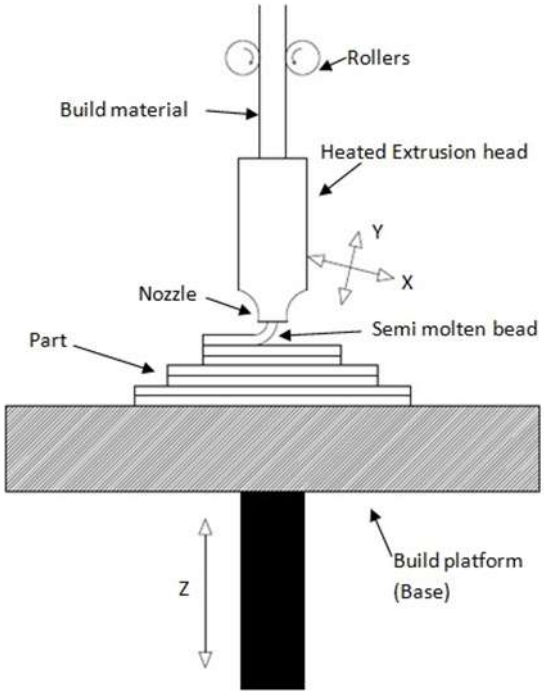

Fig. 1. Schematic of FDM Process [21]

3. Future Applications

Researchers have performed studies on the mechanical properties and surface enhancement of FDM parts. Future studies must be concentrated on improvement of mechanical strength of part by adding reinforcements to virgin materials yielding novel composites. The mechanical properties such as tensile strength, compressive strength and wear resistance can

be checked and optimization studies are required to control the output parameters. Moreover, the metal coating must be done by innovative methods such a metal spraying which gives cost effective method of surface enhancement. The metal coating can be stacked in between the layers by halting the layer deposition process in open source printers which would significantly increase the mechanical strength. The composites can be developed which would improve the thermal and electrical conductivity of 3D printed parts for electronics components as shown in Fig. 2. This business opportunity would help youth to earn money and work for growth of nation under self-reliant India mission. The composites materials developed by this process can be used as end used components in automobile, household use, toys and trophies.

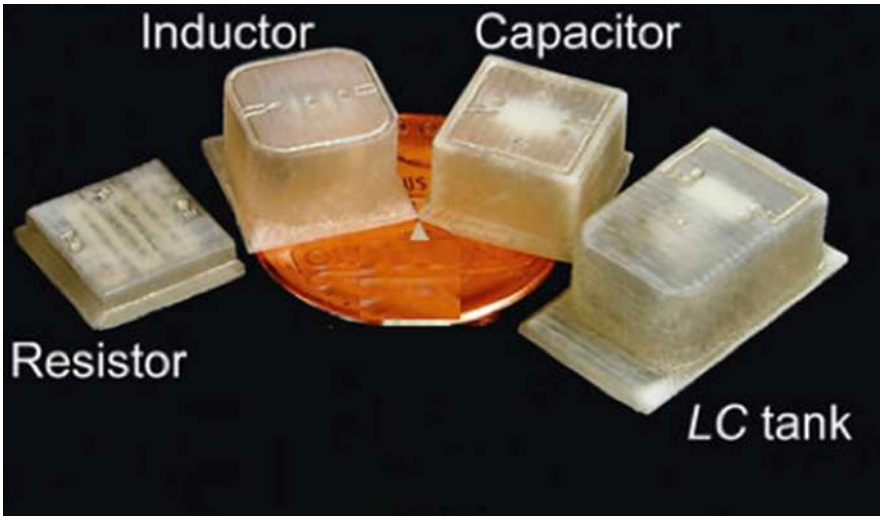

Fig. 2 3D printed electronic component

4. Conclusions

The present study concentrated on improvement of mechanical strength and surface finish of FDM parts. Fused Deposition Modeling, being a portable and flexible manufacturing, has certain process limitations such as mechanical strength and surface finish. The reasons of these limitations, methods of improvement and significant parameters have been described in detail. Potential applications for automobile and household products have been discussed by making novel composites as per requirement. The tailor made composites can be made by varying the composition and quantity of spray coating inside and above the manufactured part. Afterwards, the mechanical properties like tensile strength, hardness and compressive strength can be analyzed. The morphological characteristics and failure behavior of fabricated prototypes can be analyzed in case of composites. The development of customized parts using 3D printing would open wide range of entrepreneurship opportunities for skilled people and engineering graduates.

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Implementation of Automatic Manufacturing Technology in Small and Medium Scale Enterprises under Self-reliant India Mission

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Abstract: The paper explores the possibilities of development of advanced manufacturing technology (AMT) in medium and small scale industries of Indian sub-continent. Currently, the small and medium scale industries of India are not adapting to rapid technological changes due to economic and social causes. But, the proper awareness, training and preparation could lead to proper implementation of AMT in Indian environment. The process of modernization in Indian industries can be done through enterprises under self-reliant India Mission. These enterprises would be responsible for proper installation of AMTs in small and medium scale industries along with training and practical education of use of advanced technologies.

Keywords: Advanced Manufacturing Technology, Small and Medium scale industries, Entrepreneurship, Industry 4.0

1. Introduction

Since the time in memorial, we humans have the tendency to produce and invent new things and technologies, whether it is a small implementation or a new innovation which will turn the world upside down, we always needed the help of tools and machineries [4]. With the advancement of time these tools and machineries have taken new shapes like the new lath machines which are producing tools for helping the human society in producing and making new machines with an increased efficiency and with better speed [5]. These days we are using the artificial intelligence and robots in many of the factories and industries which have reduced the human effort and also have increased the efficiency by a great measure.

