SWOT Analysis

Excellence Initiative – Research University

Gdańsk University of Technology

2019

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Executive Summary

The SWOT analysis has been prepared to assess the scientific, educational and organisational potential of Gdańsk University of Technology (GUT) in the implementation of the "Excellence Initiative – Research University" programme objectives.

During the in-depth discussions within expert panels, the following strengths and weaknesses of the GUT, as well as its opportunities and threats in reaching the indicated objectives were analysed and defined (together with the weights that are included in parentheses):

STRENGTHS	WEAKNESSES
S1. High scientific potential and effective cooperation with domestic and foreign universities in the selected technological areas that respond to important challenges faced by the worldwide science (0.30) **S2. Achievements in the field of patent applications, commercialisation and co-operation with business (0.25)** **S3. A wide range of high-quality study programs at all levels of education (0.20)** **S4. Initiated implementation of pro-quality solutions in the area of organisation and management, in order to support scientific activity of the academic staff (0.15)** **S5. Attractive location, modern academic infrastructure, reliable financial status, good support offered to students (0.10)**	**W1. Lack of university-wide standards and procedures for the implementation of pro-quality processes in the field of scientific activity, commercialisation, support for students, PhD students and academics (0.25)** **W2. Lack of effective mechanisms for recruitment of academic staff with high research potential and recognized international position (0.25)** **W3. Limited activities supporting the professional career development of academic staff, in particular young scientists (0.20)** **W4. Poor international recognition and weak support for the development of international cooperation (0.20)** **W5. Poor scientific activity of part of researchers and PhD students (0.10)**
OPPORTUNITIES	**THREATS**
O1. Flexibility of using public subsidy that is the main source of university funding (0.35) **O2. Current rules of the research-evaluation system that assesses broad scientific disciplines and rewards more active cooperation of larger groups of researchers (0.25)** **O3. Available financial support from a diversity of sources in scientific disciplines covering priority research areas (0.25)** **O4. Demographic trends and legal regulations that stimulate improvements of the quality of education (0.15)**	**T1. Strong competition in the global market of higher education (0.25)** **T2. Changing legal regulations that hampers the functioning of the university (0.25)** **T3. Strong salary competition from the business sector that brain-drains academic staff, especially young scientists (0.25)** **T4. Unstable rules of the research-evaluation system that may lower the academic rank in the future (0.25)**

In the next step, a classic SWOT / TOWS analysis was performed to determine the number of interaction of features and the weighted number of interaction of features. The results of this analysis are shown in the table below:

	Opportunities	Threats
Strengths	Number of interactions: 40 Weighted number of interactions: 10,00	Number of interactions: 36 Weighted number of interactions: 8,50
Weaknesses	Number of interactions: 40 Weighted number of interactions: 8,95	Number of interactions: 40 Weighted number of interactions: 9,25

The experts have identified the situation of the GUT that indicates rather balanced strengths and weaknesses as well as opportunities and threats. Therefore, they have abandoned the problematic determination of the balances of opportunities vs threats and strengths vs weaknesses in favour of determining the weights of individual traits.

In the SWOT analysis special emphasis has been placed on the analysis of the GUT strengths to determine the so-called Priority Research Areas (POB). The following key features that define the status of the University as a Higher Education Institution (HEI) have been primarily analysed:

- **Research activity of the academic staff,**
- **International cooperation,**
- **Commercialization of R&D results.**

Additionally, scientific potential of the GUT has been juxtaposed with internationally recognised research priority areas. Analyses of science priorities announced by the leading international organizations (OECD, COST, ICSTI, ICSTI) together with preliminary scope of the EU Framework Programme for Research and Innovation "Horizon Europe" have revealed the following research areas to be the most favourable: health, security, digital technologies and enabling technologies, climate, energy, mobility, food and natural resources.

Taking into account the strongest internal research potential of the GUT (i.e. well-recognized academic staff, in particular young scientists, experience in international scientific cooperation, as well as excellent research infrastructure) on the one hand, and the external opportunities (i.e. best prospects for publishing research results and implementing innovative solutions) on the other hand, the following four Priority Research Areas of the University have been formulated:

- **POB1: MATERIALS ENGINEERING**
- **POB2: ENVIRONMENTAL ENGINEERING, GREEN POWER ENGINEERING AND SUSTAINABLE CONSTRUCTION (CIVIL ENGINEERING)**
- **POB3: ELECTRONICS, MECHATRONICS AND INFORMATION TECHNOLOGIES (ICT)**
- **POB4: BIOMEDICAL ENGINEERING, BIOTECHNOLOGY.**

In the next stage, all Priority Research Areas have been re-analysed in the context of recognised weaknesses of the GUT and threats to its future development as HEI.

On the basis of the SWOT analysis, the following activities of the University have been proposed to reach the "Excellence Initiative – Research University" programme objectives:

I.1. Acquisition and support of highly qualified international staff.

I.2. Development of international research teams at the GUT.

I.3. Increasing the number of acquired and executed prestigious international projects within POBs.

I.4. Increasing the number of publications in prestigious journals.

II.1. Supporting development of cooperation with leading international research centres .

II.2. Strengthening cooperation with research centres from the Baltic Sea Region.

III.1. Improvement of the education system at undergraduate and graduate studies.

III.2. Modification of PhD studies system.

III.3. Improvement of admission system using the concept of strategic enrolment management.

III.4. Talent management.

IV.1. Supporting professional development of university staff.

IV.2. Implementation of a support system for researchers' mobility and work-life balance solutions.

V.1. Optimization of research management.

V.2. Optimization of human resources management.

V.3. Professional development of administration, including organizational improvements.

V.4. Optimization of research project management.

V.5. Increasing the efficiency of technology transfer.

V.6. Improving the research infrastructure management system.

It is believed that an extensive package of ambitious activities to be performed within the "Excellence Initiative – Research University" programme will become the flywheel of the University's research and education development, bringing the GUT to the circle of internationally fully-recognized HEIs.

1. Description of STRENGTHS

S1. High scientific potential and effective cooperation with domestic and foreign universities in the selected technological areas that respond to important challenges faced by the worldwide science

Gdańsk University of Technology (GUT) has both professional scientific staff and experience in project realisations, as well as modern and unique laboratory facilities allowing for active participation in the world science development. In the period 2014-2018, 56 grant agreements were signed under bilateral and multilateral research programmes, out of which 25 projects were funded under the EU Framework Programmes (EU 7th Framework Programme and Horizon 2020). The excellence of research ran at Gdańsk University of Technology was honoured with the participation in one prestigious grant of the European Research Council (ERC). Gdańsk University of Technology was a partner in the QOLAPSERC project: which was carried out jointly - also at our University - by Prof. Paweł Horodecki.

In addition, the GUT conducted four Centres of Excellence under the EU 5th Framework Programme:

- **"CURE- Centre for Urban Construction and Rehabilitation: Technology Transfer, Research and Education" at the Faculty of Civil and Environmental Engineering,**
- **"CREM - Centre of Research and Education in Medicinal Chemistry/Biotechnology" at the Faculty of Chemistry,**
- **"CEEAM - Centre of Excellence in Environmental Analysis and Monitoring" at the Faculty of Chemistry,**
- **"CEMET - Centre of Medical Technologies" at the Faculty of Electronics, Telecommunications and Informatics.**

Moreover, at the Faculty of Electronics, Telecommunications and Informatics, there is the WiComm Centre of Excellence – the only centre of excellence in Poland that covers wireless communication issues widely.

For many years, the GUT has been among ten universities with the largest number of participants in the Erasmus exchange programme in Poland. In 2018, in terms of the grant amount (of EUR 1.076 million) awarded to its students and employees under the Erasmus + Mobility programme, it was on the eighth position among the countries participating in this programme (being also the second best university of technology in Poland in this respect). Since it joined the programme, the University has paid great attention to the mobility of the employees, which has resulted in running one of the largest employee exchange programmes in Poland. Thanks to this activity, the University has managed to intensify the co-operation with 17 countries, such as the USA, the UK, Germany, Japan, Korea, Tunisia and Ukraine. Ensuring the high quality of the exchange, the University co-operates primarily with the universities that have numerous achievements and high ranking positions to their credit, including the universities from the Top 100 of the Shanghai Ranking, such as Princeton University, John Hopkins University, Tokyo University, Aarhus University, Massachusetts Institute of Technology, Sorbonne University, Texas A&M University, TU Munich, Uppsala University.

