

Republic of the Philippines

# Pangasinan State University

Urdaneta City Campus  
San Vicente, Urdaneta City  
Telefax: (075) 632-2559



## Solid Freeform Fabrication Research Laboratory (SoFFReL)

**Engr. Rex B. Basuel**  
Project Leader

### **Members**

Dr. Honelly Mae Cascolan  
Dr. Lina Cancino  
Engr. Rodel Hacla

**Pangasinan State University**  
Implementing Agency

**DOST-PCIEERD**  
Funding Agency

**January 2, 2021-January 1, 2023 (2-year)**  
Duration of the Project

**Php. 6,494,950.00**  
Total Budget



## ACKNOWLEDGEMENT

Firstly, we want to thank God for being able to successfully complete this project. We are grateful because we managed to complete our SoFFReL Project within the timeframe given by DOST-PCIEERD. We also want to take this opportunity to thank DOST-PCIEERD, headed by its executive Director Dr. Enrico Paringit for their trust in this project.

Secondly, we want to express our gratitude and appreciation to Dr. Dexter Buted former university president, who gave us complete support for the project's success.

Thirdly, we also want to express our profound thanks to Dr. Paulo Cenas, former VP for Research, Extension, Innovation, Gender, and Development, for his supervision and encouragement in completing our project.

Fourthly, this project cannot be completed without the guidance and support from BPSU AMREL headed by Dr. John Ryan Dizon.

Lastly, we want to thank all our partner institutions for their unwavering support in fulfilling this project.



**SoFFReL**  
Solid Freeform Fabrication Research Laboratory

**3D PRINTING**

**Vision**  
To become the leading research laboratory in 3D Printing that supports the new generation of digital manufacturing and provides a state-of-the-art facility to industries, professionals, faculty and students in Northern Luzon.

**Mission**  
To provide the most advanced 3D Printing Research facility to be used in the research and development that is needed to accelerate the manufacturing capability in Northern Luzon.  
To provide exceptional services and to deliver innovative solutions to all our client's 3D Printing needs.

**THINK-DESIGN-PRINT**



## Executive Summary

The Department of Science and Technology Philippine Council for Industry, Energy, and Emerging Technology Research and Development (DOST-PCIEERD) approved the establishment of the Solid Freeform Fabrication Research Laboratory (SoFFReL) under Institution Development (IDP) with a total budget of Php. 6,494,950. The project is at PSU Urdaneta under the Machine Automation and Technology Innovation Center (MATIC).

The project is a result of a 6-month training course in Additive Manufacturing (AM) at Bataan Peninsula State University (BPSU) under Dr. John Ryan Dizon. The training lasted from January 27, 2020, until July 31, 2020. DOST-PCIEERD funded the training to capacitate four PSU faculty members: Dr. Lina Cancino, Dr. Honelly Mae Cascolan, and Engr. Rodel Hacla, and Engr. Rex Basuel to become an expert in Additive Manufacturing (AM). After the training, the SoFFReL proposal was submitted, presented, and later approved by DOST-PCIEERD.

The laboratory is equipped with modern equipment such as Industrial 3D Printer, Desktop 3D Printer, 3D Laser Printer, and 3D printing consumable materials. The laboratory focuses on thermoplastic material, a kind of plastic material. The project generally aimed to provide a state-of-the-art facility that will be used to improve and modernize the processes and production of metalcraft and the salt industry as well as academe in Pangasinan through 3D Printing technology.

On December 22, 2020, a Memorandum of Agreement (MOA) was signed through a virtual platform between PSU and DOST-PCIEERD led by Dr. Enrico Paringit and former PSU president Dr. Dexter Buted. Accordingly, Dr. Buted said that the laboratory helps the students, faculty, and researchers at PSU in additive manufacturing. The president also assured the DOST-PCIEERD that the project will be maintained and will be part of the curriculum in engineering and architecture so that students and faculty members will be more skilled in the field of additive manufacturing (AM).

The project is a 2-year project, and the implementation period started on January 2, 2021, and ended last January 1, 2023. It was in the middle of the pandemic when the project was established. The project was indeed very successful despite the situation. In the first year of its establishment, a series of webinars/workshops regarding 3D Printing awareness in universities and metalcraft industries across Pangasinan was conducted. From June 2021-January 2022, more than 100 participants attended through the online platform exceeding the set target of the project. About five memorandum of agreement (MOA) were signed in the same year with collaborating HEIs and Industries. Four research papers are also published internationally in a Scopus-indexed journal, one extension service, and two technologies produced. Additive Manufacturing (AM) was also integrated into the BS Computer Engineering curriculum of PSU Urdaneta Campus and later approved by CHED. Since its establishment, faculty, and students from various HEIs, including high school students, have utilized the laboratory for their thesis and research projects. There were also a series of benchmarking activities conducted by various HEIs and the Industry.

The laboratory will now be utilized as a research center for PSU's planned DOST NICER project in partnership with DOST AMGen. The laboratory will develop equipment made of engineering plastics for salt manufacturing in region 1. We are also working with Dr. Rigoberto Advincula, a Professor at the University of Tennessee's Oak Ridge National Laboratory, on potential material science projects.

