STUDIJŲ KOKYBĖS VERTINIMO CENTRAS

Kauno technologijos universiteto
STUDIJŲ PROGRAMOS DIDŽIŲJŲ VERSLO DUOMENŲ ANALITIKA *(valstybinis kodas - 621G12002)*
VERTINIMO IŠVADOS

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EVALUATION REPORT
OF BUSINESS BIG DATA ANALYTICS *(state code -621G12002)*
STUDY PROGRAMME
at Kaunas University of Technology

Experts' team:
1. **Prof. Miklós Hoffmann (team leader)** *academic,*
2. **Prof. Neda Bokan,** *academic,*
3. **Assoc. Prof. Ants Aasma,** *academic,*
4. **Mr. Marijus Mikalauskas,** *representative of social partners,*
5. **Mr. Henrikas Vaickus,** *students' representative*.

Evaluation coordinator -
Mr. Pranas Stankus

Išvados parengtos anglų kalba
Report language – English

Vilnius

2017

DUOMENYS APIE ĮVERTINTĄ PROGRAMĄ

Studijų programos pavadinimas	*Didžiųjų verslo duomenų analitika*
Valstybinis kodas	621G12002
Studijų sritis	Fiziniai mokslai
Studijų kryptis	Matematika
Studijų programos rūšis	Universitetinė studijos
Studijų pakopa	Antroji
Studijų forma (trukmė metais)	Nuolatinė (2)
Studijų programos apimtis kreditais	120
Suteikiamas laipsnis ir (ar) profesinė kvalifikacija	Taikomosios matematikos magistras
Studijų programos įregistravimo data	2015-06-09

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INFORMATION ON EVALUATED STUDY PROGRAMME

Title of the study programme	*Business Big Data Analytics*
State code	621G12002
Study area	Physical sciences
Study field	Mathematics
Type of the study programme	University Studies
Study cycle	Second
Study mode (length in years)	Full-time (2)
Volume of the study programme in credits	120
Degree and (or) professional qualifications awarded	Master of Applied Mathematics
Date of registration of the study programme	2015-06-09

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I. INTRODUCTION

1.1. Background of the evaluation process

The evaluation of on-going study programmes is based on the **Methodology for evaluation of Higher Education study programmes,** approved by Order No 1-01-162 of 20 December 2010 of the Director of the Centre for Quality Assessment in Higher Education (hereafter – SKVC).

The evaluation is intended to help higher education institutions to constantly improve their study programmes and to inform the public about the quality of studies.

The evaluation process consists of the main following stages: *1) self-evaluation and self-evaluation report prepared by Higher Education Institution (hereafter – HEI); 2) visit of the review team at the higher education institution; 3) production of the evaluation report by the review team and its publication; 4) follow-up activities.*

On the basis of external evaluation report of the study programme SKVC takes a decision to accredit study programme either for 6 years or for 3 years. If the programme evaluation is negative such a programme is not accredited.

The programme is **accredited for 6 years** if all evaluation areas are evaluated as "very good" (4 points) or "good" (3 points).

The programme is **accredited for 3 years** if none of the areas was evaluated as "unsatisfactory" (1 point) and at least one evaluation area was evaluated as "satisfactory" (2 points).

The programme **is not accredited** if at least one of evaluation areas was evaluated as "unsatisfactory" (1 point).

1.2. General

The Application documentation submitted by the HEI follows the outline recommended by the SKVC. Along with the self-evaluation report and annexes, the following additional documents have been provided by the HEI before, during and/or after the site-visit:

No.	Name of the document
1.	Guidelines for study programme improvement
2.	Marketing material

1.3. Background of the HEI/Faculty/Study field/ Additional information

The Business Big Data Analytics Master Programme in the field of Mathematics is carried out by the Faculty of Mathematics and Natural Sciences in a joint effort with School of Economics and Business and Faculty of Informatics, Kaunas University of Technology. The Expert Team visited the Faculty on May 9-10th. First, the Expert Team met the administrative staff of the Faculty. Next, at the meeting with staff members responsible for preparation of the Self-assessment report the Expert Team was given answers to the questions concerning less covered in the Self-assessment report issues. After that, a meeting with members of teaching

staff took place. The Expert Team had possibility to observe various study support services (class rooms, computer services, library), as well as to familiarize with students' final thesis work. The Expert Team conducted also interviews with students. The Expert Team was familiarized with students' attitude towards the study programme. The meeting was carried out in an active and constructive atmosphere. The students expressed positive as well as critical opinions about the programme. In the following, the findings of the Expert Team are outlined. The Self-assessment report submitted by the Faculty, the observations made at the time of the visit, and the supplementary material received during the visit form the basis of these assessments.

1.4. The Review Team

The review team was completed according *Description of experts' recruitment*, approved by order No. V-41 of Acting Director of the Centre for Quality Assessment in Higher Education. The Review Visit to HEI was conducted by the team on *10, May 2017*.