The four Priority Research Areas (POBs) indicated by the Applicant have been selected due to the GUT high scientific potential according to the following criteria: number of publications for the period 2013-2017 (according to the ASJC classification in Scopus); citation rate (Field Weighted Citation Impact - Scopus); citations per publication (Scopus); list of prestigious international grants in the period 2014-2018; patents; projects; inventions; laboratories; research infrastructure. Additionally, it should be emphasised that

scientific disciplines included in the distinguished POBs are in the group of scientifically attractive areas providing great opportunities for publishing research results and implementation potential in the field of innovative solutions.

Priority Research Area (POB)	Number of publications for the period 2013-2017 (according to the ASJC classification in the Scopus database)	Citation rate (Field Weighted Citation Impact – Scopus database)	Citations per publication (Scopus database)
POB1: MATERIALS ENGINEERING	1111	1.10	7.4
POB2: ENVIRONMENTAL ENGINEERING, GREEN POWER ENGINEERING AND SUSTAINABLE CONSTRUCTION (CIVIL ENGINEERING)	828	1.34	7.7
POB3: ELECTRONICS, MECHATRONICS AND INFORMATION TECHNOLOGIES (ICT)	2142	0.95	4.8
POB4: BIOMEDICAL ENGINEERING, BIOTECHNOLOGY	1044	1.14	12.4

POB1: MATERIALS ENGINEERING

This research priority area is one of the most scientifically active fields at GUT, due to the low average age of the scientists representing this discipline and the publications in prestigious journals. The achievements in this area have also a significant innovative potential in the technologies used in the maritime economy (e.g. issues of corrosion protection, energy sources and items for its storage, new materials used in sensors for measuring environmental parameters). Within the area, many projects are carried out, including

- **GoPHy MiCO - Governing Principles in Hydration of Mixed Conducting Oxides, ERA-NET,**
- **MAGENTA - MAGnetic nanoparticle based liquid ENergy materials for Thermoelectric device Applications, HORIZON 2020,**
- **LogicLab - Molecular logic lab-on-a-vesicle for intracellular diagnostics, HORIZON 2020,**
- **SEPCON - Strain engineering of proton conducting oxides, DAINA Call for Polish-Lithuanian research projects,**
- **FunKeyCat, Functional Grading by Key doping in Catalytic electrodes for Proton Ceramic Cells, ERA-NET,**
- **Control algorithm and controller for increasing the efficiency of hybrid PEMFC systems in different applications (COALA). Polish-German Programme for Sustainable Development.**

In this Priority Research Area, the University has specialised laboratories, such as: Computer Modelling of Materials; Synthesis and Investigation of Inorganic Materials Physical Properties Laboratory; Electron Microscopy Laboratory; Confocal Microscopy and IR Spectroscopy Lab; GUT Tribology; Materials Research Lab; Polymer Materials Laboratory. Most of these laboratories are located in the building of the Nanotechnology Centre, which allows for the intensification of the co-operation between the research teams.

POB2: ENVIRONMENTAL ENGINEERING, GREEN POWER ENGINEERING AND SUSTAINABLE CONSTRUCTION (CIVIL ENGINEERING)

The research priority area is directly related to the Pomeranian region and the area of the southern Baltic Sea. It deals with the issues of the ecological management of this area, the use of renewable energy sources, in particular wind energy, and the construction related to coastal and port installations. The scientists from Gdańsk University of Technology have participated in designing many structural investments in the region and have been the initiators of the discussion on the proposed investments (e.g. problem of the lower Vistula regulation). The University has a unique facility built in 2015: Laboratory for Innovative Power Technologies and Integration of Renewable Energy Sources - LINTE^2. The LINTE^2 laboratory enables conducting research on intelligent electric power grids (Smart Grids), intelligent energy islands with their own production resources, management of electricity demand, new designs of power electronic converters and their applications in the electric power system. An important research area is also the investigation related to charging and using electric vehicles and the integration of electric vehicles with the electric power system. Within the area, many projects are carried out, especially the ones relating to environmental protection, such as:

- **FLOW/Furthering Less Congestion by creating Opportunities for more Walking and cycling, funded under the HORIZON 2020 programme (EU).**
- **CRUNCH / Climate Resilient Urban Nexus Choices: operationalising the Food Water Energy Nexus, funded under the ERA-NET programme.**
- **Boron-basalt fibers/ Development of boron-infused basalt fiber reinforced concrete for nuclear and radioactive waste management application, funded under the ERA-NET programme.**
- **PEN / Effectiveness of existing policies for lifestyle interventions - Policy Evaluation Network, funded under the ERA-HDHL programme.**
- **S.O.S. Climate waterfront / A Strategy of Excellence in Research and Innovation to Design Tools for the Waterfront to face Climate Change, funded under the HORIZON 2020 programme (EU).**

POB3: ELECTRONICS, MECHATRONICS AND INFORMATION TECHNOLOGIES (ICT)

The research priority area includes strong research teams engaging in international co-operation, e.g. in such projects as:

- **DIAEXP/Ultra-Sensitive Opto-Electrochemical Detection of Liquid Explosives Fabrication,**
- **SCOTT/Secure Connected Trustable Things,**
- **PRODUCTIVE 4.0/ Electronics and ICT as enabler for digital industry and optimized supply chain management covering the entire product lifecycle.**

Part of the research carried out in this area allows for solving a number of practical issues related to maritime economy (e.g.: automation systems in the shipbuilding industry and in the control of ships and unmanned vehicles, IT systems for maritime economy enterprises and ports). The importance of these technologies for the region is confirmed by the data on the IT sector earnings, the average level of which is the highest in Poland.

The University is successively developing its modern laboratory facilities that are unique on the European scale. The resources of Gdańsk University of Technology in this area include, among others:

- **Immersive 3D Visualization Lab I3DVL,**
- **Supercomputer TRYTON, STOS CI TASK (Smart and Transdisciplinary knOwledge Services),**
- **Laboratory of Innovative IT Applications for research on the usability and quality of software in various applications, in particular for recognising computer users' emotions, testing software usability and examining the experience of application users,**
- **Research Laboratory for computing by means of such software as: Tomlab, Gams, Apros.**

POB4: BIOMEDICAL ENGINEERING, BIOTECHNOLOGY

The research priority area is of a particular importance for the Pomerania region, which is supported by the

co-operation with the Medical University of Gdańsk and the joint conduct of many projects and works (e.g. creating the repositories of unique research data MOST DANYCH, made available globally and increasing the citation rate of the obtained research results).

Within this area, such prestigious grants as:

- **"Sustainable food production through quality optimized raw material production and processing for premium quality vegetable products and generated by-products (SUNNIVA)" have been funded under the ERA-NET programme. It was a project carried out by a consortium of 15 scientific and industrial partners from 7 countries, with GUT being a co-ordinating unit.**
- **However, in the project "Ensuring the Integrity of the European Food Chain (FOODINTERGITY)," funded under the EU 7th Framework Programme and realised by a consortium of 72 scientific and industrial partners from 11 countries, GUT was a partner.**

The University carried out also other projects, such as:

- **REGENNOVA - Novel Technologies for Pharmacological Stimulation of Regeneration (STRATEGMED Programme of the National Centre for Research and Development),**
- **TARGETTELO - New Anticancer Compounds Interfering Function of Telomeres (STRATEGMED Programme of the National Centre for Research and Development),**
- **Antioxidant Power Series as a Tool Enabling Rational Design and Assessment of Health-promoting Properties of Functional Food Containing Antioxidant Phytochemical Compounds (MAESTRO Programme of the National Science Centre).**

The infrastructure supporting the development of the area includes unique laboratories equipped with the most modern measuring equipment: Confocal and Fluorescent Microscopy Laboratory, Biomacromolecular Research Workshop, NMR and X-ray Diffractometry Laboratory. Moreover, at the Faculty of Electrical and Control Engineering, there is the Technology Application Unit for testing non-standard chemical and medical equipment.

