Data Analytics to Stimulate Career Paths in Academy

Silvia Gaftandzhieva, Rositsa Doneva, Milen Bliznakov

University of Plovdiv "Paisii Hilendarski", 24 Tzar Assen Str., Plovdiv, 4000, Bulgaria

Abstract

Nowadays, innovative higher education institutions (HEIs) have been expanding data-driven decision-making to nearly all aspects of campus life and operations. Their managers understand that advanced analytics can significantly transform how they work by enabling new ways to boost faculty productivity and research. The paper presents a model for monitoring the career development of the faculty staff and a corresponding software tool designed for the needs of HEIs from the perspective of different stakeholder groups (faculty staff, members of quality committees, head of departments, deans and vice-deans, rector and vice-rector) having a role in stimulating career paths in academy. The tool allows them to monitor the career development of the faculty staff and make data-informed decisions to stimulate career paths, ensure equal access to options for career growth, set priorities and adjust them when the situation evolves. In addition, the tool can also significantly assist in the preparation of self-assessment reports with data for the faculty staff for the need for external quality assessment in HE. Research and experiments with the model and the developed tool are conducted based on the information infrastructure of a typical Bulgarian university.

Keywords[1]

data analytics, software tools, big data, career development, research, data collection, monitoring, decision making, self-assessment reports, higher education institutions

1. Introduction

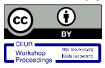
In recent years, higher education institutions (HEIs) have used many software systems to automate their activities and have the data sets needed to benefit from targeted data analytics. Worldwide, HEIs look for solutions for extracting data from different information systems and converting them into knowledge that helps HEIs to optimize their processes and improve process management (e.g. monitoring and forecasting results, enrollment of students, ensuring equal access to education and career development, monitoring research and project activities, etc.). Bulgarian HEIs have conduced some experiments for using data analytics tools, e.g. to monitor the learning process and help HEIs leadership make timely data-driven decisions to improve institutional processes and student achievements, and reduce student drop-out rate [1,2,3,4].

Data analytics has the potential to act positively on all the main areas of importance for HEIs, such as student enrolment and retention, career development, integrated information management and reporting, operational cost management, regulatory compliance and research. Data analytics can alter the existing administrative, teaching, learning and academic work processes and help address contemporary challenges facing higher education [5]. The analysis and management of big data can bring accountability and transparency to the education sector management [6] and assess institutional performance and progress to predict future results and identify potential issues related to research, teaching and learning [7]. Data analytic tools allow automatic extraction, analysis and classification of data (related to educational, scientific and other activities) and support governing bodies of HEIs to make informed decisions.

[1]**Education and Research in the Information Society, October 13-14, 2022, Plovdiv, Bulgaria**

EMAIL: sissiy88@uni-plovdiv.bg (A.1); rosi@uni-plovdiv.bg (A.2);milen@uni-plovdiv.bg (A. 3)

ORCID: 0000-0002-0569-9776 (A.1);0000-0003-0296-1297 (A.2)



Data-driven decision making is a proven path to achieving the educational and organizational goals of HEIs. Using innovative data analytics methods, they can create platforms and frameworks to measure and monitor progress over time on almost all aspects of their activities and continue to improve them – from financial results and student satisfaction, through productivity and professional development of the faculty, to strategic management of the institution. Advanced analytics [8] serves for decision-oriented forecasting to improve the management of HEIs and supports their management, academic and non-academic staff by generating new value from data.

All faculty members can use data analytics tools to monitor their research activity. HEIs leadership can use data analytics tools to aggregate and compare data for the research activity of the faculty staff (e.g. published books and papers, citations, research grants, and awards [9]) for a chosen period on a different level (university, faculty, department). Tools help HEIs leadership find answers to various questions (e.g. what the number of publications/citations/awards of the faculty staff is; which scientists have no publications; which scientists have a high number of publications/citations) and make recommendations to scientists to improve their research activity.