In manufacturing industries, machineries are playing a key role in manufacturing the products. And it's getting better and better with the help of machine learning and genetic theory. Advanced Manufacturing Technology (AMT) is a methodology of manufacturing highly incorporating automated and computerized modules and Functional components [6]. The aim of AMT is to manufacture high quality products in economic monetary value within less amount of time. It enhances the power of an Industrialized Nation. In 1979, Gross National Income (GNI) was about $780 per capita. In 1999 GNI was less than $365 per capita. Despite huge investments in the oil and gas sector of the nation's economy, with an annual average investment of US$10 billion, its contribution to the GDP has been minimal [7]. This is

largely due to the low Nigerian Content in the industry, evidenced by the over 80% of work value which is broadly hi-tech and executed abroad. Hence we can conclude that we are able to produce better economic standard and can maintain a nominal outcome with help of AMT. Moreover, the 3D printing technology served as a technological boom in each and every field but specially vehicle sectors. Aerospace industries are now making modules in CAD and directly print them over a night. And they have a working model from a module, overnight. And with the combination of Artificial Intelligence and robotics much more is yet waiting [8].

2. Literature Review

2.1 Considering AMT

The main objective of this literature is to project light on the adoption of AMT by Indian manufacturers and what could be the possible outcomes by doing that and what are the approach that is to be taken while considering AMT[9]. AMT allows the industries of manufacturing, packaging and distribution to be much efficient and faster to create and build innovative products, process or service that allows these tech-giant companies to evolve at constant pace whether they are mechanical, electrical, medical, metal or plastic manufacturing companies [10]. There are various high demand companies that rely on advanced manufacturing technologies like OEM's etc. So the manufacturing companies come in all different shapes and sizes and all have same goal to maximize their selling and extract profit out of it but in reality some are able to achieve this ideal goal but some are not so what is it, it's the productivity factor that comes under play but how to achieve that high productivity factor. This is where advanced manufacturing technologies come handy in building the action plan [11].

Let's imagine a scenario of 3D-printing it is the most commonly known AMT, it the most advanced way of manufacturing a product and will be on way to enter the small scale market in near future if considering the fact that it is very expensive at its current state but will be much affordable in near future[12]. Just as the cylinder boring machines facilitated the industrial revolution 3D printing might be opening new doors to design or fairly saying much complex design manufacturing. Components that are much complicated to manufacture are now possible to just design it in a 3D CAD environment and then scale it to real dimension [13]. In a 3D environment finite element analysis is a stress simulation we can do before the final component giving us the reliability to reduce parts and then the efforts to do a combine simulation etc. this allows us to generate the perfect component for the application. But the min area where this 3D printing technology shines is the prevention of waste material or says scrap material for example machineries require a solid work piece to perform various cutting grinding etc. manufacturing processes to craft desire part or component and that sometimes may result in 90% of the material machined out being unused [14]. Some may say that that scram metal can be melted and reused but performing such process might change the required characteristics of the metal completely [15].

There is constant pressure to reduce cost and many companies look forward to automation as the universal solution however this is not the case the automated manufacturing setup is

a very expensive process plus it also relies on supplies etc. therefore another goal of advanced manufacturing technologies is to remove the unreliable components and improve on particular field[16]. So we shall be discussing such technologies that turned out to be very positive in improving their field of function.

2.2 Adopting AMT

After all that amazing applications of 3D printing we rarely see 3d printed parts outside of prototyping models and few major facilities [17]. But why is it? The answer is its cost to profit outcomes which is one of the major key factor affecting implementation of AMT not only in India but worldwide. However there are some sectors of manufacturing that demand high precision irrespective of cost put into it like space agencies etc. [18]. On the other hand the original equipment manufacturer OEM's rely on much faster and efficient option to accel their mass production because the 3D printing is a very time taking process and when it comes to unit cost per output, It doesn't seem to be declining over time while traditional way of manufacturing results in a drastic decline in unit cost per output over time[19]. Since market was using our conventional manufacturing technologies for so long they have evolved their understanding with material and their properties and they have learned how the exact way heating and cooling affects material as a result of its internal crystalline structure suitable for manufacturing. But in case like 3D Printing we have to completely restudy the crystalline structure and how it applies to the product during printing process and how the lairing is done[20]. Basically, we have to understanding the potential contribution of an AMT to the current phenomenon of manufacturing.

Another point of view says this is not just the case for re-understanding the technical aspect of any new AMT but it also becomes a matter of labor understandings, and that is pretty straight forward if new AMT are being introduced then it will require more skilled labor to care or may don't even require labor at all so the company has to do job cutting [21]. And that is another factor there, the personnel shortage in this transition process from conventional to advanced manufacturing technologies [22]. The availability of skilled labor plays a major role in successful adoption process of AMT.

As we explore further we came to understand that there should be proper top-down planning and bottom-up implementation [23]. As a company is governed by the factor of efficiency that how well internal communication and feedback system exists there will be need of full time feedback system for AMT because the response time is important and the production will depend on it which comes through planning and taking measures so the company will need to design a feedback system that how its AMT are functioning[24].

2.3 Environmental Factors

India is the second world most populated nation in the world accounting to the fact that it is fifth largest by land area and that results in a very densely populated structure, so the concerns towards nature becomes the primary concerns to use [25]. Introducing new

technologies can be very beneficial because latest technologies are designed to be much efficient [26]. The graphical representation below clarifies how the system should be in verge with nature elements [27]. There are both sides of environmental factors that affect and lead the improvement of conventional manufacturing methods. First theory is that using new advanced manufacturing technologies will have less emissions and wastage that will result in a cleaner campus of the company providing better working environment. Secondly some AMT that are IOT inspired features a lot of simulation approach, reverse engineering, finite element analysis approach to solve the problem of prototyping and testing of new product [28]. This eliminates the portion of manufacturing in which we require frequent testing of component or product. So in India suppose if a company is using this feature of AMT then it is eliminating the delay in upgrades for future products by removing feedback time by the consumer [29]. The Improved environmental performance was not only a beneficial side-effect of beside that company can itself take notes on successive product improvement and on the other hand doing so the environmental measures are also been practiced as newly adopted AMT comes with lesser pollution and emissions with the cost of money and skill labor[30]. Fig. 1 summarizes the overall scenario of environmental performance and competitiveness, and visualizes the bidirectional interrelation between digital-solutions-triggered.