It is worth emphasising that the strong scientific co-operation between Gdańsk University of Technology and the Medical University of Gdańsk (MUG) already exists. There are several projects being realised, involving considerable financial contributions, which use and develop the potential of both universities, especially in new and promising research areas. Gdańsk University of Technology with the participation of the Medical University of Gdańsk is realising the MOST DANYCH project (with a budget of PLN 27 million), creating a repository of research data, including the unique ones related to the diagnosis of selected diseases. At the same time, at Gdansk University of Technology, the STOS investment (with a budget of PLN 114 million) is being carried out, involving the construction of new premises for the Tricity Academic Supercomputer & network. This investment will create completely new possibilities for the analysis of large sets (in particular, images and films) in order to better diagnose selected diseases using the high-tech diagnostic devices available at the Medical University of Gdańsk. The STOS investment will result in the creation of a computing and data storage centre, linked with the aforementioned universities by a high-speed connection and providing easier access for a large group of young scientists and doctoral students, thus inspiring the conduct of interdisciplinary research. These investments will combine the potential of both universities which are concurrently applying for the status of a research university. Their scientific co-operation has already concerned several Priority Research Areas featured at Gdańsk University of Technology. It also includes current projects and implementations. For example, on the basis of their common technology for the determination of BPA in urine, both universities have founded the Detoxed Home company, which is currently implementing this type of test on the market. As a result of the joint project Hal2010, both universities have developed and granted licenses for the solution: "The method of fixing an implant in the videoscopic surgery of abdominal hernia", supporting doctors in planning and conducting surgical procedures.

The universities are jointly undertaking activities aimed at implementing the invention: "A method and a device to perform the biopsy of soft (usually human) tissue" (filed under the PCT/PL2018/000110). Gdańsk University of Technology and the Medical University of Gdańsk together with the University of Gdańsk and industrial partners are carrying out "REGENNOVA" - the research project, requiring considerable financial contributions, aimed at developing new technologies of pharmacological stimulation and regeneration, within which a number of inventions have been developed that will be implemented by the project

industrial partners. Since 2017, Gdańsk University of Technology together with the Medical University of Gdańsk and the University of Gdańsk have been realising the "Innovation Incubator" project, the aim of which is to create appropriate mechanisms and tools for commercialising the results of the scientific research carried out by these universities. It is worth noting that the co-operation between the universities also includes conducting the intercollegiate field of study, i.e. Mechanical and Medical Engineering. Moreover, researchers from the Medical University of Gdańsk conduct classes in Biomedical Engineering at Gdańsk University of Technology, while students take specialist internships at the Medical University of Gdańsk.

All the above-mentioned and further activities are aimed at the federalisation of Gdańsk University of Technology and the Medical University of Gdańsk, and, in the next stage, at incorporating the University of Gdańsk and possibly other universities of the Tri-City. It is worth adding that in the most important national ranking of all Polish universities, the Perspektywy University Ranking, Gdańsk University of Technology and the Medical University of Gdańsk hold leading positions (in 2019: GUT - 7th place, MUG - 8th place).

S2. Achievements in the field of patent applications, commercialisation and co-operation with business

The most important innovation achievements include commercialised inventions and investigations that respond to the global needs of the society as regards health care: osteoporosis (OSTEMAX Polpharma); cancer, skin diseases (Chitozan - Polish Product of the Future 2019); the globally unique and already commercialised solution supporting people being awaken from coma while using the Cyber-Eye computer; the sensor detecting influenza on the basis of a diamond layer. Currently, the commercialisation process of the technology for manufacturing granulate from thermoplastic starch, protected in four European Patent Convention (EPC) countries by the European patent number EP3064542, is in progress. On the basis of this solution, it is possible to manufacture biodegradable and compostable disposable cutlery. Currently, intensive negotiations are being conducted with numerous enterprises interested in obtaining a license for the production of this granulate.

Gdańsk University of Technology was one of the first in Poland (20 June 2007) to introduce the regulations for the protection and use of intellectual property motivating employees to undertake innovative activities. Currently, GUT has a high number of national and European patent applications. According to the reports of the European Patent Office, in 2015 GUT was in the first place and in 2018 in the third place among Polish universities. Since 2016, Gdańsk University of Technology has been among the top six of the universities applying for the protection of the largest number of inventions in Poland. Based on the study of the technology transfer in European universities, conducted by ASTP Proton, Gdańsk University of Technology is among 30% of the best European universities in terms of the number of obtained protection rights and granted licenses. At the national level, Gdańsk University of Technology has a high number of European patent applications. Last year, 534 patent applications were received from Polish applicants to the EPO last year. Gdańsk University of Technology submitted four such applications.

GUT's commercialisation achievements include many implemented technologies receiving awards from the Ministry of Science and Higher Education and the President of the Republic of Poland, e.g.: the technology of producing alendronate sodium (a medicine for osteoporosis due to which Polpharma SA has captured almost 70% of the European market); „C–Eye" - the technology to support treatment and communication with people being awakened from coma, helping hundreds of patients with neurological problems; the technology of dissolving chitosan in water, used in medicine (hydrogel dressings), cosmetology and food industry (protecting food from spoilage) - recognised as the Polish Product of the Future 2019 . Other developed technologies also respond to emerging socio-economic needs, such as the technology of producing fully biodegradable cutlery from potato starch.

In 2013, GUT created a special purpose company, Excento, whose tasks include indirect commercialisation and the support of commissioned investigations. Since the first year of its operation, the company has been

recording an operating profit, and, together with GUT as the only Polish university, it has launched, under the e-Pionier programme, a proprietary acceleration programme of a total value of approximately PLN 25 million from the funds of the National Centre for Research and Development, and, within this project, over 15 research teams are currently preparing start-up projects.

For many years, Gdańsk University of Technology has been co-operating with the largest domestic fuel companies (Lotos Group, PKN Orlen, PERN "Przyjaźń", Naftoport and Trzebinia Refinery) and energy companies (Energa SA, Kozienice Power Station, Bełchatów Power Plant, Tauron S.A., PSE S.A. - Polish Power System). It conducts joint research projects with international corporations, such as Intel, Samsung, Microsoft, Orange, Ericsson, Bunge Comapany, DNV and many others. GUT is the initiator and the first administrator of Interizon - the fastest-growing (according to Deloitte) ICT cluster in Poland, currently gathering over 140 companies from the IT sector.

The University has a nation-wide position in the field of innovation for the armed forces. The Marine Military Technologies Centre (GUT organisational unit) implements unmanned underwater mine defence systems, as well as navigation and radar systems. It is currently the only scientific beneficiary of the offset programme for the supply of the AW101 Merlin helicopters for the Polish armed forces by the Leonardo group. The university has also launched a university-wide group project programme, in which students during a one-year course solve problems reported and used by partner companies.

Within the POB1 the University has the following patents: "EP 3 064 542 B1. Biodegradable thermoplastic polymer composition, method for its manufacture and use thereof", "Thermoplastic polyurethane-rubber composites and the method of obtaining thermoplastic polyurethane-rubber composites", and other inventions, such as "Corrosive tester as part of an acoustic measurement system used to locate corrosion sources for cargo tanks, ballast watercraft", "Method of obtaining inorganic salts of transition metal acid residues and monovalent cations, in particular in the form of micro- and nanocrystalline", "Hydrogel chitosan membranes".

Within the POB3, a number of inventions have been patented, many of which have been implemented in the production of a series of electronic devices that are applicable in many areas of everyday life (e.g. intelligent lighting systems, stuttering correctors, electronic assistants for children with ASD). It should be emphasised that the graduates from the fields related to this POB belong to a very well remunerated group, and the companies that they established have developed products recognised on the world market (e.g. IVONA speech synthesiser). Within this POB, GUT has rights to over 90 different inventions.

