SELF-EVALUATION REPORT
COVERING PERIOD 2016 - 2020

Department: Department of Informatics and mathematics

STAFFING AND EDUCATIONAL ACTIVITIES

The Department of Informatics and Mathematics (hereinafter the Department") was established in 2014 by merging the Department of Informatics and the Department of Mathematical Methods in Economics. It is divided into two subject sections: computer science and mathematics. The Department consists of a total of 13 academic staff with a total workload of 11.4 (one staff member with a workload of 0.8, one staff member with a workload of 0.5 and one staff member with a workload of 0.1) and two doctoral students (one doctoral student is studying a doctoral degree program in a full-time form of study - in the informatics section, the second in the combined form of study - in the mathematics section). It should be noted at the beginning that the members of the Department with a workload of 0.1 and 0.5 did not directly participate in the research activities of the Department and SU SBA in the monitored period due to their full-time work at other workplaces; in addition, another staff member with a workload of 0.5 was hired to the Department on 1.1.2020. For this reason, their activity is not further evaluated. The members of the Department provide teaching of basic and advanced courses in university informatics, mathematics and statistics in all degree programs and fields at the Silesian University in Opava, the School of Business Administration in Karviná (SU SBA). They also take part in lifelong learning in an internationally recognized Master of Business Administration course, a university of the third age or provide training in companies. The second key activity of the Department is the implementation of scientific research activities with outputs in the form of articles in peer-reviewed scientific journals, proceedings of international or domestic scientific conferences or monographs. Correspondingly, textbooks and study materials are part of the publication outputs. The Department also develops cooperation with domestic and foreign universities and cooperates with business entities. The outputs of this cooperation are clear especially in the outputs of publishing activities and degree theses (bachelor's, master's, dissertation).

State of the staff as of 31/12/2020	
Position	Number
Academic staff	
Professor	1
Associate Professor	2
Assistant Professor	9 (7,4)
Assistant	1
Lecturer	0
Teaching staff	
Professor	0
Associate Professor	0
Lecturer III.	0
Lecturer II.	0
Lecturer I.	0
Doctoral students	
Full-time	1
Part-time	1

The Department guarantees:

- Bachelor's degree program in System Engineering and Informatics with the field of Management Informatics (accreditation until 2024) with a full-time and part-time form of study;
- Master's degree program in System Engineering and Informatics with the field of Management Informatics (accreditation until 2024) with full-time study (students are no longer accepted for this degree program - accreditation was extended for this degree program during the accreditation process of the degree program in Management Informatics below, which is a replacement or continuation of the given degree program);
- Academically focused master's degree program in Management Informatics with the full-time and part-time form of study (accreditation until 2029).

The guarantor of all the above degree programs and fields is Prof. RNDr. Jaroslav Ramík, CSc. The fields of study and the degree program in Management Informatics combine courses from the field of education, informatics, and economics. The aim of the study in the above degree programs is in accordance with the needs of the current and projected future labour market to prepare globally thinking graduates equipped with a sufficient set of knowledge, skills and abilities in information and communication technologies (ICT) and management, organization and business economics, trade, law and more. The content of degree programs has always been updated within individual accreditations so that the latest ICT development trends are incorporated into courses from the educational field of informatics, in particular. The numbers of students admitted to the above degree programs are presented in Table 1.

Table 1: Numbers of students enrolled in the 1st year of study.

1st-year students 2016-2020										
Period	**2016**		**2017**		**2018**		**2019**		**2020**	
Fields of study	BA	MA	BA	MA	BA	MA	BA	MA	BA	MA
System Engineering and Informatics / Management Informatics	45	26	59	9	43	7	66		93	
Management Informatics								14		36

In the case of the number of enrolled students in the 1st year of the bachelor's degree program, an increasing trend can be seen, except for the fluctuation in 2018. Its reason is a change in the development of the demographic curve (slight growth) and the results of monitoring the employability of graduates in the labour market, which is implemented at the university level, which shows practically 100% employability of graduates of both bachelor's and master's type of study. These data are, of course, also used in the marketing activities of the SU SBA, which supports the interest of applicants in studying the specific degree program. However, a key fact is the permanent, very rapid penetration of ICT into all areas of social life and their development, which in itself increases the attractiveness of computer or computer-oriented degree programs.

