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The Integration of Artificial Intelligence and Robotics in Production Optimization of 3D Polymer Printing

A Study on Chennai Precision Engineering and Technology Cluster

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***Abstract*— The Precision Engineering and Technology Centre (PETC) have Common Facility Centre namely EOS M 396 Selective Laser Sintering (SLS) Machine which is an Industrial Grade 3D Polymer Printing installed for use of all 40 Automotive Components Manufacturers at Tirumudivakkam, Chennai, Tamil Nadu, India. The objective is to study the technical efficiency for 6 input and 6 output variables related to SLS for traditional and AI integrated. The methodology adopted is collection of data from 40 automotive components manufacturers at Chennai. It is found that all the 40 ACM use the SLS with less service charge when compared to market price since they are all members in PETC. The technical efficiency of integrated AI is greater than traditional DMLS. The Design Software's, Product Development Machines and Testing Machines are available in PETC, CFC so that 40 Automotive components Manufacturers can make use of with less service charge which leads to cost minimisation and profit maximisation. To conclude AI based usage leads to cost minimization and profit maximization of individual Automotive Components Manufacturers when compared to traditional usage of SLS.**

***Keywords* — Selective Laser Sintering, Precision Engineering Cluster, Technical Efficiency.**

I. INTRODUCTION

The Precision Engineering and Technology Centre (PETC), an initiative of the Thirumudivakkam Industrial Estate Manufacturers Association in Chennai, is supported by the Government of Tamil Nadu under the Precision Manufacturing Mega Cluster Scheme. PETC is dedicated to empowering Micro, Small, and Medium Enterprises (MSMEs) by fostering innovation and facilitating new product development in the fields of precision engineering and automotive components manufacturing.

To accelerate product development, PETC offers industrial-grade 3D printing solutions that enable the creation of complex, customized, and organic-shaped components directly from CAD models. This significantly reduces lead times and allows manufacturers to focus more on innovation.

All 3D printed parts achieve superior mechanical properties and dimensional accuracy, supported by advanced software features such as Smart Scaling, EOSAME, and continuous temperature monitoring. Exceptional productivity is delivered through a powerful laser, along with high-speed scanning and recoating capabilities. The system supports a wide range of industrial applications, enabled by 14 material types and 26 customizable parameter sets. Seamless integration into the Industrial Internet of Things (IIoT) via EOSCONNECT Core ensures a fully digital process chain—from CAD model to ERP/MES systems, and finally to the finished part. Maximum machine uptime is ensured through remote digital track-and-trace capabilities, accessible anytime, anywhere. Comprehensive evaluation and documentation of every build cycle enables continuous optimization of the entire production workflow. [1]

Figure 1: Selective Laser Sintering for Polymer

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A. Reliable Production with the Industry's Most Extensive Material Portfolio

The EOS P 396, a medium-sized and best-selling 3D printing system, supports seamless integration into Industrial Internet of Things (IIoT) environments. It enables flexible, tool-free production—from on-demand spare parts to full-scale serial manufacturing, ensuring high reliability and adaptability across applications. [1]

Table 1: EOS P396- TECHNICAL DATA	
BUILD VOLUME	340 x 340 x 600 mm (13.4 x 13.4 x 23.6 in)
LASER TYPE	CO_2; 1 x 70 W
SCAN SPEED	up to 6.0 m/s (19.7 ft/s)
POWER SUPPLY	1 x 32 A
POWER CONSUMPTION	max. 10.0 kW / typical 2.1 kW

Source [1]

The Additive Manufacturing Lab at PETC is equipped with advanced 3D printing technologies capable of producing customized products, intricate tooling, and end-use parts with high added value. Notably, the facility includes a Selective Laser Sintering (SLS) machine—EOS P396—housed within the Common Facility Centre (CFC) as shown in figure 1. This system supports flexible, tool-free production of polymer parts, from prototypes to full-scale serial manufacturing. Materials processed include PA 2200 and Thermoplastic Polyurethane (TPU).

II LITERATURE SURVEY

Additive Manufacturing (AM), also known as 3D printing, has revolutionized product development by enabling rapid, tool-free production of complex and customized components directly from digital CAD models. Among the various AM technologies, Selective Laser Sintering (SLS) stands out for its ability to produce high-strength, functional polymer parts suitable for both prototyping and end-use applications.