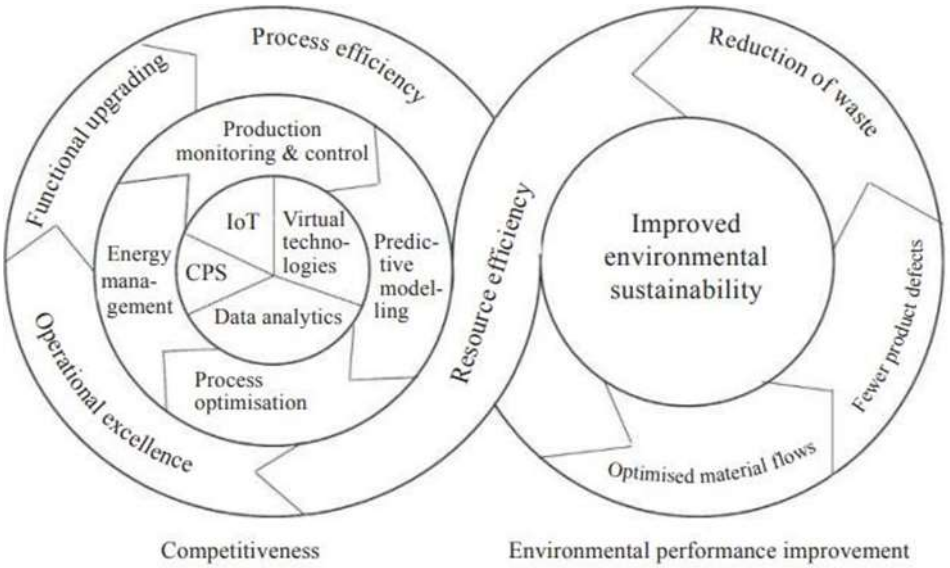

Fig: 1 Scenario of environmental performance and competitiveness

2.4 Resource Availability and management

As an industry might have to redesign its manufacturing unit and assembly basically a complete remap and management because of the introduction to AMT however some AMT that do not require major changes like implementation of robotic arms as a single function unit but if the unit is big like automated manufacturing line then it require more skilled labor and implementation of those available resource and its management[31]. To understand the management system we need to classify companies into various sizes, a company running with more than 1000 employs can be categorized as large scale companies[32]. Large

companies have higher degree of future AMT adoption plans than small companies. However, regarding future AMT investment, there is no significant difference[33]. To setup various kind of AMT, resource and end goals plays an important role. For example In India all plants produce goods for its domestic market and we can also see that most plants also seem to sell products in foreign markets also[33]. We can take about 25% plants producing products that are sold in Asia, 19% in Europe, 6% in U.S., and 28% in other countries. Which accounts to the fact that U.S. is a major market in the world, it is somewhat surprising that so few companies in India are able to sell products in U.S. market[34]. This perhaps reflects that global quality and competitive pricing levels are harder to achieve in the manufacturing sector, especially for complex industrial products. So In terms of the type of goods produced by these companies, 34% companies produce manufacturing equipment, 31% parts or components for assembling, 6% durable consumer goods, 6% supplies and other consumption goods, 3% non-durable consumer goods, 3% raw materials, and 38% companies produce other type of goods[35].

2.5 AMT in INDIA

So we know that AMT 3D-Printing for example can achieve very complex design so in India do we need that level of complex machinery[36]. The answer lies within the state of manufacturing process we have and the factors that affect change in those process are said to be our key factors. India does have its standalone space agency ISRO and latest AMT are being used by their standards and they are much cost effective compared to other agencies in the world (Fig. 2). But when we enter the market the scene is totally different for adoption of AMT Indian manufacturing companies will require a very steady rate of implementation which means a step wise breakdown of new AMT and then implementing them at different stages[37]. As few companies start implementing AMT the other companies in that market will also require to upgrade to keep up the market pace. As the companies get to experience AMT the productivity will definitely increase and the rate of resource and raw resources availability will also increase and the rate of export will show a positive result[38].

Fig. 2 Advanced Manufacturing technologies

We came to know that companies larger than of 1000 employees have higher chances of upgrading to AMT while the one below 1000 employees doesn't and India we have large number of small scale manufacturers that features employees less than 1000 people[39]. India has a variety of small scale manufacturers that make variety of products and services and rely on some limited resources like the products show common raw resource background [40]. The AMT is a methodology of manufacturing highly incorporating automated and computerized modules and Functional components that needs a well implemented action plan. In India we may also see that the manufacturing is also practiced as assembling with three simple strategies, purchasing raw equipment, licensing new technology or by customizing existing technology but very low companies in India seem to develop new technology and make it available for the market [42].

According to a study it was found that most companies said that they gained strong benefits from AMT adoption, the companies saw a good market performance by their products or services as the process now was much innovative and hence the products and services performed better. Their product increased market share, profitability and showed good returns after sale [43]. Some other benefits were improved relation with customer (as they were keeping up with the customer feedback doing changes in product), suppliers and improved worker safety [44].

However we also came across the obstacles that AMT faced in India. Some manufacturer with small market size faced high cost of equipment also the fact that the non-digital manufacturers don't need the AMT upgrade as it doesn't seem to work at that scenario [45]. They feel shortage of skill labor to operate and also lack of technical support or service.