Data analytics tools can be used also as planning and monitoring tool. Tools can assist HEIs staff responsible for human resources to collect, analyse, report, measure, interpret and share data related to faculty staff. HEIs leadership can use them to track the current performance against the strategic goals, examine trends in career development and research activity of the faculty staff, and make forecasts. Tools also provide capabilities for generating and distributing different reports, including HEIs' annual performance reports (e.g. annual reports on the publishing activity (monographs, studies, articles, reports, textbooks) and annual reports on the structure of the academic staff). It is reported that data analytics tools can improve the HEI's accountability and administrative processes [10]. Data analytics tools help HEIs monitor and manage finance, human resources and optimize resource use and ongoing business processes. They enable HEIs to allocate resources more effectively and optimize their use [9, 11, 12, 13, 14].

Data analytics help HEIs unlock and provide meaningful summarised historical data to assist stakeholders answer real tactical questions for making timely data-driven decisions across all departments and divisions [7, 12, 15]. Data analytics tools offer HEIs leadership an intuitive dashboard to track trend analysis and KPIs that help them manage the HEI more effectively, measure the impact of their initiatives in real-time and make strategic adjustments for continuous improvement. From the institutional perspective, the results allow establishing a competitive strategy to improve the university's rank among other research universities and enhance the institution's reputation [16]. In addition, data analytics tools can help HEIs to make benchmark comparisons across HEIs.

Data analytics tools can also provide data for career development of the faculty staff and its research activity needed for internal and external quality evaluations in HEIs. Many systems for quality evaluation in HEIs, developed by independent institutions (e.g. ENQA, EFMD, Quality Matters Program, ACODE, EFQUEL, NEAA, etc.) contain indicators for academic staff values of which can be retrieved from software systems used in HEIs. These indicators [17, 18, 19, 20, 21] allow the evaluating external experts to give a real assessment of HEIs for the professional level of the academic in education and research and recommendations for improving the level of academic staff competence, positions or degrees HEI. During the evaluation procedures, HEIs have to write down self-evaluation reports with a set of proofs. Many of these proofs require collecting, analysing and interpretation of data for academic staff (e.g. ratio of habilitated teachers, structure of the academic staff, number of participations in national and international scientific and educational forums in the last five years per teacher, number of international research contracts in the last five years, ratio of the number of publications of the academic staff over the past five years compared to the number of academic staff, proportion of publications abroad and from international fora over the last five years compared to the total number of publications of the academic staff, proportion of the publications in refereed scientific journals and collections compared to the total number of publications of the activity at HEI, ratio of the number of citations of scientific papers of teachers in refereed scientific journals and collections over the past five years compared to the number of academic staff [17, 18, 19, 20]). In this regard, the university's quality experts (e.g. members of quality committees) can use data analytics tools to generate proofs when they write down self-evaluation reports for external quality evaluation by independent agencies.

All this motivates the development of data analytics tools for academic staff career development in HEIs that will extract and analyse data about academic staff and allow different stakeholders (e.g. faculty staff, members of quality committees, head of departments, deans and vice-deans, rector and vice-rector) to make data-driven decisions to improve the university environment for career development of the academic staff.

The paper presents a model for monitoring the career development of the faculty staff and a corresponding software tool designed for the needs of HEIs from the perspective of different stakeholder groups (faculty staff, members of quality committees, head of departments, deans and vice-deans, rector and vice-rector) having a role in stimulating career paths in academy. The tool allows them to monitor the career development of the faculty staff and make data-informed decisions to stimulate career paths, ensure equal access to options for career growth, set priorities and adjust them when the situation evolves. In addition, the tool can also significantly assist in the preparation of self-assessment reports with data for the faculty staff for the need for external quality assessment in HE. Research and experiments with the model and the developed tool are conducted based on the information infrastructure of a typical Bulgarian university.

2. Indicators for data collection

Since no similar attempt to build a comprehensive model for monitoring the career development of the faculty staff has been found in the literature (see Section 1) it lacks prior standardization and systematic structuring of indicators that reflect success in the development of an academic career. This explains why the indicators of the proposed here models were selected based on expert analysis of real situations by university experts in the field of academic staff development. This approach also ensures the validation of the model at this stage, but if necessary, it can be regularly adjusted to improve its adequacy.