Studies by Gibson et al. (2015) have emphasized the advantages of SLS in producing geometrically complex parts without the need for molds or dies, making it ideal for low to medium-volume production. This is particularly beneficial for Micro, Small, and Medium Enterprises (MSMEs), which often face resource and time constraints in conventional manufacturing.[2]

The EOS P396 is a widely recognized SLS system, offering high precision, repeatability, and the ability to process materials such as PA 2200 and Thermoplastic Polyurethane (TPU). As highlighted in the Wohlers Report (2023), such systems have gained significant traction in the automotive sector due to their ability to reduce lead times and support lightweight, customized part production.[3]

Research by Dimitrov et al. (2006) demonstrates that SLS technology significantly shortens product development cycles by allowing quick iteration and testing of design variants. This rapid development capability enables MSMEs to stay competitive and responsive to market demands.[4]

In addition, Petrovic et al. (2011) discussed the environmental and economic benefits of AM technologies, noting their material efficiency and potential for decentralized manufacturing. These characteristics align well with the goals of sustainable manufacturing and innovation in smaller-scale industrial settings.[5]

Government-supported initiatives, such as the Precision Manufacturing Mega Cluster Scheme, further strengthen the ecosystem by providing shared access to advanced manufacturing technologies.[6] Facilities like the Precision Engineering and Technology Centre (PETC) in Thirumudivakkam serve as key enablers, empowering MSMEs with state-of-the-art infrastructure, including the EOS P396, to develop high-value components for the automotive and precision engineering industries.[7]

III OBJECTIVE OF THE STUDY

1.To study and compare constant returns to scale technical efficiency (crtse) of Traditional and AI + Robotics Integrated SLS.

2.To study and compare variable returns to scale technical efficiency (vrtse) of Traditional and AI + Robotics Integrated SLS.

3.To study and compare scale efficiency (which is crtse divided by vrtse) of Traditional and AI + Robotics Integrated SLS.

4. To study on Design Software's, Product Development Machines and Testing Machines available at CFC, PETC.

IV MATERIALS AND METHODS

In PETC, the materials processed include PA 2200 and Thermoplastic Polyurethane (TPU).

A. Exceptional Materials Expertise for Additive Manufacturing

EOS offers deep expertise in materials science and a comprehensive portfolio of advanced materials tailored for additive manufacturing. The materials, systems, and process parameters are precisely aligned to ensure optimal performance. By selecting the right material, one can achieve the ideal property profiles required for their products—efficiently and reliably.

The methodology of the study is collection of input variables like Machine Operating Hours (Moh), Material Consumption (kg) (Mc),Energy Consumption (kWh) (Eckwh), Labor Hours (Lh), Setup Time (min) (Sut), and Maintenance Downtime (hrs) (Mdt) and output variables like Number of Parts Produced (Ppn), Part Accuracy / Tolerance Achievement (%) (Pata), First-Pass Yield (%) (Fpy), Production Lead Time (inverse) (Plt), Utilization Rate (%) (Ur) and Customer Delivery Compliance (%) (Cdc) for SLS from 40 Automotive Components Manufacturers. The description are given in table 2 and 3. The data are analysed using Output Oriented Multi Stage Data Envelopment Analysis (DEA) to find constant returns to scale (crste), variables return to scale (vrste) and scale efficiency.

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CONCEPTUAL FRAME WORK

Input Variables (6) →	Output Variables(6) →	Technical Efficiency

Source: Developed by Researcher

Table 2: Input Variables	
These represent the resources consumed during the production process using the EOS P396:	
Variable	Description
Machine Operating Hours (Moh)	Total number of hours the EOS 396 is operated per unit or batch.
Material Consumption (kg) (Mc)	Amount of raw material (e.g., PA 2200 or TPU) used per batch.
Energy Consumption (kWh) Eckwh	Energy consumed during the printing process.
Labor Hours (Lh)	Total human effort involved (may decrease in AI+Robotics systems).
Setup Time (min) (Sut)	Time taken to prepare the machine and system before production.
Maintenance Downtime (hrs) (Mdt)	Time lost due to scheduled/unscheduled maintenance.
AI/Robotics System Cost (Optional for Integrated)	Capital cost or amortized cost of AI/robotics systems (only for integrated units).