## Literature





Industry, as well as the scientific and academic sectors, are becoming more and more interested in additive manufacturing (AM), often known as 3D printing. High print quality has recently been produced through the development of quicker, less expensive AM processes. In addition, polymer materials for 3D printing are now available with a larger variety of characteristics. The design, production, and customer usage of items are all continually changing as a result of these innovations [1–9].

Since 3D printing makes producing prototypes so much easier, innovators and inventors can now readily test their ideas. In fact, the design and production procedures have been shortened from weeks to a few hours [10,11], allowing for basically "on-the-fly" innovation [8].

AM has the potential to reduce manufacturing costs while increasing overall efficiency [12]. Moreover, AM offers solutions for complicated designs that demand a short lead time and small batch quantities [13].

AM is now being seriously considered to produce materials for several applications, namely, construction [14,15], apparel [16–18], dentistry [19,8,13] medicine, electronics, automotive, robots, military, oceanography, aerospace, and others.

In the Philippines, the Department of Science and Technology (DOST) has launched the Additive Manufacturing Center (AMCen) at the Metals Industry Research and Development Center and the Additive Manufacturing Research Laboratory (AMREL) at the Bataan Peninsula State University. These two projects are a state-of-the-art 3D printing research facility equipped with state-of-the-art additive manufacturing equipment [20].

## Actual Accomplishment of The Project

Actual accomplishment of the project (via-a-vis the objectives)	
OBJECTIVES	ACCOMPLISHMENTS
Establish the SoFFReL where researchers, faculty, and students can develop research using powder, and high-performance 3D printing materials with potential applications to metal fabrication. <ul style="list-style-type: none"> <li>Laboratory renovation</li> </ul>	SoFFReL is located on the 3rd Floor, Admin. Building, PSU Urdaneta Campus. <ul style="list-style-type: none"> <li>Staff corner</li> <li>Conference corner</li> <li>3D Printing laboratory corner</li> </ul> 1 faculty researcher assigned to the lab. 2 faculty members from the Electrical Department, and the Mechanical Department staffed the lab doing their research projects. Soffrel logo applied for registration.
Provide 3D print training and 3D CAD training courses for the R&D workforce.	<b>Conducted webinar:</b> <b>Title:</b> Basics of Additive Manufacturing <b>Date:</b> 20 June 2021 <b>Participants:</b> 50 faculty/researchers of PSU and BPSU.



	<p><b>Title:</b> 3D Printing Application in Metalcraft <b>Participants:</b> 10 DESWORDZMAN Workers (Sword Maker) <b>Date:</b> November 17, 2021</p> <p><b>Title:</b> 3D Printing technology, robotics, automation, and CISCO Networking <b>Date:</b> 13 December 2021 <b>Participants:</b> 15 faculty/researchers from PSU-Asingan Campus.</p> <p><b>Title:</b> 3D Printing Technology, Robotics, and Automation <b>Date:</b> 6-7 July 2021 <b>Participants:</b> 8 faculty and researchers from PSU-Urdaneta Campus and Syngenta Personnel</p> <p><b>Title:</b> Application of 3D Printing technology in different fields <b>Date:</b> 11 January 2022 <b>Participants:</b> 40 faculty and researchers from Colegio De Dagupan and PSU-Urdaneta Campus</p>
<p>Develop technologies for salt production and metalcraft with the application of additive manufacturing.</p>	<p><b>2 produced technologies:</b></p> <ul style="list-style-type: none"> <li>• Salt vibrating screen classifier w/ manual bagging machine</li> <li>• Hot Air-assisted Brine Water Solidifier</li> <li>• 3D Printed Cast Iron Mold</li> </ul> <p><b>Ongoing Research</b></p> <ul style="list-style-type: none"> <li>• Strength, Performance &amp; Durability of 3D Printed PEEK Machine Parts</li> <li>• Mechanical Performance of Powder-Based 3D Printed Machine Parts</li> </ul>
<p>Strengthen the relationship between academic institutions to further extend knowledge and skills in AM through research and extension activity.</p>	<p><b>Published manuscript/ paper:</b></p> <ul style="list-style-type: none"> <li>• Post-processing of 3D-printed polymers in collaboration with BPSU</li> <li>• 3D Printing Polymeric Materials for Robots with Embedded Systems in collaboration with BPSU</li> <li>• 3D Printing Technology and Materials for Automotive Application</li> </ul> <p><b>MOA</b></p> <ul style="list-style-type: none"> <li>• Bataan Peninsula State University</li> <li>• Institute of Computer Engineers Singapore Chapter</li> <li>• PSU-Asingan Campus</li> <li>• Colegio De Dagupan</li> <li>• DESWORDZMAN – Metalcraft Maker (sword maker)</li> </ul> <p><b>Benchmarking Activities:</b></p> <ul style="list-style-type: none"> <li>• Colegio De Dagupan visit SoFFReL</li> <li>• Pangasinan State University Asingan Campus visit SoFFReL</li> <li>• Technological University of the Philippines Taguig City</li> </ul> <p><b>Extension Services:</b></p>

