The needs of the university's socio-economic environment

– what are they and how to research them?

European Funds
Knowledge Education Development

Republic of Poland

Warsaw University of Technology

European Union
European Social Fund

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REPORT

prepared as part of a project entitled

"NERW2 PW. Science – Education – Development – Cooperation" co-financed by the European Union form the European Social Fund as part of the Knowledge Education Development Operational Programme.

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Warsaw, 2022

TABLE OF CONTENTS

INTRODUCTION

Data-driven management creates value for every project and organisation; it allows the consolidation of actions in a current, thoroughly explored context and helps sensitise organisations to future challenges, risks and opportunities as well. A research university, as a large institution engaged in a number of activities and a partner to diverse stakeholders, may only benefit from research.

Research into the needs of the socio-economic environment in various areas (quality of education, cooperation) facilitates the improvement of the quality of processes offered by universities, with emphasis on research and collaboration with external stakeholders.

We offer our university not only research on the needs of recipients / users, but also a diagnosis of the demand for processes, products and services, along with defining groups of recipients, competition research, quality analyses, evaluation assessments, e.g. in terms of process efficiency, creative problem solving (Design Thinking), development of new products and services (Service Design), Business Intelligence and usability research (UX).

For nearly 10 years, we have been perfecting the research workshop in diagnosing the needs and expectations of science and business and supporting the process of networking science and business. As an auxiliary research unit, we were established in 2012 as part of the project "Improving the quality of WUT management", and for over five years - already as the Research and Analysis Department at the Centre for Innovation Management and Technology Transfer of the Warsaw University of Technology - we have been carrying out research useful for both university units and business, supporting the development of innovations (including non-technological ones), transfer of technologies and innovations, exploring academic entrepreneurship.

At that time, we began to notice the usefulness of our works and their real impact on the functioning of the university. Consistent research commitment at the interface between science and business allows us to collect current analytical material, useful not only for making strategic and operational decisions, but above all supporting the development of relationships with the social environment.

We decided to share our experience. In the report we present our favourite research methods, the latest research, and summarise what we have learned in the difficult matter of social research at a technical university.

The Research and Analysis Department Team

1. Socio-economic environment: external stakeholders and their needs

WUT research teams conduct their studies within international consortia, our graduates seek employment on the global market, and our students take part in exchange programmes at universities in various parts of the world. The socio-economic environment of WUT is quite a considerable and versatile mosaic of stakeholders.

By external stakeholders we mean individuals and entities representing the University's socio-economic environment, including, central and local government authorities (i.e. executive agencies, Marshal's and Voivodeship Governor's offices, City Office, Ministries, chambers and associations); entrepreneurs (micro-, small and medium-sized enterprises, large enterprises, including domestic and multinational companies), and public utility organisations (e.g. associations and foundations).

General education schools and secondary technical schools, where candidates come from and where activities aimed at popularising science and promoting universities are performed, also form part of the university's socio-economic environment. Graduates are special types of stakeholders who studied at university and also gained market experience, which might significantly contribute to expanding the knowledge of building relationships between the university and its environment.

Figure 1 Research university's socio-economic environment, based on the example of WUT

Source: by Research and Analysis Department (DBA CZIiTT PW)

External stakeholders may be distinguished according to the processes implemented by the university: stakeholders of the education processes, stakeholders of technology transfer and commercialisation processes, which are separate groups sharing some common elements.

A university's stakeholder analysis, including potential stakeholders, is crucial from the perspective of making decisions and should concern groups which both actually and potentially affect the functioning of a given organisation.

The knowledge of the needs of the socio-economic environment is also vital for the quality of education in line with the standards set out by the Polish Accreditation Committee (PKA) and KAUT/ENAEE accreditation. PKA evaluates the conformity of the education concept not only with the research activities conducted at the university, but also its focus on the needs of the community with which this university should cooperate (e.g. through consultations and the improvement of the programme of study). KAUT similarly evaluates stakeholders' engagement in the education process, the range and form of such participation, the employment support system for students and graduates, and the tracking of their professional career.

In the report, we use three areas of the needs of the socio-economic environment, distinguished as a result of work on the analysis of the needs of innovative economic entities, which we carried out in 2021.The first sphere includes needs in the field of leading technologies, industries and disciplines, the knowledge of which is a hint to a university as to the planning of joint R&D works in these areas, as well as it can be used to design the education process which would be capable to ensure expert staff. Our response to the needs in this sphere includes studies aimed at monitoring current trends and changes on the market, as well as the internal processes at the university, such as the mapping of WUT's research portfolio.

The second sphere of the needs entails organisational culture and talent management, namely the work environment which graduates are likely to come across and need to be prepared for. Even the best knowledge and skills will not help if no social competencies have been developed, allowing the demonstration and use of the acquired knowledge. We explore the needs in this field through labour market research and graduate research, and through the monitoring of social trends, including generational changes.

The third sphere is cooperation with the university. The partnership relationship of the university with the social and economic environment allows mutual development and exchange of experiences. One of the key issues in this sphere is the consultation (and evaluation) of the programme of study with employers and the fostering of R&D cooperation, in particular in the context of research-based education. As a result of numerous studies conducted among the university's external stakeholders we have devised a list of cooperation forms, making distinctions between the subject-matter and form of activities, and indicating preferable solutions in specific contexts.

2. Research methods

In addition to our research curiosity, we are driven by the wish for our actions to be useful. We would like our activities to not only contribute to a better understanding of the needs and expectations of external stakeholders, but also to formulate them in a **university-friendly way**. We have resigned from lengthy studies which are difficult to read in detail, and turned to shorter papers with an additional summary section instead. We are developing our **data visualisation** skills, not only in the form of a graphic presentation of individual results, but also as a complete summary of research on **infographics**.

We assure the quality of research through the use of good practices which allow us to effectively conduct the full research process, including formulating research questions correctly, applying adequate data collection methods and techniques, analysing and interpret data, and striving for accurate results and useful recommendations.

Quantitative studies allow quantification and statistical analysis. With appropriately selected samples, the results may be addressed to the entire population in general (a representative sample). **Qualitative studies** allow us to extend the quantitative description by adding a social and cultural context, thus offering explanations and in-depth interpretation. We share the view that qualitative and quantitative methods should be seen as mutually complementary, so one of our key research assumptions is **triangulation** applied in three dimensions: methods, data and researchers (Flick, 2011; Silverman, 2018).