The proposed models for monitoring on academic staff career development with a set of indicators are deduced on the basis of a literature review in the field (see Section 1), an investigation of data for faculty staff needed for accreditation procedures (see Section 1 and [17, 18, 19, 20]) and available data in potential data sources. Solving the problem of extracting data from software systems and converting them into knowledge that may contribute to the optimization of the process for monitoring academic staff career development requires an in-depth analysis of university information systems. The analysis aims to determine the appropriate data sources, which of the stored data and how they can be extracted and analysed to help stakeholders monitor the career development of the faculty staff and make data-informed decisions to ensure equal access to career development in the HEI. The results of an analysis of the information infrastructure of the University of Plovdiv showed that the university uses 3 software systems to automate the processes related to the academic staff that can be used as a potential source of data analytics tools: human resource systems (store data on administrative and academic staff and employment relationships), academic staff development systems (store data on the career development of academic staff) and research reporting system (store data on publications, participation in conferences and citations of the academic staff).

The proposed models define what type of data should be collected from the institutional information infrastructure that stakeholders can use for continuous monitoring on academic staff career development and decision-making. The six models are developed for the needs of six different stakeholder groups – Member of the academic staff (F), Member of quality committees (QE), Head of departments (HD), Head of the Unit for development of scientific staff and PhD programs (HR), Middle Management (D, e.g. Dean and Vice-deans) and Top management (R, e.g. Rector and Vice-rectors). Each of them consists of measurable indicators allowing the relevant stakeholder to track data for academic staff for different purposes, e.g. monitoring, analysis, forecast, intervention, recommendations, but finally to improve the university environment for career development of the academic staff. Models contain hierarchies of indicators of different levels. Indicators from Level 1 represent the activity/subject to which the collected and aggregated data relate – acquisition of scientific degrees, occupying scientific/management positions, publishing and projects activity, activity in scientific events, and gender gap. These indicators group together a set of Level 2 indicators, each of which has measurable attributes whose values are extracted from the university information systems.

Table 1 presents the proposed models for different stakeholder groups and their indicators of Level 1 and Level 2. The mark "+" indicates these indicators of Level 2 that are a part of the model for the relevant stakeholder group.

Table 1: Model for monitoring the career development of the academic staff

Level 1	Level 2	F	QE	HD	HR	D	R
Acquisition of scientific degrees	1.1. Number of people with scientific degree (PhD, DSc) per faculty		+		+	+	+
	1.2. Number of people with scientific degree per professional field		+		+	+	+
	1.3. Age of obtaining a scientific degree per person	+		+	+	+	
	1.4. Average age for obtaining a scientific degree per faculty	+		+	+	+	+
Occupying scientific positions	2.1. Number of people holding an academic position (assistant, chief assistant, associate professor, professor) per faculty		+		+	+	+
	2.2. Number of people holding an academic position per professional field		+		+	+	+
	2.3. Number of people holding an academic position on 1st employment contract per faculty		+			+	+
	2.4. Average age of people holding an academic position per faculty		+			+	+
	2.5. Number of people holding an academic position registered in the National Centre for Information and Documentation (NACID) per faculty				+	+	+
	2.6. Number of people holding an academic position registered in NACID per professional field				+	+	+
	2.7. Age of occupying a scientific position per person	+		+	+		
	2.8. Average age for obtaining an academic position per faculty	+					
	2.9. Minimum age for obtaining an academic position per faculty	+					
	2.10. Ratio of habilitated members of the academic staff		+		+	+	+
Occupying management positions	3.1. Age for holding a managerial position (head of department, vice-dean, dean, vice-rector, rector) per person					+	+
	3.2. Average age of the members of the academic staff in managerial positions per faculty					+	+
Publishing activity	4.1. Number of publications in scientific journals and conference proceedings per person	+		+		+	
	4.2. Number of publications in scientific journals and conference proceedings indexed in Web of Science and SCOPUS per person	+		+		+	
	4.3. Number of publications with impact factor per person	+		+		+	
	4.4. Number of publications with SJR per person	+		+		+	
	4.5. Number of publications in scientific journals and conference proceedings per faculty		+			+	+
	4.6. Number of publications in scientific journals and conference proceedings indexed in Web of Science and SCOPUS per faculty		+			+	+
	4.7. Number of publications with impact factor per faculty		+			+	+
	4.8. Number of publications with SJR per faculty		+			+	+
	4.9. Number of citations in publications in journals and conference proceedings per person	+		+		+	
	4.10. Number of citations in publications in journals and conference proceedings indexed in Web of Science/SCOPUS per person	+		+		+	
	4.11. Number of citations in publications with impact factor per person	+		+		+	