As of 11 November 2020, a total of 203 students were studying in all degree programs guaranteed by the Department in all types and forms of study, which represents approximately 15 students per one academic staff member of the Department, resp. 17 students per recalculated workload. This number allows teachers a more individual approach to students, a more effective opportunity to motivate students and easier search, focusing on supporting talented students.

Table 2: Numbers of graduates.

Graduates 2016-2020										
Period	**2016**		**2017**		**2018**		**2019**		**2020**	
Fields of study	BA	MA	BA	MA	BA	MA	BA	MA	BA	MA
System Engineering and Informatics / Management Informatics	17	17	11	9	16	13	12	2	18	4

The number of graduates is influenced by several factors. The first is the fact that there is currently a certain, mostly variable, percentage of students who enrol only to obtain student status without actually studying. Several students do not complete their studies due to the failure to take the exams, although many of them generally re-enrol. The last significant factor is the fact that there is a great demand for people in the field of information technology in the labour market. Many students already work in the full-time form of study, which again limits their study opportunities and some of them leave their studies and start to work. Over time, some may return to study, for example, to a combined form of study.

FOCUS OF SCIENTIFIC AND RESEARCH ACTIVITIES

In the period from 2016 to 2020, the research activities of the Department were carried out in accordance with the concept of the development of research activities for this period. The main topic was "Intelligent decision support techniques" with partial research directions:

1) Modeling and simulation of socio-economic systems;

2) Decision support and system optimization using mathematical and statistical methods;

3) Intelligent systems.

These topics were developed in connection with development trends in these areas both in our country and abroad.

Within the Modeling and simulation of socio-economic systems, the output was several simulation models, especially in the field of logistics of production and business systems, whose functionality and usability were verified on sample data. This created systems that can be used as a basis for supporting process management in selected types of manufacturing and trading companies, including e-commerce systems. Furthermore, at the conceptual level, a model for structural analyzes was created based on the identification and generation of environments and links for the analysis of selected socio-economic factors. At present, the tools of precedent and incidence matrices are implemented in the model and the usability of autonomous agents and artificial intelligence is being tested. Input data for the model and other research in the area were obtained from surveys at the level of the EU, the Czech Republic, and the Moravian-Silesian region. At the EU level, the significance of the positive and negative factors of the Industry 4.0 initiative, the use of CRM systems as a tool to minimize coronavirus impacts on companies, the globalization effects of migration and the analysis of tourism sustainability factors were assessed. Within the Czech Republic, it was mainly research related to the sustainability of tourism. Furthermore, the model was used in the analysis of the possibilities of monetization of terrorism.

Research in the field of decision support and optimization of systems using mathematical-statistical methods is directed to the use of mathematical-statistical methods, especially in the field of socio-economic systems. Specifically, it is a research of methods of multicriteria and group decision making concerning applications of the pairwise comparison method and data mining, in conditions of uncertainty, uncertainty and risk, where uncertainty is modelled using intervals, fuzzy sets (FM) or stochastic FM. Part of research activities in the field is the research of methods and their applications of applied mathematics with a focus on applications in managerial decision-making in conditions of uncertainty (application of stochastic and fuzzy approaches), in the field of quantitative methods, methods of operational analysis, etc. Achieved results in the field are:

- The method of pairwise comparison was extended by the possibility of using Abelian ordered groups, which enabled the unification of the problem and the use of suitable properties of matrices of pairwise comparison and their respective priority vectors. These new properties were derived and investigated concerning their use in multicriteria and group decision making.
- The conditions of consistency of the matrices of pairwise comparisons were weakened to the condition of coherence, resp. the intensity of matrices. The properties of such matrices and their interrelationships were investigated and evaluated.
- In detail, as matrices of pairwise comparison with numerical (crisp) elements, matrices of pairwise comparison with fuzzy elements were also investigated. Similar concepts have been defined for such matrices and new relationships and properties have been derived.

Within Intelligent Systems, the research focused mainly on modelling stochastic dependencies using the so-called copula functions, which, for example, allow estimating risks in financial markets or modelling multidimensional flexible distribution functions used in the Bayesian classification. Specifically, it was about developing a methodology for constructing, estimating, and sampling a class of hierarchical Archimedean copula functions and open-source software HACopula freely available from GitHub. In cooperation with TU Dresden and the University of Waterloo, the flexible extension of this class using the so-called outer power transformations of Archimedean generators was further investigated.