Source: Developed by Researcher

Table 3: Output Variables	
These represent the results or performance outcomes of using the EOS 396 system:	
Variable	Description
Number of Parts Produced (Ppn)	Total quantity of parts manufactured per batch.
Part Accuracy / Tolerance Achievement (%) (Pata)	Precision of parts compared to design specs (measured by dimensional accuracy).
First-Pass Yield (%) (Fpy)	Percentage of parts that pass quality checks without rework.
Production Lead Time (inverse) (Plt)	Time taken from design to finished product (can be inverse to reflect efficiency).
Utilization Rate (%) (Ur)	Actual machine usage as a percentage of available time.
Innovation Index (AI+Robotics only)	Proxy for complexity of parts produced or capability to handle customized designs.
Customer Delivery Compliance (%) (Cdc)	On-time delivery rate of orders.

Source: Developed by Researcher

V RESULTS AND DISCUSSION

The Raw Materials used and Product Range produced by PETC are as given in table 4.

A. Raw Material usage in the cluster**:** The major raw materials used in the cluster include mild steel, carbon steel, alloy steel, stainless steel, aluminium, super alloy, special steels, non-ferrous metals, titanium, Chrome, nickel and Copper and so on. Most of these raw materials are available locally or obtained from other domestic markets and are manufactured in India.

B. Products produced by Cluster Members

Table 4 : Products produced by Cluster Members		
S.No	Sector	Product Range
1	Automobile and its ancillaries	Reflectors, Wiper motor gear box, foot covers, radio covers, side mirror, water pump, starter motors, Adapter plate, Arm head, Bayonet, Bottom Half greaves
2	Casting and forging	Closed die forgings, upset forgings, Press tools, Moulds, Jig & Fixtures, Precision Components & Machined parts
3	Moulding	Duplex Nickel- Chrome Plating on ABS Plastic and Duplex Nickel Barrel Plating, Plastic Injection Moulding Parts, Plastic melding Parts, Plastic Moulded Parts, Injection melded Parts, Anchor Panasonic and Moulded Parts
4	Others	Fibre re- enforced plastic products like windmill covers, bulk acid storage tanks, corrosion proof linings, security cabins, swimming pool equipment, Packaging, gravure printing cylinders

Source: PETC, Chennai

The Technical Efficiency is calculated in table 5 and 6 for the input and output variables for traditional and AI integrated SLS respectively.

DATA ENVELOPMENT ANALYSIS
BCC-O Model

$$\underset{\text{Ø}, \lambda, S^{+}, S^{-}}{\text{Max}} \quad Z_0 = \text{Ø} + \varepsilon \vec{1} S^{+} + \varepsilon \vec{1} S^{-}$$

Subject to

$$\text{Ø} Y_0 - Y\lambda + S^{+} = 0$$

$$X\lambda + S^{-} = X_0$$

$$\vec{1}\lambda \geq 1, \quad \lambda, S^{+}, S^{-} \geq 0$$

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Computing Methodology

Initially we consider First DMU as the studied DMU and the Linear Programming (LP) Model is formulated as given below

Max $\varnothing_0$

Subject to

$Y_{11}\lambda_1 + Y_{12}\lambda_2 + \ldots\ldots\ldots\ldots Y_{40}\lambda_{40} \geq Y_{11}$ Output Constraints

$Y_{21}\lambda_1 + Y_{22}\lambda_2 + \ldots\ldots\ldots\ldots Y_{40}\lambda_{40} \geq Y_{21}$ Output Constraints

$Y_{31}\lambda_1 + Y_{32}\lambda_2 + \ldots\ldots\ldots\ldots Y_{40}\lambda_{40} \geq Y_{31}$ Output Constraints

$Y_{41}\lambda_1 + Y_{42}\lambda_2 + \ldots\ldots\ldots\ldots Y_{40}\lambda_{40} \geq Y_{41}$ Output Constraints

$Y_{51}\lambda_1 + Y_{52}\lambda_2 + \ldots\ldots\ldots\ldots Y_{40}\lambda_{40} \geq Y_{51}$ Output Constraints