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		<ul style="list-style-type: none"> <li>• DESWORDZMAN – Metalcraft Maker (sword maker) Pozorrubio, Pangasinan</li> </ul>
<p>Provide assistance /services to other institutions and industries who are in need of 3D printing technology.</p> <ul style="list-style-type: none"> <li>• Develop training materials and operational manual for the laboratory.</li> <li>• Conduct additive manufacturing training (3D printing, automation, mechatronics) to academe and metal industry in Pangasinan.</li> </ul>	<p>Incorporation of Additive Manufacturing (3D Printing) for BS in Computer Engineering Program</p> <p>CpE 134 Advanced Additive Manufacturing Engineering</p> <p>The Technical Working Group (TWG) are:</p> <p>Chair: Engr. Rex Basuel Members:</p> <ul style="list-style-type: none"> <li>• Engr. Jay-Ar Pentecostes</li> <li>• Engr. Khayzelle Cayabyab</li> <li>• Engr. Jeddie Zarate</li> <li>• Dr. Kenneth Oliver Lopez – Member/Senior Faculty</li> </ul> <p>Guest Speaker during the <b>National Symposium on Makerspaces and 3D Printing Facilities</b> held on September 17, 2021, via ZOOM (sponsored by: DOST and BPSU)</p> <p>Guest Speaker during the <b>Application of 3D Printing Technology in Different Fields</b> held on January 11, 2021, via ZOOM (sponsored by: PSU and Colegio De Dagupan)</p>	
<b>Expected Outputs / 6Ps (Expected Outputs should be measurable.)</b>		
	<b>EXPECTED OUTPUTS</b>	<b>ACTUAL OUTPUTS</b>
Publications	2 research paper publish in a Scopus-indexed journal	4 research published in a Scopus-indexed journal
Patents/IP	1 patent application	
Products	3D Printed electronics, souvenirs, mold	3D Printed robotic arm, thesis prototype, souvenirs, and cast metal mold.
People Services	Training/workshop for 100 faculty, students, and researchers in additive manufacturing.	Conducted a seminar/webinar attended by around 120 participants from various universities, high schools, and industry.
Partnerships	2 MOU (academic partnership)	5 signed MOA <ul style="list-style-type: none"> <li>• BPSU</li> <li>• PSU- Asingan</li> <li>• ICPEP-Singapore</li> <li>• Colegio de Dagupan</li> <li>• DESWORDMAN (Sword Maker)</li> </ul>
Policy	1 policy	Approved BS Computer Engineering Curriculum with Additive Manufacturing Engineering course.

### Problems/Concerns Encountered

- Preparation and Filing of Patent Applications
- Low produce 3D Printed Technologies
- Lack of promotion of the laboratory in universities and industries in region 1.

### Recommendation

- Coordinate with the PSU IPOPHL



- Conduct Research In-House Review twice a year related to Additive Manufacturing
- Conduct Seminar, Webinar, Training and Workshop related to 3D Printing (Additive Manufacturing) in
- Engineering and Technology Course of Pangasinan State University.

## Personnel Involved




Personnel	Designation	Percent Time Devoted to the Project
Engr. Rex B. Basuel	Head, MATIC	30%
Engr. Rodel P. Hacla	BSEE Faculty	30
Dr. Honely Mae Cascolan	Dean, BEED	30
Dr. Lina Cancino	Chair, NatSci	30
Engr. Wyerlo Alcantara	SoFFReL Staff, Faculty Mechanical Engineering	80
Engr. Roy Flores	Faculty Electrical Engineering	40

## List of Equipment

	Equipment	Photo	Quantity	Unit Cost (PhP)
1	<b>Powder-Based 3D Printer Package:</b> <ul style="list-style-type: none"> <li>• Powder Sieve</li> <li>• Sinterit ATEX Vacuum Cleaner</li> <li>• Sandblaster XL</li> <li>• Sinterit Platform</li> </ul>	A collection of 3D printing related equipment. In the background is a large red and black Sinterit ATEX vacuum cleaner. In the foreground, there is a smaller black Sinterit platform printer, a sandblaster, and several white powder containers. A blue award ribbon graphic is overlaid on the image, stating "ALL3DP BEST DESKTOP SLS 3D PRINTER".	1 set	1,800,000.00





2	Single Material FDM 3D Printer		1 set	200,000.00
3	Dual Material FDM 3D Printer		1 set	300,000.00
4	High-Performance 3D Printer		1 set	2,200,000.00
5	Glowforge Basic 3D Laser Printer		1 set	368,000.00
6	Vacuum Cleaner		1 set	282,950.00.00



7	Glowforge Air filter		1 set	118,700.00
8	Power tool Package		1 set	30,000.00
9	Hand tool Package		1 set	20,000.00
10	3HP 50L Air Compressor, 9bar		1 unit	45,000.00
11	Laptop		1 unit	60,000.00



**Attachment**

- ▶ Integration of Additive Manufacturing (3D Printing) for BS in Computer Engineering Program
- ▶ SoFFReL is committed to promote 3D printing in education and bridging the gap between academia and industry.