Figure 2 Quantitative and qualitative research

	Quantitative	Qualitative
Research question	Conclusive questions, e.g. "How much/many", "How often"	Exploratory questions, e.g. "How", "Why"
Measurement tools	Survey questionnaire (questions of a fixed form and order)	Interview scenario (changeable order, possibility to explore more details)
Sample	Large, minimum several hundred participants	Small, between several and several dozen participants
Sample selection	Random, quota	Purposeful

Source: by Research and Analysis Department (DBA CZIiTT PW), based on Maison 2010: 18

We begin each of our studies with a desk research, and the definition of an objective which is aligned with the needs of our patrons. We try to integrate concurrent projects so that they serve as support to one another: a specific set of collected data may often be used in several projects.

We conduct **cyclical research, current analyses** (constant monitoring) and **ad hoc research** (own and third-party studies). Relying on developed research practices, we are able to efficiently suggest a research concept and to perform studies in a way that is useful for making tactical and strategic decisions in an organisation.

The following is a description of the methods we particularly prefer using in our daily research work in the sphere of the needs expressed by university's external stakeholders.

2.1. Individual In-depth Interviews (IDI)

A **structured individual interview** is one of our most frequently used data collection techniques based on a standardised questionnaire. Due to the qualitative nature of research, it mostly includes open-ended questions and problem-related structures ("why" and "how"). We might also sometimes suggest a series of hints or advance a thesis with which participants can agree or disagree. Our goal is to obtain the fullest answers possible, allowing insight into the respondent's experience: opinions, views, feelings, convictions goals and motivations, and, last but not least, their needs (sometimes conscious, and sometimes not).

Through a direct contact with respondents, individual interviews facilitate flexible conversations, not only as regards the order of the discussed issues, but also their extension (deepening) depending on a given person's knowledge and experience and the time we have to hold such conversation. Depending on the needs and possibilities, direct, phone, and on-line interviews are equally effective.

As opposed to group interviews, an individual interview allows respondents to express their views in the presence of the researcher in an unrestricted way, without the need to verify them against other opinions (cf. the possibility to confront opinions in focus group interviews). Although interviews are most often conducted by one person, we assure the triangulation of researchers at subsequent stages: transcription, coding, analysis.

2.2. Focus Group Interviews (FGI) / Expert panels

We turn to various types of group interviews (including focus groups, expert panels) equally often as to individual interviews. All the techniques share the same situation - one or two investigators confronting a group of respondents. They differ in significant details.

Similarly to an individual interview, **group interviews** may be conducted according to instructions or a standardised questionnaire with open-ended, problem-related questions. The conversation has the form of an interview where a researcher elicits answers from respondents, making sure that everyone has a chance to speak.

It is different in the case of **focus group interviews** (FGI) which resemble a discussion moderated by the researcher. The distinguishing feature of FGI is emphasis on a specific problem being analysed in the form of a joint discussion between respondents. The scenario is dominated by problem-related questions ("why" and "how") allowing thorough insight into the issue being analysed; there might also be questions posed by the respondents to themselves or to the other participants.

Although **expert panels** are also a type of a moderated discussion between study participants, they additionally differ in terms of the specific nature of the invited respondents – specialists in a given field, having expertise supported by long-standing experience. Taking part in a given study, the experts both express the views from their own (personal, expert) perspective, and declare the position of the institution they represent. This means   research difficulties in the form of distinguishing the sources of given statements, both at the moderation stage or while analysing the collected material.

Group interviews are based on purposeful sampling, which means that the composition of the group results from the objectives of a given study. A given group may be uniform in terms of key variables, e.g. undergraduate students, or diversified in terms of key variables, e.g. undergraduate, graduate and doctoral students. The diversity of such group may, but does not have to, contribute to conflicting views. Conflicting opinions which emerge during the interview should be explored by the investigator, and potential confrontations should become a strategic research decision followed by the balancing of the cognitive usefulness of a fierce discussion, research ethics and respect for the well-being of study participants.

Group interviews are held by one person, while focus group interviews or expert panels may be conducted by two persons (lead moderator and supporting moderator).

2.3. On-line surveys (CAWI)

The triad of our most frequently used methods (apart from individual and group interviews) is completed with web interviews. Standardised online **CAWI** survey (Computer Assisted Web Interview) include close-ended, semi-open, and open-ended questions arranged into thematic modules according to the order of research questions. Questionnaires are meant to be completed independently by the respondents online, and a possibility is provided to take a break and return to the questionnaire at a later time (the "rescheduling" function).

This technique may seem to be strictly quantitative, as the data is collected in an orderly manner, categorised, and ready to be calculated. However, according to research rules, it is required to include an unpredicted option in close-ended questions, by adding the "Other" option. Research curiosity requires the addition of a follow-up phrase: "Please specify", making a close-ended question a semi-open one, and we sometimes add an extra question "why" underneath, suited to an extensive answer. Many respondents willingly use this field to explain the context of their answer, especially with issues which are more complex or closely related to the specificity of the University. Studies which were meant to be quantitative change into very interesting qualitative research, providing us with several hundreds of pages of in-depth data.

In justified situations we conduct research by phone using a standardised questionnaire (**CATI**, Computer Assisted Telephone Interview) or paper surveys (**PAPI**, Paper and Pencil Interview), whereas the latter is the best solution in case of short forms, for example evaluation questionnaires following workshops.

2.4. Desk research

Each study begins with **desk research** which includes both own and third-party data. The basic desk research includes secondary data from existing sources, such as publications, reports, scientific papers, and internet resources in a given field (**netnography**). The advantage of desk research is not only the provision of context for planned activities, but also the identification of gaps, i.e. spheres which required new (or repeated) research.