1. **Prof. Miklós Hoffmann (team leader),** *Full Professor, Head of institute of mathematics and Computer Science, Eszterhazy Karoly University, Hungary;*

2. **Prof. Neda Bokan,** *Former Professor of the University of Belgrade, Serbia;*

3. **Assoc. Prof. Ants Aasma,** *Associate Professor, Department of Mathematics and Finance , Tallinn University, Estonia;*

4. **Mr. Marijus Mikalauskas,** *CEO of insurance company "Būsto paskolų draudimas;*

5. **Mr. Henrikas Vaickus,** *student of Vilnius University study programme Physics of Energy*

Evaluation coordinator – Mr. Pranas Stankus

II. PROGRAMME ANALYSIS

2.1. Programme aims and learning outcomes

The Business Big Data Analytics Master Programme in the field of Mathematics is carried out by the Faculty of Mathematics and Natural Sciences in a joint effort with School of Economics and Business and Faculty of Informatics, Kaunas University of Technology. This Master is a unique opportunity in Lithuania to study this field, which is a definite plus. The declared programme objectives and implementation are clearly defined and fully in line with European and Lithuanian higher education recommendations, standards and legal requirements. The objectives fit the mission, operational objectives and strategy of the Kaunas University of Technology. The title of the programme well reflects the goals of the programme. The title of the

degree awarded, which is „Master of Applied Mathematics" does reflect the content of the Master. Further on, the programme is aiming at fulfilling the requirements of the Descriptor of the Study Field of Mathematics, whilst the aim is to prepare specialists who have acquired *balanced* knowledge in mathematics, computer science and business as well.

The Master is aiming at improving student's competences gained during the second cycle study programme Business Big Data Analytics, including competences such as to analyse big data sets for business, to identify problems of business, to apply the acquired knowledge, to create mathematical models and algorithms for business decision making, as well as development for strategic business insights.

The intended learning outcomes of the Programme are well presented in the SER, and are publicly announced, which is an asset. These objectives correspond with Dublin descriptors and cover scientific and soft skills as well. According to the formulated learning outcomes of the Programme students are supposed to obtain integrated knowledge of mathematics, computer science and business, as well as skills of its application and ability to improve business processes, to participate in interdisciplinary teams by developing new products, services and technologies, to provide recommendations based on mathematical models about management of various business processes, optimization, forecasting, and risk assessment and mitigation. In addition, soft skills such as social abilities and personal abilities are included in the list.

Although it is declared that contacts with representatives of some companies exist, how industrial and further non-educational partners provide regular and structured feedback and support to adjust and assess the content and outcomes of the Programme could be further improved while developing programme in the future. The feedback from non-educational actors is of central importance in case of applied sciences, especially in this economy-related field. Since the Programme and the KTU itself possesses several industrial partners, the introduction of internships could be an asset to further improve the applied konwledge of students. The review team aknowledges that these recomendations are more related to curriculum design, however cahnges in curriculum will need reflection of learning outcomes in the future.

The learning outcomes are well assigned with modules and courses, which is credible. There is a core part of the Master following elective courses and modules. A presentation could be more clearly declared and summarized what learning outcomes can be gained through the core part and what further outcomes can be obtained by the elective courses. Beside the degree awarded, a diploma supplement with the description of the elective courses is attached to the diploma, which is an asset in this regard.

2.2. Curriculum design

The master degree study programme Business Big Data Analytics is in line with the Lithuanian legal acts regulating the structure of study programme. The ratio of obligatory, alternative and elective subjects in the Programme satisfy the Description of General Requirements for Master's Study Programmes, Approved by the LR Minister of Education and Science on 3 June 2010, Order No. V-826, Amendments No. V-727 of 7 July 2015. The second

cycle study programme Business Big Data Analytics is also grounded on the Lithuania's progress strategy which includes three key areas of the progress: smart society, smart economy and smart governance.

It has full time 2 years form and the scope of the programme is 120 ECTS. Two semester projects (12 ECTS) are foreseen in the Programme for educating students' abilities in scientific works. 30 ECTS are allocated for Final Degree Project. Such programme structure and indicated number of credits is appropriate for students to achieve successfully the objectives of the studies.

Generally speaking subjects of study (modules) are taught in a consistent manner. But analyzing subjects description in Annex 2 of SER some overlapping in content of some courses from bachelor level study programme Applied Mathematics and some courses of this programme can be indicated. In the course Matrix analysis among sections and themes are: 1. Matrices and determinants; 2. Systems of linear equations; 4. Elements of linear algebra; 7. Least squares estimation. The first three themes belong to the course Linear Algebra of the bachelor study programme, and the last one is surely considered either in Numerical Analysis or Mathematical Statistics (also on the bachelor level). Software for business analytics and Data mining software are the same: R, Hadoop, Spark, Python, but they are considered in two courses: Multivariate Statistical Analysis Models and Big Data Mining Methods. The theme Business Big Data Analytics appears in courses: Big Data Mining Methods and Multivariate Statistical Analysis Models. The themes: Special probability theory, Graph theory, Optimization and operational research fields are considered in the course Business Logistics Analytics as well as on the bachelor level study programme Applied Mathematics in corresponding courses, etc. The review team recognises that some of these topics might be thought at the higher level comapred with BA programme, however the programme providers should croscheck, take a deeper look at the subjects thought in different courses of the currient programme to avoid any overlaping and finally, make sure the course decriptors reflect the higher level of knowledge being provided as wel as prerequisites should be clear.

