RESEARCH PERFORMANCE OF THE DEPARTMENT OF INDUSTRIAL MANAGEMENT AND TECHNOLOGY

Strategic Planning Committee of the Department

Prof. D. Karalekas
Prof. D. Emiris
Prof. G. Chondrokoukis
Prof. D. Sidiras

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1. Research policy of the Department

The research policy of the Department is in line with its objectives and is determined by the research activity of the faculty members. For this purpose, the laboratories of the Department have been established and operate, and, along with the educational activities, also host basic and applied research activities.

The main areas of activity concern: (a) the promotion of current scientific and technological trends, (b) the interdisciplinarity and collaboration with other research institutions, (c) the increase of the quality and efficiency of undergraduate and postgraduate education and (d) the enhancement of the connection with industry and the business environment

2. Monitoring of the research policy of the Department

In general, the research activity of faculty members is monitored through the number, quality and recognition of their scientific work. The quality and relevance of the faculty members' work to the Department's areas of interest is assessed during staff evaluation and promotion processes.

The research work of the faculty members of the Department is recorded annually by the Internal Assessment Team (OM.E.A.) using the information posted at the web sites of the faculty members and the web sites of the laboratories, international google scholar databases, Scopus SciVerse and Web of Science and data from the University of Piraeus Research Center. The data is forwarded to the Department's Strategic Planning Committee for evaluation. The report of the overall research activity is communicated to all faculty members and discussed at the Assembly of the Department.

3. Research infrastructure

The Department has four (4) statutory laboratories, the Laboratory of Advanced Manufacturing Techniques & Testing (LAMTT), the Laboratory of Simulation of Industrial Processes (LSIP), the Laboratory of Production Management Information Systems (LPMIS), and the Laboratory of Technoeconomics of Energy Systems (LTES)[1], supporting educational activities and the research activities of PhD candidates and faculty members of the Department.

Details for the Laboratories can be found below:

LAB	ADDRESS	WEBSITE	CAPACITY
LAMTT	107 Deligiorgi Str., Industrial Management & Technology Building, ground floor	http://www.tex.unipi.gr/labs/lamtt/	70 m^2/25 people
LSIP	107 Deligiorgi Str., Industrial Management & Technology Building, 1st floor	http://www.tex.unipi.gr/labs/lsip/	70 m^2/30 people
LPMIS	107 Deligiorgi Str., Industrial Management & Technology Building, 2nd floor	http://www.tex.unipi.gr/labs/epsp/	70 m^2/25 people
LTES	78 Tsamadou Str., Neo-classical Building, 1st floor	http://www.tex.unipi.gr/labs/teeslab/	30 m^2/8 people

Research infrastructures are funded by national and European programs, while infrastructure maintenance is mainly funded by the University's regular budget. Existing laboratories have the necessary infrastructure (benches, storage areas, plumbing and wash basins, electrical sockets, fire detection systems, gas extractors, lighting, air conditioning, ventilation, etc.).

With the help of research funds, which have been quite high in recent years, significant scientific equipment (experimental and computational) has been acquired to cover high-level research activities. The age of equipment is relatively young (in all cases <10 years, on average 5-6 years). As the use of equipment is intense, there is always a need for its maintenance and update. Laboratory Directors ensure the maintenance of the older equipment, although its replacement is difficult, depending on the funding that the research teams receive from national and European programs.

The available infrastructures were largely shaped by the research activity of the faculty members who founded the laboratories. Subsequently, efforts were made, in several cases, to cover other related research activities. For example, the LSIP also supports research activity

[1] LTSE established in 2017.

in environmental metrology, biomedical engineering and nanosensors, while the LAMTT is also active in 3D printing for biomedical and medical applications.

The use of research infrastructures is daily and intense. They are used for projects by undergraduate and postgraduate students, as well as by PhD candidates in the context of their doctoral research.

