NEPTUN

NEW APPROACH TO INNOVATIVE TECHNOLOGIES IN MANUFACTURING

Deliverable 3.2

Focus group reports & Exploratory Research Report

Work package No. 3 – Research Project

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Lead participant: TUB

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Revision History

Author Name, Partner short name	Description	Date
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SUMMARY TABLE – Focus Group Reports

No.	Activity	Dates	Venue	Participants	Alignment with GA
1.	Focus Group 2023	13.09.2023	Gdansk Tech	George C. Vosniakos – NTUA Athens Lihui Wang – KTH Thomas Braun – TUB W. Wojnicz, M. Deja, M. Chodnicki, M. Mazur, M. Galewski, O. Nosko, Y. Tsybrii, J. Łubiński, P. Bielski, K. Chodnicka-Wszelak, P. Szalewski – GDANSK TECH	No deviations from GA
2.	Focus Group 2024	16-26.09.2024	Gdansk Tech	George C. Vosniakos, Panorios Benardos – NTUA Athens, Xi Vincent Wang – KTH Stockholm Thomas Braun – TU Berlin M. Deja, M. Chodnicki, P. Szalewski, P. Bielski, W. Sieklicki, K. Chodnicka-Wszelak – GDANSK TECH	No deviations from GA

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1. Introduction

Focus groups are directly connected to the Exploratory Research Project to be realized within the project, as well as other research activities undertaken within the NEPTUN project. ERP goal stated in the project proposal consisted in the investigation of the influence of technological parameters during the fabrication of samples (by means of additive technologies) on strength and fatigue life. Focus groups taking place during partner's meetings are aimed at identifying the research gap, formulation of a research problem, determination of research questions, designing research methodology (research strategy, data collection, analysis techniques), conducting research process that will result in formulating research hypothesis. Focus groups are also designed to help create research groups which will work on scientific papers and other research activities, as well as specify the equipment to be purchased within the NEPTUN project activities. First focus group was organized during the second Partners' meeting in September 2023.

2. Focus group reports

2.1 Focus group during second Partners meeting in September 2023

NEPTUN Project Focus Group took place on the third day of the partners meeting, i.e. on September 13, 2023. To provide a basis for discussion and help define the research areas, the Focus Group was preceded by a presentation of the capacities of the Institute of Mechanics and Machine Design delivered online by Wiktoria Wojnicz, PhD, the head of the institute. Next, participants of the focus group visited the laboratories run by the Faculty of Mechanical Engineering and Ship Technology, including the labs which had been recently launched: Robotics and Haptics Lab, Additive Manufacturing and Reverse-Engineering Lab, Tribology Lab and Materials Strength lab. Each visit included a presentation of the available equipment and its capacities and a short Q&A session.

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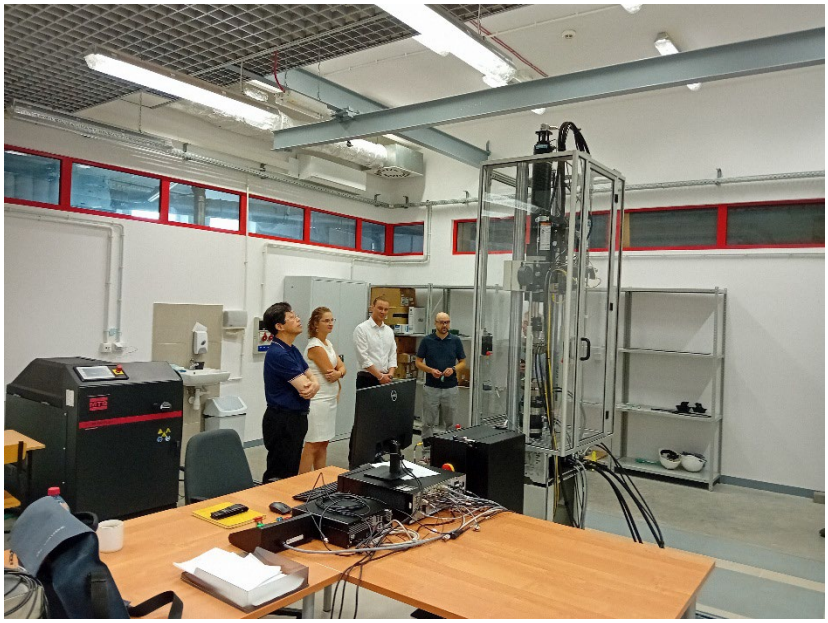