$Y_{61}\lambda_1 + Y_{62}\lambda_2 + \ldots\ldots\ldots\ldots Y_{40}\lambda_{40} \geq Y_{61}$ Output Constraints

$X_{11}\varnothing_0 - X_{11}\lambda_1 - X_{12}\lambda_2 - \ldots\ldots\ldots X_{40}\lambda_{40} \geq 0$ Input Constraints

$X_{21}\varnothing_0 - X_{21}\lambda_1 - X_{22}\lambda_2 - \ldots\ldots\ldots X_{40}\lambda_{40} \geq 0$ Input Constraints

$X_{31}\varnothing_0 - X_{31}\lambda_1 - X_{32}\lambda_2 - \ldots\ldots\ldots X_{40}\lambda_{40} \geq 0$ Input Constraints

$X_{41}\varnothing_0 - X_{41}\lambda_1 - X_{42}\lambda_2 - \ldots\ldots\ldots X_{40}\lambda_{40} \geq 0$ Input Constraints

$X_{51}\varnothing_0 - X_{51}\lambda_1 - X_{52}\lambda_2 - \ldots\ldots\ldots X_{40}\lambda_{40} \geq 0$ Input Constraints

$X_{61}\varnothing_0 - X_{61}\lambda_1 - X_{62}\lambda_2 - \ldots\ldots\ldots X_{40}\lambda_{40} \geq 0$ Input Constraints

$\lambda_1 + \lambda_2 + \ldots \lambda_{40} = 1.$

$\lambda_1, \lambda_2, \ldots \lambda_{40} \geq 0$, $\varnothing_0$ is unrestricted.

By solving the above equations and continuously changing the studied DMUs the value of λ_i's and $\varnothing_i$'s

Table-5: Traditional Efficiency Summary

firm	crste	vrste	scale	
1	1.000	1.000	1.000	-
2	1.000	1.000	1.000	-
3	1.000	1.000	1.000	-
4	1.000	1.000	1.000	-
5	1.000	1.000	1.000	-
6	0.932	0.991	0.940	drs
7	1.000	1.000	1.000	-
8	1.000	1.000	1.000	-
9	1.000	1.000	1.000	-
10	0.982	1.000	0.982	drs
11	1.000	1.000	1.000	-
12	0.932	1.000	0.932	drs
13	1.000	1.000	1.000	-
14	1.000	1.000	1.000	-
15	1.000	1.000	1.000	-
16	1.000	1.000	1.000	-
17	1.000	1.000	1.000	-
18	1.000	1.000	1.000	-
19	1.000	1.000	1.000	-
20	1.000	1.000	1.000	-
21	0.955	1.000	0.955	drs
22	1.000	1.000	1.000	-
23	1.000	1.000	1.000	-
24	1.000	1.000	1.000	-
25	1.000	1.000	1.000	-
26	1.000	1.000	1.000	-
27	1.000	1.000	1.000	-
28	1.000	1.000	1.000	-
29	1.000	1.000	1.000	-
30	1.000	1.000	1.000	-
31	1.000	1.000	1.000	-
32	0.931	1.000	0.931	drs
33	1.000	1.000	1.000	-
34	0.929	1.000	0.929	drs
35	1.000	1.000	1.000	-
36	1.000	1.000	1.000	-
37	1.000	1.000	1.000	-
38	1.000	1.000	1.000	-
39	1.000	1.000	1.000	-
40	1.000	1.000	1.000	-
mean	0.992	1.000	0.992	

Note: crste = technical efficiency from CRS DEA
vrste = technical efficiency from VRS DEA
scale = scale efficiency = crste/vrste

Table-6: AI Integrated-Efficiency Summary

firm	crste	vrste	scale	
1	1.000	1.000	1.000	-
2	1.000	1.000	1.000	-
3	1.000	1.000	1.000	-
4	1.000	1.000	1.000	-
5	1.000	1.000	1.000	-
6	1.000	1.000	1.000	-
7	1.000	1.000	1.000	-
8	0.995	1.000	0.995	drs
9	1.000	1.000	1.000	-
10	0.986	1.000	0.986	drs
11	1.000	1.000	1.000	-
12	1.000	1.000	1.000	-
13	0.989	1.000	0.989	drs
14	1.000	1.000	1.000	-
15	0.951	0.981	0.970	drs
16	1.000	1.000	1.000	-
17	1.000	1.000	1.000	-
18	0.987	0.998	0.989	drs
19	1.000	1.000	1.000	-
20	1.000	1.000	1.000	-
21	1.000	1.000	1.000	-