4. Support of research

The research activities of the Department are financially supported by the University's Research Centre. The faculty members, in collaboration with researchers from other Institutions, have implemented and are implementing a sufficient number of competing research projects. In addition, the Department ensures the proper operation of the Laboratories and their timely reinforcement in logistical infrastructure. PhD candidates and postgraduate students participating in funded research programs are financially supported (full or partial funding). Faculty members also encourage undergraduate students to undertake research work in the context of undergraduate projects (Project I & II). At the postgraduate level, the Department also financially empowers postgraduate students to present the results of their dissertation research at international conferences in Greece or abroad.

The Department encourages and supports faculty members in conducting high-level research. The enhancement of the Department's research activity is a strategic objective pursued by the following:

- Integration of all faculty members in one of the Departmental Laboratories in order to support their research activities and promote research collaborations between faculty members[2].
- Increasing the number of academic and scientific staff by attracting internationally acclaimed and high-potential scientists and top PhD candidates.
- Supporting all Laboratories with specialized staff.
- Increasing the research programs[3].
- Promoting research collaborations of the Department with universities or research centers in Greece or abroad.
- Participation of faculty members in recognized international research networks.
- Strengthening the Department's cooperation with professional bodies and linking research with industry.
- Increase the dissemination of the research achievements of the members of the Department.
- Increasing the number of faculty members' publications in high-profile scientific journals[4].

[2] Collaborations with senior faculty members are expected to effectively support the research activity of assistant professors through guidance and the right choice of research orientation.

[3] The faculty members are informed about the possibilities of research funding through the announcements of the University's Research Centre and the holding of relevant information workshops at the University. The Department encourages faculty members in the preparation of funding proposals.

[4] To this end, the compilation of a list of scientific journals, classified by quality, for all the subjects treated in the Department is ongoing.

Regarding the incentives provided for the conduct of research activities by faculty members, the most important of these are (a) the scientific recognition and development and (b) the adaptation of faculty members to the Department's research culture. The granting of educational leaves to conduct research in foreign institutions is an important incentive. In addition, research activity is a critical pre-requisite in the evaluation and promotion of faculty members.

5. Dissemination of research results

Dissemination of research results is mainly through publications in internationally acclaimed scientific journals and conferences, national conferences and professional workshops. Also important is the contribution of faculty members in books and book chapters.

Dissemination processes are evaluated based on the impact of the published work of the faculty members of the Department.

6. Evaluation of Department's research

6.1 Research fields

The activities of the faculty members of the Department cover a relatively wide range of research areas such as:

- Industrial systems techniques, including computational techniques and rapid product development methods
- Robotic production systems and automatic control
- Mathematical programming in production
- Materials technology – industrial applications, design & development of new products
- Advanced product manufacturing technologies and computer aided design and production
- Design of chemical and biotechnology products
- Industrial processes and natural resources management
- Informatics, information systems and soft computing techniques
- Product transport & distribution systems and procurement management
- Technoeconomics of energy systems
- Corporate strategy
- Financial management

Particular emphasis has been given in recent years to promoting research in niche fields such as:

- *Additive manufacturing techniques, materials, design of three-dimensional microstructures and devices for industrial, medical and environmental applications*
- *Advanced energy systems and energy management*: technoeconomic analysis, climate change and sustainability
- *Environmental management*: advanced environmental protection systems, measuring systems, natural resources management, recycle
- *Project management*: intelligent time scheduling and resource allocation techniques, project risk management

- *Robotics and mechatronics*: robotic vision and navigation of autonomous systems, dynamic properties of optimized geometries for modular robots, human movement modeling for computer simulations
- *Logistics*: ERP systems, green logistics
- *Decision support systems*: fuzzy networks, neuronic networks, data safety
- *Corporate strategy and management*: ambiguous strategies in rapidly changing industries, knowledge management and innovation development strategies, team performance and dynamics, multi-level analysis models
- *Corporate finance*: investments, energy and environmental finance, financial economics

