

Erasmus+ Programme Key Action 2 Cooperation Partnerships for Higher Education (KA220-HED) Agreement number 2023-1-RO01-KA220-HED-000155412 European Network for Additive Manufacturing in Industrial Design for Ukrainian Context AMAZ



Additive manufacturing used in industrial design of complex parts

Assoc. Prof. Dr. Eng. Băilă Diana-Irinel University POLITEHNICA of Bucharest, Romania Faculty of Industrial Engineering and Robotics



Erasmus+ Programme Key Action 2 Cooperation Partnerships for Higher Education (KA220-HED) Agreement number 2023-1-RO01-KA220-HED-000155412



European Network for Additive Manufacturing in Industrial Design for Ukrainian Context – Acronym AMAZE

Project Partners:

1- National University of Science and Technology Politehnica Bucharest – Project Coordinator: Assoc.Prof. Diana Băilă

- 2- Yuriy Fedkovych Chernivtsi National University (Ukraine) Mr. Dean Prof. Igor Fodchuk
- 3- Poznan University of Technology (Poland) Project Responsible Mr. Prof. Remigiusz Labudzki
- 4- Edibon International S.A. (Spain) Project Responsible Mrs Myrian Judit Bonilla





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Casa Poporului, Bucharest, Romania Castelul Kretulescu, Bucharest, Romania













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3D Printers that will be used in AMAZE Project - University POLITEHNICA of Bucharest



Hybrid 3D Printer Zmorph 2.0 SX Full SET - FDM (Fused Deposition Modeling)



Photocentric Liquid Crystal - DLP (Digital Light Processing)











Phenix Systems – PXS&PXM - DMLS (Direct Metal Laser Sintering) – collaborating company)





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Project activities- <u>www.amaze2023.eu</u> Staff Training STTE

Agenda for Staff training in VR and AR programming EDIBON INTERNATIONAL S.A. Company, Madrid, Spain 7-10.5.2024

Date and <u>time</u> period	7.05.2024	8.05.2024	9.05.2024	10.05.2024
8.30 - 8.45 AM	Registration of the participants	EDIBON International S.A.	EDIBON INTERNATIONAL	AMAZE platform (basic concept, vision,
8.45 - 9.00 AM	Introduction – welcome words+	visit (manufacturing and	S.A. Company	organizing into different rooms) - lecture
	presentation of training scope	assembling rooms / facilities)	(manufacturing of AR /	
9.00 - 9.45 AM	Additive manufacturing used in		VR rooms and testing of	Research realized concerning materials used
	industrial design of complex		the facilities in the	in industry (Prof. Adam Patalas, Prof. Pawel
	parts (Assoc.Prof. Băilă Diana –		rooms)	Zawadzki – PUT)
	Politehnica Bucharest)			
9.45 - 10.30 AM	AR/VR software presentation	VR presentation (basic	AR presentation (basic	AMAZE application – laboratory – uploading
	(EDIBON)	concepts) – lecture (EDIBON)	concepts) – lecture	the rooms / VR & AR apps on the virtual
			(EDIBON)	platform
10.30 - 11.00 AM	Coffee break	Coffee break	Coffee break	Coffee break
11.00 - 12.15 PM	AR/VR applications - laboratory	Reverse Engineering	Exploring Polymeric	AMAZE application - laboratory - releasing of
	work	(As.Prof. Natalia Wierzbicka,	Materials: Innovations	the draft variant of AMAZE platform on the
		Prof. Remigiusz Labudzki –	and Uses in 3D Printing	AMAZE website
		PUT)	(Prof. Zaharia Cătălin-	
			Politebnica Bucharest)	
12.15 - 13.00 PM	New materials used in Industrial	Design Methods	New materials and	Testing of AMAZE platform and final
	Design. Sensors and electronics.	(Prof. Dumitrescu Andrei –	properties used in	feedbacks related to the functionality and
	(Assoc.Prof. Băilă Diana –	Politehnica Bucharest)	architectural design	content of the platform, next steps about
	Politehnica Bucharest)		(YFCNU Ukraine)	what has to be improved
13.00 - 14.00 PM	Precision and dimensional	Architectural design CAD in	Conclusions, feedbacks	Closing words, releasing of the certificates,
	control used in industry (Prof.	industrial products (YFCNU	and interim evaluation of	final conclusions related to realizing training
	Ionescu Nicolae – Politehnica	Ukraine)	progress work	and future work and closing ceremony
	Bucharest)			









Co-funded by the European Union

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To come ...

2nd Transnational Project Meeting

Poznan, Poland 10 -12 Jun 2024

Flyer

Project activities- www.amaze2023.eu



To come ...

2nd Multiplier Event

Bucharest, Romania 18 Jun 2024

Flyer



To come ...

3rd Multiplier Event

Chernivtsi, Ukraine 20 Jun 2024

Flyer









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Project activities- www.amaze2023.eu

Transnational Project Meeting TPM3

3rd Transnational Project Meeting

Who can participate? -Students (BSc/MSc/Ph -Professors/ Researche



To come ...