LEVEL OF SCIENTIFIC AND RESEARCH ACTIVITIES

In the years from 2016 to 2020, the staff of the Department created as authors or co-authors 1 monograph, 3 chapters in monographs, 26 articles in scientific journals listed in the Web of Science database (of which Q1 - 8; Q2 - 10; Q3 - 4; Q4 - 5), 12 articles in scientific journals listed in the Scopus database (of which Q1 - 1; Q2 - 2; Q3 - 5; Q4 - 3), 13 articles in scientific peer-reviewed journals and 74 articles in conference proceedings. These numbers represent publications that were created at the Department and are dedicated to the project that was solved at the SU SBA, or to the institutional support of the SU SBA. The numbers of individual types of publications in individual years are contained in Table 3.

Table 3: Number of publications by type.

	Publications	2016	2017	2018	2019	2020
1	Monograph (B)	0	0	0	0	1
2	Chapter in monograph (C)	0	1	0	1	1
3	Article in the scientific journal with impact factor (J_{imp})	3	6	4	6	8
4	Article in the scientific journal listed in Scopus database (J_{sc})	1	4	3	3	1
5	Article in other scientific journal (J_{ost})	3	3	3	1	3
6	Article in conference proceedings (D)	16	19	14	19	6

In the years from 2016 to 2017 there were still evaluated quite highly articles in proceedings from conferences listed mainly in the Web of Science database within the valid methodology of evaluation of scientific publications. Since 2017, the methodology referred to as Methodology 17+ has changed quite significantly, with the main emphasis on publications in scientific journals. The decisive parameter is the position of the selected journal within the given field in the Web of Science database, which is expressed by the relevant quartile. Based on this fact, the goal of the university and department management is to support and motivate the staff of the Department to carry out quality research, the outputs of which are and will be possible to publish articles in renowned scientific journals.

In addition to the above publications, however, there is still a need to encourage participation in conferences and publications in conference proceedings, mainly for two main reasons. The first is the

fact that articles from conference proceedings are recognized as publication outputs to document the publishing activities of individual employees in the courses taught within the applications for accreditation. The second reason is related to scientific research, where ongoing research or better partial results are presented at conferences, where authors can get the first feedback, which they can use to improve their research and achieve better results published in high-ranking scientific journals.

In terms of publication outputs and their quality, an increasing focus on publications in journals included in the Web of Science database and the growing quality of these publications can be observed at the Department, which are increasingly included in journals with higher Article Influence Score. Overall, the publication performance of the Department can be considered balanced with the growing quality of publication outputs.

Intending to further improve the publication outputs, the SU SBA creates a background for sharing the primary results of scientific research activities in the form of so-called working papers, which are accessible on the website of the Institute of Interdisciplinary Research (https://www.iivopf.cz/working-papers/). The purpose is to get initial feedback from a professional audience before submitting an article to a journal or scientific conference. In the monitored period, only one employee of the Department used this "service". Due to the success of the publishing activities of the department staff, this fact is not a significant weakness.

In cooperation with the Department of Business Economics and Management, the Department has been organizing an international scientific conference Decision Making for Small and Medium-Sized Enterprises (with a two-year period since 2017 http://demsme.cms.opf.slu.cz/). The proceedings from the 2nd year of this conference were listed in the Web of Science database.

SCIENTIFIC PROJECTS

Research projects are among the basic mechanisms of funding science and research at Czech universities. It is also one of the important qualitative indicators of scientific research activities of universities and their staff. Projects are categorized into internal and external according to the type of funding sources. Internal projects at the SU SBA include, for example, the Student Grant Competition and the Internal Grant System. External ones include, for example, EU projects such as Horizon 2020, or national and regional projects such as the Grant Agency of the Czech Republic, the Technology Agency of the Czech Republic, the Visegrad Fund, and projects of the Moravian-Silesian Region. If the investigator fails to obtain support for the submitted project from the above external calls, the SU SBA offers project financing from the institutional support for science and research, which individual universities obtain on the basis of achieved scientific results. The aim of this is to ensure a smooth continuation of the research activities of individual teams, within which they can expand the existing scientific background and prepare a better starting position for further submission of the project in the following calls.

In the period from 2016 to 2020, two projects financed from the Grant Agency of the Czech Republic were solved at the Department (see Table No. 4).