If possible, we try to base the desk research on the **elements of systematic review**. This means that we conduct an orderly review of sources regarding a specified research problem, documenting the information we manage to derive (Booth, Sutton, & Papaioannou, 2016; Mazur & Orłowska, 2018). We use generally accessible sources, industry portals and open-access scientific resources in such repositories as Directory of Open Access Journals, ResearchGate and GoogleScholar,

as well as scientific resources in Web of Science or SCOPUS. We search for study reports and analyses prepared by research and consulting centres (both domestic and foreign) or industry organisations (both domestic and foreign) and scientific papers. Desk research is not only a review of literature on the subject but also of statistical data, documents, legal acts or strategic documents. The use of a given piece of information is conditional upon the quality of a given source, its topicality and relation to the subject-matter of research work. Materials are collected until the point of theoretical saturation.

2.5. Benchmark

Benchmark involves the identification of reference points, and rankings may serve as a good example here. **Benchmarking** is a type of comparative analysis and means the conduction of the entire comparison process. Such analysis consists in the collection of available information about the issues being studied and comparing them from the general and specific perspective. In this method, it is important not only to compare the individual parameters, such as similarity of organisations in the analysed scopes, enabling further implementation, but also to focus on the benchmarking process being a point of reference in growth and supporting learning organisations (Hämäläinen, Hämäläinen, Jessen, Kaartinen-Koutaniemi, & Kristoffersen, 2002).

Benchmarking is a complex and multi-stage process, entailing multiple comparisons of the changes being introduced, both inside an organisation and with model entities (benchmarks). This type of a comparative analysis is useful in strategic management, change, quality, knowledge, project and innovation management, and in the contexts of higher education institutions, it is a perfect tool for university management (Kuźmicz, 2013). As regards universities, process benchmarking is most useful in cognitive terms, as it allows the qualitative analysis of processes (causes, effects, implementation methods) taking place at a given university and at a university which has been identified as a benchmark.

2.6. Observation

In the studies of group spaces or processes, we used observation, mostly overt non-participant observation, which allows us to follow a given respondent/user and **observe their experience** real time in a given environment. Non-participant observation eliminates interference with the social processes taking place. Observation sheets allow us to collect comparable data and to further order materials. Objectivity is enhanced by the performance of observations by several researchers and by an interpretation session which consists in a joint discussion about the results collected.

2.7. SWOT analysis

SWOT analysis (Strengths, Weaknesses, Opportunities, Threats) provides a systematic assessment of external and internal factors determining the current state of an organisation and its potential for growth. The assessment is arranged along the organisation's strengths / weaknesses (internal factors) and its opportunities / weaknesses in the surroundings (external factors). Each of the dimensions involves appropriate actions: threats should be avoided or neutralised, opportunities should be exploited, an organisation should rely on its strengths and strive to eliminate weaknesses. The credibility of SWOT analysis is built on a proper selection and quality of data used for the assessment. In our case, the method is useful for strategic and operational activities, e.g., for the diagnosis of the

university's environment, and the offering in the context of stakeholders' expectations or relations with stakeholders.

2.8. Delphi

The **Delphi method** belongs to the group of expert and heuristic methods, applied in a partly formalised formula. The objective of applying the Delphi method is to forecast changes taking place in the macro-environment, in particular in the technological, economic, and socio-demographic segments. The study involves the presentation to a selected group of experts of specified theses (close-ended questions) to which they are asked to assign specific numerical value and justify their choice. The numerical values can be summed up or treated as guidelines for prioritising. The greatest value of the research method is provided by the justifications which are an expert analysis of causes / consequences of given activities in specified contexts.

The distinguishing features of the method include anonymity, multiple stages, provision of feedback and aggregation of the obtained answers (Rowe, Wright 1999: 354). Anonymity ensures experts' independence in the sharing of opinions and supports the objectivity of assessment. The multiple juxtaposition of opinions, in particular the opposing ones, allows thorough analysis. Feedback, consisting in opinions provided by other study participants, allows them to verify views and add more details to their position (Nazarko 2013). It is important to make sure that the same group of experts takes part in subsequent stages of the study, as the respondents may uphold or change their views / predictions based on matter-of-fact arguments provided in the feedback. A given issue may be considered to be resolved (examined) if a consensus is reached between experts. The method makes it possible to adapt the process to specified properties of the issue being discussed (Hirschhorn 2019, Kezar, Maxey 2016).

2.9. Workshop / user-centred methods

Workshop methods intended for the development of new solutions and for co-creation, are a useful cognitive mechanism. Discussion and co-creation provide an opportunity to observe the values, goals, needs and challenges which are significant to a given group.

Brainstorming is a popular method for generating ideas and has many methodologies. The process is based on the freedom to put forward ideas and discussing them in a constructive way. Ideas may be generated individually or in a group, while most often it is combined into two consecutive stages, the first one being individual work and the second entailing the generation of ideas in groups. Discussion of ideas should consist in describing, explaining and expanding on them. After the discussion, participants may vote on the best ideas with clear evaluation criteria and elements of prioritising (importance, implementation time). As a work method, it has proven useful at various stages of research processes or during studies with respondents, for instance, as a way to encourage the participants of group interviews to generate ideas and continue discussions.

Design Thinking is a method of design work which goes beyond the traditional boundaries between the public, private and non-profit sectors (Brown, Wyatt, 2020), and it is focused on the needs of given groups which will get a chance to benefit from the developed innovative solution in the future. We adapt the Design Thinking process or use some of its parts (empathise, define, ideate, prototype, test)

to understand the needs and their context, which in turn allows us to prepare better recommendations and adapt to the specific nature of a given issue.

As regards experience analyses, we use **Customer Journey Maps (CJM)** which help us understand customer's/ user's perspective. As a graphic representation of stages a user goes through to experience a given service, it makes it possible to notice critical points and areas for improvement. The tool is not limited to the development of a "journey" but aimed at the entire step-by-step context of cooperation with the user's perspective at each of the stages. The map outlines doing, thinking, and feeling.

Service Design allows the description, analysis and proposal of a new process. One of the tools we use is **service blueprint** which is frequently applied for designing new services. It facilitates the analysis and strategic planning of services, accompanying processes and necessary activities. Based on a customer journey, it presents the process in two ways: the front stage, including subsequent steps taken by the user, and the backstage with actions taken behind the scenes for a given service to be provided. Service blueprints allow process mapping, and thus the possibility to examine to what extent our solution design corresponds to addressing a previously diagnosed problem.

