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Abstract
Studies at the Department of Production Engineering, Faculty of Technical Sciences, University of Novi Sad are realized at all three national academic qualification levels, namely: Undergraduate academic studies in Production Engineering, Master academic studies in Production Engineering, and Doctoral academic studies in Mechanical Engineering, as well as at one level of professional studies, i.e., Master professional (applied) studies in Production Engineering. This paper presents the analysis of enrollment and study in the study programs of academic and professional studies of production engineering in the period from the academic year 2014/15 until the 2024/25 academic year.

Keywords
Mechanical engineering; Faculty of technical sciences; Department of production engineering; Study programs; Enrollment analysis; Study success analysis

The activity of higher education in the Republic of Serbia is realized through academic and applied (professional) studies by conducting accredited study programs, according to the law on higher education [1]. In academic studies, programs are conducted that train students in the development and application of scientific, artistic, and professional achievements. In applied (professional) studies, study programs are conducted that equip students with the knowledge and skills necessary for the application and development of professional expertise required for inclusion in the work process.

The Law on higher education in the Republic of Serbia divides studies into three levels. Completing each level leads to a specific degree of professional qualification, as shown in Figure 1.

First-level (cycle) studies include Undergraduate Academic Studies (Bachelor's), Bachelor's Applied Studies, and Specialist Applied Studies. Graduates of these programs achieve a professional qualification of 6, 6.1, or 6.2. Second-level (cycle) studies include Master's Academic Studies, Master Applied Studies, and Specialist Academic Studies. These lead to a 7th degree of professional qualification, specifically 7.1 and 7.2. Some academic programs combine undergraduate and master's studies and are called Integrated Academic Studies, which lead to the 7.1 degree. Third-level (cycle) studies include Doctoral Academic Studies, which lead to the 8th level of professional qualification. At the Faculty of Technical Sciences, all types of studies are offered except Integrated Academic Studies (IAS). Academic studies here include Undergraduate Academic Studies (UAS), lasting 4 academic years or 8 semesters, totalling 240 ECTS. Master Academic Studies (MAS) last 1 school year or 2 semesters, totaling 60 ECTS. Doctoral Academic Studies (DAS) last 3 years or 6 semesters and are worth 180 ECTS.

After completing their studies, students receive professional, academic, and scientific titles, as defined by the rulebook [2]. For mechanical engineering, these titles are listed in Table 1. The table highlights the types of studies and the corresponding titles awarded at the Department of Production Engineering (DPE) of the Faculty of Technical Sciences in Novi Sad (FTS).