Level 1	Level 2	F	QE	HD	HR	D	R
	4.12. Number of citations in publications with SJR per person	+		+		+	
	4.13. Number of citations in publications in journals and conference proceedings per faculty		+			+	+
	4.14. Number of citations in publications in journals and conference proceedings indexed in Web of Science/SCOPUS per faculty		+			+	+
	4.15. Number of citations in publications with impact factor per faculty		+			+	+
	4.16. Number of citations in publications with SJR per faculty		+			+	+
Projects activity	5.1. Number of university projects in which the member of the academic staff participates	+		+		+	
	5.2. Number of national projects in which the member of the academic staff participates	+		+		+	
	5.3. Number of international projects in which the member of the academic staff participates	+		+		+	
	5.4. Number of university projects in which the members of the academic staff participate per faculty		+			+	+
	5.5. Number of national projects in which the members of the academic staff participate per faculty		+			+	+
	5.6. Number of international projects in which the members of the academic staff participate per faculty		+			+	+
	5.7. Number of university projects managed/coordinated by a member of the academic staff	+		+		+	
	5.8. Number of national projects managed/coordinated by a member of the academic staff	+		+		+	
	5.9. Number of international projects managed/coordinated by a member of the academic staff		+			+	+
	5.10. Number of university projects managed/coordinated by members of the faculty staff per faculty		+			+	+
	5.11. Number of national projects managed/coordinated by members of the faculty staff per faculty		+			+	+
	5.12. Number of international projects managed/coordinated by members of the faculty staff per faculty		+			+	+
Activity in scientific events (conferences, workshops, etc.)	6.1. Number of participations in national events per person	+		+		+	
	6.2. Number of participations in international events per person	+		+		+	
	6.3. Number of participations in national events per faculty		+			+	+
	6.4. Number of participations in international events per faculty		+			+	+
Gender gap	7.1. Ratio of women and men among academic staff with scientific degrees per faculty					+	+
	7.2. Ratio of women and men among academic staff with scientific degrees per professional field					+	+
	7.3. Average age for obtaining a scientific degree for women and men per faculty					+	+
	7.4. Ratio of women and men in an academic position per faculty					+	+
	7.5. Ratio of women and men in an academic position per professional field					+	+
	7.6. Average age of women and men in an academic position per faculty					+	+
	7.7. Average age on which women and men occupy an academic position per faculty					+	+
	7.8. Minimum age on which women and men occupy an academic position per faculty					+	+
	7.9. Ratio of women and men in a managerial position (head of department, vice-dean, dean, vice-rector, rector)					+	+

Level 1	Level 2	F	QE	HD	HR	D	R
	7.10. Number of publications written by women and men per faculty					+	+
	7.11. Number of publications indexed in Web of Science and SCOPUS written by women and men per faculty					+	+
	7.12. Number of publications with impact factor written by women and men per faculty					+	+
	7.13. Number of publications with SJR written by women and men per faculty					+	+
	7.14. Ratio of women and men among academic staff who participate in research projects (university, national, international) per faculty					+	+
	7.15. Ratio of women and men among project (university, national, international) managers per faculty					+	+
	7.16. Ratio of women and men who participate in national events per faculty					+	+
	7.17. Ratio of women and men who participate in international events per faculty					+	+

3. Data analytics tool description

Based on the proposed model (Section 2), a corresponding data analytics tool for monitoring the career development of the academic staff called AcadStaffAnalyst is designed and implemented.