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22	1.000	1.000	1.000	-
23	1.000	1.000	1.000	-
24	1.000	1.000	1.000	-
25	1.000	1.000	1.000	-
26	1.000	1.000	1.000	-
27	0.986	0.999	0.988	drs
28	0.929	1.000	0.929	drs
29	1.000	1.000	1.000	-
30	1.000	1.000	1.000	-
31	1.000	1.000	1.000	-
32	1.000	1.000	1.000	-
33	1.000	1.000	1.000	-
34	0.916	1.000	0.916	drs
35	0.981	1.000	0.981	drs
36	1.000	1.000	1.000	-
37	0.974	0.995	0.979	drs
38	1.000	1.000	1.000	-
39	0.983	1.000	0.983	drs
40	1.000	1.000	1.000	-
mean	0.992	0.999	0.993	

The constant returns to scale technical efficiency (crste) for traditional is 0.992 and that of AI is 0.992. The variable returns to scale technical efficiency (vrste) for traditional is 0.992 and that of AI is 0.999. From the table 5 and 6, it is found that Scale Technical Efficiency for using AI integrated DMLS is 0.993 which is greater than traditional DMLS is 0.992.

The summary of Lamba peer weights is given in table 7.

Table 7: Summary of Peer Weights for Traditional and AI Integrated

firm peer weights:	firm peer weights:
1 1.000	1 1.000
2 1.000	2 1.000
3 1.000	3 1.000
4 1.000	4 1.000
5 1.000	5 1.000
6 0.069 0.412 0.314 0.205	6 1.000
7 1.000	7 1.000
8 1.000	8 1.000
9 1.000	9 1.000
10 1.000	10 1.000
11 1.000	11 1.000
12 1.000	12 1.000
13 1.000	13 1.000
14 1.000	14 1.000
15 1.000	15 0.066 0.892 0.041
16 1.000	16 1.000
17 1.000	17 1.000
18 1.000	18 0.077 0.250 0.181 0.217 0.244 0.032
19 1.000	19 1.000
20 1.000	20 1.000
21 0.265 0.144 0.217 0.082 0.216 0.075	21 1.000
22 1.000	22 1.000
23 1.000	23 1.000
24 1.000	24 1.000
25 1.000	25 1.000
26 1.000	26 1.000
27 1.000	27 0.415 0.000 0.182 0.137 0.266
28 1.000	28 1.000
29 1.000	29 1.000
30 1.000	30 1.000
31 1.000	31 1.000
32 1.000	32 1.000
33 1.000	33 1.000
34 1.000	34 1.000
35 1.000	35 1.000
36 1.000	36 1.000
37 1.000	37 0.742 0.019 0.239
38 1.000	38 1.000
39 1.000	39 1.000
40 1.000	40 1.000

EOS P 396: Productive mid-volume polymer laser sintering system is given in figure 3.

Figure 3: SLS

Usable build size:

- Width 340 mm
- Depth 340 mm

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- Height 600 mm
- Max. volume: 69.4l per build

Main properties:

- The “workhorse” in the mid-volume segment
- High mechanical homogeneity across full build

volume thanks to EOSAME feature

The raw materials used by Automotive Components Manufacturers at Tirumudivakkam are given in figure 4.

Figure 4: Raw Materials Used

Figure 5: Parts printed in SLS for Automotive Components Manufacturers

The Parts printed in SLS for Automotive Components Manufacturers at PETC are shown in Figure 5.

3D Scanner
A 3D scanner is used to scan any physical object in three dimensions and provide the scan data into a digital format that can be used for the design, development, analysis, and development process. The digital CAD file can be exported into different file formats. It can also export files in Standard Triangulate Language (STL) format and produce prototypes using 3D printers. Here, the granularity of scan data significantly decreases the manual time taken to produce a robust model. Early in the reverse engineering phase, high-quality CAD files' development significantly enhances the results through mitigating time and devaluation from improper data. 3D scanning enables any item to be studied in greater depth.