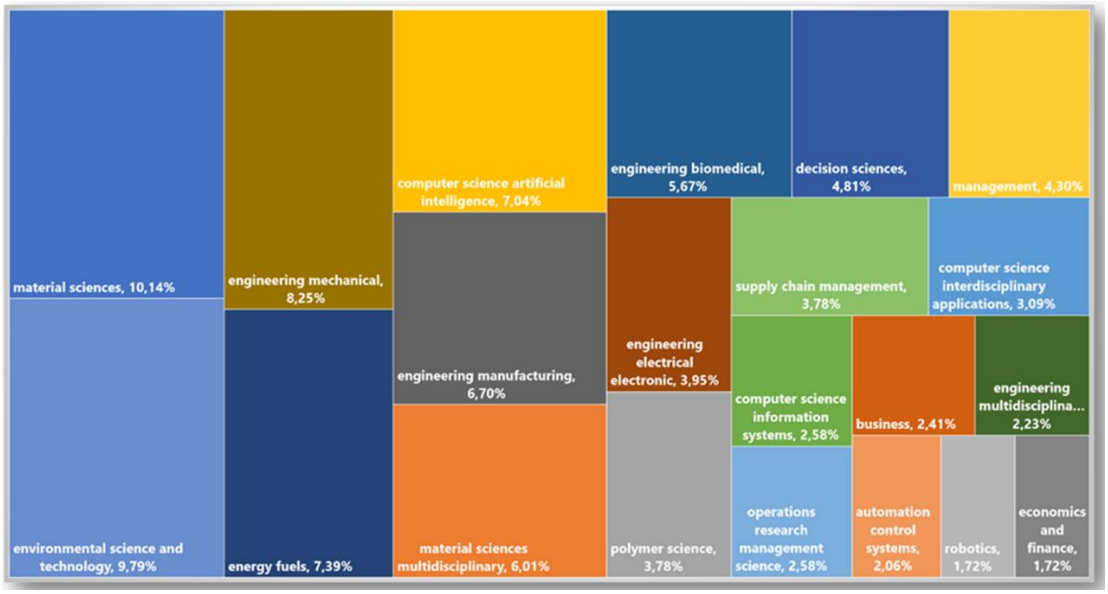

Figure 1. Web of Science categories for the publications of the Department in the period 2000-2018 (source: Web of Science, Clarivate Analytics).

The publications of the faculty members fully imprint the interdisciplinariry and multidisciplinarity of the Department. Figure 1 presents the Web of Science[5] analysis using the Clarivate Analytics for the period 2000-2018. Subjects/research fields include by 67.7% the technology dimension, by 17.87% the management dimension, by 12.71% the computer sciences dimension and by 1.72% the economics dimension.

A similar analysis was carried out on the google scholar database, where the research fields were defined by the categories that the faculty members posted on the database and cross-checked with the categories reported by scientific journals or conferences. According to the results (Figure 2), the subjects/research fields involve by 58.6% the technology dimension, by 25.9% the management dimension, by 12.3% the computer sciences dimension and by 3.2% the economics dimension.

[5] Rankings and percentages are automatically derived from the Web of Science according to the categorization of scientific journals and the number of publications.