3. Future Scopes

From the above points to be pondered over we can sum up that we are on the verse of making such a manufacturing technology which can generate the technology for its own purpose with the use of artificial intelligence. At present we are using robotic arms as technology for the manufacturing of Automobiles and later on we can get a high-class 3D printed model for the aerospace industry where we can directly print the working machine overnight. Also, each scope is enhanced by enhancing the AMT. Researchers are having more scopes to do research works and carry on experiments in the fields. The rate of Patent and non-patented papers shows that we are going to create a world full of new technologies and new opportunities for job. And it may happen that the recently bloomed smart phones will be replaced by nano-technologies and the production of such technologies will be done by the robots and mechanical arms inside the industry. And from the Resources we can conclude that we have such kinds of research and developments from all over the world.

4. Conclusions

We conclude that there are few major key factors that affect the encouragement of moving to AMT in India as follows. Firstly, the cost effectiveness of any AMT matters a lot. Secondly the adoption of AMT itself is a very broad topic of interest likesome of the AMT might require a complete redesign of manufacturing unit while some don't while it is not necessary that some need to install high end machinery but instead companies could also adopt the automated maintenance machinery as small load machinery system. Adopting AMT might lead to personnel shortage or say skilled labor; it needs well defined objectives to opt for AMT, its pace of implementation etc. Next comes the environmental factor which is the most important at the end because India being second most densely populated country in the world so the new cleaner AMT becomes a deal for Indian manufacturingcompanies. Hence, the self-reliant India mission could prove beneficial for development AMTs in small and medium scale industries and improve the quality of products in addition to human resource development.

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ANB-NEP-2020P19

INNOVATIONS IN CURRICULUM DESIGN FOR IMPLEMENTATION OF NEP 2020 TO ACHIEVE ATMANIRBHAR BHARAT OBJECTIVES

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ABSTRACT: A curriculum is an attempt to communicate the essential features of an educational program preferably using specific objectives and a systematic approach to the design and management to teaching and learning. In order that the curriculum evaluation may serve its aims, it must be a continuous process consisting of constant observation, measurement, and reporting of all the stages of curriculum development so that appropriate corrective measures at appropriate stages can be taken at appropriate time. The new education policy NEP 2020 stresses on contextual designing of education focusing on multilingual aspect of instructional material design. It articulates the goal of changing the teaching and learning process to foster inquiry, discovery, analysis and critical thinking. Its time for India to plan change in teaching, learning, examination and assessment that will ensure that the Indian system withstands tough times like present pandemic situation in future and make itself reliant- AtmaNirbhar.The paper explores the paradigms relating to how a curriculum might be conceived to deal with issues.

Keywords: Curriculum, National Education Policy, Curriculum design process, AtmaNirbhar Bharat

1. Introduction

The quality of Education mirrors the nature and extent of the planning of curriculum. Curriculum Design is a complex undertaking and its complexity and difficulty are heightened by the absence of clear and consistent know how of planning, designing, development, implementation and evaluation. "The planned and guided learning experiences and intended learning outcomes, formulated through the systematic reconstruction of knowledge and experience. The syllabus prescribes the content of the teaching to be given and the curriculum prescribes the methods to be used. It is made up of pedagogical directives intended to provide assistance, advice, suggestions and information to assist the teachers in carrying out his task successfully" [1]. Traditional curricula emphasize low- level skills neglecting the meaningful content and higher- order thinking. The curriculum ought to involve complex and holistic thinking, than focusing on simple and discrete skills.

Thinking curricula based on "new" ways of thinking and treat both contents and processes differently. The overarching characteristic of thinking curricula is: “Thinking curricula fulfill a dual agenda by integrating content and process”. A thinking curriculum unites process and content, in real-world situations; students are taught content through processes encountered in the real world.

1.1 Curriculum Development Stages

Curriculum development process comprises of four stages as depicted in Fig 1. The various stages involved are briefed in this section.

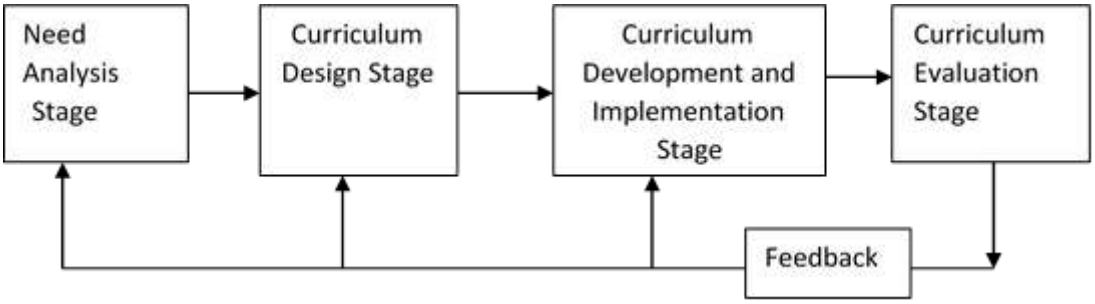

Fig 1 : Curriculum development process

Need analysis stage deals with identification of needs for determining employment opportunities, technological development at work places and competency profile of technical manpower. Curriculum design has also been defined as long term identification of educational goals and objectives; selection and organization of content; learning teaching pedagogy; assessment and evaluation of performance; resources for implementation and a scheme for evaluating the effectiveness of the curriculum" [2]

The concern of a good curriculum design is not only to maintain the quality but also continuous improvement in the programme. The effectiveness and efficiency of a curriculum depends on the changes in technology, pedagogy and andragogy. Curriculum design is determined by decisions at a broad level which involves the technical planning and implementation of curriculum elements. Curriculum evaluation is carried out to determine the effectiveness of curricula, resulting in continuous updating and revision of curricula. The revision of curricula in systematic and comprehensive manner provide information for further revision of curricula. The curriculum evaluation helps in bringing changes and making them relevant and effective; the policy formulation, planning and implementation of educational programmes.

The rest of paper is divided into four sections as follows. Section 2 presents NEP 2020 and section 3 details Pillars of Atmanirbhar Bharat. Curriculum development model for multidisciplinary curriculum is presented and explained in Section 4 followed by conclusion.