Research is a key component of the **user experience design process**. Our examples of activities in this area include needs and expectations analyses and usability testing, verifying the adequacy of the response to such needs, the effectiveness of a given solutions and the assessment of its efficiency, which from the user's perspective are highly valuable. By assuring convenient use of our solutions to users, we not only provide the actual possibility to use it but also strengthen our relations with recipients.

3. Good practices of Research and Analysis Department (DBA CZIITT PW)

The chapter presents our good practices in the field of research with the participation of the socio-economic environment of the University.

3.1. Benchmarking of selected processes at the university

We take a close look at our environment on a regular basis, in a local and international perspective. We analyse the needs of the socio-economic environment (e.g., demand for skills) and observe leading trends in higher education (e.g. innovative education methods).

In a report entitled "The Identification of Business Entities' Innovation Needs" (NERW2 PW) we have reviewed over 100 domestic and international scientific research projects and consulting analyses concerning innovative enterprises, including Industry 4.0. As a result of the review, we defined the competencies of persons employed with innovative enterprises and possible methods of cooperation with the university. The full version of the report is available on our website.

In "The Monitoring of Educational Trends" (NERW2 PW) we have made an attempt to answer a question how to teach to cater for the needs of innovation-based economy. We described innovative education methods in place at 22 universities in Europe and in the USA, i.a., in Aalborg (Denmark), Aalto (Finland), Maastricht (the Netherlands), Technical University of Berlin, and RWTH Aachen (Germany), as well as NTNU (Norway), MIT and Caltech (USA). We were interested in innovation from the perspective of the curriculum (e.g., problem-based or research-based learning), and the shape of education in general, focused on activating students and developing hands-on experience (e.g. student-driven learning, flipped classroom or learning by doing). The analysis not only helped us specify areas for improvement, but also to note that the quality of education means immense content-related support for the staff and analytical support at the university level. The full version of the report is available on our website.
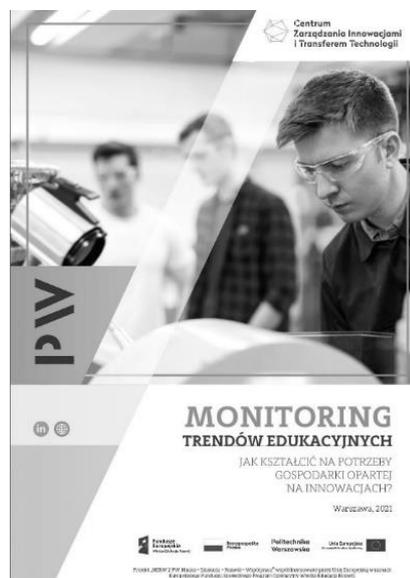
3.2. The study of the needs and expectations of employers and institutions cooperating with WUT.

One of the longest studies of WUT's socio-economic environment we have been conducting are employer panels which were first launched in 2013, and had subsequent editions in 2018, 2020, 2021 and 2022, with research objectives that include:

- diagnosing the needs and expectations of employers and institutions cooperating with WUT as regards selected course programmes within a given field of study,

- verifying key graduate competencies in the view of employers in the scope of a given field of study: for employees in a specialist position and for employees having management functions,

- diagnosing preferred cooperation forms, and

- mapping leading R&D directions and preferred sectors for cooperation with the socio-economic environment in the scope of a given field of study.

The population in the study constitutes the university's socio-economic environment, including employers of WUT graduates, defined as representatives of enterprises (possibly various types from micro-enterprises through SMEs to large companies, including multinationals) and public institutions and research centres (purposeful sampling from among the Faculty existing contact network). As part of the 2018/2019 edition we surveyed over 100 employers!

A huge asset of this form of research is direct meeting, providing the possibility to build relationships and networking activities. During the pandemic, we organised on-line panels which lacked the charm of in-person meetings, but it turned out to be a great facilitation (for instance, for stakeholders from outside Warsaw).

The panels are held individually to suit the needs of a given field of study/faculty or as series: for fields of study (2013 edition) or for scientific disciplines (2018 edition). A survey report is prepared each time for a field of study / faculty, and a collective study for the entire university is prepared as a summary of a series of panels. The results are useful to Faculties in relation to PKA and KAUT accreditations (as a response to accreditation committees' guidelines in the form of Standards for education quality and cooperation with the socio-economic environment). Research carried out under the projects "Improving the quality of WUT management" European Social Fund 2012-2014, "NERW PW" and "NERW2 PW" European Social Fund as part of the Knowledge Education Development Operational Programme.
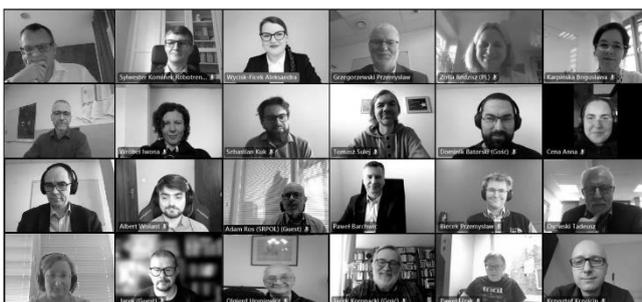
25.11.2021 Panel pracodawców dla Wydziału Matematyki i Nauk Informacyjnych Politechniki Warszawskiej

3.3. Preferred forms of cooperation between science and business

Thanks to the research "Diagnosis of the needs and expectations of employers and institutions cooperating with WUT", as a result of additional analyses, we were able to determine not only the preferred forms of cooperation but also their time frames. Our study has shown differences between long-term cooperation and short-term targeted activities. The results allow the university to plan activities in an appropriate manner for all parties in the science-didactics-business relations. The results have been presented in our report and in the infographic.

3.4. Innovative enterprise study

The topic of the needs of the socio-economic environment was also continued in the nationwide quantitative research. In 2022 we focused especially on the needs of the Innovative Business Entities. The aim of the study was to identify the needs expressed by innovative business entities towards universities, including the Warsaw University of Technology, in respect of educating prospective employees and cooperation between science and business circles.