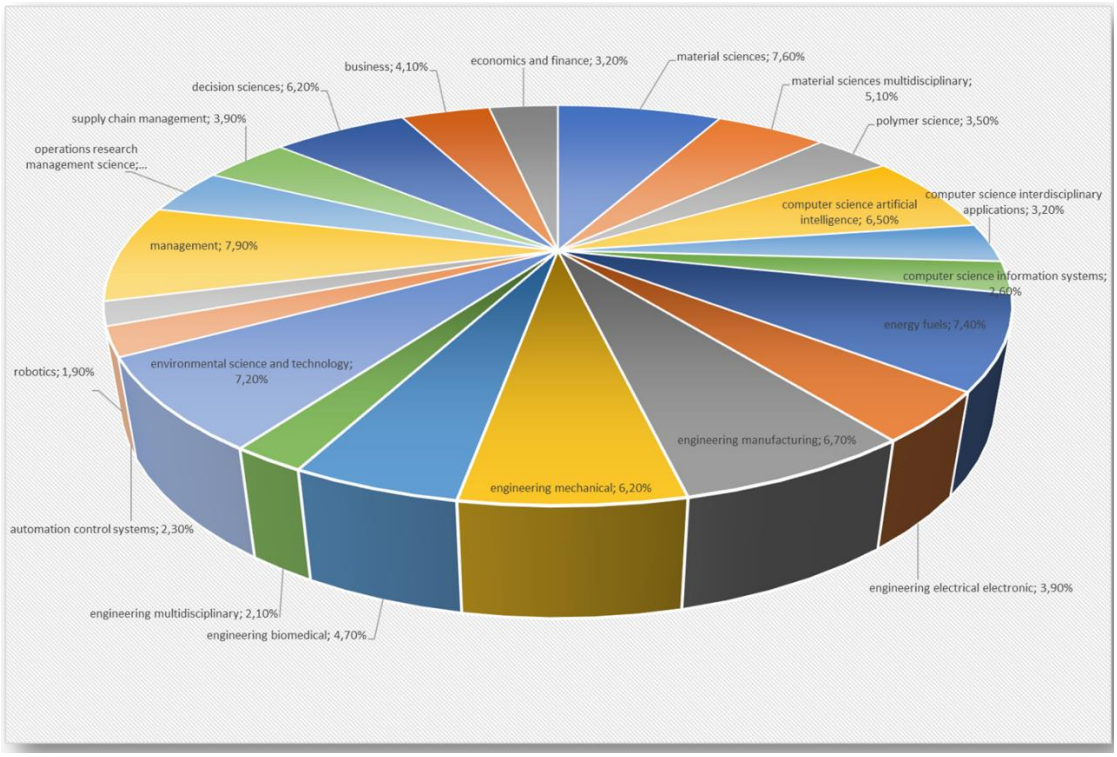

Figure 2. Categorization of the Department's publications included in the Google Scholar database for the period 2000-2018.

6.2 Research projects

According to the data of the University's Research Centre, 12 research projects were carried out in the Department in 2016, 3 of which were competitive European (> 200,000 €). In 2017, 21 research projects were carried out in the Department, 4 of which were competitive European and 3 involved > 200,000 € in funding. These projects supported the research activity of 80 external partners.

In particular, the Department's projects for 2000-2018 include the following:

European projects

- «Energy-Aware Factory Analytics for Process Industries» (FACTLOG) 2019-2023.
- «Sustainable Energy Transitions Laboratory» (SENTINEL) 2019-2022.
- «Enhancing at an Early Stage the Investment Value Chain of Energy Efficient Projects» (Triple-A) 2019-2022.
- «Enhancing the Implementation and Monitoring and Verification practices of Energy Saving Policies under Article 7 of the EED» (ENSMOV) 2019-2022.
- «Market Uptake of Solar Thermal Electricity through Cooperation» (MUSTEC) 2017 – 2020.
- «Peer Powered Cities and Regions» (PROSPECT) 2017 – 2020.
- «TRANSRISK, Transitions Pathways and Risk Analysis for Climate Change Mitigation and Adaptation Strategies», EC Horizon2020, 2015-2018.
- «CARISMA, Coordination and Assessment of Research and Innovation in Support of climate Mitigation Actions», EC Horizon2020, 2015-2018.

- «ENSPOL, Energy Saving Policies and Energy Efficiency Obligation Scheme», EC-EASME, 2014-2016.
- «POLIMP, Mobilizing and Transferring Knowledge on Post-2012 Climate Policy Implications», EC-DG Research FP7 R&D, 2013-2016.
- «GREENECONET - Accelerating Progress Towards the Green Economy», EC-DG Research FP7 R&D, 2013-2016.
- «APRAISE, Assessment of Policy Impacts on Sustainability in Europe», EC-DG Research FP7 R&D, 2011-2014.
- «Towards2030-dialogue - Dialogue on a RES Policy Framework for 2030», EC-IEE, 2014-2016.
- «DIACORE -Policy Dialogue on the Assessment and Convergence of RES Policy in EU Member States», EC-IEE, 2013-2015.
- «BETTER -Bringing Europe and Third countries closer together through renewable», EC-IEE, 2012-2015.
- «Creation and Operation of an EU-GCC Clean Energy Network», EC DG-RELEX, 2010-2013.
- «REACCESS, Risk of Energy Availability: Common Corridors for Europe Supply Security», EC-DG Research, 2008-2011.