2. National Education Policy 2020 (NEP 2020)

The new policy has been released after more than three decades with a vision to reform Indian education system. The NEP-2020 has proposed multidisciplinary approach which will encourage innovation and skill development [3-4]. The NEP 2020 envisions creating educational institutions which will produce graduates having knowledge and skills required for 21st century world.

Under the umbrella of a new education policy, major changes in the pedagogical structure of the curriculum is to be adopted. As per the latest directive, students will be having increased flexibility and choice of subjects as they will be able to take up any courses they want. The major features of NEP – 2020 are highlighted below:

(i) Quality Institutions: NEP-2020 envisions to transform the existing institutions into a new and forward-looking institutions with the introduction of multidisciplinary approach. Another major reform is to offer programmes with local/Indian languages as medium of instruction. More institutional and faulty autonomy, establishment of a National Research Foundation, autonomous boards of governors, and single regulator for higher education are some of the many features of NEP – 2020 for developing quality institutions.

(ii) End of Affiliation System: The NEP – 2020 advocates the establishment of universities and autonomous colleges which will grant degrees. There will be two types of universities: Research intensive universities and Teaching intensive universities. The first type shall focus on conducting significant research and the second type that will emphasize on teaching. The integration of professional and vocational education in higher educational institutions (HEIs) has also been highlighted by the NEP – 2020.

(iii) Multidisciplinary and Flexible curriculum: NEP-2020 has placed a large emphasis on the development of holistic and multi-disciplinary curriculum which should also support flexible structure with multiple entry and exit options. It highlights the establishment of an Academic Bank of Credits (ABC) that will store the credits earned by the learner in digital form. These credits shall be transferable from one HEI to other.

(iv) Technology Adoption in teaching – learning NEP – 2020 proposes to create a National Educational Technology Forum (NETF) to give a major push to the use of technology to improve teaching – learning process. The development of educational softwares and their accessibility to the all students and teachers is also a key feature of the NEP – 2020. The emerging AINR based technologies shall be targeted for creating instructional material in these cutting-edge domains.

(v) Online and Digital Education: To provide the equal opportunity to all learners to access quality education, the NEP – 2020 proposes to leverage the advantages of online/digital education. However, this requires the availability of affordable computing devices and internet. NEP – 2020 proposes to conduct the pilot studies to analyze the advantages of integrating the existing system with online education. The strengthening of existing e-learning platforms (SWAYAM, DIKSHA, etc.) has also been highlighted to provide equal access to quality learning material [5-6]. The creation of virtual labs to offer quality practical and hands-on learning environment is another major characteristic of NEP – 2020.

3. Role of Technical Higher Education Institutions In Making Atmanirbhar Bharat

Technical education is the way forward to create an Aatmanirbhar Bharat. Whenever we seek to be self-reliant on our own, then we have to look no further than what we call 'Technical Education'. Technical education not only plays a vital role in the human resource development of our country, but also, it enhances the industrial productivity and goes a long way to improve the quality of life of our people.

Modern teaching philosophy, unlike the traditional approach, advocates for deep learning. A teacher should be a facilitator, who facilitates the deep learning to happen.Teachers focus on education methodology how abstract ideas can be designed into a digital form to make learning interesting. The evaluation process involves the students, and assessment is done in the form of quiz and games. Another area of concern is the way in which we evaluate students - the Indian evaluation or assessment system is information-based, we read a lot and try to remember things only till we put it on answers sheets, and then the focus is only on getting those digits on our certificates

Firstly, online education can help reduce inequality in the "Quality" of faculty and education available to students across different schools and colleges in India [7]. By removing the nuisance of unnecessary overheads and administration, and by bringing the best faculty in direct contact with the students through online learning can do wonders for motivation of both, the faculty and student.

Secondly, access to online classes and digital media will provide room to students to develop self-motivation and become independent. After all, conventional teaching is often criticized with spoon – feeding and over emphasis on exams and internal tests and assessments. This reduces the creativity in students and makes them dependent on marks, and placements that are related to exam results.

Thirdly, online teaching will save the time to travel as well as the negative sides of gossip and bullying from peers, both for students and faculty.

Fourthly, access to the best digital content for all, as well as the room for creativity and innovation will help our future citizens to think, analyze and get clarity about what is right and wrong for themselves, for society as well as future of our nation. Faculty will get more time to do research, as administrative work will get reduced.

Fifth, online classes are the best solution to protect our children from corona infection and also ensure continuity of education at least until the pandemic threats exist. Parents will not worry as their kids can study safely from home. Teachers can also teach from home and give more time to self-study and research. Students will be forced to learn to study by themselves at home through text books and through online classes.

As our students become more independent, they will carry these values as they grow old to be more responsible citizens, will have more time to pursue their passion, and may create their own start-ups, thus help towards making of an Atma-Nirbhar Bharat.

Millennial and generation alpha learners along with anxious faculty will certainly change the conventional classroom transactions that need to build on the growing need for meta cognitive skills of students and the changing role of faculty as a facilitator. The existing norms and standards for higher education institutions need to pave way for a fine blend of physical and digital assets [8-9]. Pure physical assets have neither worked well in best-case nor in worst-case. Higher education needs to move the use-case way. Norms and standards need a contemporaneous review

4. Multidisciplinary Curriculum Design

An innovative curriculum does not moves in a direction to produce 'manual encyclopedias,' filled with definitions, facts, and figures. An intelligent and a knowledgeable student possess all these information, but also, they possess in depth knowledge with conceptual background, application oriented concepts, creative and innovative mindset and communicating knowledge in a field. In a critical curriculum, students develop a deep understanding of concepts and capability in dealing with those concepts, and an understanding to tackle tasks and problems in all disciplines. The innovative curriculum gives students the techniques, the perspectives, the understanding, and methodologies to carry out creative imaginative tasks [10]

The motive of the NEP 2020 is to transform education institutions into multidisciplinary universities, and Higher Education Institutes, Knowledge Hubs, possessing 3,000 or more students that will finish the fragmentation of upper education.