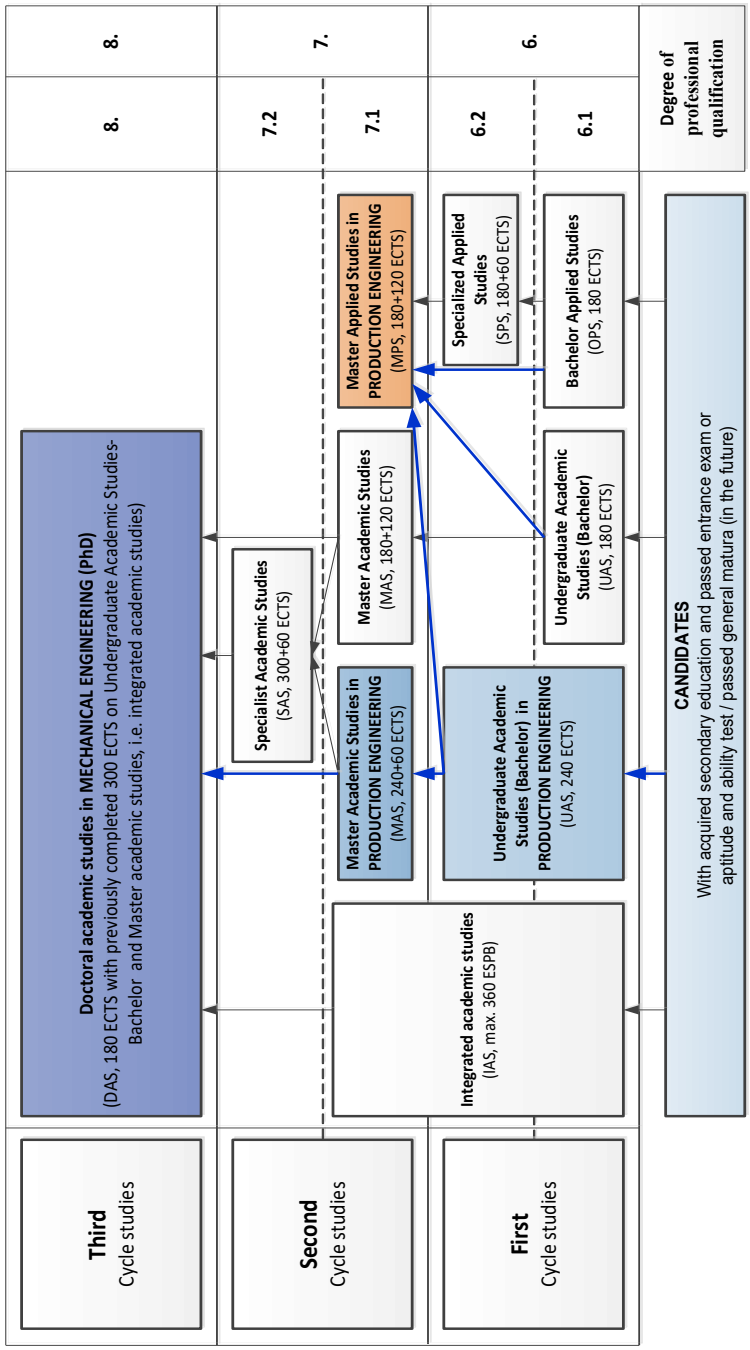

Fig. 1. Levels of education and the corresponding acquired level of professional qualification in the Republic of Serbia with an emphasis on study programs at the Department of Production Engineering of the FTS in Novi Sad

Table 1. List of professional, academic and scientific titles in the field of production engineering at FTS

Level of studies	Types of studies	Professional, academic and scientific title
Academic Studies	(UAS) Undergraduate Academic Studies (Bachelor) in Production Engineering (240 ECTS)	Bachelor's in Mechanical Engineering
	(MAS) Master Academic Studies in Production Engineering (300 ECTS)	Master's in Mechanical Engineering
	(DAS) Doctoral Academic Studies in Mechanical Engineering (480 ECTS)	Doctor of Science in Mechanical Engineering
Applied (professional) Studies	(MPS) Master Applied (Professional) Studies in Production Engineering (300 ECTS)	Professional Master's in Mechanical Engineering

Studies at the Department of Production Engineering, Faculty of Technical Sciences, University of Novi Sad are realized at all three national academic qualification levels, namely: Undergraduate academic studies in Production Engineering, Master academic studies in Production Engineering, and Doctoral academic studies in Mechanical Engineering, as well as at one level of professional studies, i.e., Master professional (applied) studies in Production Engineering [3].

This manuscript presents the analysis of enrollment and study in the study programs of academic and professional studies of production engineering in the period from the academic year 2014/15 until the 2024/25 academic year. Based on this analysis, a policy for enrolling in studies and raising the quality of the implementation of the teaching process at the Department of Production Engineering can be created in the future. The analysis was carried out based on data obtained from the student service on the number of students enrolled at the faculty, which are used to analyse enrollment and study results, as well as to define the workload of the teaching staff.

The basic hypothesis of the research: The number of students enrolled in the first year of Undergraduate Academic Studies (Bachelor) in Production engineering, as well as the passing percentage of students in higher years is gradually increasing, while the number of students enrolled in Master Academic Studies in Production

engineering and Master Applied (Professional) Studies in Production engineering is variable in the last ten school years.