Within POB4 Gdańsk University of Technology has commercialised inventions and research that respond to the global needs of humanity, including:

- **osteoporosis - the original method of synthesising alendronic acid, used in the treatment of osteoporosis. Thanks to it a new generic drug, Ostemax 70 Comfort, produced by Polpharma S.A., appeared on the market,**
- **neoplastic diseases - the compounds with anticancer properties that have obtained a European patent and a US patent (patent procedures are being continued in Canada and Japan)**
- **skin diseases - the invention regarding chitosan composition and the method of producing a hydrogel chitosan membrane: cosmetic Chitozan Natural Sun - soothing sunburns and other skin irritations; ChitoVelum PRO chitosan hydrogels - recognised as the Polish Product of the Future in 2019.**

Another example of a granted patent is "P 3 070 078 B1 Assymetric bis-acridines with antitumor activity and the use there". The most important inventions are as follows: "Asymmetric bisacridines with anticancer activity" and "Antifungal derivatives of Amphotericin B with improved selective toxicity". It should be added that the granted patents have been received recently and their implementation may be expected soon.

S3. A wide range of high-quality study programs at all levels of education

Gdańsk University of Technology develops study programmes in accordance with market expectations and requirements. All first-cycle studies comprise a minimum 120 hours of internships. In addition, the second-cycle studies offer the possibility of long-term research and industrial internships. Long-lasting cooperation with dozens of entrepreneurs and a wide participation of companies at the stage of creating study programmes guarantees graduates' preparation to work in various branches of modern industry and to meet requirements of the 4.0 economy. This is achieved by projects (team projects) and diploma theses where students solve real socio-economic problems reported by entrepreneurs, developing teamwork skills at the same time.

The attractiveness of the offered studies is evidenced by the fact that Gdańsk University of Technology was in the top position for the third time in the ranking of universities most often chosen by candidates for studies in the year 2018/2019, developed by the Ministry of Science and Higher Education. The university is consistently improving its position in key Polish rankings. In 2018, it was ranked ninth among all universities in the country and the fourth among technical universities in the ranking of higher education institutions by the Educational Foundation "Perspektywy". Additionally, three fields of study conducted by two faculties: Civil Engineering accompanied by Geodesy and Cartography at the Faculty of Civil and Environmental Engineering, as well as Electronics and Telecommunications at the Faculty of Electronics, Telecommunications and Informatics were on the podium of the Engineering Studies Ranking by "Perspektywy".

The quality of education undergoes regular assessment by the Polish Accreditation Committee (PKA). In 2018, GUT held 22 valid PKA accreditations, of which 3 were outstanding in terms of programme evaluation. In addition to the PKA standard accreditation certificates, five fields of study at GUT are accredited by KAUT, which is equal to being awarded the European quality certificate 'EUR-ACE® Label' by the European Network for Accreditation of Engineering Education (ENAEE). The Faculty of Management and Economics has achieved the AMBA accreditation (https://zie.pg.edu.pl/de/-/miedzynarodowa-akredytacja-amba-dla-international-management-oraz-master-of-business-administration) and is currently undergoing the AACSB (The Association to Advance Collegiate Schools of Business). accreditation process. The Faculty's ultimate goal is to be granted Triple Crown accreditation for business schools by AMBA, AACSB i EQUIS.

In the academic year 2019-2020, the first-cycle studies are conducted in 33 fields (including five in English), and the second-cycle studies are conducted in 32 fields (including fourteen in English). The growing range of English-language study offer, especially at the second level, results in the dynamic increase of foreign students. In 2019, there are 871 foreigners studying at Gdańsk University of Technology, of which 560 students are undertaking the full education cycle, while the others - at least two semesters of study. In comparison to 2017, the number of foreign students has increased by 30%. One of pro-quality actions that improve the effectiveness of education is reducing the ratio of the number of students per teacher (student-staff-ratio). Compared to 2016, the number of students in the first and second cycle has declined by approximately 20%. This is mainly due to changes in the university's admission policy, which has significantly increased the requirements for candidates, and not the demographic situation.

Gdańsk University of Technology is one of the most pro-doctoral universities in Poland according to the PRODOK competition, which is organized by the National Representation of Doctoral Students (in 2018 GUT took the third place). Doctoral studies have been conducted for 30 years, currently in 18 disciplines at all faculties. Owing to continuous improvement of their programmes and organisation, doctoral studies meet the principles of innovative education for doctoral students.

The quality of doctoral studies is also enhanced by projects implemented from external funds (previously from the POKL programme, currently from the POWER programme), which provide additional funding for conference trips, research internships or lectures by visiting professors. Of particular importance is the project implemented since April 2018, namely "Integrated Development Programme of Gdańsk University of Technology" (POWER 3.5), which aims at improving the quality of education in the second and third cycle studies. The university also benefits from the PROM programme financed by the Polish National Agency for Academic Exchange - NAWA. For two years, GUT has been funding several scholarships for foreign doctoral students annually.

The doctoral offer also includes initiatives that go beyond the university, for example, interdisciplinary environmental studies INTERCHEM and InterPhD2 (conducted jointly with the Faculty of Chemistry at the University of Gdańsk). INTERCHEM doctoral students participate in the project "Development of an

Interdisciplinary Doctoral Study Programme at International Level".

It is noteworthy that since the academic year 2018/2019 three faculties at Gdańsk University of Technology have introduced the possibility of implementation doctorates programme conducted in cooperation with the industry.

For 10 years, Gdańsk University of Technology has also been offering MBA studies at the Faculty of Management and Economics. In 2019, for the first time the MBA GUT programme was ranked in the international QS ranking, which classifies the best MBA Executive programmes in the world. The "International MBA in Strategy, Programme and Project Management" programme was classified in the range of 101+ universities from all over the world, among prestigious universities such as MIT (USA), Penn (USA), London Business School (Great Britain), Berkeley (USA) and IESE Business School (Spain). It should be emphasized that the MBA GUT programme is the only Polish programme classified in this ranking.

Due to its attractiveness and appropriate recruitment of candidates, the MBA GUT programme obtained the highest score in the Executive Profile indicator (one of the five making the ranking), which ranked it 10th in Europe and 19th in the world in this indicator classification. In another indicator, measuring the average salary increase of students from pre to post programme, the MBA GUT took the 26th place in Europe. MBA studies at GUT were also awarded the international certificate of Association of Masters in Business Administration (AMBA). This accreditation confirms the highest quality of education.

In the scope of selected POBs, Gdańsk University of Technology provides education the following fields:

- **POB1: Chemistry in Construction Engineering; Materials Engineering; Corrosion; Nanotechnology; Chemical Technology.**
- **POB2: Civil Engineering; Environmental Engineering; Power Engineering; Electrical Engineering; Chemistry in Construction Engineering; Spatial Development; Marine and Coastal Engineering; Ocean Engineering; Engineering and Technology of Energy Carriers; Green Technologies and Monitoring.**
- **POB3: Informatics; Mechatronics; Data Engineering; Biomedical Engineering; Electronics and Telecommunications; Automation, Robotics and Control Systems.**
- **POB4: Biotechnology; Nanotechnology; Medical and Mechanical Engineering; Chemistry; Biomedical Engineering. In all above-mentioned areas, about 9,800 students are educated, which constitutes 65% of all students currently studying at GUT.**

S4. Initiated implementation of pro-quality solutions in the area of organisation and management, in order to support scientific activity of the academic staff

Gdańsk University of Technology attaches great importance to continuous development and offers new solutions in the area of organizational and management, whose aim is to support enhancement of scientific and research activity. One of the initiated actions in terms of organization is the decision to synchronize the activity of researchers representing these scientific disciplines and working at different faculties. The change will consolidate and strengthen research capacity, and consequently, contribute to the enhancement of research activity.

With the introduction of the Constitution for Science - the Law on Higher Education and Science, academic teachers were asked to identify their research and teaching activity with an appropriate discipline, or two. In the next stage, faculties authorities defined future career paths for their academic staff, either in the scope of research and teaching, or teaching as their primary responsibility. Individual career paths were devised after interviews between faculty authorities with employees and also on the basis of academic teachers individual development plans, as well as their scientific achievements measured by publication bibliometric indicators, research projects obtained, and citation rates. The procedures implemented are essential in view of disciplines evaluation in 2020. Thus, research and teaching positions will be held by motivated academic staff, able to meet the requirements for their scientific activity. At the same time, the potential of academic staff holding teaching positions is used, ensuring the education of future engineering staff, sought after by business and industry of the region and country.