Prerequisites in majority of courses are described in a very general and unclear form. For example, as prerequisites one can find: mathematics, informatics, programming, calculus (see description of study subjects: Time Series Analysis, Financial Markets Models, Seminar on Big Data Analysis and Application, Business Risk and Uncertainty Analytics,, Big Data Analytic Tools, etc.).

The review team discussed all of these shortcomings with the administrative staff, the self-assessment group, teaching staff, students' representatives and social partners. After all observations during the meetings the review team learned the admission criteria for this master study programme is 22 ECTS in mathematics during Bachelor studies. But this programme is based mainly on the bachelor degree study programme Applied Mathematics. According to the various background in mathematics knowledge of students enrolled in the programme, this study programme has been designed to include certain part of bachelor level subjects to equalize the various unalaced knowledge students bring to the programme. Thus an additional risk of

overlapping occures which should be managed.

To overcome these weaknesses the review team encourages to restructure the curricullum aiming at stimulating critical and logical thinking and creating a possibility to develop both research competence and subject-specific abilities. The review team believes that admission criteria needs to be improved as 22 ECTS in mathematics are not enough to study important advanced courses. For students who do not have a proper preknowledge it is necessary to organize more „equilizer" courses to achieve necessery balance in acquiring the corresponding learning outcomes.

The content and prerequisites of some subjects should be declared in a more precise form. In this spirit to avoid overlapping with bachelor level studies the review team suggests to relocate contents mentioned above in the corresponding bachelor level courses and reorganize some courses and introduce new courses such as algebraic topology, computational algebra, Hilbert spaces, measure theory. The review team does understand the necesity of deeper knowledge in some courses which might look as repetition from the bachelor courses, however this deeper knowledge should be emphasised in course descriptors providng clear prerequisites and course learning outcomes corresponding to the higher level of knowledge.

 When students enter more advanced courses they are required to do more individual work and problem-based methods, aiming to stimulating critical and logical thinking and creating a possibility to develop both research competence and subject-specific abilities, as it is already pointed out above. These contribute to a better learning outcomes. Especially the review team emphasizes the topological data anlysis which seems to be a must if one really can feel comfortable to deal with data. Furtermore, students need to have a chance to do more advanced optimization problems. Review team suggest considering introducing a course in optimization in Hilbert space. With a proper knowledge of Hilbert spaces or functional analysis a more advanced topics, for example decision making, risk analysis, financial market, time series and also data mining could be discussed at higher levels. The review teams suggest also to innitiate discussions when improving the curriculum design in respect to knowledge of complex analysis or topological concepts or functional analysis. The theoretical treatment as subject for data analysis is important due to the fact that the review team believes it will be beneficial for students facing and dealing with real-time large quantity of data when they are confident in theoretic understanding of data and their structures.

Considering the teaching/learning methods the review team learned the teaching staff made a big effort. They prepared teaching materials available online as well as recording of lectures to be also available online. Teacher training modules and intensive short courses in a broad helped them to teach subjects in a proper way. This teaching approach, and generally this study programme contributes to covering the demand of employers in development of big data analysis. A part of study modules is organized by the team of professional teachers composed of employees from several departments. The synthesis of theory and practise is implemented in the Programme, whereas business representatives are included in the study process along with the

theorists. Real business data and business situations are used for practical applications.

During the meeting with students the review team learned they are interested in business and there exists a lack of deeper research possibilities. The review team recommends teaching staff to motivate students for development of research skills. In this spirit some proposals are given above.

Generally speaking with overcoming mentioned above weaknesses the content of subjects (modules) corresponds to the type and cycle of studies described by Descriptor of the Study Field of Mathematics, approved by the order of the Minister of Education and Science of the LR, July 23, 2015, No. V-813, Description of General Requirements for Study Execution, approved by the order of the Minister of Education and Science of the LR, December 30, 2016, No. V-1168., etc.

The content of the programme corresponds to the latest academic and technological achievements. This is a consequence of the long traditional, and recognizable KTU mission to adopt and develop study programme consistent with newest science research and innovations as well as of good cooperation with stakeholders.

2.3. Teaching staff

In total there are 30 lecturers affiliated with the Programme, besides 26 lecturers are full time employees at KTU. The academic staff, working in the Programme, consists of 12 professors, 13 associate professors and 5 lectures (4 with PhD). Research experience of all professors and associate professors exceeds 10 years as required. There are a good balance between older, middle-age and young researchers. There exist some older high qualified experienced professors and many perspective and productive middle-age and young lecturers.