II. Education in the Field of Production Engineering at FTS

The Faculty of Technical Sciences of the University of Novi Sad was founded in 1960 as the Faculty of Mechanical Engineering. The strong development of the economy and the needs of society contributed to the launch of new professions of electrical engineering and civil engineering, so in 1974, the Faculty of Mechanical Engineering grew into the Faculty of Technical Sciences within the University of Novi Sad [4].

The Faculty of Technical Sciences was accredited for the first time under the Bologna Declaration in 2007 for conducting scientific activities, and then re-accredited in 2010, 2013, and 2020. Currently, more than 85 study programs at all levels are accredited at the faculty, covering the technical-technological, natural-mathematical, artistic, and medical fields through interdisciplinary studies. More than 2,500 students enrol at the faculty annually, and currently, around 17,500 students are studying at all levels of study. The faculty consists of 13 departments: Production Engineering; Mechanization and Design Engineering; Energy and Process Engineering; Technical Mechanics; Power, Electronic and Telecommunication Engineering; Computing and Control Engineering; Civil Engineering and Geodesy; Traffic Engineering; Architecture and Urban Planning; Industrial Engineering and Management; Graphic Engineering and Design; Environmental Engineering and Occupational Safety Engineering; and Fundamental disciplines in Engineering. [4].

The Department of Production Engineering, formerly the Institute of Production Engineering, is the institution with the longest tradition at the Faculty of Technical Sciences, having been established in 1960. Through its study programs, the department has produced more than 2,000 engineers, graduate engineers, master engineers, masters, and doctors of science in the field of production engineering, who today are employed in numerous economic and educational institutions in Serbia, the former countries of Yugoslavia, but also in numerous countries of the EU and the world. In more than half a century of work and development, notable personnel and significant material potentials have been created, which represent a guarantee of success in educational and scientific research work.

The Department of Production Engineering is organized into five chairs: Chair of Material processing technologies, Chair of Machine tools, Process planning, Flexible manufacturing systems and Design processes, Chair of Materials and Joining Technologies, Chair of Forming Technologies and Surface Engineering, Chair of Metrology, Quality, Fixtures, Cutting Tools, and Environmental-engineering aspects. The Department has 15 laboratories at its disposal: Conventional Machining Methods; Unconventional Machining Methods; Machine

Tools Technological systems and Design automation; Process planning, Technoeconomical Optimization and Virtual Design; Material Testing; Joining Technologies; Casting; Thermal Processing and Surface Engineering; Plastic Deformation Technology; Polymers; Aditive and Virtual manufacturing; Metrology, Quality and Reverse Engineering; Technical diagnostics, Tribology, Cutting Tools and Fixtures; Environmental-engineering aspects and Computer Integrated Manufacturing (CIM) [5].

The department currently has 58 employees, of which 29 are teachers (12 full professors, 12 associate professors and 5 assistant professors), 19 associates (1 assistant with a doctorate, 14 master's assistants, 4 teaching associates), 3 researchers (1 research associate and 2 research trainees), 6 laboratory workers, and 1 administrative worker. The department publishes two international scientific journals, Journal of Production Engineering and Advanced Technologies and Materials. Since 1976, it has been organizing the International scientific and professional conference MMA - Flexible technologies, and since 2006, the Scientific conference with international participation ETIKUM. The department is a member of the Association of Scientific Research Institutions of Production Engineering of Serbia, within which it has organized several times the International Conference on Production Engineering of Serbia (formerly Yugoslavia).