Fig. 1 Visit to Materials strength lab

Fig. 2 Visit to tribology lab

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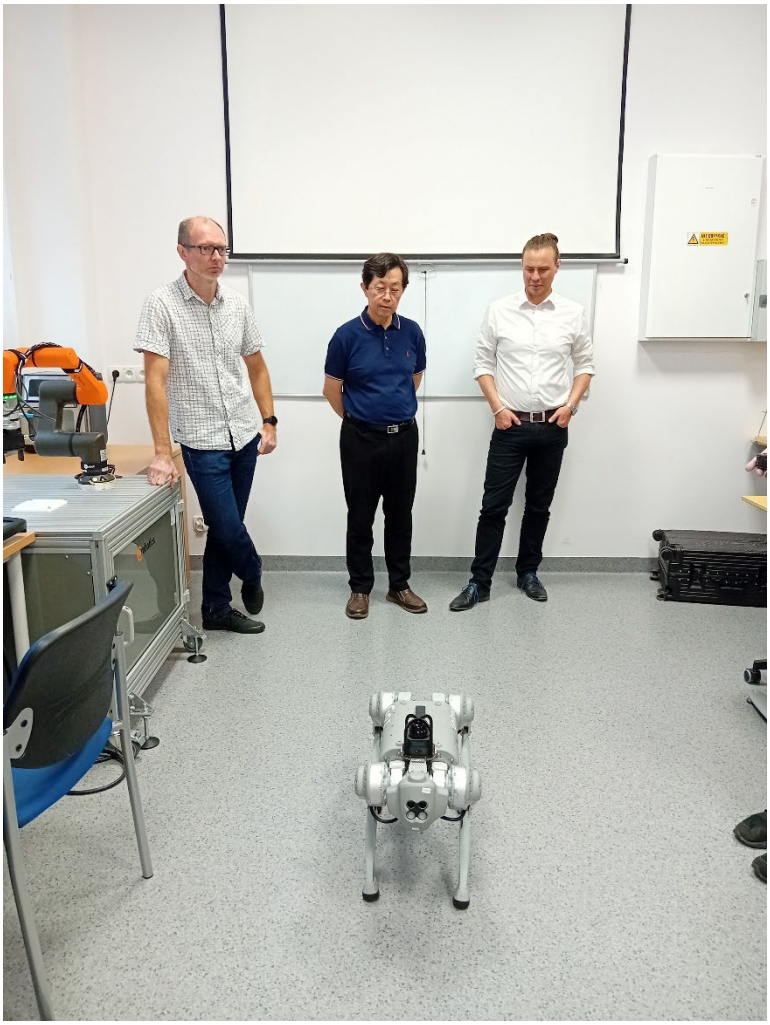

Fig. 3 Visit to Robotics and Haptics lab

Focus group that took place was centered on the areas of cooperation, exploratory research project and future project proposals. Gdansk Tech scientists discussed their current research interests and fields of interests. Together with the guests representing KTH, TUB and NTUA, they discussed the possibilities of scientific cooperation, which included: metamaterials, additive manufacturing and testing methods; metal powder printing, with recycling metal into powder which can be used as a base material for 3D printing; project planning, part planning, monitoring, parameters selection; human-robot interaction, especially predicting human behaviour in robot-rich environment, safety measures and protocols; cyber-physical systems and

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digital twins. The attendees agreed that the area for cooperation is very wide and that it can be strengthened through staff exchange between the institutions.