This will help build vibrant communities of students and peers and break down silos. The students will have all round development across disciplines including artistic, creative, and analytic subjects. This will also enhance and develop active research capability in the student across disciplines including cross-disciplinary research, and increase resource efficiency.

To give multi-disciplinary all-encompassing education at the undergraduate level for integrated, flexible curricular structures, inventive combinations of study, integration of vocational education and various exit points have to be introduced. The intent in NEP 2020 is to lead the pedagogic reforms nationally resulting in developing appropriate curricula, examination modalities. [11-12]. A multidisciplinary education would aim to develop intellectual, aesthetic, social and all capacities of citizenry, including physical, emotional, and moral in an integrated manner. Multidisciplinary education will develop well-rounded individuals in fields across the arts, humanities, languages, sciences, social sciences, and professional, technical, and vocational fields. In multidisciplinary education the structure and lengths of degree programmes shall be adjusted accordingly.

5. Conclusion

NEP has focused on multi-disciplinary, holistic higher education with flexible curricula and multiple entries and exit points with appropriate certification. It has removed boundaries

between curricula and extra-curricular activities. The new innovative curriculum should take into account what outcomes are expected, about designing rubrics and integrating all the expected parameters. NEP envisages broad-based, multi-disciplinary, holistic Under Graduate Program with flexible curricula, creative combinations of subjects, integration of vocational education.

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Development of a Low-Cost Real Time Non-Contact Health Monitoring System for Rotary Machinery

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ABSTRACT: Condition based maintenance and condition monitoring are associated with maintenance of equipments based on the real-time condition of subsystem(s) of the machine. Vibration, temperature and acoustic signals have been used for machinery health monitoring, vibration signature being the most widely used parameter. In this paper, a low-cost indigenously non-contact type vibration measurement system has been proposed to capture the real-time vibration data for monitoring the health of rotary machinery. The results with the developed system compare well with the accelerometer data. The low-cost indigenous solution established will assist the Indian industry in improving productivity, especially in micro small and medium-scale industries.

1. Introduction

The covid-19 pandemic has changed the economic and social infrastructure globally, but worst hit is the Micro, Small and Medium Enterprise (MSME) sector in India. The world is now standing at the verge of a heavy economical breakdown. In the era of pandemic, the government led a true Swadeshi movement by starting the "Atmanirbhar Bharat Abhiyan" campaign. However, in the quest to attain a self-reliant India, it is necessary to develop a low-cost solution for monitoring the health of the machine that can help MSMEsenhance productivity. Condition based maintenance and condition monitoring are two terms associated with maintenance of equipments based on the current condition of subsystem of the machine. Vibration, temperature and acoustic signals have been used for machine health monitoring, vibration signature being the most widely used parameter[1, 2]. Vibration caused by rotary or reciprocating components is one of the major reasons for failure of rotating equipment. The moving components due to wear and tear create vibrations before complete failure which is an indication of condition of the component. For example, a ball bearing before complete failure may result in eccentric running of the shaft which will start generating noise and produce vibrations in the machine or in some components of the machine. In few cases, it may be possible to identify the vibration producing components and take corrective actions but in majority of the cases, the vibration producing components may not be visible as it may be hidden inside the structure of the machine. In such cases, sensors called accelerometer are mounted on the machine at suitable places. The accelerometers pick up the vibration signal which is further used for monitoring the health of the equipment.

However, the accelerometers have to be physically mounted on the machine and wired connections have to be made to the data acquisition system for further analysis and processing. The physically mounted accelerometers and connected wiring system may interfere with the working of the system. The accelerometers if not placed at proper location do not give the true vibration signatures resulting in non-reliable and unusable data. To obviate the problem on physical placement of the contact type sensors, an economical non-contact type vibration measurement system has been developed to capture the real-time vibration data for monitoring the health of rotary machinery.

2. Experimental Methodology

For non-contact vibration based condition monitoring, a vibration pickup has been designed based on basic principle of reflection of light [3]. The developed system consists the following components:

a) Laser Emitter and Reflector: A laser beam was aimed at the device under test in order to obtain the reflected beam produced from the reflector mounted on the vibrating object by an array of light dependent resistors (LDR) for data acquisition. An optimal angle of 8° was calculated between the incident and reflected rays to obtain the maximum information related to machine health [4]. The arrangement of the sensor was positioned in front of the reflector to prevent any loss of reflected light over the array of LDR.

b) Vibration Pickup Sensor (Receiver): By observing the alteration in the deviation and of the beam due to the system's vibration, an array of six LDR sensors embedded in the printed circuit board was used to acquire the vibration signal. The suggested sensor was intended for the extraction of two-dimensional data. The printed circuit board contains a sensing element and a resistor interface capable of transporting data from the sensing element to the microcontroller and transmitting an analogue signal. Five sensors (PIN 0, PIN 1, PIN 2, PIN 4, and PIN 5), have the form of a two-dimensional cross to obtain the difference in laser light intensity occurred due to vibrations, are put together. During operation, the noise (in the form of light) interference which continuously comes from the atmosphere were ignored by locating the sixth sensor (PIN 3) at a certain distance. PIN 1 serves as a reference pin, the difference in light intensity between PIN 0 and PIN 2 was used to determine the vibrations of the X-axis, whereas the calculation of the vibrations of the Y-axis was measured between PIN 4 and PIN 5.

c) Microcontroller based DAQ device: The testing apparatus was interfaced with a DAQ system via appropriate microcontroller arrangement. Two programs were independently built in different software environments to acquire the vibration data in both horizontal and vertical directions. The schematic diagram of component integration for non-contact measurement system is shown in Fig. 1.