Education at the Department of Production Engineering of the Faculty of Technical Sciences includes all three levels of academic studies and one level of professional (applied) studies that were last accredited in 2020. (Figure 1):

- ***Undergraduate Academic Studies (Bachelor) in Production Engineering***

(4 years, 8 semesters, 240 ECTS, title: Bachelor in Mechanical Engineering)
Number of students for enrollment: 80 budget students + 20 self-financing students

- ***Master's Academic Studies in Production Engineering***

(1 year, 2 semesters, 60 ECTS, title: Master's in Mechanical Engineering)
Number of students for enrollment: 25 budget students + 45 self-financing students

- ***Doctoral Academic Studies in Mechanical Engineering***

(3 years, 6 semesters, 180 ECTS, title: Doctor of Science in Mechanical Engineering)
Number of students for enrollment: 5 budget students + 25 self-financing students

- ***Master Applied (Professional) Studies in Production Engineering***

(2 years, 4 semesters, 120 ECTS, title: Master's degree in mechanical engineering)
Number of students for enrollment: 8 budget students + 24 self-financing students

Within the framework of academic studies, students can choose one of four modules, i.e., study groups: Computer Aided Technologies (abbr. CAT), Modern Materials Forming Technologies (abbr. MMFT), Modern Plastics Forming Technologies (abbr. MPFT), and Software for Mechanical Engineering (abbr. SM).

Some of the characteristics of the Department of Production Engineering at the Faculty of Technical Sciences in Novi Sad are:

- 30 doctors of science, 18 associates and 3 researchers participate in the teaching process (with over 500 papers on the SCI list)
- All teachers were participants in a large number of domestic and international scientific, research and professional projects, most of which were realized in cooperation with the economy,
- Availability of modern professional equipment (machines and devices), as well as appropriate information resources (hardware and software), which are distributed in 15 laboratories
- Great cooperation with business entities, signed contracts of scientific and technical cooperation and contracts on the implementation of professional practice,
- Significant representation of career education from various scientific and professional fields in the form of lectures, courses, seminars, trainings, etc.,
- Having a library with a huge number of literary sources, etc.

In this chapter, the Faculty of Technical Sciences and, within it, the Department of Production Engineering are briefly presented, in order to clearly see the importance and role of this faculty and department in the education of mechanical engineers in AP Vojvodina and the Republic of Serbia. Based on the great interest of business entities in the territory of AP Vojvodina and the surrounding area for mechanical engineers (Continental, Nidec, BMTS Technology, ZF Serbia, Grundfos, Bosch, Unimet, FKL, Termometal, LPO, ATB Sever, Siemens, Cooper Standard, Telsonic, Le Belier, IGB Automotive, Tarkett, Grindex, Hutchinson, Mecafor, etc.), as well as the inability of the faculty to educate a sufficient number of them within the quota set for enrollment in studies in the field of mechanical engineering and of the number of students who complete their studies, the idea came to carry out an appropriate analysis of enrollment and study success at the Department of Production Engineering.

III. Analysis of Enrollment and Studies in Study Programs of the Department of Production Engineering

Table 2 shows the analysis of enrollment in the last 11 school years (from 2014/15 to 2024/25) in the study programs UAS (Undergraduate Academic Studies in Production engineering), MAS (Master Academic Studies in Production engineering) and MPS (Master Applied (Professional) Studies in Production engineering) within the Faculty of Technical Sciences in Novi Sad. Figure 2 shows a graphic representation of these data.

Table 2. Analysis of enrollment in study programs in production engineering at FTS[1]

School years	UAS Production Engineering	MAS Production engineering				MPS Production Engineering
		Study group **CAT**	Study group **MMFT**	Study group **MPFT**	**Total**	
2024/25	100	21	4	3	28	17
2023/24	100	23	22	-	25	8
2022/23	100	16	7	3	26	17
2021/22	94	5	8	4	17	20
2020/21	100	13	10	1	24	17
2019/20	96	11	12	2	25	-
2018/19	92	12	16	4	32	-
2017/18	87	17	8	3	28	-
2016/17	84	16	5	4	25	-
2015/16	82	7	8	4	19	-
2014/15	77	12	11	2	25	-
Total	**1012**	153	111	30	**274**	**79**

[1] Note: The data in tables 2 and 3 are taken from the number of students for the teaching load at FTS. These data do not show whether the mentioned students studied regularly, i.e. whether they renewed their years of study.