Summer School

Bucharest, Romania 8 - 17 Jul 2024

Flyer





Flyer

To come ...

Madrid, Spain 4 - 6 Sep 2024







To come...

4th Multiplier Event

Poznan, Poland 4 Nov 2024

Flyer



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Kick off Meeting – Transnational Project Meeting TPM1 – UNSTPB Bucharest, 27-29 nov 2023

Project Results:

Results: What project results and other outcomes do you expect your project to have?

The project will achieve the following results: IO1 – AMAZE e-book for developing of complex design industrial parts, IO2 – AMAZE e-toolkit manual for digital learning in producing of complex design industrial parts, IO3 – AMAZE e-learning VR/AR platform, IO4 – AMAZE e-case studies.

-1 open acces book

-1 open acces toolkit manual

-2 academic papers (in journals with high visibility, open-acces) and 2 papers in International Conference open-acces and 1 patent submitting application.











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AMAZE Project Results

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International Conferences













Acceptance Notification

- BRAMAT 2024, Brasov, Romania, 13-16 March 2024

- KreativEU 2024, Targoviste, Romania, 16-17 may 2024

Project Results: 2 articles accepted for publishing in



Igor Fodchuk Remigiusz Łabudzki Myrian Bonilla

ACCURACY OF SLA AND MATERIAL MORPHOLOGY USED IN ARCHITECTURE



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Kick off Meeting – Transnational Project Meeting TPM1 – UNSTPB Bucharest, 27-29 nov 2023

Project workpackages:

<mark>IO1</mark> - AMAZE e-book for developing of complex design industrial parts <mark>(15.11.2023 – 14.03.2024) – Leading organisation –</mark> UNSTPB

comprising the next module courses:

- 1-Additive Manufacturing (UPB); UPB
- 2-Smart (Intelligent) Materials (YFCNU+PUT); YFCNU
- 3-CAD/CAM/CAE design (YFCNU);
- 4- Reverse Engineering (PUT);
- 5-Computer Programming (<mark>Edibon</mark>);
- 6-Sensors and Electronics (UPB); UPB
- 7-Virtual Reality/Augmented Reality (Edibon)

Multiplier EVENT ME1 -1 day (40 persons from different companies and 8 foreigners) – EDIBON International S.A. –
25th April 2024











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Kick off Meeting – Transnational Project Meeting TPM1 – UNSTPB Bucharest, 27-29 nov 2023

Project workpackages:

✓ IO1 - AMAZE e-book for developing of complex design industrial parts (15.11.2023 – 14.03.2024) – Leading organisation – UNSTPB

<mark>IO2</mark> - AMAZE e-toolkit manual for digital learning in producing complex design industrial parts <mark>(15.03.2024 – 14.06.2024)</mark> – Leading organisation CHNU

<mark>IO3</mark> - AMAZE e-learning VR/AR platform for virtual laboratory <mark>(15.06.2024 – 14.09.2024) - Leading organisation Edibon</mark> International S.A.

IO4 – AMAZE e-case studies for project-based learning method used in developing, testing and manufacturing of customized industrial parts by Additive Manufacturing technologies (some 3D models, cases of design or architectural models) (15.09.2024-14.11.2024) – Leading organisation PUT

Project Management and Dissemination Results (15.11.2023 – 14.11.2024)











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Kick off Meeting – Transnational Project Meeting TPM1 – UNSTPB Bucharest, 27-29 nov 2023

Project workpackages:

I<mark>O2</mark> - AMAZE e-toolkit manual for digital learning in producing complex design industrial parts <mark>(15.03.2024 – 14.06.2024) – Leading organisation CHNU</mark>

comprising the next toolkit modules:

1-Additive Manufacturing (UNSTPB);

2-Smart (Intelligent) Materials (YFCNU+PUT);

3-CAD/CAM/CAE design (YFCNU);

4- Reverse Engineering (PUT);

5-Computer Programming (Edibon);

6-Sensors and Electronics (UNSTPB);

7-Virtual Reality/Augmented Reality (Edibon)

Multiplier Events:

ME2 – 1 day hosted by UNSTPB (ROM) (20 persons out from UNSTPB) and 18 June 2024

ME3 – 1 day hosted by YFCNU (UKR) (20 persons from outside of university) – 20 june 2024

Training staff feedbacks EDIBON (SP) during 4 days, participating from each partner institution 4 persons (in total 16 persons) – 7 may – 12 may 2024

For TPM2 –hosted by PUT (POL) will participate 2 staff, professors, key persons by each institution involved in project (Total 8 pers) and others – 3 days (10 – 12 June 2024)











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Kick off Meeting – Transnational Project Meeting TPM1 – UNSTPB Bucharest, 27-29 nov 2023

Project workpackages:

<mark>IO3</mark> - AMAZE e-learning VR/AR platform for virtual laboratory <mark>(15.06.2024 – 14.09.2024) - Leading organisation Edibon</mark> International S.A.