The survey was conducted with the use of computer-assisted telephone interviews (CATI) on a sample of 1051 representatives of business entities. The survey results are representative in terms of the amount of business entities' outlays on innovative activities divided by selected sections and divisions of the Polish Classification of Business Activities (PKD 2007). The value of such a study is to verify the opinions, intuition and trends identified in qualitative research. Quantification also has the advantage of helping to prioritize the most important areas for improvement.
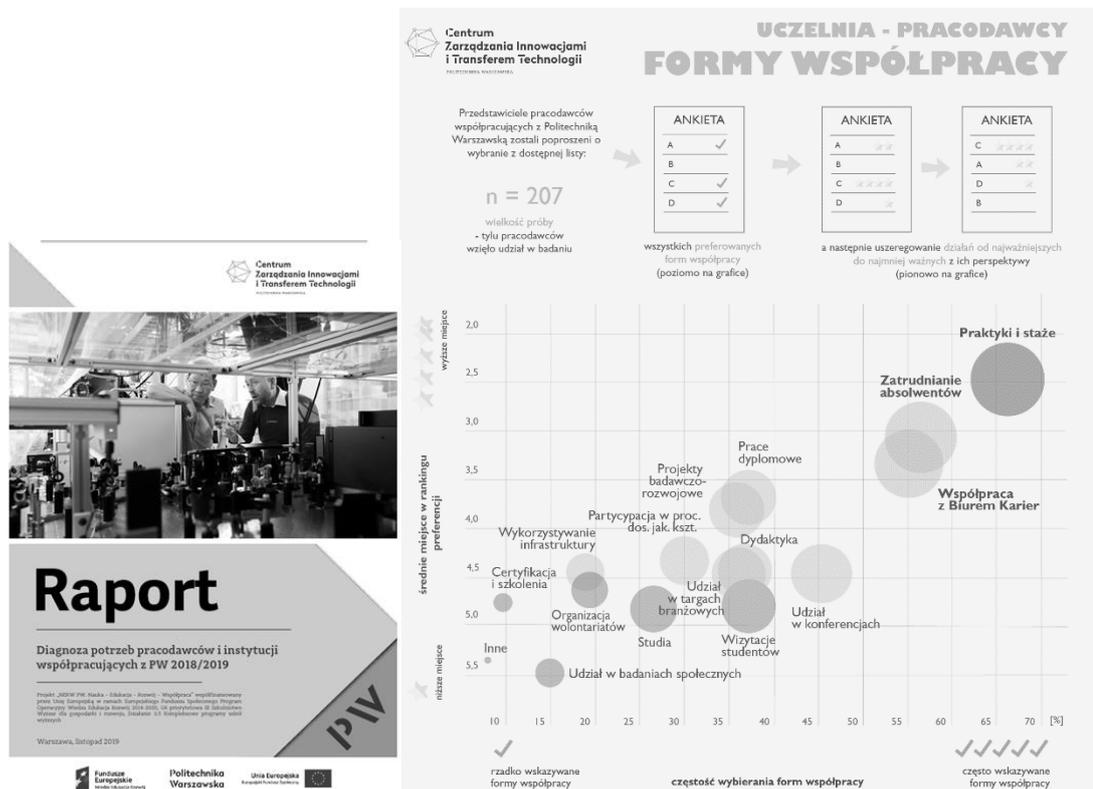
3.5. Research for scientific and implementation projects

Scientists specialise in their fields: architecture, geospatial data management, the construction of innovative products. Quite often, end users and research into their needs fall outside a scientist's domain knowledge. At Research and Analysis Department we deliver research projects allowing the supplementation of this sphere, so that scientists can focus on their work and acquire substantive social research.

We conducted studies which supplemented the analyses included in a doctoral dissertation on innovative use of floating objects in Poland. We studied the business environment for floating objects (the needs of hotel industries, food establishments and water tourism in Poland), and the results were published in co-authorship with the scientist in an appropriate journal.

For the purpose of the international FabSpace 2.0 project (INSO-4-2015, no. 693210), we supported the diagnosis of social issues and challenges to be faced by stakeholders in such areas as smart cities, agriculture, health & well-being and Intelligent Transport Systems. We focused on issues which are possible to address with the use of geospatial data resources, including satellite data (Galileo, Earth Online, Copernicus, in line with the open knowledge concept). We also dealt with the assessment of collaboration with geospatial data resources, including satellite data, in their current forms, and the benefits, obstacles, and problem prediction in the studied spheres from the perspective of selected stakeholder groups.

Additionally, as part of a project called "Warsaw University of Technology as the Innovation Ambassador for Accessibility" (POWER) we also studied the needs of users, including external stakeholders, in respect of the marking of space and its accessibility. The studies have shown that the WUT space is a complex labyrinth even for its community, so persons from the outside find it even more difficult to move around the campus space. The Report is concluded with about a dozen recommendations in respect of universal design, which means the design of space accounting for stakeholders' needs.

In a report for PIAP Space sp. z o.o. we discussed the opportunities for cooperation between science and business in projects of the European Space Agency, and in the study entitled „The Development of Competencies of Future Space Sector Staff" we analysed case studies of teams taking part in the European Rover Challenge to identify key competencies and needs in the scope of education and practical preparation of future employees in the space sector.
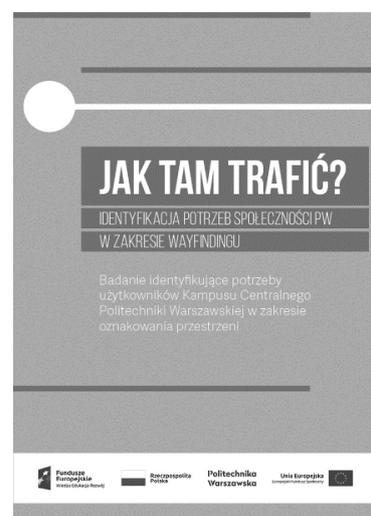
3.6. Research for business

As a response to specific problems of external stakeholders, we perform commissioned works, focusing on a given issue. As regards commercial commissioned work, we most often focus on researching customer needs and specifying ways to refine a product or a service, and sometimes on promotional activities.

We examined the public perception of a proposed technology, i.e. users' readiness to use the proposed solution, and diagnosed the potential demand for such solution.

In respect of completely new undertakings, we verified the business assumptions behind a new brand, identified potential target groups and diagnosed their needs.