4 <sup>th</sup> YEAR - 1 <sup>st</sup> SEMESTER					
Course No.	SUBJECTS	Hours/Week		Total Number of Units	Prerequisite/Co-requisite
		Lec	Lab		
CpE 132	Embedded Systems	3	3	4	Microprocessors
CpE 133	Computer Architecture and Organization	3	3	4	Microprocessors
CpE 134	Advanced Additive Manufacturing Engineering	2	3	3	Computer Aided Drafting, Fundamentals of Electronics Circuits, Chemistry for Engineers
CpE 135	CpE Practice and Design I	0	3	3	Microprocessors, Methods of Research
CpE 136	Digital Signal Processing	3	3	4	Feedback and Control Systems
ES 2	Industrial IT and Automation	1	6	3	Embedded System Design
<b>Sub-Total</b>		<b>12</b>	<b>21</b>	<b>19</b>	



**Courses Added**

- Additional courses

**Additional Address**

- Meeting Experiences
- Work Development

**Recommendation from**

- Internal system coordination to keep pace with the rapid development of technology (Industry & its and industry's needs).
- How course will be offered at 1<sup>st</sup> year 1<sup>st</sup> semester and 2<sup>nd</sup> year 1<sup>st</sup> semester.
- The 3D printing technology has already been available in the Philippines since 2011. It is a 3D printed object in the form of a solid object. It is a 3D printed object in the form of a solid object.
- It is a 3D printed object in the form of a solid object.

Prepared by:  
**RES B. BASUEL, M.Eng, CPE, CCPe**  
 Classroom, Computer Engineering  
 01-Feb-2017

FM-RE-RDE-01  
 Rev. 0  
 01-Feb-2017

**RESEARCH DEVELOPMENT AND EXTENSION PROPOSAL**  
 PANGASINAN STATE UNIVERSITY

**BASIC INFORMATION**

RESEARCH TITLE: 3D Modeling and Printing Workshop  
 PROPOSERS: Engr. Rex B. Basuel, Engr. Wyrlo A. Alcantara  
 IMPLEMENTING AGENCY: Pangasinan State University  
 PROJECT DURATION: 1 Year, 2022  
 LOCATION: Urdaneta City National High School, Urdaneta City  
 BUDGET REQUESTED: Php. 49,000

**TECHNICAL DESCRIPTION**

Technology is evolving rapidly. Artificial intelligence, automation, and many other more advancements set the stage for more technological evolutions. But with 3D printing, we can cope-up with the advancement in fast evolving technology.

3D Printing is a method of creation that requires only some basic computer skills and a few rules of thumb. This training will allow trainees to discover for themselves the potential and limitations of 3D Printing through a build intensive design project. This workshop is an excellent option for anyone who ever wanted to prototype an invention, create a work of art, customize a product, or just make something unique and usable. No prior technical knowledge needed.

**RATIONALE**

With this, we must recognize the opportunity to build our future better. We are committed to pooling our expertise and experience to support trainees in their respective measures and efforts to achieve the sustainable development goals. We need to develop long-term sustainable strategies to address the challenges facing the continuous technology advancement. This proposal focuses on STEM teachers who teaches STE continuous technology advancement, on the simple way of extending the 3D printing series. Trainees must able to continue their lecture at the same time the proposed workshop series. The budgetary requirements will be spending to the 3D printer school, the Urdaneta City National High School, Urdaneta City, Pangasinan.

**OBJECTIVES**

The trainees should perform all steps necessary to 3D print a simple, custom:

- Be able to open, view, manipulate and edit three-dimensional
- To create new three-dimensional object files from scratch.
- Prepare and optimize those files for 3D printing.
- Successfully fabricate the file design through a 3D printing set and method selections.

**METHODOLOGY**

Qualified lecturers will discuss the topics. Participation of the Professors/Exp. facilitate on the said activity.

**REFERENCES**

CADnRx (2018). SolidWorks 2018: A Power Guide for Beginners and Inter

**EXPECTED OUTPUT**

Recipients acquire knowledge on webinar topics  
 Recipients continuing education  
 Recipients expected to put up personalized 3D printed output

**POTENTIAL IMPACT**

This workshop aims to target Senior High School Teachers that handles 5<sup>th</sup> level engineering courses. This training will help and aid SHS Teachers in less knowledgeable in 3D modeling and printing in a way to cope-up with the cost.