NSRF projects

- «Synthesis and Study af Biological, Bioengineering and Micromechanical Properties of New Types of Reconstructed Bone Cement Based on Calcium Phosphate and Geopolymers», THALIS Program, NSRF 2012-2015.
- «Design and Manufacture of 3D Micro-Stereolithography Scaffolds for the Development of Artificial Soft and Hard Tissues», THALIS Program, NSRF 2012-2015.
- «Development of New Material from Disposable Biomass for Hydrocarbon Adsorption in the Aquatic Environment», THALIS Program (MIS 377356) 2011-2015.
- «Provision of Computer Services for the Production of Teaching Material Using New Technologies», Sub-project 6 of Project «Greek Open University» NSRF 2011–2014.
- HERAKLEITOS II, Department of Nursing, National and Kapodistrean University of Athens, Operational Program "Education and Lifelong Learning", NSRF 2011-2014.
- «Analysis of Supply and Production Systems: an Integrated Approach», THALIS Program, NSRF 2011-2014.
- «Teacher Awareness and Professional Development Activities - Priority Axis 1, 2». Provider: "GSEE Educational Policy Development Center" (KANEP / GSEE). NSRF 2013-2014.

National Projects

- «In Situ Monitoring Additive Rapid Manufacturing – SMART», ARISTEIA II, 2014-2015.
- «RE-PV: Design and Recycling of Photovoltaic Panels», COOPERATION 2011, 2013-2015.
- «Organizational ambidexterity in high velocity markets: Antecedents and performance at different levels of analysis» 10/2017-present, Hellenic Foundation for Research and Innovation.
- «How Do Resources and Demand-Side Factors Affect the Resource Value in New Product Development Projects?» Swiss National Science Foundation, 2015-present.
- «Performing Scientific Research in the Field of Management», ARISTEIA, 2013-2016.

- «An Economic Impact Study of the Athens International Airport», Athens International Airport SA, 2013.
- «A Study on the Innovation Capacity of Greek Small and Medium-sized Enterprises (SMEs)», 2012–2013.
- «Open Access Digital Services of the University of Piraeus Library», 2012-2014.

6.3 Production and recognition of research work

Data submitted to the Hellenic Quality Assurance and Accreditation Agency (HQA) for the years 2016 and 2017 include data from the google scholar database. Table 1 compares the course of the Department's research activity for the years 2016-2018 using the databases: google scholar, scopus SciVerse and Web of Science.

Table 1. Trendline of the Department's publications in the period 2016-2018.

	Google scholar			*Scopus*			*Web of science*		
	2016	**2017**	**2018**	**2016**	**2017**	**2018**	**2016**	**2017**	**2018**
Publications in journals	537	559	580	377	430	456	248	273	286
Journal impact factor							0,757-5,914	1,757-5,914	0,757-9,184
h-index	7-23	7-23	10-23	4-14	6-20	9-20	4-18	4-19	8-20
citations	7058	8267	9241	3938	4897	5804	3614	3775	4320
Number of citations (self-citations excluded)							3245	3358	3861

The google scholar database, which includes all publications in scientific journals and conferences, shows a steady upward trend with 21.5 new publications per year. It is noted that, although the range of the scientific quality index remains constant, its distribution varies. In 2016, 70% of faculty members had an h index > 10, while in 2018 > 70% of faculty members increased their h index to > 13. The impact of research, as shown by the number of citations, shows an increasing trend of around 12% per year.