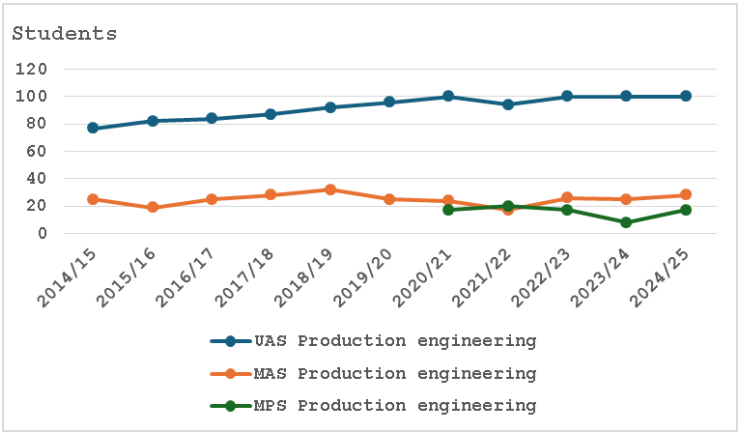

Fig. 2. The number of students enrolled in the study programs of the Department of Production Engineering

Based on the data in Table 2, the following conclusions were drawn. Considering the great need of business entities in the territory of the Republic of Serbia and the environment for mechanical engineers, interest in this type of study has grown significantly in the last period, as indicated by the number of students enrolled in the UAS in production engineering, especially in the last couple of years, when the maximum number of students was enrolled. On the other hand, due to the large lack of mechanical engineers on the labor market, students begin to get involved in the work process already in the third or fourth year of study (through professional practices, as an intern or by concluding an employment relationship), i.e. after obtaining a diploma in mechanical engineering, which also affects the number of students enrolled at MAS in production engineering.

Table 3 shows the analysis of study success for the last 11 school years, through the percentage of passing from 1st to 2nd year, from 2nd to 3rd year, from 3rd to 4th year of study, then passing from 1st to 4th year, from 4th year of UAS to 1st year of MAS and from 1st year of UAS to 1st year of MAS.. A graphical representation of the data from Table 3 is given in Figures 3, 4 and 5.

Table 3. Analysis of the success of studying on the UAS and MAS production engineering study programs at FTS

School years	UAS				MAS	Pass rate/enrollment rate in multiple years of study (%)					
	1st year	*2nd year*	*3rd year*	*4th year*	*1st year*	*1st to 2nd year*	*2nd to 3rd year UA*	*3rd to 4th year UA*	*1st to 4th year UA*	*4th year of UAS to 1st year of MAS*	*1st year of UAS to 1st year of MAS*

						UAS	*S*	*S*	*S*		
2024/25	100	53	51	50	28	53,00	86,44	86,21	53,19	62,22	28,00
2023/24	100	59	58	45	25	59,00	89,23	75,00	45,00	39,68	26,04
2022/23	100	65	60	63	26	69,15	86,96	103,28	65,63	53,06	28,26
2021/22	94	69	61	49	17	69,00	81,33	87,50	53,26	30,91	19,54
2020/21	100	75	56	55	24	78,13	91,80	94,83	63,22	51,06	28,57
2019/20	96	61	58	47	25	66,30	100,0	95,92	55,95	53,19	30,49
2018/19	92	58	49	47	32	66,67	74,24	104,44	57,32	82,05	41,56
2017/18	87	66	45	39	28	78,57	71,43	92,86	50,65	59,57	-
2016/17	84	63	42	47	25	76,83	93,33	92,16	-	56,82	-
2015/16	82	45	51	44	19	58,44	92,73	112,82	-	79,17	-
2014/15	77	55	39	24	25	-	-	-	-		
Avrg. value	**92,0**	**60,8**	**51,8**	**46,4**	**24,9**	**67,5**	**86,8**	**94,5**	**55,5**	**56,8**	**28,9**

Based on the data from Table 3, it can be concluded that the worst passing rate of students from the 1st to the 2nd year is UAS (67.6%), while in the following years, this percentage increases, from the 2nd to the 3rd year (86.8%), and from the 3rd to the 4th year (94.5%). The analysis shows that slightly more than half of the enrolled students (55.5%) pass from the 1st to the 4th year of UAS. The percentage of students who from the 4th year of UAS enroll in MAS studies is only (56.8)%, for which the

justification should be sought in the fact that the economy also seeks and employs mechanical engineers without a master's degree. Likewise, the analysis shows that less than 1/3 of students (28.9%) who start UAS studies enroll in MAS studies.