34.8 % of study subjects are given by full time professors (no less than 20% required). The study programme to a great extent corresponds to the research interests of the teaching staff (mathematical modelling, mathematical analysis, differential equations, numerical analysis, probability theory and statistics, time series analysis, complex systems, computer science and information systems, software engineering, industrial mathematics). The requirement not less than 80% of the study subjects to be given by teachers, who perform research in the field of taught subject, is fulfilled, since 92 % of study subjects are delivered by the professors and associated professors that do the research work, projects and write scientific articles in the fields of delivered study modules.

During the assessment period, all members of teaching staff participated in various activities to raise their teaching skills and professional qualification. For example, courses for teaching staff: "KTU educational excellence development", "Study programme update: learning outcomes and didactic system", "Open and distance learning", "Use of electronic sources of scientific information", "Basis of video conferences methodology", etc. Lecturers use traineeship possibilities at foreign studies and research institution, possibility to work of

associated researcher at foreign studies and research institution. There were 32 and 33 skills improvements in 2015 and 2016 year respectively.

As this Programme is relatively new, then there is the space for future improvement of knowledges and teaching skills for teaching the subjects of this Programme. Now there is only one lecturer who has defended PhD exactly in Big Data Analysis.

Summarizing, the qualification and competence of the current academic staff are of a good level for achieving the aims and learning outcomes set for the Programme, and surely meet the legal requirements.

2.4. Facilities and learning resources

The Faculty of Mathematics and Natural Sciences has a sufficient number of classrooms and laboratories for the study Programme. The same material resources are used by bachelor programme in Mathematics. The premises used by the studies are adequate both as to the size and as to the quality. The academic premises generally conform to the requirements of occupational safety and hygiene. Regarding smaller sizes of students in master programme the classrooms are more suitable for group work.

All teaching workplaces are equipped in appropriate level: auditoriums repaired during the last 6 years, computer classrooms renewed every 5-6 years (part of them renewed in year 2016), equipped by video and audio equipment, wireless internet access. The various software and programming tools used in the learning process are adequate and sufficient. The review team discussed with teaching staff as well as with students and social partners the big data databases. After on site discussions it is clear that big data resources are provided for a student which is very positive. During the visit students did not express any complaints regarding the material resources.

As the master students have considerably higher amount of independent work, the library and other premises serves well for such work. During our visit to the library, the reading room was rather fully occupied by the students working with their laptops rather than using the literature. The library has the contemporary electronic catalogue with many necessary scientific databases present. The students informed review panel that all necessary information for their independent work is well presented; the Moodle platform is well established and intensively used by the students.

The teaching materials and accessibility to the students are suitable. Moodle learning environment is used for this purpose. The review team had a chance to visit distance learning laboratory which is beneficial.

There is no obligatory internship in the program. Student's voluntary can use the Erasmus+ program for summer practice or they can participate individually in Lithuanian Science Council organized competitions for students' scientific practice.

2.5. Study process and students' performance assessment

Entrance requirements are well-founded clear and transparent. Admission procedure to the second cycle study programme is organised by the faculty level admission commission, which ranks applicants according to the competitive points system. The competitive marks are composed based on grades from the first cycle study programme (weight factor 0,7), grades based on research activities (weight factor 0,2) and motivation (weight factor 0,1). In addition, one of the requirements is to have 22 ECTS credits in field of mathematics, economics or computer science. As a result, it may allow to join this programme for students, who do not have an appropriate bachelor's education to study this programme.

There is a high competition for the programme: the number of applicants is more than twice bigger than a number of admitted students (there were 89 applicants in 2015 and 103 in 2016, there were admitted respectively 27 and 41). The average competitive score of admitted candidates is more than moderate (6,75 in 2015 and 6,69 in 2016). In addition, there is a noticeable increase in the highest points of admitted students (from 8,33 in 2015 to 9,26 in 2016).

Organisation of the study process ensures proper implementation of the programme and achievement of the intended learning outcomes. The programme itself is interdisciplinary, with options for a study process individualisation (elective subjects) and shows a strong orientation to application. Studies are flexible and compatible with other personal activities: a schedule is rationally harmonized annually in collaboration with students regards to their needs, consultations about study plan composition are available. Virtual teaching means, i.e. Moodle is widely used for teaching. Considering the subjects of the programme, a wide range of databases is used, which allows to pay more attention on knowledge application. Nonetheless there are examples of alternative ways of teaching, the standard ways of lectures are still the majority. There is a working system of feedback from lecturers to students as well as the opposite feedback from students to lecturers in order to improve this relatively new programme. It is highly advisable, to continue the encouragement of students to fill the surveys about studies quality.