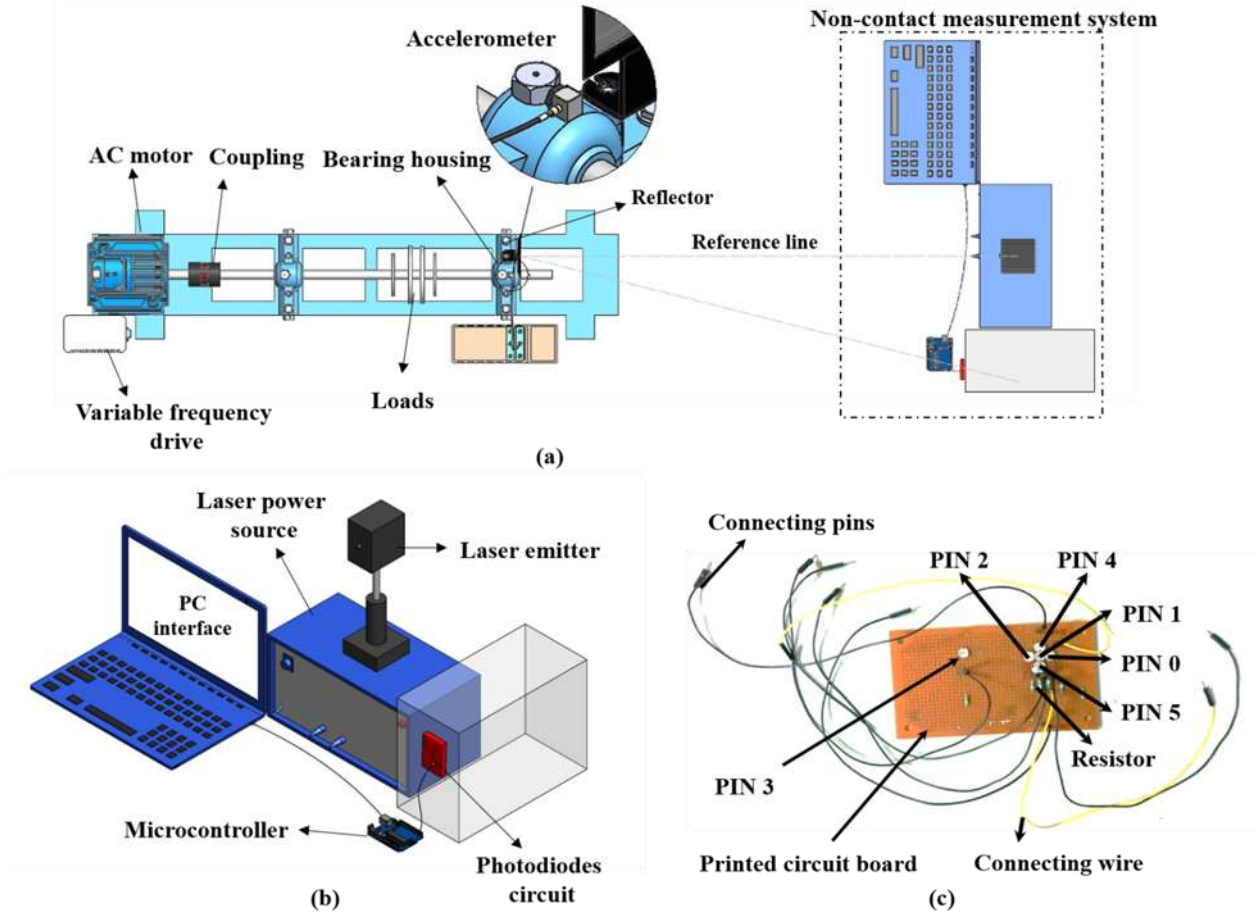

Fig. 1: Experimental setup (a) test rig (b) non-contact vibration measurement system (c) sensor [3]

Experiments on test rigs with various bearing conditions have been performed to produce vibration-related data for training and testing. Contact type based accelerometer and non-contact type developed vibration sensors were used to acquire the vibration signatures. A total of 30k samples were collected for three rotor speeds of 1600, 1800 and 2000 rpm and 0, 4 and 8 kg loads at sampling frequency of 12.8 kHz in both x and y axes. To obtain the mean value, each experiment was repeated five times. Three bearing defects, namely outer raceway defect, inner raceway defect and rolling defect were induced using EDM. The vibration data obtained with healthy bearings as the baseline data, were then considered for contrast with signatures attained under faulty conditions. The performance of non-contact condition based monitoring system has been compared with the results obtained using accelerometer. The results with the developed system compare well with the accelerometer data. The proposed strategy is promising for detecting the bearing damage and identifying its class.

3. Economic Evaluation of Different Vibration Analyzers

Majority of the existing processes for vibration measurement use contact type instruments that have to be mounted on the machine. Further, the sensor is connected to other components of the measurement system by wiring that adds to the cost and complexityof the system. The sensors are liable to get damaged while mounting/dismounting and during use on the machine/equipment. In order to resolve these issues, the current work recommends a proactive non-contact type condition monitoring system for assessing the health of rotary machinery. In the market economy, the economic assessment provides the fundamental sub-bases for decisions on realizing an action. The various features assessment and cost analysis of the proposed non-contact vibration measurement system are compared with state-of-the-art commercially available vibration measuring equipments in the market as shown in Table 1. A comparative analysis has been presented by taking the hardware and software capabilities into consideration.