As part of focus research, we consulted existing and potential customers' preferences related to the perception of products of a specific brand, their shopping habits and preferable marketing narratives.

We also conducted focus research among the youngest viewers concerning a pilot episode of a cartoon series, asking about their impressions, interest in further episodes, and analysing the educational value of the materials.

Our studies are not only used for further activities pursued by our patrons, but also as market analysis, and support them in applying for additional funds as part of competitions for enterprises.

3.7. Research for financing entities

The socio-economic environment also include support entities, i.a., entities financing research works.

Based on research and interviews with experts, we developed the "Handbook on Classifying Tasks in Socio-Economic Projects to the Definition Set out in the Act on the Rules for Financing Science" for the National Centre for Research and Development (NCBR). The study includes suggestions concerning the classification of research tasks performed as part of socio-economic projects, taking into account specified types of research (fundamental research, industrial research, development works), and their characteristic features. We provided specific examples in addition to advice on how to describe tasks so that they are clear to the audience.

NCBR also ordered an evaluation in which we examined whether and in what extent the support provided at universities as part of Priority Axis 3 of the Knowledge-Education-Development Operational Programme contributed to the fulfilment of the set objectives. We also identified activities which might enhance the effectiveness and accuracy of support in future competitions and in the next programming period. Detailed information can be found in a study entitled „The Assessment of the Quality and Effects of the Implementation of Priority Axis 3 of KED OP Higher Education for Economy and Development"

In turn, for the Ministry of Economic Development, we prepared a review and assessment of policies and support instruments for business support institutions promoting the innovativeness of enterprises in selected countries with recommendations concerning the functioning of BSIs.

3.8. Research for the society and local communities

As part of a project entitled "The Sustainable Development of the Mazowieckie Voivodeship in the New System of NUTS2 and NUTS 3 Units. Metropolitan, Regional and Subregional Levels" (NCBR, Gospostrateg, 2018-2020) we explored the specific features of the most developed and the most economically diverse Polish region. The Mazowieckie Voivodeship is a challenge in many ways, and the objective of our research was to provide the knowledge necessary to plan and implement policies focused on sustainable development. In a series of individual interviews we talked to entrepreneurs, representatives of communes and districts, foundations, associations and employer groupings, as well as the representatives of municipal and district employment offices and business support organisations. The research included the use of the Delphi method with the participation of key experts in regional development and a quantitative study of entrepreneurs from various industries operating in the Mazowieckie Voivodeship. The research allowed us to diagnose the key factors stimulating the development of the Warsaw capital city region (NUTS 2) and the Mazowieckie region, and their mutual interactions and interdependencies. The conclusions were compiled in a brief report.

During the pandemic, we also conducted surveys allowing the update of the results of conducted research by adding information about the impact of the COVID-19 epidemic on the functioning of communes and cities with district rights. The survey included questions about, i.a., the digitisation of offices (remote work and e-services) and the needs in this sphere.

Also, as part of our project "The Social Responsibility of Science – from Promotion to Social Innovation" (MEiN, 2020-2022) we dealt with the issue of popularising science and scientists. In a report entitled "The Social Responsibility of Science in the Context of Addressing Complex and Vital Issues in the Mazowieckie Voivodeship" we analysed the notion of social responsibility of science, social innovation and the way science can support the solution of vital social problems, improving the quality of life - all this in a local, Mazovian context.

Having identified key social issues, as part of the same project we organised meeting with the residents Mazovia interested in searching for solutions to vital social problems in the area of the Voivodeship. Using the Design Thinking methodology, we were able to not only gain a rich, high-quality research material, but also to offer new experience to individuals participating in the study. The participation in the co-creation process and creative project work in groups is certainly very time-consuming, yet, from the participants' point of view, it is slightly more interesting than filling in questionnaires or being interviewed.

The additional value of this form of research was the possibility to work on a result which would be possible to demonstrate and discuss. Instead of a report on needs, as a deliverable, the representatives of the City of Warsaw and the Marshal's Office of the Mazowieckie Voivodeship received prototypes, which are proposals of ready-made solutions which demonstrated not only the main need they respond to, but also a number of values which have inspired the users to create and benefit from the solution.

The prototypes developed during workshops were described on flashcards, and selected three ideas were developed with the use of the service design blueprint methodology.
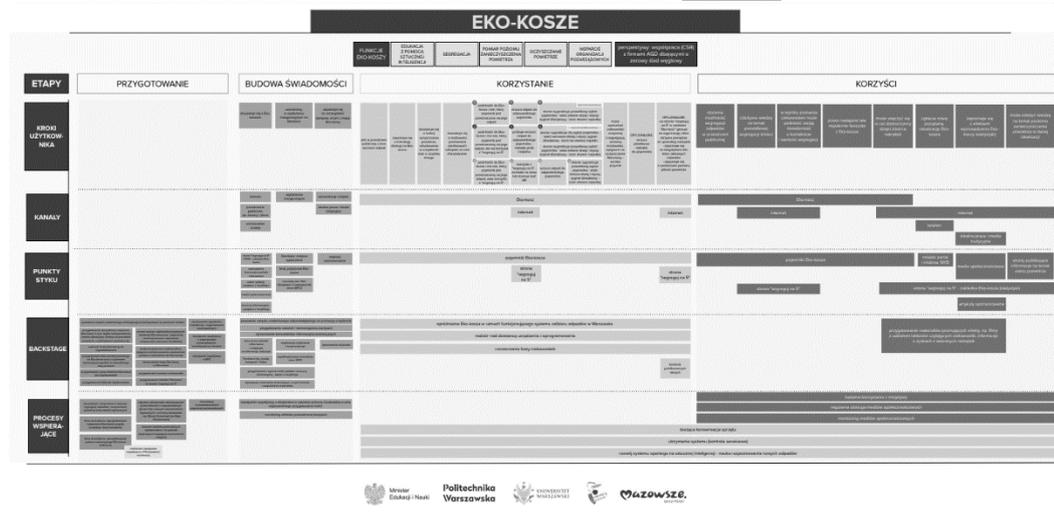
3.9. The graduates' perspective

One of our regular studies and an interesting source of information about the needs of our socio-economic environment is the Monitoring of Graduates' Professional Careers, in which the needs of the environment are filtered through the experience of studying at WUT. The study is conducted each year by our department at the request of the WUT Career Office and allows insight into our graduates' opinions on the knowledge, skills and competencies acquired at the University, verified against the market situation. In a single study we bring together the perspective of external stakeholders (employees, employers) and, until recently, internal stakeholders (former students, doctoral students).