Figure 6 : 3 D Scanner

3D optical scanning technology as shown in figure 6 and technical specification in table 8, can deliver accuracy for complex machine parts used in various industrial sectors and how reverse engineering can be useful for manufacturing from existing products as reverse engineering is one of the best forms to manufacture prototypes or short productions.

Table 8: Technical Specification

Parameter	Data
Dimensions	325 x 240 x 90 mm Resolution 2 x 8 megapixel
Weight	3.8 Kg
Rotary table	Motorized with 350 mm diameter 20 kg max. load / approx. 11 rpm and weighs 7.5Kg
rotation table	Software GOM Inspect Suite Software for Scanning and Inspection Analysis

Applications of 3D scanner includes digitize physical object, reverse engineering, designing of complex curved surfaces, calculation of tool wear, aerospace, development of industrial tools, prototyping, metrology, quality management, etc.

Technology Interventions
The key technologies that are required in the cluster along with the proposed intervention to be set up under the CFC are as shown in the figure 7 and the same is detailed in the table 9.

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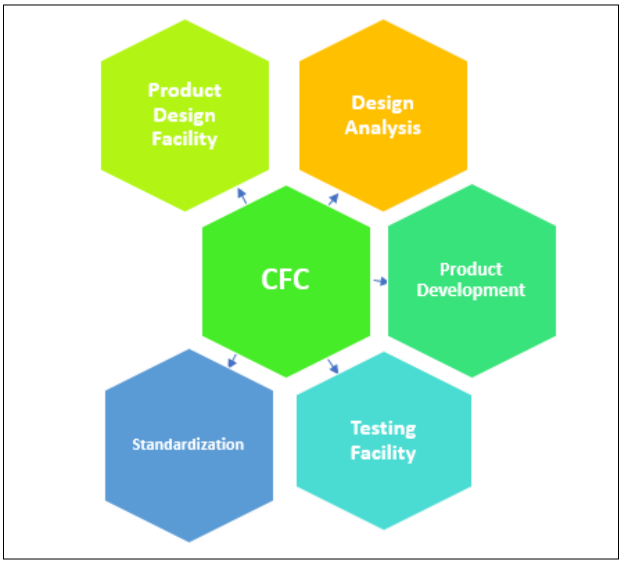

Figure 7 : Technology Intervention

Table 9: Technology interventions to enhance cluster competitiveness through CFC

Technology Interventions	Outcome
Product design facility	
Product design facility using the software CATIA and Siemens Uni-Graphics. CATIA boosts the capacity for innovation and enables quick development of high-quality mechanical products. The features of CATIA include global collaboration innovation, sketching tools, modelling complex intelligent systems, and developing distributive systems. CATIA is best for surfacing elements and Unigraphics is best for real time NX-CAD by adding physics simulation and alternation on real time. Thereby, finishes the job very fast, saves time and cost effective as well.	Convenient access to such design facility is not available in the existing cluster. This will result in new product development in the upcoming areas of Aerospace, E-vehicles etc.
Design Analysis	
Finite Element Analysis (FEA) is used to simulate physical phenomena and thereby reduce the need for physical prototypes, while allowing for the optimisation of components as part of the design process of a project. Mould Flow analysis (MFA) finds visual defects, resolves weaknesses in design and evaluation of various material before production. Stress Strain Analysis identifies many mechanical properties such as strength, toughness, elasticity, yield point, strain energy, resilience, and elongation during load.	Convenient access to such analytic facility will really add value in modelling, visualize any vulnerability in design thereby resultant high degree of accuracy ensures in the final product.
Testing Facilities	
NABL accredited testing laboratory consists of two major components viz. Physical testing and Chemical testing.	Convenient access to such facility. Due to lack of these facilities, units face higher costs, thereby reducing their competitiveness, especially compared to other competitive areas, where such facilities are available.
Product Development	
Vacuum casting is a reproduction technique based on 3D printing technology. Additionally, the process can be used, when there are intricate details and undercuts on the mould. This facility will strongly connect with market related developments enabling creation of new designs with marketing accessibility.	Convenient access to this process, which uses a 3D-printed master pattern to create a silicone mould that delivers high quality, short-run parts as an economical alternative to low-volume injection moulding.