**MILESTONE**

Targeted Date	Descr
Jan 2022	Protocols are secured; Extension Proposal; Training Needs Analysis
Feb 2022	Information Dissemination (Collaboration preparation)
Mar - Nov 2022	Conduct Workshop Series and Document
December 2022	Monitoring, Evaluation and Training Report

**Extension Service for Urdaneta City National High School (UCNHS)**

REV. 0  
 01-Feb-2017

**USERS OR BENEFICIARIES**

Senior High School Teachers for STEM strand students of Urdaneta City National High School

**DETAILED BUDGET REQUIREMENT**

Amount	Description
Php 30,000	Filament and 3D printer Accessories, Dry Filament Box, and Tools
Php 15,000	Food and Snacks
Php 4,000	Transportation

**BRIEF PROFILE OF PROPONENTS**

<b>Res B. Basuel, M.Eng, CPE, CCPe</b> Master of Engineering Major in Computer Engineering (Angela University Foundation, Pangasinan, 2017-2020, Graduate) Bachelor of Science in Computer Engineering (Pangasinan State University, Urdaneta City, 2010-2016, Graduate)	<b>Wyrlo A. Alcantara, RME</b> Master of Science in Mechanical Engineering (Mapua University, Manila, Nov 2020 to Present, On-Going) Bachelor of Science in Mechanical Engineering (Saint Louis University, Baguio City, 2010-2016, Graduate)
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**SUBMITTED BY:**

**Res B. Basuel, M.Eng, CPE, CCPe**  
 Extension Proponent 1

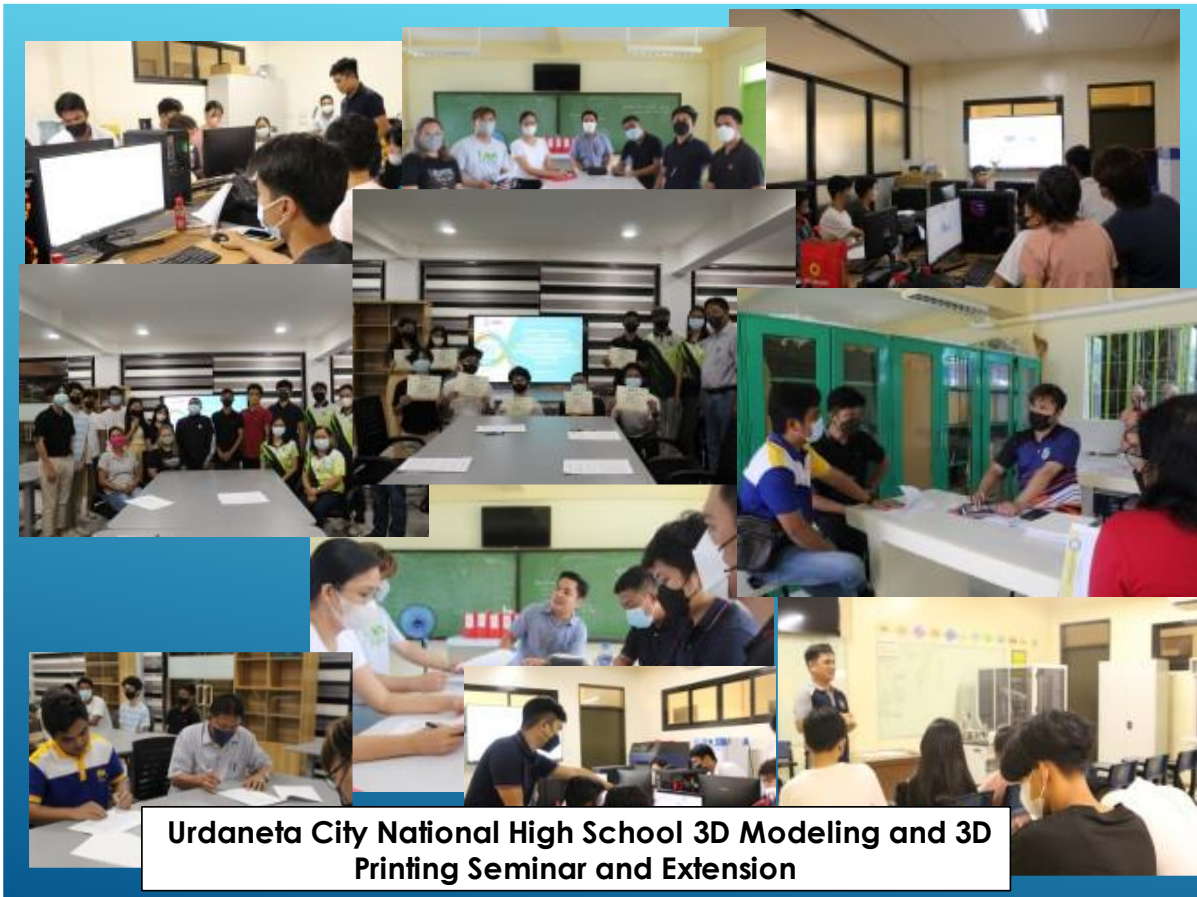
**Wyrlo A. Alcantara, RME**  
 Extension Proponent 2