The Scopus database, which includes publications and conference proceedings of Elsevier and affiliates, shows a steady upward trend with 39.5 new publications per year. The quality index range is improving, with > 50% of faculty members recording h index > 13 in 2017, while the following year 40% of faculty members showed an h index> 16. The impact of the research, as shown by the number of citations, shows an increasing trend of approximately 20% per year.

The Web of Science database, which includes publications and conference proceedings of journals listed in the Journal Citation Reports database, shows a steady upward trend with 19 new publications per year. Figure 3 also presents the aggregated view for the Department, as recorded on the Web of Science database for the period 2000-2019.

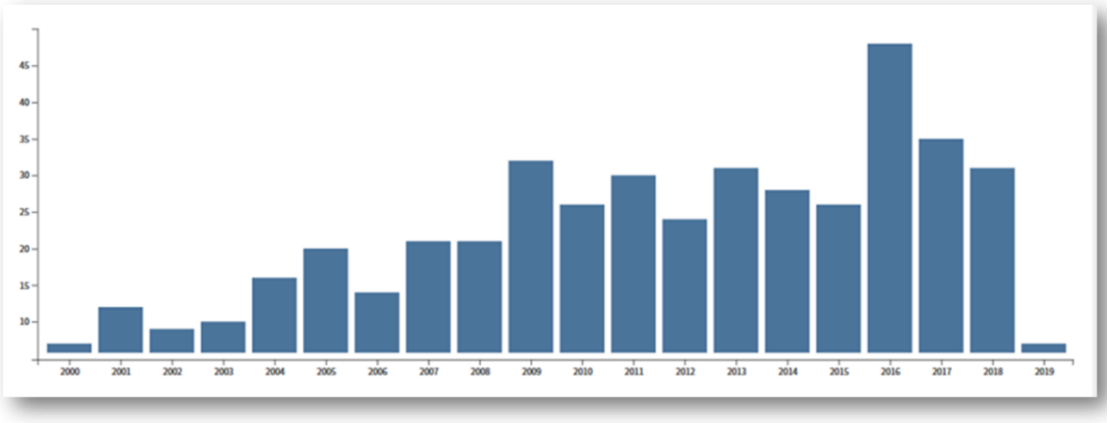

Figure 3. Progress of the number of publications of the Department for the period 2000-2019 (source: Web of Science, Clarivate Analytics).

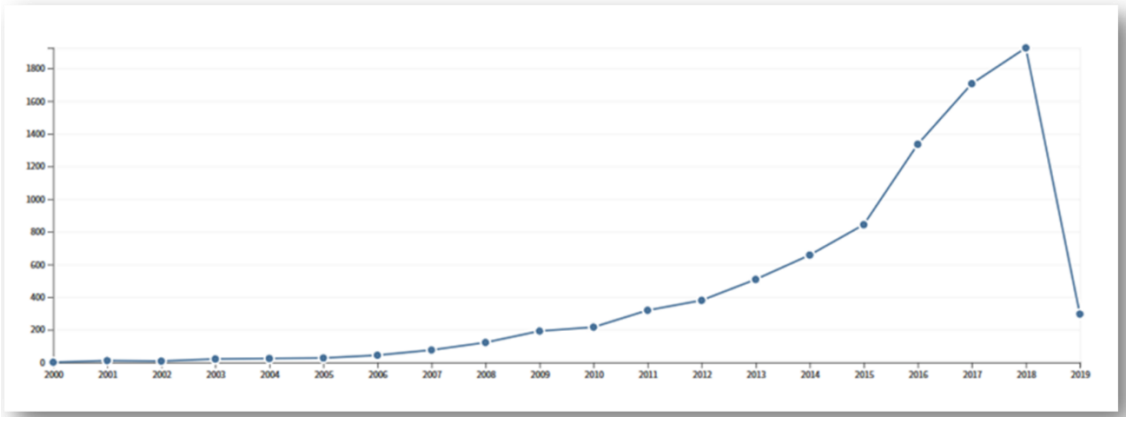

Figure 4. Progress of the citations (self-sitations excluded) of the Department for the period 2000-2019 (source: Web of Science, Clarivate Analytics).