Equipment and Technology options

For the proposed precision engineering cluster, following are the major Equipment and Technology options. The CFC will provide various machining support to MSMEs in the region. The machines in the production area would be the latest in its class and will have accuracies in the range of 10 microns or less on a case-to-case basis.

Due care has been taken during the identification of machines for production systems and associated services, processes, plants and equipment in the CFC. This will make the CFC environmentally friendly and energy efficient and would be better equipped to manufacture more products with less material, energy and waste.

Presently, the units in the Cluster do not have access to the facilities proposed as they are capital intensive.

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Design
NX Mach 2 & Mach3 Product Design (Floating)
NX Mach3 Mold Design (Floating)
NX Mach3 Progressive Design (Floating)
NX Easy Fill Analysis (Advanced)
NX Total Machining
CATIA Sheet Metal
CATIA Mechanical & Shape Designer
CATIA Mold & Tooling
CATIA Stamping Die Designer
CATIA Electrical 3D Designer

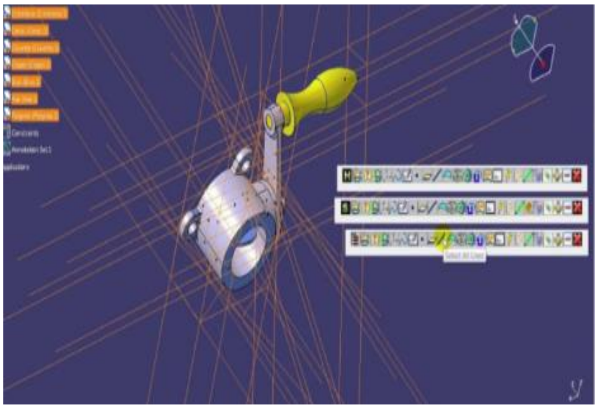

Figure 8 : Design Software

Analysis & Simulation

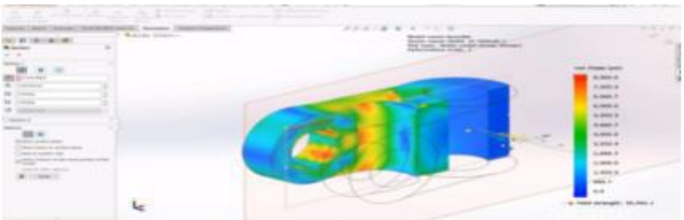

Figure 9: Analysis and Simulation

NX Easy Fill Analysis
CATIA Function Driven Generative Designer
CATIA SIMULA Abaqus

Table 10: Design Specification

Software	Design Content
NX Mach 2 Product Design (Floating)	Solid & Feature Modelling Assembly Modelling
	Design Logic
	Grip Runtime
	Knowledge Fusion Runtime Process Studio runtime license
	Translators (IGES, DXF/DWG, STEP 203/214, 2D Exchange) Rapid Prototyping
	Freeform modelling, basic Straight Brake Sheet Metal Drafting- Routing Base Web Express
	Process Solutions for Stress and Vibration Check-Mate Runtime
	User Defined Features
	3D Annotation (GD&T and PMI) Dynamic and Photorealistic Rendering
NX Mach 3 Product Design (Floating)	Numerous data exchange tools for working with and sharing Multi-CAD data with NX
	Parametric, feature based 2D and 3D wireframe construction including dimensional, constraint based sketching
	Parametric, feature based solid / surface modelling for constructing intelligent, robust and adaptable designs
	Synchronous modelling for making fast changes to parametric or imported data
	Freeform construction of lofted, swept or curve network based shapes
	Support for explicit, history free modelling as needed
	User definable, reusable feature templates
	Top down and bottom up assembly modelling and design in assembly context
	2D drawing based and 3D model based (PMI) product documentation
	Design time validation checking
	Execute automation programs developed from a variety of languages
	Team center integrated managed design environment
NX Mach 3 Mold Design (Floating)	Solid & Feature Modelling Assembly Modeling Design Logic
	Grip Runtime
	Knowledge Fusion Runtime Process Studio runtime license
	Translators (IGES, DXF/DWG, STEP 203/214, 2D Exchange) Rapid Prototyping
	Freeform modelling, basic Straight Brake Sheet Metal Drafting
	Web Express
	Process Solutions for Stress and Vibration Check-Mate Runtime
	User Defined Features
	3D Annotation (GD&T and PMI) Freeform Modeling, Advanced Molded Part Validation
	Mold Wizard
NX Mach 3 Progressive Die Design	Solid & Feature Modeling Assembly Modeling Design Logic
	Grip Runtime
	Knowledge Fusion Runtime Process Studio runtime license
	Translators (IGES, DXF/DWG, STEP 203/214, 2D Exchange) Rapid Prototyping