**NOTED BY:**

**EMMERSON RAMIR B. ESPAÑA**  
 Campus Extension Coordinator

**HONORIO L. CASCOLAN, PhD**  
 Campus Executive Director





**Urdaneta City National High School 3D Modeling and 3D Printing Seminar and Extension**



**Colegio De Dagupan University 3D Modeling and 3D Printing Seminar and Extension**





**3D Printed Medicine Dispenser**



**Mechanical Engineering Students Conducted Thesis Experimentation Using 3D Printing Technology**





**3D Printed Robotic Arm**



**2022 DOST Regional Science and Technology Week**





## Published Research Projects

### 3D Printing Technology and Materials for Automotive Application: A Mini-Review

Brian J. Tuazon<sup>1,a\*</sup>, Nick Anthony V. Custodio<sup>1,b</sup>, Rex B. Basuel<sup>2,c</sup>  
Lanz Andre Delos Reyes<sup>3</sup>

<sup>1</sup>Department of Industrial Engineering, Bataan Peninsula State University, Bataan  
<sup>2</sup>Solid Freeform Fabrication Laboratory, Bataan Peninsula State University, Bataan  
<sup>3</sup>Department of Industrial Engineering, Bataan Peninsula State University, Bataan  
<sup>4</sup>DR3AM Center, Bataan Peninsula State University, Bataan  
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a)lanzandredelosreyes@gmail.com

**Keywords:** Additive Manufacturing, 3D Printing, Automotive

**Abstract.** Additive Manufacturing (AM) is a process of creating a 3D object by adding material layer by layer. It is especially in the automotive industry where it can be used to create complex parts that are difficult to manufacture using traditional methods. This paper reviews the current state of AM technology and its application in the automotive industry. It also discusses the challenges and opportunities of AM in the automotive industry.



3D Printing Research International Journal  
Hosted by DOST  
D



Journals / Technologies / Volume 9 / Issue 3 / 10.3390/technologies9030061



### technologies

Open Access Review

## Post-Processing of 3D-Printed Polymers

by John Ryan C. Dizon<sup>1,2,\*</sup>, Ciara Catherine L. Gache<sup>2</sup>, Honelly Mae S. Cascolan<sup>3</sup>, Lina T. Cancino<sup>4</sup> and Rigoberto C. Advincula<sup>5,6,7</sup>

<sup>1</sup> DR3AM Center, Bataan Peninsula State University, City of Balanga 2100, Philippines  
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CATEGORY: ENGINEERING, MULTIDISCIPLINARY  
46/169

JCI YEAR	JCI SCORE	JCI RANK	JCI PERCENTILE
2020	0.1289	52	73.8%
2019	N/A	N/A	N/A
2018	N/A	N/A	N/A
2017	N/A	N/A	N/A

### Content metrics

#### Journal information

Emerging Sources Citation Index (ESCI)

ENGINEERING, MULTIDISCIPLINARY - ESCI

English

SWITZERLAND

2020

#### Publisher information

MDPI

ST ALBAN-ANLAGE 66, CH-4052 BASEL, SWITZERLAND

4 issues/year





Review

## 3D Printing Polymeric Materials for Robots with Embedded Systems

Ray Noel Medina Delda <sup>1</sup>, Rex Balisalisa Basuel <sup>2,3</sup>, Rodel Peralta Hacla <sup>2,4</sup>, Dan William Carpiano Martinez <sup>5</sup>, John-John Cabibihan <sup>6</sup> and John Ryan Cortez Dizon <sup>1,7,\*</sup>

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- <sup>6</sup> Department of Mechanical and Industrial Engineering, Qatar University, Doha 2713, Qatar; john.cabibihan@qu.edu.qa
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- \* Correspondence: jrcdizon@bpsu.edu.ph

Citation: Delda, R.N.M.; Basuel, R.B.; Hacla, R.P.; Martinez, D.W.C.; Cabibihan, J.-J.; Dizon, J.R.C. 3D Printing Polymeric Materials for Robots with Embedded Systems. *Technologies* 2021, 9, 82. <https://doi.org/10.3390/technologies9040082>

Academic Editors: Jeng-Ywan Jeng and Ajeet Kumar

Received: 28 September 2021  
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Published: 2 November 2021

**Abstract:** The fabrication of robots and their embedded systems is challenging due to the complexity of the interacting components. The integration of additive manufacturing (AM) to robotics has made advancements in robotics manufacturing through sophisticated and state-of-the-art AM technologies and materials. With the emergence of 3D printing, 3D printing materials are also being considered and engineered for specific applications. This study reviews different 3D printing materials for 3D printing embedded robotics. Materials such as polyethylene glycol diacrylate (PEGDA), acrylonitrile butadiene styrene (ABS), flexible photopolymers, silicone, and elastomer-based materials were found to be the most used 3D printing materials due to their suitability for robotic applications. This review paper revealed that the key areas requiring more research are material formulations for improved mechanical properties, cost, and the inclusion of materials for specific applications. Future perspectives are also provided.