Fig. 4 Focus group – GDANSK TECH scientists

Fig. 5 Focus group – Prof. G. Vosniakos (NTUA), Prof. M. Deja (Gdansk Tech), Prof. L. Wang (KTH)

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After the discussion, professor Mariusz Deja (Gdansk Tech) summarized the focus group proceedings. Professor Deja said that the discussion was very important and valuable. In turn, Marek Chodnicki (Gdansk Tech) proposed creating working groups composed of scientists representing the institutions partnered in the NEPTUN Project. These groups will cooperate more closely in terms of specific research, publications and project proposals. The working groups will be established after the Gdansk Tech's team visit to TU Berlin.

Professor George Vosniakos (NTUA) mentioned that the papers should primarily be written by these working groups.

Professor Lihui Wang (KTH) stated that it is necessary to start working on the papers as soon as possible, since the publication process is a time-consuming one. He also mentioned that due to the nature of the project it might be difficult to generate the publication material, he also said that working groups mentioned earlier are a sensible approach to the problem. Possible research topics are listed in the table 1 below.

University	Research topic	Subtopic
NTUA	Carbon fibre reinforced polymer 3D printing	1. Path and parameter optimization 2. Mechanical testing 3. Design for AM
	Human-Robot collaboration in manufacturing	4. Manufacturing tasks recognition of humans 5. Extended reality human operator interface for collaboration 6. Grasping strategies and sensor for H-R collaboration
	Intelligent add-ons for smart manufacturing	7. MI process model based on sensors and cameras 8. Manufacturing process optimization, including correction using AI 9. FPGA deployment of intelligent prediction-correction tools
KTH	10. Human-Robot collaboration.	
	11. Cloud and function block-based processes planning, remote control	

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	and manufacturing systems	
KTH	12. 3D printing for shape memory polymers	
TU Berlin	13. Additive Manufacturing of lightweight components (e.g. carbon fiber enforced)	
	14. Topology optimization for complex geometries	
	15. LPBF/SLS Manufacturing system modulization and process monitoring	
	16. AM-process chain evaluation and optimization including pre- and post-processing	

Table 1. Possible research topics defined during the focus group

Professor Deja proposed a modus of operandi on writing papers, resembling a peer-review model. Papers written by the working groups will be sent to other partners who will review them and, if necessary, add some content or expand the existing one. In this case, the contributors will be listed as co-authors.

Marek Chodnicki mentioned that it is also possible to invite other universities to the paper writing process.

Finally, the partners discussed possible journals where papers written within NEPTUN project can be published.

2.2 Focus group during NEPTUN Summer School – September 2024

Second Focus Group meeting took place during the proceedings of NEPTUN Summer school in September 2024. During the meeting, representatives of KTH, NTUA, TUB and GDANSK TECH discussed the current progress of the research groups which were formed after the previous FG. The research areas were reported and evaluated, it was also decided which topics can be expanded and used as a basis for publications or research projects. The attendees also discussed the current status of papers submitted for publication in scientific journals.

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Representatives of GDANSK TECH reported the status of the 3D carbon fiber printer purchase procedure – the planned activities involved the application of the device in the research. In turn, the attendees of the meeting discussed the purchase of components and raw materials which will be used to produce specimens for the experiments planned in the nearest future.

The Focus Group was also discussing the possible topics for staff visits to the partnered universities and lectures delivered during the virtual/real-life visits of experts to GDANSK TECH.

Another subject raised during the proceeding of the Focus Group was associated with the planned participation in conferences – it was decided to continue the participation in FAIM conferences, since the quality is high, and the topics/themes are closely related to the general theme of the NEPTUN Project.