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	Freeform modelling, basic Straight Brake Sheet Metal Drafting
	Web Express
	Process Solutions for Stress and Vibration Check-Mate Runtime
	User Defined Features
	3D Annotation (GD&T and PMI) Dynamic and Photorealistic Rendering Advanced Assemblies
	Freeform Modelling, Advanced Advance Sheet metal Design Progressive Die Wizard
NX Easy Fill Analysis	Assembly modelling environment
	Translators for IGES, STEP, Parasolid, etc.
	Toolpath replay and material verification
	Generic motion control
	Hole making and probing cycle support
	Tool path editor
	Shop Documentation
	Work Instruction Authoring
	Post processing
	Interactive Post Configurator
	Turning
	Wire EDM
	2.5 Axis roughing, profiling and face milling
	3 Axis surface finishing
	NURBS machining
	5 axis surface machining and swarfing
	5 axis roughing
	G-code driven machine simulation
	Multi-channel program synchronization
	Feature Based Machining Authoring
	Solid Modeling and Drafting
	Feature Modeling and advanced Freeform
	User Defined Features
	Sheet Metal design
	Quick Check, Web Express, and Xpress Review
	Geometric tolerancing
	Studio visualization
	Check-Mate Runtime
	HD3D Visual Reporting

Product Development

Figure 10: Product Development

Metal Additive -DIrect Metal Laser Sintering - -(DMLS) Machine
Polymer Additive -Selective Laser Sintering (SLS)

Testing

Figure 11: Testing

Universal Testing Machine for Plastic Material & Mechanical
Optical Emission Spectrometer
Metallurgical Microscope
Hot/cold Thermal Analysis
X-ray Machine
Rubber tensile tester
Chemical testing for Metals
Salt Spray Test Chamber
Shot Blast Testing

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Standardization

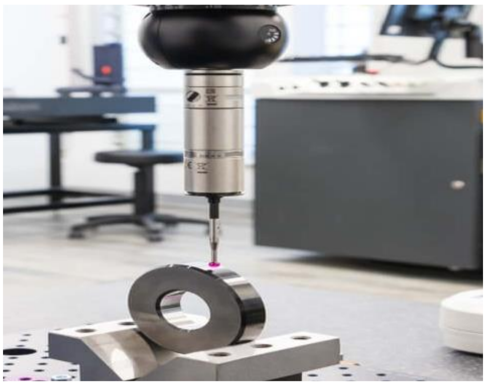

Figure 12: Standardization

Co-ordinate Measuring Machine (CMM)
Other Measuring Equipment

The above Design Software's, Product Development Machines and Testing Machines are available in PETC, CFC so that 40 Automotive components Manufacturers can make use of with less cost which leads to profit maximisation.

VI. CONCLUSION

The Precision Engineering and Technology Centre (PETC) have Common Facility Centre namely EOS P 396 – Selective Laser Sintering (SLS) Machine which is an Industrial-Grade 3D Polymer Printing installed for use of all 40 Automotive Components Manufacturers at Tirumudivakkam, Chennai, Tamil Nadu, India**.** The technical efficiency is calculated for 6 input and 6 output variables related to SLS for traditional and AI integrated. It is found that all the 40 ACM use the machine with less service charge when compared to market price since they are all members in PETC. The technical efficiency of integrated AI is greater than traditional SLS. The Design Software's, Product Development Machines and Testing Machines are available in PETC, CFC so that 40 Automotive components Manufacturers can make use of with less service charge which leads to cost minimisation and profit maximisation. To conclude AI based usage leads to cost minimisation and profit maximisation of individual Automotive Components Manufacturers when compared to traditional usage of SLS.

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