Development of IT systems of Gdańsk University of Technology constituted an essential organisational change, which began in 2010 with the contract for eUniversity, a project devising and implementing

eServices platform at GUT for information society of the Pomerania voivodship. In the period of execution of the project, a number of innovative tools for efficient management and functioning of the university has increased. The development of IT systems supporting university resources and devising procedures and tools, which supported publishing Open Science, continued and resulted in the implementation of the project MOST Wiedzy (Knowledge Platform). The project included designing and building the platform which integrates records from many databases, including that of Gdańsk University of Technology, as well as other research units. The platform MOST Wiedzy improves accessibility and makes it possible to share and re-use scientific knowledge and technologies. It contributes towards promotion of scientific achievements, improves citation rate, and increases the visibility of research findings.

The project MOST Wiedzy (the funding of which exceeds PLN 9.7m) received an award 'Cloud Computing – solutions in a cloud' in the competition Liderzy IT 2018 (IT Leaders 2018), organised within IT Future Expo fairs. The 'eUniversity' project received a prestigious award Skrzydła IT in Administration (IT Wings in Administration) in 2017. Another project which needs to be mentioned is called MOST DANYCH, the funding of which amounts to 27m PLN. The objective of the project is to design and build a platform which allows open research data to be collected, searched, analysed and made available. It also makes it possible to provide the platform with unique data gathered from the three most important universities in Pomerania: Gdańsk University of Technology, Medical University of Gdańsk and University of Gdańsk. The data will be available to scientific community, entrepreneurs and society free of charge. The data will be made available free of charge to academics, researchers, entrepreneurs and society. Thus created database will enable the implementation of the Open Research Data policy and make use of research data to receive more citations of scholarly output by GUT scientists. The funds obtained for this project will allow for setting up MOST DANYCH - a centre of competence unique on the national level.

In 2017, the European Commission granted Gdańsk University of Technology the right to use the prestigious HR Excellence in Research logo. Gdańsk University of Technology was thus recognised as an institution creating one of the best working and development conditions for researchers in Europe. The HR Excellence in Research logo is a quality mark confirming the application of the highest standards in conducting research and in employing the research staff. The right to use this logo confirms that a given institution meets the highest European standards and increases the interest of potential candidates for scientific positions. Gdańsk University of Technology has also joined the prestigious EUA-Institutional Evaluation Programme, within which its activity in the areas of education, research and cooperation with the environment has been assessed by an international team of experts from the EUA.

In addition, GUT has twice received the ELSEVIER Research Impact Leaders award, for 2016 and 2017, in the Social Sciences category. The award is granted to the universities whose publications have had the greatest impact on the way in which the Polish science is perceived in the world. The increase in the number of articles in the most prestigious scientific journals with the participation of foreign co-authors and the level of citations in a given discipline were taken into account. Granting this award confirms that a technical university like GUT pays great attention to the development of disciplines that go beyond technical sciences. The appreciation of the GUT scientists' achievements in the category of social sciences indicates that the interpenetration of individual disciplines plays an important role in the conducted research and supports the ascertainment that the University is an organisation serving the environment.

S5. Attractive location, modern academic infrastructure, reliable financial status, good support offered to students

Gdansk is a multidisciplinary and strong scientific center. Three universities: the Gdańsk Medical University, Gdańsk University of Technology and the University of Gdańsk conduct research, practically in all scientific disciplines. The growing scientific cooperation of these universities allows to achieve results of international importance. The educational offer is wide and also in this respect is cooperation between universities in the implementation of many fields of study. Such an integrated learning environment offers candidates for study a wide range of choices.

Thanks to the attractiveness of the region, the unique location of Gdańsk University of Technology by the

Baltic Sea can be another encouraging factor to study and cooperate in all areas of the university activity. Gdańsk is an exceptional city due to its beautiful architecture and geographical location as well as its extraordinary history stretching back over 1000 years. It seems to be one of the most attractive tourist cities in Europe, which is proved by its third position in the European Best Destinations poll in 2017.

The campus of Gdańsk University of Technology is located almost in the heart of the city and covers an area of 77 ha. Historic buildings are combined here with modern research laboratories and green areas in a particularly picturesque way. In 2018 the campus of GUT came the 6th in the Times Higher Education ranking and thus it was amongst the top 10 most beautiful universities in Europe, together with universities in Bologna, Salamanca and Uppsala.

The university systematically invests in the development of research infrastructure. Annually, Gdańsk University of Technology spends over PLN 3 million on investment. (In 2018 it was PLN 5.6m, in 2017 – PLN 2.8m, in 2016 – PLN 4.5m, in 2015 – PLN 18.9 m, and in 2014 – PLN 4.6 m.)

Currently, GUT has over 600 teaching and research laboratories, many of which offer a high, world-class standard. Among them there are: the Nanotechnology Centre, the Laboratory for Innovative Power Technologies and Integration of Renewable Energy Sources LINTE^2, Immersive 3D Visualization Lab I3DVL, the ProtoLab Prototype Workshop, and already planned investments like the High-Performance Computing and Data Storage Centre STOS or the Eco-Innovation Centre.

Gdańsk University of Technology has a modern Academic Sports Center consisting of a complex of swimming pools, a newly renovated, full-sized sports hall for team games, a football pitch, climbing wall, two beach volleyball courts and a rowing tank, which is a unique facility in Poland. Several dozen sports sections are active in the Academic Sports Center, including swimming, athletics, judo, volleyball, football, tennis and table tennis. Their players are successful both in Polish Academic Championships and in international sports events.

The student housing facilities of GUT offer nearly 3,000 places of accommodation in 12 dormitories situated in three different locations in Gdansk. Dormitories include well-equipped single and double rooms, bathrooms, kitchens, gyms and tennis halls, all with a universal access to the high-speed broadband Internet (10 Gb/s). Most student dormitories have been adapted to meet the needs of people with disabilities.

The Academic Club of Gdańsk University of Technology 'Kwadratowa', which is geared towards students, has been operating for over 60 years. The club is located in the building of the GUT Student Centre 'Bratniak', where the first Student Parliament in Poland was established. In the course of its long history, the club has hosted concerts, cabaret performances, shows and events aimed at integrating the widely understood academic community. In addition to organizing regular events, 'Kwadratowa' gives both students and residents of the region the opportunity to participate in many cultural events.

As far as PhD students support is concerned, they can participate in additional courses, such as lectures given by visiting professors, soft-skills classes in English and summer schools. It is also possible to receive additional financial support in the form of scholarships awarded through a competition process (e.g. pro-quality scholarship financed under several dedicated support programmes for PhD students). The university supports the mobility of PhD students also within the framework of other projects implemented at GUT, i.e. Erasmus+ programme and the PROM project financed by the Polish National Agency for Academic Exchange. PhD students also have an opportunity to participate in internships, conferences, seminars and symposia as well as summer and winter schools of international character.

Foreign students enrolled on doctoral programmes in 2018/2019 can obtain, in a competition process, a scholarship of PLN 3,000 per month. The InterScholar PhD Alpha competition is addressed to all foreigners wishing to be admitted to doctoral programmes on conditions other than those applicable to Polish citizens. It provides a scholarship for a period of 4 years, together with the exemption from tuition fees. The InterScholar PhD Beta competition is addressed to foreigners from selected countries wishing to be admitted to doctoral programmes on conditions other than those applicable to Polish citizens. It provides a scholarship for one year, with the possibility of applying for its extension and for exemption from tuition fees. The admission of PhD students from outside Poland is also planned as part of scholarships awarded to PhD students who will be admitted to the newly organized Doctoral School.

At Gdańsk University of Technology operates one of the most active branches of the Erasmus Student Network (ESN). It offers new students participation in an 'Orientation Week' as well as integration meetings, tourist trips and sports activities during the academic year. The ESN is engaged in the Social

Erasmus programme, whose participants work for local communities (meetings in schools, hospitals, etc.). Moreover, the ESN runs a programme under which every exchange student has a mentor assigned, whose task is to facilitate acclimatization in a new place and help in choosing accommodation.