As a result of an analytical review of software solutions for extracting, analyzing and visualizing data from various information sources, we selected technologies and tools for software development. The AcadStaffAnalyst is developed by the integration of existing software solutions, namely *JasperReport Server,Jaspersoft ETL* and *JasperSoft Studio* tools (developed by TIBCO Software, https://www.tibco.com/) and the software framework *Dynamic Presentation Framework* (DPF) developed at the University of Plovdiv.

The architecture of the AcadStaffAnalyst (see Fig. 1) follows the standard type of 3-tier architecture with three layers – Presentation, Application and Data layers.

The software framework DPF is the basis of the AcadStaffAnalyst *Presentation Layer*. Through DPF the user can request the generation of a report by a chosen template and view the result of the request. There are currently six separate user roles: faculty staff (F), members of quality committees (QE), head of department (HD), head of the unit for development of scientific staff and PhD programs (HR), Dean/Vice-dean (D), Rector/Vice-rector (R). DPF (using XML Parser and Style Control Module functionalities) allows users through predefined conditions to modify some view attributes such as color, font size, etc., to visualize the report in the web browser in a user-friendly way.

The core functionality of the *Application Layer* of AcadStaffAnalyst and its business logic is implemented through the report templates design tool JasperSoft Studio. Key elements of this functionality are modelling of the developed models for the needs of six different stakeholder groups (see Section 2) and acquisition of values for the models' indicators of different levels from systems of HEI information infrastructure.

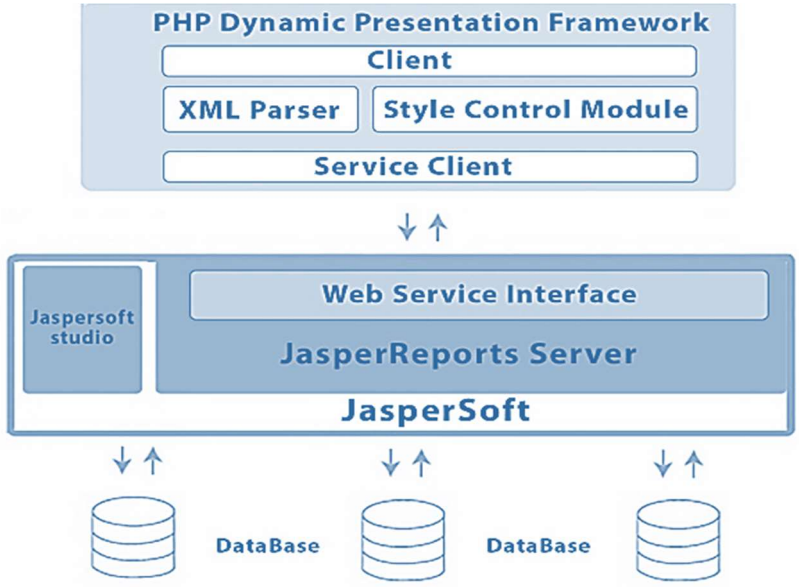


Figure 1. AcadStaffAnalyst Architecture

In the first stage of tool development, the information infrastructure of the University of Plovdiv "Paisii Hilendarski" is analysed. The university uses a lot of software systems to automate its processes (e.g. human resource systems, academic staff development systems, research reporting system, etc.) that store data for faculty staff. Therefore, the university has the data sets needed to benefit from data analytic tools to automate monitoring on the career development of the academic staff. The next step of the analysis examined how stored data can be extracted and analyzed to be used for forming values of the indicators from the proposed models. Finally, human resource systems, academic staff development systems, research reporting system are defined as **appropriate data sources** of the designed data analytic tool, and then they are integrated through *JasperSoft*ETL.