The participants of the Focus Group talked about the project proposals which can be submitted in the nearest future. Marek Chodnicki (GDANSK TECH) suggested that the project proposals should be submitted in various programs, including (but not limited to) ERASMUS+, Horizon Europe (incl. MSCA), and other. Such an approach will allow the maximum coverage of possible topics and themes and will also translate into higher number of proposals and higher number of personnel involved in the projects on various stages of their lives, starting from the preparatory work and proposal writing to the application of the project once the financing is granted. Mariusz Deja supported this proposal and added that we should intensively work to find new partners who could be involved in the future projects – each partner should use their contacts and networks to build upon.

In the final part of the Focus Group meeting, the partners acknowledged that the NEPTUN project is entering its final year and stated that it is necessary to intensify the effort and work hard to deliver satisfactory results and complete all the assumptions and planned products, outcomes and impacts.

2.3 Conclusions

Discussion and findings from the focus group proved to be very valuable. The cooperation within the consortium is very good, which results not only from the long-lasting cooperation of the personnel involved in the NEPTUN project but also from convergent scientific interests. There are many ideas for the cooperation in the future, in many areas such as scientific papers, project proposals, research projects. Working groups consisting of the members of each institution involved in NEPTUN project will

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contribute to reaching the set goals of the project and they will also translate into new opportunities beneficial for each involved institution.

3. Exploratory Research Project

3.1 Introduction

Exploratory Research Project was one of the most important products of the NEPTUN Project and it was decided that it will be led by TU Berlin. In the first stage of the ERP, the personnel involved in this activity conducted literature research in an attempt to formulate a relevant and up-to-date research problem. The literature research was followed by interviews with the representatives of industry. This activity's goal was to ensure that the selected topic is relevant for the industry and that it can provide benefits not only for the academics, but also for entrepreneurs and industrialists. Before the specific research problem was formulated, the project partners agreed that in general it should revolve around additive technologies and new mechanical metamaterials. The initial hypothesis formulated for the ERP was that 3D-printed mechanical metamaterials with special structures will allow the production of the mechanical components with increased fatigue life and strength.

3.2 Preliminary activities

During the kick-off meeting in Gdansk it was decided that GDANSK TECH will purchase a specialized Industrial Carbon Fiber 3D printer in order to conduct the research activities associated with the ERP. The delivery of the equipment was scheduled for the end of the 1st year of project life, however, certain risks associated with the purchase procedure, accessibility of the equipment and delivery issues materialized, and the device was acquired in the final year of the project (The purchase of the equipment is described in a separate report). In the view of the above, steering committee delegated focus group to find an alternative solution. It was decided that instead of focusing on one pilot research, the Exploratory Research Project will be broken into several ERP groups and each of these groups will work on a specific pilot research. In the course of the discussions during focus groups and research groups, the following pilot research topics were selected:

- Pilot Research Topic 1: Human-Robot Collaboration in the disassembling of door hinges, realized by: GDAŃSK TECH and NTUA
- Pilot Research Topic 2: Digital Transformation of Manufacturing Companies: Mapping Cross-Domain Interactions, realized by: GDAŃSK TECH and KTH

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- Pilot Research Topic 3: Strength and stiffness of lattice structures manufactured with Laser Powder Bed Fusion from Ti6Al4V titanium alloy: experimental and numerical analysis, realized by: GDAŃSK TECH and TUB

3.3 Conclusions

Exploratory Research Project which was conducted throughout nearly the entire duration of the NEPTUN project was an excellent tool which allowed the formulation of interesting, relevant and innovative research topics. This activity was also very important from the networking and internationalization points of view. Scientists and researchers from GDANSK TECH, National Technical University of Athens, Technische Universitat Berlin and the Royal Institute of Technology (KTH) Stockholm formed research teams whose work produced some substantial and important results. Activities conducted within the ERP and its various components contributed not only to increased excellence of the GDANSK TECH scientific staff, but also to the formulation of research groups and networks which will continue to thrive beyond the NEPTUN Project.

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