The perspective of the socio-economic environment strongly resonates in the "Success Stories. WUT Graduates" project, as part of which we analyse the needs and expectations of employers of WUT graduates. As part of the study, we interviewed graduates who had achieved scientific, commercial or social success. Over a hundred graduates told us about their careers, their experience related to studying at WUT, the difficulties they encountered and successes they had. In a series of five reports, we thoroughly discussed a range of topics related to success: the definitions of success, the impact of external and internal factors on success, the importance of family in achieving success and also the question of whether WUT graduates' successes were the product of favourable circumstances or rather the result of hard work.

3.10.   Job market monitoring

As part of a series of studies "The Labour Market in Mazovia in the Context of Education at a Technical University" were explored selected issues which are significant for the selection of professional career for WUT students and graduates (e.g. salaries or the impact of the COVID-19 pandemic on the labour market), and we also analysed the professional situation of graduates of technical universities in the Mazowieckie Voivodeship in the initial years following the award of diplomas. The analyses were performed on the basis of desk research: resources of Statistics Poland (GUS), the Polish graduate tracking system (ELA) and our own research: "The monitoring of WUT Graduates' Professional Careers" or "Engineer's Employer" carried out for BEST Student Association.

Taking part in an international and cross-sectoral project called Global Entrepreneurial Talent Management 3 (MSCA-RISE-2016, no. 734824: RISE, 2016-2022) we focused on the issues of the youngest generations on the labour market and challenges which future employees and employers need to face. Process management in generational changes requires knowledge of the preferences and requirements and possibilities of the youngest generation. For more information on the issue, refer to the article entitled "Why are we like that? The Identification of Factors Shaping Polish Generations Y and Z." Another article, "Determinants of Entrepreneurial Intentions at Universities: Warsaw University of Technology Case" combined data from graduates' perspective and job market monitoring and focused on academic entrepreneurship.
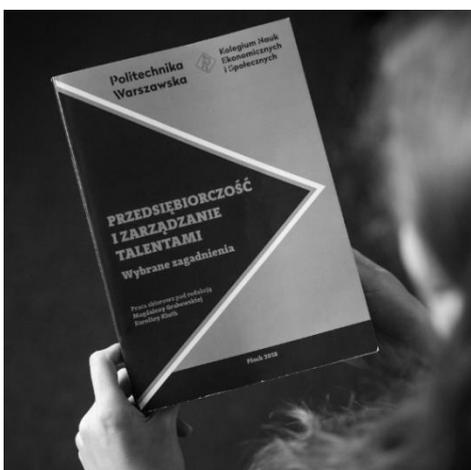
3.11.   Mapping the research portfolio

We have mapped our research proposal twofold, using different approaches - the city-wide approach and the university approach. The usefulness of the solution from the perspective of external stakeholders consists in disseminating knowledge of the existing potential for cooperation: research teams, their portfolio of R&D services, available research equipment, previous experience and the scope of possible joint projects.

WARSAW (MASOVIAN VOIVODESHIP). At the request of the City of Warsaw we identified leading research centres in the Mazowieckie Voivodeship engaged in R&D activities. As a result of the works, a report entitled "Warsaw Space for Research and Development - Catalogue of Leading Entities Creating the Warsaw R&D Ecosystem" was prepared. The Catalogue is available in Polish and English.

THE UNIVERSITY OF TECHNOLOGY. The mapping at University level was focused on diagnosing future-oriented directions of research and development works offered at WUT. The listing was based on a regular collection of descriptions of proposals put forward by WUT research teams and the arrangement of the materials in a way which would allow external stakeholders to conveniently get acquainted with the R&D cooperation opportunities. Consultations of the process with internal WUT stakeholders were held concurrently with the systematic collection and ordering of the descriptions. The experience drawn from the process shows how difficult it is to compile a complete and properly formulated portfolio which would be legible and useful for recipients from outside the university.

The mapped material was compiled in the form of a catalogue which is available in electronic (pdf) and paper versions provided with a proper graphic design. In 2022 we issued a second, revised and extended edition, that includes over 350 teams, out of which nearly 200 are interdisciplinary teams. The catalogue "WUT Research Teams. R&D Portfolio" is available on the University's website.

3.12. R&D portfolio consultations

The mapped catalogue of our research proposal is a huge step in the direction of strengthening relationships with external stakeholders. To initiate cooperation effectively, the tool needs to be useful to the target audience. We decided to consult the form of presenting the WUT R&D portfolio with our stakeholders, i.e. representatives of enterprises, public institutions and research centres.

Our intention was to identify the strengths and weaknesses of the presentations, taking into account the evaluation of the usefulness of the contents and the clarity of form which is essential in terms of initiating R&D collaboration, and possible improvements in this sphere. We asked whether the complete publication is convenient, what they wished to find out from the contents, as potential partners of cooperation, and what suggestions they had for us.

We were able to confirm that we respond to the needs of recipients, presenting the services offered, the available infrastructure, the teams' experience, highlighting the projects being delivered, patents and awards. We specified areas for improvement, thanks to which getting acquainted with the R&D Portfolio of WUT will become even more convenient to stakeholders.

3.13. Mapping infrastructure for the socio-economic environment

As part of the project called "Find it at WUT! Browsing WUT Resources Including Scientific and Research Equipment and Services", implemented for the Rector's Committee for Scientific and Research Equipment, we examined the needs and requirements of University employees and external stakeholders (both scientists and business clients) related to searching information about the research equipment resources at WUT.