In the next development stage, templates of reports are designed and developed through JasperSoft Studio to **collect appropriate data** for the proposed indicators (see Table 1) for the needs of different stakeholder group. All developed templates of reports have been stored on the JasperReport Server. JasperReport Server plays an intermediate role between the three architectural layers. The Client Application requests the REST services of JasperReports Server to run a chosen template and generate a report through the Service Client. Then, the JasperReports Server Web Service interface responds to HTTP requests from the client application.

The Data Layer of the AcadStaffAnalyst includes the chosen data sources from the university information infrastructure (human resource systems, academic staff development systems, research reporting system) as well as the JasperReports Server repository itself. JasperReport Server addresses them to retrieve the necessary data when generating reports.

The data analytics tool fills these templates with data retrieved from information systems or obtained through calculations and generates reports depending on the user's role. This is possible because indicators from Level 1 and Level 2 are the same for different stakeholder groups, but they differ in the lower levels and this is embedded in the designed report templates in AcadStaffAnalyst. For example, a dean of a faculty can generate reports that provide data only for the faculty s/he heads, and a representative of top management can generate reports with data for the entire university.

For example, for the ***Indicator 2.1. Number of people holding an academic position (assistant, chief assistant, associate professor, professor) per faculty*** the related data sources for acquisition of values of the indicators of Level 3 and the indicators/values themselves for each user role will be different (see Table 2).

Table 2. Indicators of Level 3 according to user role for Indicator 2.1.

User role	Input data	Output Values
QE (Member of quality expert)	Without input data for the entire university Faculty Professional Field	Faculty Assistants (number) Chief assistants (number) Associate professors (number) Professors (number)
HR (Head of the Unit for development of scientific staff and PhD programs)	Without input data for the entire university Faculty Professional Field	Faculty Assistants (number) Chief assistants (number) Associate professors (number) Professors (number)
D (Faculty Managers: Dean, Vice Deans)	Faculty	Department Assistants (number) Chief assistants (number) Associate professors (number) Professors (number)
R (University Managers: Rector/Vice-Rector)	Without input data for the entire university Faculty Professional Field	Faculty Assistants (number) Chief assistants (number) Associate professors (number) Professors (number)

From there the generated reports for different stakeholder groups provide different data (retrieved from the information systems) depending on the user's role in AcadStaffAnalyst (F, QE, HD, DR, D, R as mentioned above).

AcadStaffAnalyst allows for each indicator of the proposed models that is included in the models for more than one stakeholder groups, to be generated reports with retrieved different values from the information systems depending on the user's role in AcadStaffAnalyst. User can generate report when s/he wants to see the current situation in the faculty/university. In addition, the tool can generate reports automatically according to a predetermined schedule and to store them in its repository. Then, user with access to the part of the repository when the generated reports are stored can view them.

The results of data processing are presented in the form of tables and diagrams and allow users to perform various analysis on the retrieved data. For example, AcadStaffAnalyst allows deans to monitor:

- current number of members of the academic staff with a scientific degree (indicators 1.1-1.2) and age for obtaining a scientific degree (indicators 1.3-1.4);
- structure of the academic staff in the faculty (indicators 2.1-2.3), incl. average age of people holding an academic and manager positions in the faculty (indicators 2.4 and 3.2);
- how many people holding an academic position registered in NACID members of the academic staff and can participate in scientific panels and accreditation procedures (indicators 2.5-2.6);
- ratio of habilitated members of the academic staff (indicator 2.10);
- number of publications in scientific journals and conference proceedings (indicators 4.1 and 4.5.), including the number of publications indexed in SCOPUS/Web of Science (indicators 4.2 and 4.6), publication with impact factor (indicators 4.3 and 4.7) or SJR (indicators 4.4 and 4.8) for selected person or the entire academic staff of the faculty;
- citation of selected members of the academic staff (indicators 4.9-4.12) or the entire academic staff of the faculty (indicators 4.13- 4.16);
- participation of selected members of the academic staff or the entire academic staff of the faculty in university (indicators 5.1 and 5.4), national (indicators 5.2 and 5.5) and international projects (indicators 5.3 and 5.6);
- number of university (indicators 5.7 and 5.10), national (indicators 5.8 and 5.11) and international projects (indicators 5.9 and 5.12) managed/coordinated by a member of the academic staff of the faculty;
- participation of selected members of the academic staff or the entire academic staff of the faculty in national (indicators 6.1 and 6.3) and international (indicators 6.2 and 6.4) scientific

events;