The range of the Quality Index on the Web of Science database is improving, with > 50% of faculty members recording h indices > 10 in 2017, while the following year 32% of faculty members had an h index > 14. The impact of the research, as shown by the number of citations, is increasing. This is also illustrated by the aggregate representation for the Department, as recorded on the Web of Science database for the period 2000-2019 (Figure 4).

Of particular interest is the impact factor of journals on the Web of Science database, where in 2016 40% of publications were in journals with impact factor > 2, while in 2018 this percentage increased to 80%. In 2018, 30% of publications were in journals with impact factor> 5.

6.4 Research collaborations of the Department

Faculty members collaborate in academic and research fields with other Departments of the University, such as the Department of Business Administration and Management, the Department of Economics, the Department of Information and Digital Systems and the Department of Maritime Studies.

Also, faculty members collaborate in academic and research fields with other Universities and Institutions of Greece, including: National and Technical University of Athens, Department of

Natural Resources Engineers – Polytechnic of Crete, Economic University of Athens, Foundation for Research and Technology in Heraklion (Crete), Hellenic Centre of Marine Researches, NCSR "Demokritos", Centre for Renewable Energy Sources and Saving, Public Power Corporation Renewables SA, Piraeus Chamber of Commerce and Industry, Laboratory of Strength of Advanced Materials and Construction (LAMCO), Institute of Bodymetrics, Centre of Technology and Design of the Department of Engineering (Univ. Thessaly), Department of Mechanical Engineering and Aeronautics (Univ. Patras), Department of Materials Science (Univ. Patras), School of Dentistry (Univ. Athens), School of Medicine (Univ. Athens).

Of importance are, also, the collaborations of the Department with foreign institutions, such as:

- Switzerlans: École Polytechnique Fédérale de Lausanne / ETH Zurich
- Sweden: Chalmers University of Technology / Linköping University
- Portugal: Dept. de Engenharia Quvmica e Biologica, Instituto Superior Tecnico, Universidade Tecnica de Lisboa / Universidade de Coimbra
- UK: Department of Process Integration, U.M.I.S.T. / University of Sussex / Dept. of Chemical & Process Engineering, University of Surrey
- Germany: Institut fuer Kern- und Energietechnik, Forschungszentrum Karlsruhe GmbH / University of Stuttgart (USTUTT)
- Czech Republic: Dept. of Biomagnetic Techniques, Institute of Systems Biology and Ecology AS CR
- Slovenia: Laboratory for Energy Policy, University of Ljubljana
- Norway: University of Stavanger - Centre for Sustainable Energy Solutions
- Italy: Politecnico di Torino (POLITO) / Venice International University / Fundacion General de la Universidad Nacional de Educaciòn a Distancia
- Austria: University of Graz
- Netherlands: University of Utrecht
- USA: Dept. Chemical Engineering, University of Minnesota / Dept. of Biomedical Engineering, Rutgers (State University of N. Jersey)
- Canada: Dept. of Chemical Engineering, Universite Sherbrooke, Quebec

Also, faculty members of the Department collaborate with foreign bodies and/or are members of international networks, such as: Cambridge Econometrics, Swiss Federal Institute of Technology (Ελβετία), Fraunhofer Institute for Systems and Innovation Research (DE), Joint Implementation Network (JIN), Stockholm Environment Institute – York, Joanneum Research (JR), Science and Technology Policy Research, Centre for European Policy Studies (CEPS), Government Institute for Economic Research (VATT), Deutsches Zentrum fór Luft-und Raumfahrt - German Aerospace Center (DLR), the Spanish National Renewable Energy Centre (CENER), French Agency for the Environment and Energy Management (ADEME), Electricity Supply Board International (ESBI), MVV Energie (DE), Institute for Structural Research (IBS), Energy Research Centre of the Netherlands (ECN), Basque Centre for Climate Change (BC3), Applied Systems Analyses, Technology And Research, Energy Models (ASATREM), - Centro de Investigaciones Energeticas, Medioambientales y Tecnologicas (CIEMAT), Institute for the Economy in Transition (IET), Technical Research Centre of Finland (VTT), Institute of Methodologies For Environmental Analysis (CNR–IMAA), Potsdam Institute for Climate Impact Research (PIK), Institute for Structural Research (IBS), Fondazione Eni Enrico Mattei (FEEM).