The lowest passing rate is in the 1st to 2nd year of UAS studies, which may be linked to the transition from high school to higher education, i.e., a more difficult adaptation to study requirements due to changes in the way of working at the university compared to high school. In the higher years, the percentage of passing in the higher year of study is much higher, which can be justified by the fact that less prepared and poorer students dropped out of their studies, while those who remained had already adapted to the way of studying, as well as by the fact that students have a greater motivation as the end of their studies and the possibility of employment approaches.

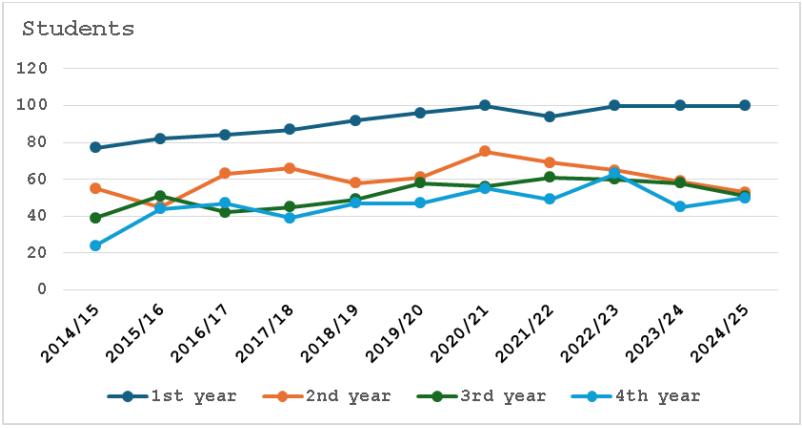

Fig. 3. Number of students enrolled in 1st to 4th year of Undergraduate Academic Studies (Bachelor) in Production engineering in the last 11 school years

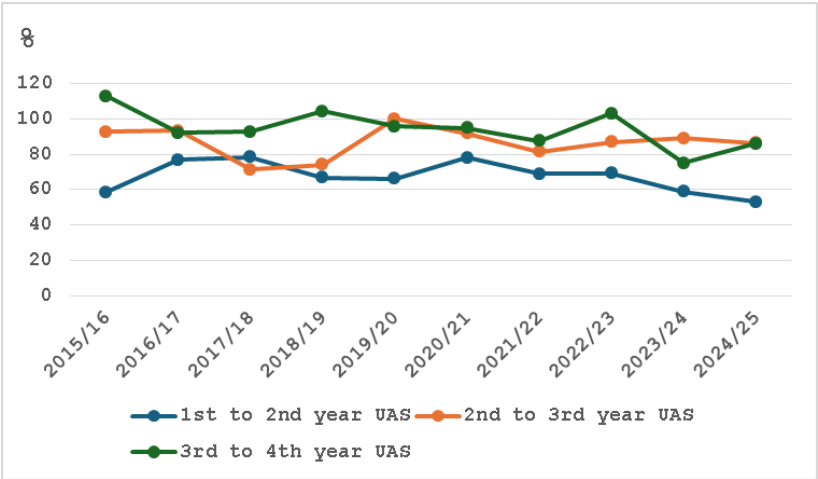

Fig. 4. Percentage of passing students from the lower to the upper year in the study program UAS production engineering