Summer School feedbacks given by students and staffs involved in AMAZE project – UNSTPB – 10 days (staffs and students) – 8-17 July 2024

TPM3 (3 days), hosted by Edibon company (8 persons – 2 persons/institution) – 4-6 sep 2024











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Kick off Meeting – Transnational Project Meeting TPM1 – UNSTPB Bucharest, 27-29 nov 2023

Project workpackages:

IO4 – AMAZE e-case studies for project-based learning method used in developing, testing and manufacturing of customized industrial parts by Additive Manufacturing technologies (some 3D models, cases of design or architectural models) (15.09.2024-14.11.2024) – Leading organisation PUT

Multiplier Event ME4 realized at PUT (POL), having invited 20 persons from different companies, universities, research centers (out of PUT) and 5 foreigner's participants – 4 nov 2024











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Dissemination Results

SLS – material PA12 FDM – PEEK, PLA, PLA Silk Rainbow, PLA Silk Like Kingfisher Rainbow Colours (Silicone properties) DLP, SLA – biocompatible photopolymer resins DMLS/SLM – Ti6Al4V, superalloys INCONEL and Co-Cr

Analysis Test recommended for the materials used for the components:

✓ SEM (Scanning Electron Microscopy)
TEM (Transmission Electron Microscopy)
✓ EDAX (Energy Dispersive X-ray Analysis) – JOURNALS PUBLICATION
XRD (X-Ray Diffraction)
FTIR (Fourier Transform Infrared Spectroscopy)
RAMAN (Raman Spectroscopy)
AFM (Atomic Force Microscopy)
Contact angle test
Mechanical tests



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SLM (SELECTIVE LASER MELTING) process





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Metallic powders used in SLM (SELECTIVE LASER MELTING)

Comparatii ale pulberilor metalice (Ti6Al4V, INCONEL 625 si INCONEL 718) utilizate in Selective Laser Melting



SEM - 718 INCONEL (X500; X5000)



SEM - 625 INCONEL (X500; X5000)



- SEM - Ti6Al4V (X500; X5000)











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Metallic powders used in SLM (SELECTIVE LASER MELTING)



Mapping 625 INCONEL











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Metallic powders used in SLM (SELECTIVE LASER MELTING)



Mapping 718 INCONEL











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Metallic powders used in SLM (SELECTIVE LASER MELTING)



Mapping Ti6Al4V









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Sintered parts used in SLM (SELECTIVE LASER MELTING)



625 INCONEL



Ti6Al4V











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Sintered parts used in SLM (SELECTIVE LASER MELTING)



625 INCONEL





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Sintered parts used in SLM (SELECTIVE LASER MELTING)

625 INCONEL











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Sintered parts used in SLM (SELECTIVE LASER MELTING)



Ti6Al4V











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Sintered parts used in SLM (SELECTIVE LASER MELTING)



Ti6Al4V





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Sintered parts used in SLM (SELECTIVE LASER MELTING) ⑧ ≤ ↔ × △ × ④ ▲↓ Q↓ ТК V K Tik AIK VK 1.40 4.40 keV:6.850 FS:3598 5,40 9.40 ke\ Amp 2.40 3.40 6 40 7.40 8 48 CPS:253 DT%:24 Lsec:281.6 Cnts:16 TotC 76K FT=3.9 Queue:0 Frames: 110/25

Ti6Al4V











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Manufacturing System SLM (SELECTIVE LASER MELTING)



Optimization of laser trajectory to eliminate the remanent tensile





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Manufacturing System SLM (SELECTIVE LASER MELTING)



Figuri transversale

Ejectarea de bile metallice de metal topit pe cuprafata liberă a materialului

Structural defaults that appear in the sintered parts by SLM/DMLS













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Manufacturing System SLM (SELECTIVE LASER MELTING)

Echipament de printare 3D metale cu accesorii

Firma producătoare: DMG MORI Model: LASERTEC 30 SLM An fabricație: 2017 Echipamentul utilizează o tehnologie prin care un model computerizat 3D poate fi transformat cu o precizie ridicata într-un model fizic, cu orice geometrie complexa, prin utilizarea unui proces complet automatizat. Dim. construcție: 300 x 300 x 300 mm

Laser : 400 W Grosime strat: 20 – 100 µm Materiale: Inconel 625, Ti6Al4V, CoCrMo







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Manufacturing System SLM (SELECTIVE LASER MELTING)



Flange design, 3d printed using Voxelizer software





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Flange printed by FDM technology

Assembling of modular device





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AMAZE PROJECT - RESEARCH DIRECTIONS

This project will lead to the opening of new topics and research directions that will be capitalized in projects such as:

- ► HORIZON 2020
- CORDIS EU
- ➢ EEA GRANTS
- EUROSTARS (EUREKA)
- ≻ TEMPUSV
- ➢ ERASMUS-MUNDUS ACTION3, etc.



Thank you!