**Keywords:** 3D printing; robotics; 3D printing materials; embedded systems; polymers





**1<sup>st</sup> PHILIPPINE SALT CONGRESS**  
**26-27 November 2022 // Lingayen Pangasinan**  
*Recognizing the Salt Industry  
Towards Salt-Sufficient Philippines*

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**1<sup>st</sup> PHILIPPINE SALT CONGRESS**  
THEME: RECOGNIZING THE SALT INDUSTRY TOWARDS A SALT-SUFFICIENT PHILIPPINES

**Parallel Sessions for  
Research Presentations**

**Parallel Session 1**  
**Venue: Sison Auditorium - Capitol Complex  
Technology Development (TD)**

**Research Titles:**

- QUALITY EVALUATION OF SEA SALT USING DIFFERENT PLASTIC PLATFORMS THROUGH SOLAR EVAPORATION
- DETECTION OF IMPURITIES FROM LOCALLY-MADE SEA SALTS IN ILOCOS NORTE, PHILIPPINES
- SOLAR SALT PRODUCTION: THE MARINDUQUE STATE COLLEGE EXPERIENCE
- SALT CRUSHING AND IODIZER MACHINE
- DEVELOPMENT OF SOLAR-POWERED SALT HARVESTER FOR CLAY-LINED SALT BEDS
- GSM BASED WATER SALINITY MONITORING SYSTEM FOR WATER GATE MANAGEMENT IN SALT FARMS
- EVAPORATION RATE OF BRINE USING DIFFERENT CONFIGURATION OF AN OPEN PARABOLIC THERMAL COLLECTOR RECEIVER
- UTILIZATION OF NYPA FRUITICAN IN HOUSEHOLD SALT FARMING
- EXTRACTION AND UTILIZATION OF DISTILLED WATER AS BY-PRODUCT
- SALT VIBRATING SCREEN CLASSIFIER WITH MANUAL BAGGING MACHINE

## Conference Involvement

eting - Basuel 4 - NASYM-3D

Recording

CLEIFFORD ALF...

CLEIFFORD ALFARERO

via Cassandra P...

**Certificate**  
Of Appreciation

This Certificate is Awarded to

**Engr. Rex Basuel**

for sharing his knowledge and insights as resource speaker during the  
"National Symposium on Makerspaces and 3D Printing Facilities"  
held on September 17, 2021 via Zoom Meetings.

Given this 17th day of September 2021.

DR. GREGORIO J. RODIS DR. HERMOGENES M. PAGUIA

Speakership on 3D Printing Technology  
This is to promote awareness about 3D Printing Technology





## Conference Involvement



## Partnerships



MOA Signing Ceremony between PSU-SoFFReL-BPSU-AMREL





## PARTNERSHIPS

MOA between PSU&OFFReL-  
Deswordzman  
Metalcraft

## Partnerships

PANGASINAN STATE UNIVERSITY URDANETA CAMPUS



### SIGNING CEREMONY

#### Memorandum of Understanding

-Between-

Pangasinan State University Urdaneta Campus  
College of Engineering and Architecture

-And-

Institute of Computer Engineers of the Philippines  
Singapore Chapter

September 6, 2021

#### PROGRAM OF ACTIVITIES

##### SIGNING CEREMONY

- Opening Prayer: **Eng. Mark Aniel Lopez**, Computer Engineering Faculty
- AGP: **Pangasinan Hymn**, **Eyo! Hymn**
- Welcome Remarks: **Eng. Rex B. Masull**, Dean, College of Engineering and Architecture
- Remarks: **Dr. Honorio L. Casulan**, Campus Executive Director, PSU Urdaneta
- Introduction of the Speaker: **Eng. Emerson A. Casull**, Computer Engineering Faculty

MOA Signing Ceremony between PSU-SoFFReL-Institute of Computer Engineers of the Philippines Singapore Chapter





## Extension Services



DeswordzmaMetalcraft  
located at Rozurrobo  
Pangasinan (Sword  
Maker)

## Benchmarking Activities



Colegio De Dagupan visit  
PSU-SoFFReL







## Benchmarking Activities



PSU Asingar Campus visit  
SoFFReL



## Benchmarking Activities



Technological University  
of the Philippines visit  
SoFFReL





## Speaker

**COLEGIO DE DAGUPAN**  
**WEBINAR ON 3D PRINTING AND DATA ANALYTICS APPLICATION**  
January 11, 2022 • 9:00 am - 9:00 pm

**OPENING PROGRAM**

- I. Prayers** - Audio Visual Presentation (AVP)
- II. National Anthem** - AVP
- III- Co-D Honors and Recognition of PAMC** - Welcomes Participants
- IV- Welcome Remarks** - Dr. Felisa Arizabal-Sun, Vice President for Academic Affairs
- V. Statement of Purpose and Introduction of Participants** - Engr. Jesse B. Maglio, II, Director, IRDO
- VI- Introduction of the Resource Speaker** - Ms. Rizza Aquino, Guidance Coordinator
  - 3D Printing - Engr. Rex B. Basuel, MS, Engr., Dean, College of Engineering and Technology, PSU Urdaneta and Center Head, M&E, PSU main
  - Data Analytics Application - Ms. Kristeen Shing V. Salvia, MIT Center Head, University Data Analytics Center, Pangasinan State University

**SEMINAR PROPER**

- VII- Resource Speaker:** 1) 3D Printing - 9:30 am - 12:00 noon  
Topic: 2) Data Analytics - Overview Applications of Data Analytics, Entrepreneurial University and SMART University - 1:00 pm - 5:00 pm
- VIII- Impressions** - Representative from the School/Unit
- IX- Open Forum**
- CLOSING PROGRAM**
- X- Closing Remarks** - Mr. Jam Alfred A. Quiso, AVP Finance, Planning and Research  
Ms. Rizza Aquino, Master of Ceremonies

**COLEGIO DE DAGUPAN**  
Urdaneta City, Pangasinan, 2600 Philippines

December 6, 2021

DR. HOWARD L. CASCALAN  
General President/Chancellor  
Pangasinan State University  
Urdaneta Campus

Dear Dr. Cascalan,

Greetings of Peace and Love from Colegio de Dagupan!