There is a lack of encouragement of students to take a part in scientific, artistic or applied science activities. Scientific research is usually made only for studies assignments and final projects, generally students are oriented to application of knowledge. As a result, majority of the students do not see themselves as researchers of this field.

The second cycle programme was launched only 1,5 years ago, consequently the students' mobility is very low because of understandable lack of time to sign bilateral agreements and mobility programs' promotion. Nonetheless, KTU makes effort to provide conditions for students to take part in mobility programmes, there already is 3 options of studies abroad.

The higher education institution ensures proper academic and social support. University

provides actual studies' information in a few sources, which guarantees an efficient information spread between academic community. University pays extra attention on the freshmen introduction to the studies through additional courses and events, students are satisfied with the introduction to the studies. The University provides additional support and attention for especially gifted students and those, who have learning difficulties, this support was positively evaluated by students. There is a high level of students' career consultations and support, which is proved by very successful Career Days. The opinion of students in support processes is represented by Students' Broad.

The system of assessing student achievements is clear, public and appropriate. This is achieved through appropriate dissemination of information and introductory lectures. The system of assessing is clearly defined by internal regulations of University. It is good that virtual information system is widely used for assessing implementation. Another strength of assessing is operative feedback from lecturers about evaluations and individual schedules are always made in agreement between students and lecturers. Final degree projects are going to be made and defended in a common process, which is usual for most universities in Lithuania.

Although there are no graduates, there are some evidences, that professional activities of programme graduates should fulfil the expectations of the employers and programme operators. To begin with, the programme was established on purpose to satisfy suggestions of social partners to prepare employees with a strong background of mathematics, economics and computer science jointly. Secondly, majority of students are already employed in a big data sphere, despite the fact that they are not graduated in this programme. The social partner expressed very positive opinions about the programme and some students who are currently working in their companies.

The programme was established in order to correspond to the state economic, social and cultural and future development needs, as social partners suggested with reference of their experience. It is the result of fine communication between social partners (employers) and the University.

Fair learning environment is ensured, there is a legal basis, preventative measures. The exams are supervised, laboratory assignments are defended orally, all final projects are checked by anti-plagiarism software. The academic community emphasizes, that there are no examples of cheating cases: it is said, that there was no written complaints by students during 2015-2016.

Processes of complaints and appeals submission are clearly defined by internal regulations in all spheres of studies. They are considered by a competent group of commissioners. Students' representatives take part in these commissions (i.e. round table discussions) in order to express students' opinion and improve studies quality. Students' opinion about their side representation is good, their noticed problems are usually fluently solved.

2.6. Programme management

The review team noticed the faculty management who has good cooperation with social

partners and has shown the will to cover demand of employers need with starting a new master study programme. To prepare teaching staff for teaching/learning methods for interdisciplinary work the Education Laboratory is established. The administration staff has also organize intensive short courses for teachers. To acquire objectives of the master study programme Business Big Data Analytics responsibilities for decisions and monitoring of the implementation of the programme are clearly allocated. According to SER the programme management, decision-making and control are implemented on the basis of the KTU Statute and other legal acts of the University and Lithuania which regulate the area of higher education. Study programme administration and internal study programme quality assurance activities are managed and coordinated by the Vice-Rector for Studies who is assisted by Study Department of the University, Study Quality Assurance and Development, Student Affairs Department and other administrative units. The role of Senate, Faculty Council, Field Study Programmes Committee and other bodies in these procedures are clear described. Students, stakeholders have their own representatives in all management units in compliance with their interest. There exists the Field's Study Programme Committee. It consists of lecturers (scientists), social stakeholders and students. Their work is regulated by Guidelines for improvement of KTU study.

For the purpose of improvement of study quality the University has own feedback system. The procedures for feedback organizing are regulated by the Description of Feedback Organizing Procedures of KTU. Each year, University Survey Plan is prepared and approved. A systematic collection of opinions and feedback is organized from all study process participants: students, lecturers, graduates, employers. The general feedback results are discussed at the meetings of the Rector and Senate, Deans and Department; they are published on University Intranet.

Since this study programme is new the review team cannot conclude if this management system works well on each level. The review team supports these analysis at the various levels as well as publishing on University Intranet. To provide a proper analysis of the achievement indicators the review team recommends to use more statistical data and concluding by proper statistical methods. Of course, it is important to harmonize teaching process supporting better communication among teachers.

Faculty Study Centre, headed by the Vice-Dean of Studies, coordinates the major processes of studies, ensures the establishment of procedures for the implementation of study programme. The Study Centre collects, accumulates and systematizes the data of the implemented study programme. A periodical analysis of programme implementation is organized on various levels: from Senate, through Faculty, Department and other corresponding bodies as well as by the coordinating lecturer.