Table 1: Features comparison of various vibration analyzers

Category	Features	Proposed system	Commercially available systems			
		Developed non-contact sensor	NI-cDAQ-9178	Oros OR34	Pruftechnik Vibguard	OMS LaserPoint LP01-HF (LDV)
Hardware	No. of channels	Flexible	Flexible	4	16	Flexible
	Portability	✓	✓	✓	✓	✓
	System weight	1.1 kg	1.2 kg	1.42 kg	2 kg	4.2 kg
	PC requirements for signal analysis	✓	✓	✓	✓	✓
Software	Open source	✓	✘	✘	✘	✘
	Offline signal analysis	✓	✓	✓	✓	✓
Approximate cost (INR)		13,000	5,79,570	23,77,730	32,69,375	25,26,335

The proposed framework has an assortment of software features such as fast Fourier transform, power spectral density, signal editing utility, and realistic presentation of acquired data. These features can be implemented using any relevant open source/commercial software. With these highlights, it has been found that the proposed framework can perform the greater part of the functions available in complex and independent vibration measuring instruments. The developed sensor is very cost-effective and faster as it does not require mounting of the sensor on the machine. In addition, single system can be quickly taken to multiple machines for taking vibration data from different machines.

4. Conclusions

The developed real-time non-contact measurement system has the following unique features:

a) Non-contact measurements
b) Low cost indigenously developed device
c) Quick measurement and analysis of data
d) Does not require the sensors to be mounted on the machine
e) Single equipment can be used for any shape and size of the target
f) The output from the device can be transmitted on internet to remote place.

The method being very economical compared to accelerometer based method can be replicated at multiple machines independently and can be integrated into the Industrial Internet of Things (IIoT) environment for remote monitoring of the machine condition. Further, the developed low cost indigenous solution and its implementation in Indian industry is a step towards “Make in India” initiative of Government of India.

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Recommendations of the Conference

One day National Conference on "Unlocking Atmanirbhar Bharat through NEP-2020" was held on 27 November 2020, organized by Atmanirbhar Task Force of NITTTR Chandigarh. This was 3rd event organised by NITTTR Chandigarh in-light of Atmanirbhar Bharat (ANB) mission of Government of India (GoI). The 1st event was 5-Days webinar series on "Atmanirbhar Bharat: Transmutation from Privation to Exuberance" organized from 27-31 July 2020. The 2nd event was conducted in the form of panel discussion for implementation and roadmap of ANB and National Education Policy (NEP) 2020 in which all 04 NITTTRs participated. Based on the deliberations of delegates, the recommendations of this 3rd event i.e National Conference on "Unlocking Atmanirbhar Bharat through NEP-2020" are mentioned below:

The relation between NEP 2020 and ANB through multidisciplinary courses in curriculum implementation process is significant for engineering institutions. To attain the goal of ANB, the reforms such as multi-disciplinary approach suggested in NEP 2020 will play a crucial role. NEP 2020 is necessary for developing a bright and successful future for the youth of our country if implemented in phased manner.

Recommendations of the Conference

Small technical interventions under ANB may be made through researchers at University/ Institute levels for better implementation of NEP-2020. This may be useful for addressing environmental issues through circular economy, providing better job opportunities to coming generations by enhancing entrepreneurial qualities and may contribute in nation building (by developing useful and economic technical solutions) for bridging the gap between industries and research/ academic institutes.

ANB will accelerate the development of product/system and selling it at India and global level. Apex bodies in India like UGC, AICTE and institutes of national importance like IITs, NITs, NITTTRs should consider this approach as a step towards self reliant India.

The role of engineering colleges in solving the problem of rural areas by taking into account the policy changes has been introduced by NEP-2020. As the focus of NEP 2020 is introducing technology education in early ages (i.e. middle and secondary school), the foundation of the education system leading towards engineering education becomes stronger. At the same time, aggressive participation of engineering colleges in solving the problems of rural areas becomes important for making India self-reliant.

Recommendations of the Conference

The digital/advanced innovation in the manufacturing system is breaking the dividers of manufacturing because of the ongoing improvements in areas like, 3D printing, human-machine association, computerization and mechanical technology alongside a blast in information and new registering capacities. Under ANB initiatives, the additive manufacturing can be used for start-ups related to preparation of dental crowns, biomedical implants, scaffolds, organs, daily essential products etc. especially for job/ batch production.

3D printing plays pivotal role in the designing of product and evolution by decreasing the lead time of product development, expenses and increase end product performance. Compared to another conventional machining process, the design and production of the material is carried out efficiently.

Nanoscience and nanotechnology can serve as a channel to reconsider science and technology education and public policy in support of science education goals. The opportunities exist to educate students about critical areas of nanoscience and technology. The research in the areas of nanoelectronics, artificial intelligence (AI), internet of things (IoT), Robotics, nano-sensors etc. require nanoscience and nanotechnology interventions. NEP-2020 has potential to change the research and innovation culture and make India a self-reliant nation by developing it as a global research and development hub.

Recommendations of the Conference

The economic liberalization taking place around the globe and India will open new avenues of industrial job opportunity. Factors like gig economy, diversity, necessity of sustainable development, innovation and transition from Industry 4.0 to 5.0 is transforming the role of engineers in industry and society alongside the growth in new sectors of engineering.

The NEP-2020 will truly revolutionize the education system of the country in the near future. In the field of methods, scope, jobs, chances, and much more, the education and technology industry will experience a great boom. Over all in order to achieve the NEP-2020 objectives for the country over the next years the education-tech industry will certainly play a huge role. The bunch of opportunities provided by NEP-2020 thus plays an immense role in strengthening India in one way or other.

Finally, in light of the opinions expressed by various delegates, it is concluded that NEP-2020 is a power tool in hand of technocrats to achieve the target of 5 trillion economy as envisioned in ANB initiatives. With effective and successful adoption of NEP-2020, technical institutions will lead to strengthen all 5 pillars of ANB leading to self reliant nation as outlined by Sh. Narendra Modi Ji, the Hon'ble Prime minister of our country.

Organizing Team

"Partnering builds Strength
Networking creates Wealth
Empowering leads Progress"

" United we Perform
Together we Achieve
Team we Win "

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