Regarding foreign students and scientists visiting the university, a similar role is performed by the International Relations Office (IRO). The IRO holds information meetings, such as the 'Welcome meeting', 'How to apply for Polish Residence Permit' as well as any other according to the needs, e.g. 'Safe and Security'.

Gdańsk University of Technology is the first university in the region that has launched its own participatory budget. Each employee and student of GUT can propose an idea, which is then put to the vote. The participatory budget in each of the three previous editions amounted to PLN 500,000, of which PLN 350,000 was allocated to the implementation of employee projects, and PLN 150,000 to the implementation of the student ones. The projects already completed include the queuing system for the dean's office and the Faculty Scholarship Committee implemented at two faculties, the ecological and energy-saving lighting of two buildings at the Faculty of Electrical and Control Engineering and a sauna at the Academic Sports Center of Gdańsk University of Technology.

Gdańsk University of Technology designs its financial policy in an effective manner, and so does not experience problems with financing its activities in virtually all areas. The GUT business balance is positive, which allows for rational planning of both investment expenditure and expenditure on scientific equipment. In 2018, the university balances its accounts with a surplus of PLN 26m.

2. Description of WEAKNESSES

W1. Lack of university-wide standards and procedures for the implementation of pro-quality processes in the field of scientific activity, commercialisation, support for students, PhD students and academics

Survey carried out among 503 academic teachers from Gdańsk University of Technology shows that fundamental factors hindering the scientific activity are: excessive bureaucracy (indicated by about 70% respondents) and organisational duties (about 80% respondents). It confirms lack of uniform university standards and procedures concerning execution of all processes at the University, particularly, administrative and technical services.

In a preliminary analysis of current procedures carried out by the University authorities, lack of uniform standards and regulations in some scientific activity areas has been observed, including comprehensive support in grant acquisition and implementation. It also concerns support for publishing articles in journals and scholarly books with an international dimension as well as membership in international organisations. Moreover, there are no process standards and uniform solutions on the university level, i.a. concerning commercialisation, support for students, visiting professors, IT infrastructure and research infrastructure management. The University seems to function more like a federation of faculties than an organized entity basing on uniform regulations where necessary.

The Constitution for Science has introduced an opportunity of education exempt from tuition fees for doctoral students from countries outside the EU. The University expects a significant increase of interested candidates from this group. In 2018, the number of foreigners willing to pursue doctoral students was already greater than it had been up till then. As a result, the number of foreign students on doctoral programmes is the highest in history (38 persons as of 31 December 2018). The reason for the rising number of applications may not be real willingness to pursue studies in the doctoral school but rather an opportunity to come to Poland and obtain a grant. Each application needs to be investigated, answered and supported, which poses a risk that it will not be feasible to process the increasing number of applications by GUT administration within the present organisational regulations.

W2. Lack of effective mechanisms for recruitment of academic staff with high research potential and recognized international position

Recent years have witnessed a growing number of lectures conducted by visiting professors, which may be partially the result of taking advantage of the Erasmus+ programme. However, there is a problem of recruiting staff with a significant international position for scientific research. The GUT does not have a comprehensive recruitment system of such staff. Job offers for professors are now limited to the national level, with remuneration and organisational offer considerably different from the one in developed countries. There are no mechanisms of establishing contacts with both prominent and young researchers - the ERC grant winners, encouraging them to implement them at GUT. Neither are there promotion elements of GUT related to attractive conditions arising from its location in Pomerania and infrastructure.

W3. Limited activities supporting the professional career development of academic staff, in particular young scientists

In a survey carried out among 503 academic teachers from Gdańsk University of Technology, together with individual interviews, respondents pointed out three desirable directions of the staff competences development. It includes language skills, teamwork skills (within the same and different disciplines) and organisational (management) skills. Respondents also notice the necessity to improve soft skills such as autonomous work, creativity, time management skills, ambitions and curiosity. Other needs include development of the following: technical and scientific skills, programming, analytical and specialist skills (related to particular research areas). Young research workers, in turn, emphasised the necessity to improve research results presentation skills. The administration that is supposed to support research and teaching workers has limited opportunities to participate in both external and in-house training. Taking into account internationalisation of education at the University, there is a need for language courses also for staff members providing teaching process support and widely understood research activity.

The University lacks so called 'soft' Human Resources that would deal with development paths planning, training courses, mentoring and coaching for all groups of employees. Another low position in the survey is held by the current employee interim evaluation system, mainly because it it very subjective.

W4. Poor international recognition and weak support for the development of international cooperation

A significant factor influencing international cooperation is the limited mobility of GUT researchers. The survey carried out among 503 academic teachers from Gdańsk University of Technology shows that main factors limiting the international mobility are: family circumstances (for example, child care) - 40% respondents, lacking or insufficient financial support from the University - 30%, teaching duties (e.g. impossibility to organise replacement) - 25%.

Insufficient international promotion is another disadvantage. The University does not have tools to satisfactory position its research achievements despite some progress in this field, namely the introduction of the MOST WIEDZY platform, which provides information on achievements of every GUT employee. In spite of individual employees attempts, the number of undertakings in international cooperation, international contracts and publications prepared within international cooperation is relatively low.

In the recent years, the offer of study programmes in English has been extended by additional fields of study, mainly in second-cycle programmes; however, due to an insufficient number of candidates for studies in English, there are instances when the courses do not start. In 2018, the number of students in the fields conducted in English fell by 17%, and the number of foreign students - by ca. 6%.

Gdańsk University of Technology participates in fifteen projects funded under the HORIZON 2020 Programme. Compared to previous years, we are observing some decrease, which is related to the fact that our University researchers are becoming less interested in the EU Framework Programmes. It is caused i.a. by a significant release of national resources for research provided by the National Science Centre and the National Centre for Research and Development under other bilateral and multilateral research programmes. Thus, an incentive system for GUT research workers must be introduced (for example, financing active participation in information days and brokerage events organised by the European Commission), which will allow for an increase of the University international recognition and enable realisation of research projects on the highest international level at GUT.

Gdańsk University of Technology has a vast cooperation network but is not present in most important higher school rankings, which affects both international cooperation and the admission process of increasingly better prepared candidates for studies and doctoral studies.

Another factor contributing to the University poor international recognition is the fact that the University employs few foreign academic teachers and rarely coordinates international projects. Furthermore, insufficient resources are allocated for international promotion. This situation could be resolved by appointing a team for image campaigns and an extensive promotion of the University outside Poland.

W5. Poor scientific activity of part of researchers and PhD students

The survey carried out among 503 academic teachers and doctoral students from Gdańsk University of Technology shows that the age structure of the respondents provides partial explanation to the causes of poor activity. It can be observed that the higher the age, the lower the scientific activity. The target of the survey were all staff members, and the age structure of the respondents is the following: up to 30 years - 40%, 36-45 years - 29%, 46-55 years - 18%, over 55 years - 13%. It can be assumed that low staff interest in the survey may also prove low staff activity.

According to the same survey, in the individual interviews part, the respondents indicated factors hindering the scientific activity. Among these factors were: excessive teaching work load limiting the time for conducting research, insufficient research funding and remuneration, insufficient interest in European grants acquisition as project leaders, insufficient interest in organisation of international research teams - greater emphasis being on organisation of smaller-range teams, for example within one department.

The poor scientific activity is also caused by the age structure of research workers. In some organisational units there is an evident generation gap, and many senior employees are inactive in the area of scientific activity.

3. Description of OPPORTUNITIES

O1. Flexibility of using public subsidy that is the main source of university funding

The transition of university funding basis from grants to subsidies is a great opportunity for the university. Gdańsk University of Technology, whose scientific potential and achievements on the international scale indicate that it has a chance to become a research university, already this year has increased funding for research in relation to the last year's level of financing these expenses. The university authorities declare that such a policy will be continued in the following years. The additional funds will be used, among others, for the support of researchers (especially young workers) and for the support in preparatory work while applying for grants, especially in POBs.