- career development in terms of equality between women and men (indicators 7.1-7.9;
- how active are women and men in their publication activity (indicators 7.10-7.13) and scientific events (indicators 7.16-7.17);
- numerical data on the ratio of women and men among members of the academic staff who participate in research projects (indicator 7.14);
- numerical data on the ratio of women and men among project managers (indicator 7.15);

In addition, deans can use the tool to generate annual reports for the structure of academic staff, publishing and project activity and track trends by comparing monitoring results from different time periods and make data-informed decisions to stimulate research activity and career development of the academic staff.

Figure 2. presents a part of the generated report through the developed tool for ***Indicator 2.10. Ratio of habilitated members of the academic staff*** by user with role quality expert. The report shows the number of members of academic staff and ratio of habilitated members of the academic staff in each faculty.

When the tool generates the reports, users can **analyse** them to understand key gaps between different faculties/departments. This analysis will help users take data-informed decisions to stimulate career development in the university, ensure equal access to career development in the university, set priorities and adjust these priorities as the situation evolves. The data in the generated report (see Figure 2) show that most faculty members in some faculties are habilitated (e.g. Law Faculty) and in others less than half of the members of the academic staff are habilitated (e.g. Faculty of Pedagogy, Faculty of Philology, Faculty in Mathematics and Informatics). The latter shows that the top management of the faculties where the ratio of habilitated members of the academic staff is low can take measures to stimulate the career development of the academic staff. The generated report can be attached as proof to self-assessment reports for institutional accreditation (see the content of criteria 5.1.1 [17]). When entering parameter values (name of faculty and professional field), the generated report contains only data for the respective faculty and can be used for programme accreditation of professional fields, doctoral programme and distance learning in a professional field [18, 19, 20].

Ratio of habilitated members of the academic staff

Faculty	Academic staff	Habilitated members
Faculty of Biology	65	52.31%
Faculty of Pedagogy	94	41.49%
Faculty of Economics and Social Sciences	56	60.71%
Faculty of Mathematics and Informatics	92	46.74%
Physico-Technological Faculty	54	51.85%
Faculty of Philology	109	43.12%
Faculty of History and Philosophy	59	67.80%
Faculty of Chemistry	43	51.16%
Law Faculty	51	74.51%

Figure 2. Generated report

The tool generates **annual monitoring reports** for each indicator at the end of the year, which contains data for each faculty and the whole university. Users with access to these reports can use the tool to visualize and download them. Then, they can review the annual reports to identify the impact of activities performed during the year and compare the results from two consecutive years to show the progress/lack of progress made.

4. Conclusions

The AcadStaffAnalyst tool is provided for testing at the University of Plovdiv. During the testing period, representatives of different stakeholder groups will use the tool to generate reports needed for monitoring the career development of the academic staff, internal and external quality evaluation and annual reports. They will give feedback that will be taken into account in the development of the final version.

The next version of AcadStaffAnalyst will extract data for other quantitative indicators (e.g. the number of publications of women and men, average numbers of years needed for women and men to make career advancements, etc.) and perform analysis of the results of surveys for the satisfaction of professional development conducted among academic staff.

The tool can be adapted for the needs of each HEI, regardless of the type of relevant information systems. For this purpose, it needs to identify data analytics purposes and map the context at the university.

5. Acknowledgements

The paper is partly supported within the project MU21-FTF-018 "Application of big data analysis methods in higher education" of the Scientific Research Fund at the University of Plovdiv “Paisii Hilendarski”.