According to SER outcomes of internal and external evaluations of the programme are used for the improvement of the programme. The Field Study Programme Committee is directly responsible for the implementation of the programme, its quality and improvement, annual study programme self-assessment and preparation of development plans. It directly participates in decision making concerning the programme composition and gridline formation (selection of modules), study programme alternatives or specialization package, selection of means for

internal quality assurance, formation of the teachers' team, submission of recommendations regarding the rise of teachers' qualification or replacement of teachers, supervision of the study programme quality and the results of external assessment. Any major changes of the programme structure are approved at the Faculty Council.

Outcomes of internal evaluation are checked by students' opinion. According to the results of the surveys (2015-2016 autumn and spring semesters), it can be noticed that students of the Programme positively evaluate the need of the core modules (on average 51% of students that responded gave 4-5 points (where max=5, min=1), the innovative teaching methods used during theory lectures or labs (on average, 81% of students that responded gave 4-5), the study material uploaded in Moodle system (on average, 84% of students that responded gave 4-5), etc. Overall opinion retains positive that shows the newly established study programme was successfully carried out during its first academic year. During the meeting with students' representatives the review team learned there exists a lack of communication between teachers from different faculties. Therefore teachers from different faculties explain all topics in different ways and it implies some confusions. It is important to harmonize teaching process supporting better communication among teachers. There does not exist results of external evaluations of the programme as it is a new programme (date of registration of the study programme June 09, 2015.).

As it is mentioned, this study programme is a result of good cooperation between KTU and stakeholders. The social partners initiated starting this master study programme. They are also active in teaching process to show big data analysis in practice. Social partners also organize conferences with students aiming big data work. They offer access to big data due to proper implementation of some subjects. Hence the review team concludes the evaluation and improvement processes involve stakeholders. By participating in the work of the Field Study Programme Committee, Faculty Council, Faculty Attestation and Tender, Masters Qualification Commissions, the social partners not only evaluate activities but also provide each year their remarks, conclusions on the quality of studies, proposals for the topics of the final degree project.

The internal quality assurance measures are effective and efficient in various aspects. It can be illustrated by students evaluation results, mentioned above, the influence of stakeholders and Study Field Programme Committee. The implementation of their recommendations, play an important role in the innovations in the study programme to achieve better quality. Possible improvements are recommended in this report.

*2.7. Examples of excellence *
* if there are any to be shared as a good practice
Core definition: Excellence means exhibiting characteristics that are very good and, implicitly, not achievable by all.
Explanatory context Excellence enshrines one meaning of quality: a traditional view that associates quality with the exceptional

III. RECOMMENDATIONS*

1. The Review Team suggests to improve the admission criteria, which are currently 22 ECTS credits in field of mathematics, economics or computer science. As a result, it may allow to join this programme for students, who do not have an appropriate background in mathematics. University should consider changing criteria to the necessity of bachelor's diploma in mathematics, economics or computer science studies.

2. The curriculum of first year must be adapted, reconstructed and modularized according to the background of students, with more „equalizer" elective courses.

3. Subjects description need to be more precisely defined in compliance with analysis of curriculum design presented above.

4. Teaching/learning methods should be adopted to the needs of development of soft skills, especially communication skills and teamwork.

5. Lack of deeper research possibilities need to overcome with more active involvment of students in projects.

6. It is necessary to improve communication between teachers from different faculties to harmonize teaching process.

7. To have a proper analysis of QA it is important to use statistical data and appropriate statistical methods.

IV. SUMMARY

In terms of programme aims and learning outcomes the will the university tries to cover the demand of employers need with starting a new master is highly appreciated. Further strengths are the high employment rate and good level of communication with employers. European and Lithuanian higher education recommendations, standards and legal requirements are all fulfilled. Learning outcomes are clearly presented in the SER and online as well, and are assigned with courses. The needs analysis is convincing.

Since the Programme possesses several industrial partners, the introduction of internships could be an asset to further improve the applied knowledge of students.

In terms of curriculum design the programme structure corresponds the needs of law, the scope of Programme is sufficient to ensure the learning outcomes; The need of this programme comes from institutions and enterprises using big data or applications. Overall description of study subjects is well designed. However, the first year is inappropriately designed, the number of „equalizer" courses is insufficient to give the necessary basic knowledge in all three fields (maths, computer science and economy), therefore students reported difficulties according to their scientific background. Content and prerequisities are not everywhere declared in a precise form.

The academic staff is highly qualified and competent: the academic staff includes the high percentage of professors and associated professors; most of the lecturers are active in the research work and have published several scientific publications and performed some research projects. Teacher training modules and intensive short courses in abroad are organized. Academic staff members participate in international conferences, research traineeships, international exchange programs. Some lecturers do research together with the industrial and academic organizations in the regions. Teaching materials, including recorded lectures are available online, which is also a plus. However, the high percentage of the high qualified academic staff members (professors and associated professors) are approaching retirement nearest years, which is a potential risk. Teaching load is too high, not enough space and time for research. Although lecturers' mobility for academic work increased in last years of the evaluation period, there exists the space for improving this component. Lack of communication between teachers from different faculties is evidenced during the visit of the Expert Team, which is also a weakness.