Gdańsk University of Technology has a good financial situation and there are no problems with financing the wage bill and planned investments, so such pro-development activities can be undertaken. Funds have already been allocated and a competition system has been created to obtain funding for visiting professors, proofreading support and a scholarship system for students and PhD students from outside Poland.

O2. Current rules of the research-evaluation system that assesses broad scientific disciplines and rewards more active cooperation of larger groups of researchers

The new rules of research-evaluation system, assessing research activity within broad disciplines, will promote a more even level of scientific involvement among all employees. The obligation to fill four "slots" by each qualified researcher will motivate employees on the one hand and will be the basis for staff monitoring and evaluation of the scientific activity on the other hand. It also broadens the staff awareness of common contribution to the assessment of the university and of the fact that it depends on every one of them how the GUT will be assessed.

A wide information campaign about the necessity of publishing in renowned international journals has been carried out for many years. This also forced radical organizational changes. All employees who want to have the status of a research and teaching worker had to present their scientific plans, on the basis of which the faculties' authorities assessed their feasibility. This is an opportunity for the university to verify the staff policy, as well as to manage the support for scientific employees who are seeking rapid development.

These statutory regulations, if properly used, are an opportunity for the Gdańsk University of Technology to obtain the status of a research university. This requires the involvement of research and teaching staff and it can be concluded that a large group of them is motivated to scientific development. On the basis of research conducted on a sample of 503 academic teachers and 112 doctoral students from the Gdańsk University of Technology, it can be stated what are the motivating factors for them to engage in scientific activity. In the case of academic teachers, 56% declare their willingness to develop scientifically and 59% their own satisfaction with the role played at university. In the case of PhD students, 77% declare the will to develop scientifically and 57% their own satisfaction. It can be assessed that the motivation to intensify scientific work is relatively high.

O3. Available financial support from a diversity of sources in scientific disciplines covering priority research areas

As a result of the analysis, funding programmes were selected to allow the extension of the university's presence in the international environment in the context of scientific research conducted within the POBs. These include ERC - European Research Council; HORIZON 2020, HORIZON EUROPE; EIT - European Institute of Innovation and Technology; SPS - NATO Science for Peace and Security; EUREKA; International Research Agendas; COST – the European Cooperation in Science and Technology; Maria Skłodowska-Curie actions (ITN, IF, RISE, COFUND); NAWA / Bilateral exchange of scientists; NAWA / the Bekker Programme; Bilateral and Multilateral Cooperation International Programmes funded by the National Science Centre and the National Centre for Research and Development. All the indicated programmes give a chance to obtain significant funds for cooperation and international exchange for GUT researchers, regardless of budget subsidies. The

growth of programmes and funding sources means the increase in chances of obtaining them, especially when organizational changes at GUT will force greater activity of scientists in the need to raise funds for research and international cooperation.

O4. Demographic trends and legal regulations that stimulate improvements of the quality of education

Demographic changes in Poland have been noticed at all levels of education for several years. The number of students is also decreasing annually – in 2018 the number of applicants for all types of graduate studies decreased by 7.5%. This means a tightening of competition for students among universities, which results in improvements in the quality of the education offered.

Following this situation, the new regulations for financing higher education make the amount of subsidies dependent on the student-staff-ratio (SSR). This is to change the model of education from the current mass model to a high-quality educational model.

At the GUT certain measures have already been taken to departs from mass education. The admission limits have been reduced for the majority of fields of study. A smaller number of students is an opportunity to introduce more effective and quality-oriented organization of the educational process, e.g. by accepting smaller groups of students, introducing study programs with a modular structure and offering new project-based teaching curricula.

Also in the case of PhD education, the new regulations impose on universities the obligation of significant pro-quality reorganization. In the academic year 2019/2020, the GUT launched a doctoral school which will have a new program implemented entirely in English, which will contribute to the internationalization of the studies. The number of candidates for PhD students from outside Poland is expected to increase. The new regulations and related activities related to the launch of a doctoral school are an opportunity to increase the quality and efficiency of the process of obtaining doctoral degrees at the GUT.

4. Description of THREATS

T1. Strong competition in the global market of higher education

Global competition in higher education is a relatively new phenomenon, associated with the development of the worldwide "knowledge economy" and the impact of globalization. Global competition is fueled by the idea of the "world-class university", supported by international organizations like the World Bank and the OECD, and now manifested in global rankings of universities that first appeared in the early part of this century. As a result, more and more universities define themselves in global competitive terms.

Prestige hungry universities seek enrollment strategies, and faculty recruitment and promotion procedures, seek research capacity-building and excellence initiatives, and regionalization and international cooperation that are different than in the past. They are becoming or want to become, in one form or another, transformed institutions. Adding the pressure to improve their rankings, national ministries and other university stakeholders also evaluate the quality and performance of their national leading universities through the prism of rankings that focus largely on research productivity and citation analysis (Chirikov, UC Berkeley 2016).

Poor recognition of the GUT on the international arena applies to both scientific and educational activities. Low university positions in prestigious international rankings, including Times Higher Education - World University Rankings (THE), QS World University Rankings, are becoming a barrier in acquiring the best foreign students who make their decisions based on the rankings and international position of the university. In recent years, Gdańsk University of Technology has been classified in the THE ranking in the ranges of 600-1000+. As far as the QS ranking is concerned, the GUT unfortunately does not qualify for the global ranking, but since 2017 it has been noted in the regional ranking of QS EECA (Emerging Europe and Central Asia University Ranking) on the 137th position, and in 2018 on the 108th position.

T2. Changing legal regulations that hampers the functioning of the university

Frequent changes in legal regulations concerning not only the Law on Higher Education and Science but all aspects of the university activities, may cause serious disruptions in the university functioning. There is no doubt about the significance of changes; however, the deadline for their implementation provided by the legislator is often too short. It can be exemplified by the change of the grant division algorithm from two years ago, or the Constitution for Science implemented in this academic year, which fundamentally changes the functioning of the university in practically all areas. The most dangerous is the implementation of laws to which not all ordinances are prepared yet.

In such large and complex systems as higher education, changes should be well prepared and introduced gradually, with a sufficiently long transitional period.

Problems with obtaining a visa (e.g. in India, in consulates in New Delhi, Mumbai and Abuja) constitute one of the major barriers to further development of education for foreigners and hinder the internationalization of the university. Visa problems often make it impossible for candidates who have successfully passed the admission procedure to take up their studies on time.

Changes of legal regulations are a noticeable difficulty in preparing an offer and conducting admission procedure for foreign students. Such changes require the university to properly prepare and implement them well in advance, bearing in mind the decision-making time of candidates who need several months to decide to study in Poland. Moreover, the introduction of statutory provisions which do not provide for exemptions from fees for studying in a foreign language for foreigners from the European Union countries, may reduce the number of candidates for studies conducted in English.

T3. Strong salary competition from the business sector that brain-drains academic staff, especially young scientists

The analysis of independent reports on the labor market, eg "Talent shortage 2018" (Manpower) or "Labor barometer" (Voivodeship Labor Office, Kraków 2018), indicates a growing deficit of employees in engineering professions. This applies mainly to industries related to the ICT market and in the field of electrical engineering, chemistry and construction. Due to the lack of engineers, employers tend to hire people without full education, including studying graduate students. The high demand for specialists is primarily

found in large cities, where the GUT also operates.

A reflection of the demand for engineering staff is the high level of salaries received by the GUT graduates, as evidenced by the National Remuneration Research (OBW, Sedlak & Sedlak). High demand on the labor market, and therefore strong salary competition in industries that partly overlap with the research priority areas (POBs), may be the reason for the outflow of young researchers to the business sector.

The scholarship system for doctoral students is not competitive in relation to salaries offered by companies. Similarly, salaries of young employees after PhD studies is not a motivating factor to stay at the university, which results in the resignation of many young and talented researchers from work at the university. Another factor is high mobility in the group of doctoral students and young scientists, resulting in the ease of finding financially attractive work, not only in Poland, but also in the European or even the world market.

As a consequence, this risk is reflected in the academic staff structure of the GUT, which is characterized by a nearly two-fold advantage of employees over 40 years of age over persons aged up to 40. The generation gap among scientists increases for last years.