Table 4: Projects financed from external sources.

Source	Time period	Project Title	Co- / Investigator	Registration number
Czech Scientific Foundation	2014-2016	Development of Non-standard Methods of operations research for decision support under uncertainty	Jaroslav Ramík	# 14-02424S
Czech Scientific Foundation	2018-2020	Nonstandard Optimization and Decision Methods in Management Processes	Jaroslav Ramík	# 18-01246S

The solution of grants financed from external sources is an important criterion for the evaluation of the university, its components and, of course, the individual staff who are the investigators of these projects. The importance of these projects for the evaluation of scientific research activities and the accreditation of new degree programs is arousing the growing interest of Czech universities in the mass submission of these proposals. This is ultimately reflected in the rate of acceptance of project proposals for funding, especially by the Grant Agency of the Czech Republic and the Technology Agency of the Czech Republic. At the end of the period under review, this rate was around 20%.

In the monitored period from 2016 to 2020, 3 projects were implemented at the Department from internal sources (see Table No. 5). The staff of the Department, who did not participate in the projects from the Czech Scientific Foundation, were mostly involved in the solution of projects from internal sources.

Table 5: Projects financed from internal sources (university sources).

Source	Time period	Project Title	Co- / Investigator	Registration number
Institutional Support of Long-term Research Development	2018	Optimization and decision-making methods in economic processes	David Bartl	IP-03/2017
Student Grant Competition	2016-2017	Advanced mining methods and simulation techniques in business process domain	Radim Dolák	SGS/19/2016
Student Grant Competition	2019-2020	Application of Customer Relationship Management Systems in Small and Medium-sized Enterprises	Milena Janáková	SGS/19/2019

The solution of internal projects led to the creation or preparation of materials for the creation of many publications both in the category J_{imp} and J_{sc}, as well as D (the category - conference proceedings).

NATIONAL AND INTERNATIONAL COOPERATION

At the national level, scientific research was carried out in the period under review with the Institute of Informatics of the CAS (Czech Academy of Sciences), the Institute of Mathematics of the CAS and IT4Innovations (https://www.it4i.cz/en).

- In cooperation with the Institute of Informatics of the CAS, the University of Waterloo (Canada) and the Dresden University of Technology (Technische universität Dresden), open-source software (https://github.com/gorecki/HACopula) for modelling stochastic dependencies was created and developed.
- Cooperation with the Institute of Mathematics of the CAS was carried out in the field of variational analysis, as part of optimization, and operational research, which is finding ever wider application in several practical areas.
- The cooperation with IT4Innovations was focused on the analysis of user behaviour in systems related to the detection of hidden links within large graphs using methods for data analysis and artificial intelligence methods.

Cooperation with foreign research institutions was implemented within the solution of the CSF (Czech Science Foundation) projects, on the basis of long-term cooperation or in connection with mostly short-term internships. Within the solution of CSF projects, cooperation was carried out whose thematic focus was the research of methods and computational algorithms of multicriteria decision making, comparison of pairwise comparison methods using Monte Carlo simulations, simulations of algorithms for inconsistency reduction in pairwise comparisons and organization of International MCDM (Multiple Criteria Decision Making) conferences. It was a collaboration with:

- University of Technology Rzeszow, Poland;
- AGH University of Science and Technology Krakow, Poland;
- Faculty of Informatics, University of Napoli, Italy.

The topic of research of multicriteria methods and organization of the MCDM workshop was also the main focus of long-term scientific research cooperation with the Polish University of Economics Katowice, Department of Operations Research.

The thematic area of simulation of socio-economic systems was covered by cooperation with Wyższa szkoła informatyki i zarządzania in Bielsko-Biała, Poland, while the cooperation was focused on modelling and simulation of production, logistics, e-commerce and e-business systems. An essential part of the research activities was the creation of mathematical simulation models, which represented proposals for new system patterns usable for the above types of systems. As part of scientific activities, two software simulators were created. Models and simulators were designed and created with a direct link to the monitored development in the scientific field. This cooperation is planned to continue in the next period.

The mentioned cooperation with Czech and foreign institutions was the basis for the creation of many scientific publications in the form of articles in renowned scientific journals or conference proceedings and defined the starting points for the continuation and further development of scientific research activities for the next period.