The College is continuously upgrading and re-shaping its human resources to ensure an effective, efficient and productive delivery of their respective functions.

As part of our partnership and knowing the existence of the Data Analytics Research Center and the Machine Automation and Technology Innovation Center (MATIC) in your campus, we request for the services of Mr. Kristeen Shing V. Salvia, Center Head, University Data Analytics Center and Engr. Rex Basuel, Center Head, MATIC, and Dean, College of Engineering and Technology during our Webinar on the Applications of Data Analytics and Applications of 3D Printing in Different Fields as Resource Speakers, respectively on January 11, 2022.

Looking forward for your favorable approval to this request.

Thank you very much.

Very truly yours,  
VOLTAREE P. ABZADON, Ph.D.  
President

(075) 632-2405 / 632-0143  
09171381390

**3D Printing Application Webinar**

**Rex Basuel**  
Pangasinan State University  
Verified email at psu.edu.ph  
Embedded Systems Mechatronics Robotics Additive Manufacturing

TITLE	CITED BY	YEAR
3D Printing Polymeric Materials for Robots with Embedded Systems RNM Delda, RB Basuel, RP Hada, DWC Martinez, JJ Cabibhan, ... Technologies 9 (4), 82	14	2021
3D Printing Technology and Materials for Automotive Application: A Mini-Review BJ Tuazon, NAW Custodio, RB Basuel, LA Delos Reyes, JRC Olzon Key Engineering Materials 913, 3-16	6	2022
3D Printing Polymeric Materials for Robots with Embedded Systems. Technologies 2021, 9, 82 RNM Delda, RB Basuel, RP Hada, DWC Martinez, JJ Cabibhan, ... s Note: MDPI stays neutral with regard to jurisdictional claims in ...	3	2021
IoT-based fish pond water condition monitoring systemforbangus farming RB Basuel, RV Reyes aquatic 7 (16), 2020	1	2020
Identification of Dried Sea Cucumber Species using Color and Texture Extraction R Basuel, A Fajardo, ND Perac 2022 9th International Conference on Information Technology, Computer, and ...		2022

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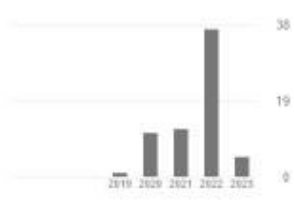
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Awareness and acceptability of the Pangasinan State University vision, mission, campus goals and the program objectives HMS Cascolan, M Ventura Journal of Education, Management and Social Sciences 2 (2), 73-77	8	2019
Students' conceptual understanding, metacognitive awareness and self-regulated learning strategies towards Chemistry using POGIL approach HMS Cascolan ASEAN Multidisciplinary Research Journal 1 (1), 2019	7	2019
<b>A Comprehensive Review on the Application of 3D Printing in the Aerospace Industry</b> Diy Martinez, MT Espino, HM Cascolan, JL Crisostomo, JRC Dizon Key Engineering Materials 913, 27-34	5	2022
Learning Styles and Difficulties of College Students in Chemistry MB Montenegro, HMS Cascolan ASEAN Journal of Basic and Higher Education 1 (1), 25-35	4	2020
Cause analysis utilizing e-assessment on the least mastered contents of K-12 basic education curriculum RT Cajmat, DDR Errabe, HMS Cascolan, MS Prudente Proceedings of the 2020 11th International Conference on E-Education, E ...	4	2020
Using process oriented guided inquiry learning in teaching climate change HMS Cascolan, MS Prudente Advanced Science Letters 24 (11), 7961-7965	3	2018
Exposition of Improved Practice on Technology Embedded Approach to Learning Exemplars Demonstration for Science Investigation DDR Errabe, HMS Cascolan, RT Cajmat, MS Prudente Proceedings of the 2020 11th International Conference on E-Education, E ...	2	2020

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<b>Development of a Self-Sustaining Fountain through Pico-Hydro Power Generator</b> RP Hacla, AM Tomeldan, JCN Sanchez 2020 IEEE International Conference for Innovation in Technology (INOCOT), 1-6	2020	
Development of a Pedal Powered Air Compressor Generator JRM Galinato, JWG Bastasa, KAM Subido, RP Hacla, RD Nicolas Journal of Engineering, Technology and Computing Sciences 2 (2), 1-7	2020	

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