T4. Unstable rules of the research-evaluation system that may lower the academic rank in the future

In the last evaluation of scientific activity, carried out in 2017 for the years 2013-2016, most faculties of Gdańsk University of Technology obtained very good results. Changes to the principles of parameterization resulting from the introduction of the new Law on Higher Education and Science are a serious threat. The transition from assessing organizational units (faculties) to assessing disciplines, as well as a significant change in the procedure for selecting publications for evaluation, can have consequences that are difficult to predict. There are faculties including more than one discipline, so the output counted so far per faculty shall now be divided into disciplines. The second important factor is the inclusion of all researchers in the assessment of publications, which can have a significant impact on the assessment with uneven achievement of individual employees. In such cases, it can be assumed that the obtained assessment will be strongly influenced by a group of less active people in a given discipline.

Another risk factor is the lack of a list of journals and points assigned to them. Due to the fact that the publication cycle lasts sometimes even two years, submitting an article proposal to a currently well-rated journal may turn out to be a failure, regarding the assessment of the scientific activity quality, if its position is lower or it is not included in the new list.

SWOT

STRENGTHS

S1 High scientific potential and effective cooperation with domestic and foreign universities in the selected technological areas that respond to important challenges faced by the worldwide science

S2 Achievements in the field of patent applications, commercialisation and co-operation with business

S3 A wide range of high-quality study programs at all levels of education

S4 Initiated implementation of pro-quality solutions in the area of organisation and management, in order to support scientific activity of the academic staff

S5 Attractive location, modern academic infrastructure, reliable financial status, good support offered to students

WEAKNESSES

W1 Lack of university standards and procedures for the implementation of pro-quality processes in the field of scientific activity, commercialisation, support for students, PhD students and academics

W2 Lack of effective mechanisms for recruitment of academic staff with high research potential and recognized international position

W3 Limited activities supporting the professional career development of academic staff, in particular young scientists

W4 Poor international recognition and weak support for the development of international cooperation

W5 Poor scientific activity of part of researchers and PhD students

OPPORTUNITIES

O1 Flexibility of using public subsidy that is the main source of university funding

O2 Current rules of the research-evaluation system that assesses broad scientific disciplines and rewards more active cooperation of larger groups of researchers

O3 Available financial support from a diversity of sources in scientific disciplines covering priority research areas

O4 Demographic trends and legal regulations that stimulate improvement of the quality of education

THREATS

T1 Strong competition in the global market of higher education

T2 Changing legal regulations that hampers the functioning of the university

T3 Strong salary competition from the business sector that brain-drains academic staff, especially young scientists

T4 Unstable rules of the research-evaluation system that may lower the academic rank in the future

Priority Research Areas (POB) identified within the SWOT Analysis

Description of the POB scope	« POB1 » MATERIALS ENGINEERING	
Fields and disciplines of science laid down in the Regulation of the Minister of Science and Higher Education of 20 September 2018 on fields and disciplines of science and disciplines of arts (Journal of Laws, item 1818), related to POB	Web of Science *subject categories* related to POB	Scopus ASJC (*all science journal classification*) categories related to POB
2.7 - Engineering and technology / Materials engineering 6.5 - Natural sciences / Chemical sciences 6.6 - Natural sciences / Physical sciences	– Construction & Building Technology – Crystallography – Materials Science, Biomaterials – Materials Science, Ceramics – Materials Science, Coatings & Films – Materials Science, Composites – Nanoscience & Nanotechnology	– Mechanics of Materials – General Materials Science – Condensed Matter Physics
Fields of study related to POB	Chemistry in Construction Engineering; Materials Engineering; Corrosion; Nanotechnology; Chemical Technology	

Description of the POB scope	« POB2 » ENVIRONMENTAL ENGINEERING, GREEN POWER ENGINEERING AND SUSTAINABLE CONSTRUCTION (CIVIL ENGINEERING)	
Fields and disciplines of science laid down in the Regulation of the Minister of Science and Higher Education of 20 September 2018 on fields and disciplines of science and disciplines of arts (Journal of Laws, item 1818), related to POB	Web of Science *subject categories* related to POB	Scopus ASJC (*all science journal classification*) categories related to POB
2.1 - Engineering and technology / Architecture and urban studies 2.6 - Engineering and technology / Civil engineering and transport 2.9 - Engineering and technology / Environmental engineering, mining and energy 6.5 - Natural sciences / Chemical sciences	– Construction & Building Technology – Energy & Fuels – Engineering, Electrical & Electronic – Engineering, Environmental – Environmental Sciences – Green & Sustainable Science & Technology – Water Resources	– Earth and Planetary Sciences (miscellaneous) – Atmospheric Science – Economic Geology – Geochemistry and Petrology – Geology – Geophysics – Geotechnical Engineering and Engineering Geology – Oceanography – General Energy – General Engineering – Civil and Structural Engineering – Building and Construction – Architecture – General Environmental Science
Fields of study related to POB	Civil Engineering, Environmental Engineering; Energetics; Electrical Engineering; Chemistry in Construction Engineering; Spatial development; Marine and coast engineering; Ocean Technology; Engineering and technologies of energy carriers; Green Technologies and Monitoring	

Description of the POB scope	« POB3 » ELECTRONICS, MECHATRONICS AND INFORMATION TECHNOLOGIES (ICT)	
Fields and disciplines of science laid down in the Regulation of the Minister of Science and Higher Education of 20 September 2018 on fields and disciplines of science and disciplines of arts (Journal of Laws, item 1818), related to POB	Web of Science *subject categories* related to POB	Scopus ASJC (*all science journal classification*) categories related to POB
2.2 - Engineering and technology / Automation, and electronic and electrical engineering 2.3 - Engineering and technology / Information and communication technology 2.4 - Engineering and technology / Biomedical engineering	– Automation & Control Systems – Computer Science, Artificial Intelligence – Computer Science, Cybernetics – Computer Science, Information Systems – Engineering, Electrical & Electronic – Telecommunications	– General Computer Science – Computer Science (miscellaneous) – Computer Networks and Communications – Computer Science Applications – Human-Computer Interaction – Information Systems – Signal Processing – Aerospace Engineering – Control and Systems Engineering – Electrical and Electronic Engineering – Industrial and Manufacturing Engineering – Mechanical Engineering – Ocean Engineering – Computational Mathematics – Modelling and Simulation – Theoretical Computer Science
Fields of study related to POB	Informatics; Mechatronics; Data engineering; Biomedical engineering; Electronics and communication; Automatic Control and Robotics Systems	

Description of the POB scope	« POB4 » BIOMEDICAL ENGINEERING, BIOTECHNOLOGY	
Fields and disciplines of science laid down in the Regulation of the Minister of Science and Higher Education of 20 September 2018 on fields and disciplines of science and disciplines of arts (Journal of Laws, item 1818), related to POB	Web of Science *subject categories* related to POB	Scopus ASJC (*all science journal classification*) categories related to POB
2.5 - Engineering and technology / Chemical engineering 3.1 - Medical and health sciences / Pharmacology and pharmacy 3.4 - Medical and health sciences / Health sciences 6.5 - Natural sciences / Chemical sciences	– Biochemistry & Molecular Biology – Biotechnology & Applied Microbiology – Cell Biology – Chemistry, Analytical – Chemistry, Applied – Chemistry, Medicinal – Chemistry, Organic – Microbiology – Nutrition & Dietetics – Pharmacology & Pharmacy	– Food Science – General Biochemistry, Genetics and Molecular Biology – Biochemistry – Biotechnology – Cell Biology – Clinical Biochemistry – Molecular Biology – Structural Biology – General Chemical Engineering – General Chemistry – Analytical Chemistry – Organic Chemistry – Spectroscopy – Biomedical Engineering – General Medicine – Medicine (miscellaneous) – Immunology and Allergy – Oncology – Pharmacology (medical) – Radiology Nuclear Medicine and imaging – Drug Discovery – Pharmacology
Fields of study related to POB	Biotechnology; Nanotechnology; Mechanical and Medical engineering; Chemistry; Biomedical Engineering	