In terms of facilities and learning resources, Overall well-equipped building and classrooms are observed. Wide access of online scientific materials, and access of real-life big databases, which is essential in this Master are also available.

In terms of study process and students' performance assessment, fine communication with social partners and employers in order to satisfy the demand of labour market is observed, which is a definite plus. Comprehensive academic, social and etc. support for students is available, including wide usage of virtual teaching materials, and recorded lectures online. Strong orientation to applications is evident throughout the Programme. The knowledge and

abilities of students very well correspond to the expectations of employers, which causes a very high level of graduates' employment. However, the rate of mobility of students is low. There is a need for efficient internalisation strategy to increase a number of incoming/out coming students. Relatively small percent of students participating in scientific research. There is a need to develop a deeper students research in this science field.

In terms of programme management, implementation of various principles of KTU quality assurance of studies is present. Graduates, members of Field Study Programme Committee, social partners and companies discussions with potential employers are also involved in studies' quality assurance and improvement process. Implementation of the programme is strongly regulated by the University administration. Students take part at all level of Programme management and their opinion is appreciated, which is a definite plus. However, the descriptive statistical methods are not used very much to evaluate achieved improvement of the study programme (employability, number of enrolled foreign and domestic students, etc.). Participation of the industry representatives in programme according to students opinion to have more practice adaptable to business.

V. GENERAL ASSESSMENT

The study programme *Business Big Data Analytics* (state code – 621G12002) at Kaunas University of Technology is given **positive** evaluation.

Study programme assessment in points by evaluation areas.

No.	Evaluation Area	Evaluation of an area in points*
1.	Programme aims and learning outcomes	4
2.	Curriculum design	2
3.	Teaching staff	3
4.	Facilities and learning resources	4
5.	Study process and students' performance assessment	3
6.	Programme management	3
	Total:	**19**

*1 (unsatisfactory) - there are essential shortcomings that must be eliminated;

2 (satisfactory) - meets the established minimum requirements, needs improvement;

3 (good) - the field develops systematically, has distinctive features;

4 (very good) - the field is exceptionally good.

Grupės vadovas: Team leader:	Prof. Miklos Hoffmann
Grupės nariai: Team members:	Prof. Neda Bokan
	Assoc. Prof. Ants Aasma
	Mr. Marijus Mikalauskas
	Mr. Henrikas Vaickus

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V. APIBENDRINAMASIS ĮVERTINIMAS

Kauno technologijos universiteto studijų programa *Didžiųjų verslo duomenų analitika* (valstybinis kodas – 612G10002) vertinama **teigiamai**.

Eil. Nr.	Vertinimo sritis	Srities įvertinimas, balais*
1.	Programos tikslai ir numatomi studijų rezultatai	4
2.	Programos sandara	2
3.	Personalas	3
4.	Materialieji ištekliai	4
5.	Studijų eiga ir jos vertinimas	3
6.	Programos vadyba	3
	Iš viso:	**19**

*1 - Nepatenkinamai (yra esminių trūkumų, kuriuos būtina pašalinti)

2 - Patenkinamai (tenkina minimalius reikalavimus, reikia tobulinti)

3 - Gerai (sistemiškai plėtojama sritis, turi savitų bruožų)

4 - Labai gerai (sritis yra išskirtinė)

<...>

IV. SANTRAUKA

Vertinant programos tikslus ir studijų rezultatus, puikiai vertinamos universiteto pastangos patenkinti darbdavių poreikius sukuriant naują magistro programą. Kitos stiprybės yra aukštas įsidarbinimo lygis ir geras bendravimas su darbdaviais. Europos ir Lietuvos rekomendacijos, standartai ir teisiniai reikalavimai aukštajam mokslui yra įvykdyti. Studijų rezultatai aiškiai pateikiami savianalizės suvestinėje ir internete, yra priskirti dalykams. Poreikių analizė yra įtikinanti.

Kadangi programoje dalyvauja keli pramonės dalininkai, galima būtų pasiūlyti praktiką, skirtą toliau tobulinti taikomas žinias.

Vertinant programos sandarą, programos struktūra atitinka įstatymų reikalavimus, jos apimtis yra pakankama studijų rezultatams pasiekti. Poreikis programai kyla iš institucijų ir įmonių, naudojančių didžiuosius duomenis ar programas. Geras studijų dalykų aprašymas. Tačiau pirmieji akademiniai metai yra netinkamai suplanuoti, nepakanka „išlyginamųjų" kursų, kad būtų suteiktos reikalingos pagrindinės žinios visose trijose srityse (matematika, kompiuterių mokslas ir ekonomika), todėl studentai nurodė sunkumus savo mokslinėje srityje. Turinys ir pasirengimo dalykams reikalavimai ne visur tiksliai nurodyti.