SOCIAL IMPORTANCE OF SCIENTIFIC AND RESEARCH ACTIVITIES

The main research directions of the Department cover key areas of knowledge and technological development in individual thematic contexts. The starting points of research activities are the current outputs of the academic and practical environment and the research aims to expand the existing knowledge base and implementation or share in the implementation of outputs applicable in authentic practice. In terms of academic outputs and focus, research activities are carried out on a global scale and in a direct connection or connections with established cooperation, especially with employees from foreign research institutions. The practical outputs are mostly directed to the area of the region in which the SU SBA is located, and the key in this context is cooperation with companies operating mostly in Karviná, Ostrava and its surroundings or even in the Moravian-Silesian Region. This fact fully corresponds with the characteristics of the SU SBA, i.e. the entire Silesian University, which with its scope fits into the position of a regional public university.

COOPERATION OF THE DEPARTMENT WITH THE APPLICATION SPHERE

The SU SBA is a member of IT Cluster, z.s., which is a registered association operating mostly in the Moravian-Silesian region, associating businesses and secondary and higher education institutions operating in the field of ICT. Its main mission is close cooperation with educational institutions to create an environment for all-round development of IT professionals, support of innovation processes, research and innovation activities, consulting services, project preparation and implementation, organization of seminars, workshops, etc. Cooperation with IT Cluster is based in particular on:

- Providing topics for degree theses;
- Definition of research topics, in particular for the purposes of applied and contract research;
- Support for project preparations (in the monitored period a project for the Technology Agency of the Czech Republic entitled Virtualization of the educational process (project submitted for evaluation in October 2020) - the application investigator is Linuxbox.cz - a member of the IT Cluster);
- Possibilities of implementation of professional internships student especially in the field of study in Management Informatics;
- Participation in the implementation of scientific and professional conferences (DEMSME, Opensource solutions in networks).

Since 2020, the SU SBA has been a member of the Czech Society for Systems Integration, which is a non-profit platform for the exchange of information and opinions in the field of information systems and ICT associating users and suppliers of ICT services and products. The cooperation will be based on:

- Definition of research topics focused mainly on the area of applied and contract research;
- Implementation of a regular IT conference for practice.

Two academic staff members of the Department are external experts for project evaluation of the Operational Program Enterprise and Innovation for Competitiveness, within which projects with the content of scientific research and innovative activities are submitted to support the development of business entities in the Czech Republic. Projects from the Potential, Applications, ICT and Shared Services, Knowledge Transfer Partnership, Proof of Concept and Cooperation - Clusters - Collective Research support programs are evaluated.

Cooperation with practice tied to the teaching process and content focused on corporate information systems using practical examples of ERP systems in teaching is implemented with the companies Navertica, a.s., K2Atmitec and ITICA.

Within the cooperation with the Moravian-Silesian Region, the project "Creation of a methodology and tools for monitoring the financial health of municipalities" was implemented. The project aimed to create a comprehensive simple methodology for assessing the financial health of municipalities. A member of the Department participated in the creation of a web application that allows representatives of municipalities and towns to find out through clearly defined and interpretable indicators of the state of the municipality in terms of financial health. The main benefit of the project is to improve the awareness of municipalities and towns about their financial health and potential risks associated with further irresponsible management.

METHOD AND RESULTS OF INTERNAL EVALUATION OF SCIENTIFIC AND RESEARCH ACTIVITIES

Research activities at the SU SBA are regularly evaluated both comprehensively and within individual departments. At all SU SBA departments, the head of the department sets a so-called personal development plan within an individual consultation with each academic staff member, which specifies specific tasks and their controllable resp. measurable results in advance for one full academic year. The tasks are set in 4 areas, namely qualification growth, pedagogical activities, scientific research activities and publications and other activities. Typical tasks for research and publication are, for example, preparing and submitting an article to a peer-reviewed journal included in the Scopus or Web of Science database, preparing, and submitting an internal or external project proposal, continuing to address such projects, establishing cooperation with new people working on others, mostly foreign, research institutions, etc. At the end of the academic year, the fulfilment of individual tasks is evaluated and the level of their success is related to the change in the performance component of the salary. On the one hand, this approach is an effective form of control and management of the activities of individual members of the department and the department as a whole, on the other hand, it is motivational support for employees both in terms of financial evaluation and their career growth.

In Karviná, 15.1.2021

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