We placed special emphasis on computing centres, machining and manufacturing devices, services and research groups, as well as software and scientific and research equipment. To prepare a catalogue, it was necessary to define categories of items together with the boundaries of their applicability – we asked stakeholders how they understood scientific and research equipment and about their previous experience relates to searching for information about the topic. We also asked how the users would like to search for information about the research equipment resources at WUT, which allows the development of a useful and user-friendly catalogue. Thanks to our studies, the components of the catalogue (the structure of an individual record and the interface of the electronic system) will be created based on the opinions and preferences of target users.
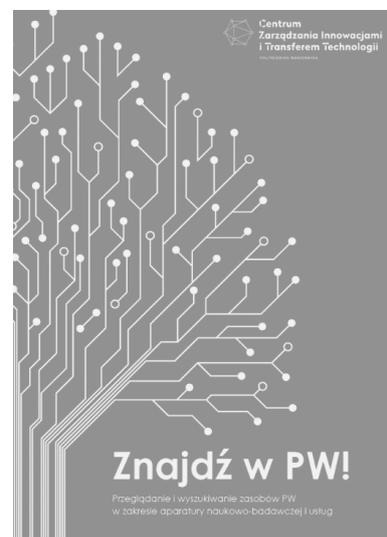
3.14. Support for technology transfer

The needs of the socio-economic environment do not only include business challenges and the research which may help address them, it is also networking and industry meetings during which participants can share their knowledge and learn a lot themselves. Our Research and Analysis Department regularly takes part in the exchange of opinions and experience which allows a better understanding of the context in which external stakeholders operate.

As part of a study entitled "Effective Tools for Promoting the Results of Research to be Implemented in Economy" (Dialog, MNiSW), we analysed the methods for promoting research results used by technology transfer centres, assessed their effectiveness and analysed potential investors' views about these methods. In our report, we described proposed tool kits and good practices.

In a study carried out for the WUT Institute of Applied Research we analysed the methods of promoting implementation research. We talked to the representatives of special purpose vehicles, technology transfer centres and university offices/departments whose operations are focused on promotion and communications about the effectiveness of tools for promoting scientific research being implemented in economy. In addition to a report, the study resulted in the development and calibration of effectiveness measurement methods in respect of the promotional activities pursued by IBS PW sp. z o.o.

In a report entitled "Effective Cooperation between Science and Business from Entrepreneurs' Point of View" for the Inventity foundation we examined which factors hinder the development of effective relationships between academia and business and the most important needs in the sphere of innovation and research commercialisation. During our conversations with entrepreneurs who have experience in cooperation between science and business, we were particularly interested in improvements on the part of the university, support offered to enterprises in respect of implementation, and support for scientists in respect of the readiness of proposed solutions to be implemented. We also asked about the ways in which we can foster the willingness to invest in innovation and research commercialisation, and what factors may facilitate the building of successful relationships between universities and business in the future.

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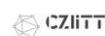
Politechnika
Warszawska

2019
Innowacje w procedurach
transferu technologii:
Nauka-Przemysł

Ministerstwo Nauki
i Szkolnictwa Wyższego

DIALOG

ISBN: 978-83-951174-1-1

EFEKTYWNA PROMOCJA

wyników badań naukowych do
gospodarki

Dariusz Parzych
Adam Müller
dr Aleksandra Wycisk
Mateusz Kałamarz

4. Lessons learned

While researching the needs of the socio-economic environment, we were open not only to various topics relevant to various groups of external stakeholders, but also we tried to select research methods in such a way that the conducted research could become an opportunity to develop the relationship between didactics, science and business, and not a burden or duty.

In addition to getting to know the needs of various groups of external stakeholders in relation to a number of issues of education quality and R&D cooperation, we have developed our own know-how and we are constantly working on popularising social research and designing university processes to meet the needs of users. Here are some of the more important lessons we've learned in our experiences.

SOCIAL RESEARCH IS USEFUL. The foundation of our activities was to convince internal stakeholders to use research on the needs of external stakeholders. The key was not so much to design the research as needed, but to deliver the right research product. Even the most interesting report will not be read if it is too long and fails to attract attention with its form. To be useful, the summary of research work should include: a summary, data visualisation, and context-based recommendations.

THE STAKEHOLDER MAP was one of the most important job that we had to do in order for our research to be carried out adequately. We defined not only external stakeholders whose needs should be investigated, but also internal stakeholders who could benefit from this knowledge. Mapping individuals seeking information that we can provide is a process that we improve and which should be periodically updated.

RESEARCH REPRESENTATIVENESS is a term that is sometimes used to disprove qualitative research. However, it is difficult to disprove a study that is not representative in principle and never was supposed to be. Qualitative research works as a trend exploration (before quantitative research which will measure trends) or as an explanation (explaining a trend: why does it appear, where does it come from, where does it lead?). A skilful explanation of what social research is all about, defending qualitative research and clarifying the purpose of a representative sample and the situations in which it can be used, was very important to us.

RESEARCH METHODS should be selected according to the context: the research problem and the population they concern. Practice shows that, so far, expert panels, individual interviews and on-line surveys are the most effective for the research of our organisation, but whenever we have the opportunity, we extend the research with other methods and constantly develop the research workshop.

RESEARCHING THE NEEDS OF THE ENVIRONMENT required from us a precise selection of the sample, taking care of the representation of various perspectives within a given industry / discipline / direction. Conducting an expert panel requires the moderator not only to be vigilant about the nuances, but also to quickly get familiarised with the specialised terminology used by experts when talking about the needs of their company, institution, market, and the upcoming challenges. The development of a catalogue of forms of cooperation would not be possible without listening to the opinions of entrepreneurs and partner institutions about their experience to date when trying to cooperate with the university.

WE LEARNED FROM EVERY RESEARCH. The work commissioned by external partners kept us in line, close to the market, which allowed us to improve on formulating recommendations useful for decision-making. The variety of disciplines and the

specificity of the community of experts in a given area supported us in developing openness and noticing both important issues and details that affect the type of actions taken with the university.

INTERNATIONAL COOPERATION, especially in cross-sector projects as part of Horizon 2020, allowed us to broaden the research perspective with good practices in the field of cooperation with stakeholders. We became convinced that the research of needs and expectations is necessary for continuous development and quality improvement, and we were able to compare the practice of cooperation with external stakeholders with partners from England, Ireland, Slovenia and South Korea.

THE ANALYSIS OF GOOD PRACTICES of other universities allowed us to see that analytical and research activities related to the needs of an organisation are carried out at many universities: from internal research departments, through departments supporting rectors with analytics, to competence centres. The value of basing the university's decision-making process on research is appreciated not only at WUT.

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