Akademinis personalas turi aukšto lygio kvalifikacijas ir yra kompetentingas: didelę jo dalį sudaro profesoriai ir docentai, daugelis dėstytojų aktyviai dalyvauja mokslinių tyrimų veikloje, yra išleidę keletą mokslinių publikacijų ir atlikę keletą mokslinių tyrimų projektų. Organizuojami dėstytojų rengimo moduliai ir intensyvūs trumpi kursai užsienyje. Akademinis personalas dalyvauja tarptautinėse konferencijose, mokslinių tyrimų stažuotėse, tarptautinėse mainų programose. Kai kurie dėstytojai atlieka tyrimus kartu su pramonės ir akademinėmis

organizacijomis regione. Metodiniai ištekliai, tame tarpe paskaitų įrašai, yra pateikiami internete – tai yra privalumas. Didelė dalis aukštą kvalifikaciją turinčių akademinių darbuotojų (profesorių ir docentų) artimiausiais metais išeis į pensiją, o tai yra potenciali rizika. Dėstymo apkrova yra per didelė, tyrimams nepakanka vietos ir laiko. Nors pastaraisiais vertinimo laikotarpio metais dėstytojų judumas akademiniam darbui padidėjo, šis komponentas turi būti gerinamas toliau. Ekspertų grupės vizito metu nustatyta, kad trūksta bendravimo tarp skirtingų fakultetų dėstytojų. Tai yra dar viena silpnybė.

Vertinant materialiuosius išteklius, pastatai ir klasės apskritai yra gerai įrengti. Suteikiama plati prieiga internetu prie mokslinės medžiagos, taip pat prieiga prie realių didelių duomenų bazių. Tai yra būtina šiai magistrantūros programai.

Kalbant apie studijų procesą ir studentų rezultatų vertinimą, pastebimas geras bendravimas su socialiniais partneriais ir darbdaviais, kad būtų patenkinta darbo rinkos paklausa, o tai yra neabejotinas pranašumas. Siūloma visapusiška akademinė, socialinė ir kitokia parama studentams, įskaitant platų virtualių metodinių išteklių naudojimą ir paskaitų įrašų teikimą internete. Visoje programoje matoma stipri orientacija į programas. Studentų žinios ir gebėjimai labai gerai atitinka darbdavių lūkesčius, todėl labai aukštas absolventų įsidarbinimo rodiklis. Tačiau žemas studentų judumas. Reikalinga veiksminga internalizacijos strategija, kad padidinti atvykstančių ir išvykstančių studentų skaičių. Santykinai mažas procentas studentų, dalyvaujančių moksliniuose tyrimuose. Šioje mokslo srityje reikia vystyti gilesnius studentų mokslinius tyrimus.

Programos vadybos stiprioji pusė yra tai, kad yra įgyvendinami įvairūs KTU studijų kokybės užtikrinimo principai. Į studijų kokybės užtikrinimo ir tobulinimo procesą taip pat įtrauktos diskusijos tarp absolventų, krypties studijų programos komiteto narių, socialinių dalininkų, įmonių ir potencialių darbdavių. Programos įgyvendinimą griežtai reglamentuoja universiteto administracija. Studentai dalyvauja visuose programos vadybos lygmenyse ir jų nuomonė yra vertinama – tai yra pliusas. Nepaisant to, vertinant studijų programos pagerėjimus (įsidarbinimo galimybes, įstojusių užsienio ir šalies studentų skaičių, t.t.), trūksta apibūdinamųjų statistinių metodų. Reikėtų didinti įmonių atstovų dalyvavimą programoje, nes studentų nuomone reikėtų daugiau įmonėms aktualios praktikos.

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III. REKOMENDACIJOS

1. Ekspertų grupė siūlo tobulinti priėmimo kriterijus, kurie šiuo metu yra 22 ECTS kreditai matematikos, ekonomikos ar kompiuterių mokslo srityje. To rezultate universitetas šiuo metu gali į programą priimti studentus, neturinčius reikalaujamų matematikos žinių. Universitetas turėtų apsvarstyti galimybę pakeisti reikalavimą.

2. Pirmųjų metų mokymo programa turi būti pritaikyta, pertvarkyta ir suskirstyta į modulius pagal studentų žinias, siūlant daugiau „išlyginančiųjų" pasirenkamųjų dalykų.

3. Dalykų apibūdinimai turi būti patikslinti pagal aukščiau pateiktą programos sandaros analizę.

4. Mokymo (-si) metodai turi būti pritaikyti socialinių, ypač bendravimo ir komandinio darbo, įgūdžių ugdymui.

5. Gilesnių mokslinių tyrimų galimybių nebuvimas turi būti kompensuojamas aktyvesniu studentų įtraukimu į projektus.

6. Būtina tobulinti skirtingų fakultetų dėstytojų bendravimą, kad būtų suderintas studijų procesas.

7. Siekiant tinkamai atlikti kokybės užtikrinimo analizę, svarbu naudoti statistinius duomenis ir atitinkamus statistinius metodus.

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