6. References

[1] R. Doneva, S. Gaftandzhieva, M. Bliznakov, S. Bandeva, Learning Analytics Software Tool Supporting Decision Making in Higher Education, International Journal on Information Technologies and Security 2 (2020), 37-46

[2] D. Kabakchieva, Business Intelligence Systems for Analyzing University Students Data, Cybernetics and Information Technologies, 15 (2015), 104-115

[3] D. Miteva, K. Stefanov, E. Stefanova, e-Analytics for e-Learning, International Journal of Human Capital and Information Technology Professionals (IJHCITP), 8(2017), 1-13

[4] I. Popchev, D. Orozova, Towards big data analytics in the e-learning space, Cybernetics and information technologies, 19(2019), 16-24

[5] L. Baer, J. Campbell, Game changers, 2011, URL: http://net.educause.edu/ir/library/pdf/pub72034.pdf

[6] L. Madamshetty, K. Suresh, B. Naidu, Integrating big data in higher education: Perspectives and challenges, 2020, URL: https://www.ee.co.za/article/integrating-big-data-in-higher-education-perspectives-and-challenges.html

[7] B. Daniel, Big Data and Analytics in Higher Education: Opportunities and Challenges. British Journal of Educational Technology, 2015 (5), 904-920.

[8] M. Krawitz, J. Law, S. Litman, How higher-education institutions can transform themselves using advanced analytics, 2018, URL: https://www.mckinsey.com/industries/public-and-social-sector/our-insights/how-higher-education-institutions-can-transform-themselves-using-advanced-analytics

[9] Clamson, Academic Analytics at Clamson, 2021, URL: https://www.clemson.edu/institutional-effectiveness/academic-analytics2.html

[10] D. Slapak, W. Jenkins, AI Conversations: Reimagining Success in Higher-Education, 2020, URL: https://www.cio.com/article/3565200/ai-conversations-reimagining-success-in-higher-education.html

[11] A. Zorić, Benefits of Educational Data Mining. Journal of International Business Research and Marketing, 2020 (6), 12-16.

[12] A. Nguyen, L. Gardner, D. Sheridan, Data Analytics in Higher Education: An Integrated View. Journal of Information Systems Education, 2020 (31), 61-71.

[13] S. Suhirman, T. Herawan, H. Chiroma, J. Zain, Data Mining for Education Decision Support: A Review, iJet, 2014 (9), 4-19.

[14] C. Romero, S. Ventura, Data mining in education. WIREs Data Mining and Knowledge Discovery, 2013 (3), 12-27.

[15] Y. Nieto, V. Gacía-Díaz, C. Montenegro, C. González, R. Crespo, Usage of Machine Learning for Strategic Decision Making at Higher Educational Institutions, IEEE Access, 2019 (7), 75007-75017.

[16] F. Swiontek, A. Lawson-Body, L. Lawson-Body, The Use of Machine Learning in Higher Education, Issues in Information Systems, 2019 (20), 56-61.

[17] NEAA, Criteria system for institutional accreditation of higher schools, https://www.neaa.government.bg/images/Criteria_EN/Kriterii_IA_EN.pdf

[18] NEAA, Criteria for programme accreditation of doctoral programmes, URL: https://www.neaa.government.bg/en/evaluation-and-accreditation/programme-accreditation/doctoral-programmes

[19] NEAA, Criteria for programme accreditation of professional fields, URL: https://www.neaa.government.bg/en/evaluation-and-accreditation/programme-accreditation/professional-fields

[20] NEAA, Guidelines and criteria for assessment of distance learning in a professional field, URL: https://www.neaa.government.bg/images/Criteria_EN/Kriterii_DFO_EN.pdf

[21] E. Huertas, I. Biscan, C. Ejsing, L. Kerber, L. Kozlowska, S. Ortega, L. Lauri, M. Risse, K. Schörg, G. Seppmanne, Considerations for quality assurance of e-learning provision, European Association for Quality Assurance in Higher Education AISBL Brussels, 2018.