6.5 The implementation of research in industry

The research activity of the Department aims at the direct or indirect application in industry. For example,

- The design and 3D printing equipment of the LAMTT has been used in both research projects and in direct collaboration to support development and design projects by several Greek companies (INTRACOM, ELAIS, EAB, ARGO, CARAD, MORNOS, MAVILEK, BIORAL, MIKRON, LALIZAZ, LOUKREZIZ, PHEE).
- The results of an extensive child bicycle redesign study carried out at the Department were used by FIELD to develop ergonomic bicycles adapted to the Greek population.
- The results of the National Anthropometric Survey conducted in the Department are used by the Centre of Technology & Design and its member companies to design products adapted to the anthropometric data of the Greek population.
- Theoretical models as well as variables measurement scales developed in the framework of the corporate strategy have been used to conduct quantitative business research by the European Commission (DG Enterprise and Industry), Athens International Airport, SAS Institute, Emporiki Bank, and the Athens Urban Transport Organization.
- The research results of the project "THALIS - Development of New Material from Disposable Biomass for aquatic Environment" (2011-2015) contributed to the domestic development of technology and production of new biomass and non-waste biomass adsorbents. This model can be adapted, with the appropriate transfer of know-how, to less developed regions, taking advantage of local economic and technological resources and economies of scale.
- Various time planning and resource balancing methodologies are used in machinery maintenance projects.
- Various innovative field metering devices (nano-sensors and multi-array devices) have been used for real-time environmental monitoring on the ground (water and soil quality assessment).

Also important is the activity of the faculty members in writing textbooks.

The increasing number of citations (Table 1 & Figure 4) indicates the utilization of the Department's research activity by other researchers. Also, despite the relatively small number of competitive research programs implemented in the Department (see Section 6.2), the European programs implemented are successful proposals based both on publications and on the immediate applicability of research results, e.g., (a) decision-making in the field of technoeconomic energy systems with emphasis on energy and climate policy (e.g. adoption in Greece) and (b) development of tools such as a web tool for quantifying the risks of energy supply or developing a BSAM energy model.

7. Conclusions

According to the above results, the Department's research policy is well implemented. All faculty members carry out research work and make significant efforts to align with the Department's strategic goals and improve their respective quality indicators.

The faculty members of the Department are involved in European and national research programs involving many research teams in Greece and/or abroad. This ensures

interdisciplinarity, while collaborating with various institutions and scientists. In addition, the dissemination processes of the research results are judged to be satisfactory based on the impact of the published work of the faculty members of the Department.

It is noted that in a recent study published in webometrics on the ranking of Greek researchers on google scholar basis[6], faculty members of the Department, which make up 8.88% of the faculty members of the Foundation, rank in the top 25% of University's members, contributing 10% to the number of publications and 23.5% to University's citations. Looking at the Department's ranking on the Web of Science, it was found that the faculty members rank in the top 15% of the University's members, contributing 31.96% to the number of publications and 41.98% to the citations.

However, the present study also showed the possibility of further extending and strengthening research infrastructures. In particular, the capacity of the laboratories is considered to be marginally adequate for the research activities they support, while the number of laboratories is proposed to be increased in order to support other appropriate subjects of the Department.

[6] Kouropoulos G (2017) Ranking of researchers and scientists in Greece in 2017 according to google scholar database. Ranking Web of Universities (www.webometrics.info/en)