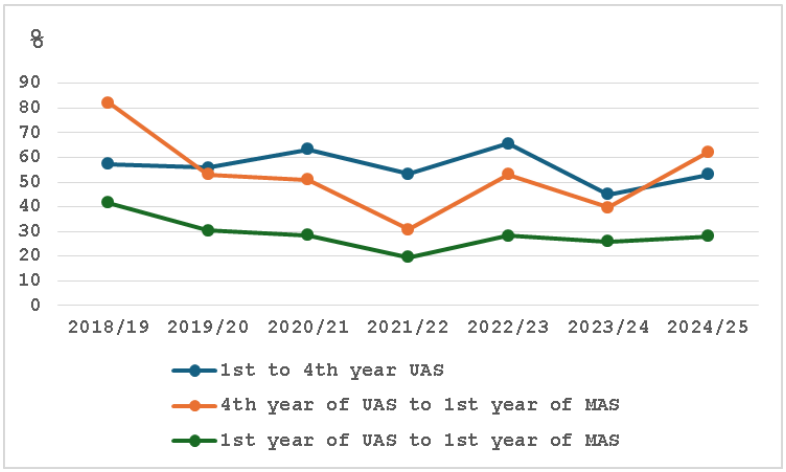

Fig. 5. Study success in the study programs UAS and MAS Production Engineering

Table 4 shows the analysis of first and second year enrollment in the observed study program Master Applied (Professional) Studies in Production engineering at the Faculty of Technical Sciences in Novi Sad.

Table 4. Analysis of the enrollment and passing rates of students in the Master Applied (Professional) Studies in Production engineering at the FTS

School years	Number of students enrolled in the 1st year			Number of students enrolled in the 2nd year	Passing of students from 1st to 2nd year in percentage (%)
	Budget students	*Self-financing students*	*Total*		
2024/25	8	9	17	5	62,5
2023/24	8	0	8	14	82,4
2022/23	8	9	17	19	95,0
2021/22	8	12	20	15	88,2
2020/21	8	9	17	-	-
Average value	**8**	**8**	**16**	**13**	**82,0**

Based on the analysis of the previous table, it can be concluded that there is justification for the realization of the study program of Master Applied (Professional) studies in Production Engineering (MPS), but that the number of enrolled students is still significantly lower than the accredited one. It is also concluded that the success in the MPS studies in Production Engineering (on average about 82% pass rate from 1st to 2nd year, for the period 2021/22-2024/25) is significantly better than the pass rate in the UAS studies in Production Engineering, which can be interpreted by the fact that the enrolled students are more serious, have previously completed UPS (Undergraduate Applied (Professional) Studies) or UAS studies, and a large percentage of them are employed, they understand the studies as an opportunity to improve their knowledge, and their diploma is required for advancement at work or obtaining licenses from the Serbian Chamber of Engineers.

In addition to the above, the block method of teaching in these studies has a significant impact on higher passing rates, where students can take exams immediately after listening to a block of classes in two subjects. An increase in the enrollment of students from outside the AP Vojvodina has been observed, so it is expected that an increasing number of such students will enrol as information about the quality and opportunities of these studies spreads [6].

IV. Conclusion

This paper presents an analysis of enrollment and studies in academic and professional study programs in production engineering for the period from 2014/15 to 2024/25 academic year at the Faculty of Technical Sciences in Novi Sad.

Based on the extensive analysis for the UAS (Undergraduate Academic Studies in Production engineering), MAS (Master Academic Studies in Production engineering) and MPS (Master Applied (Professional) Studies in Production engineering) study programs, a final review can be given:

- The number of students enrolling in the first year of UAS has increased by 20% in the last couple of years,
- The passing rate of students from the 1st to the 2nd year of UAS is the lowest and ranges from 53-78% (average 67.5%), while it increases significantly in higher years, from the 2nd to the 3rd year (average 86.8%), and from the 3rd to the 4th year (average 94.5%).
- The percentage of students who go from the 1st to the 4th year is 45-65% (average 55.5%), the percentage of those who enroll in MAS after graduation is 40-82% (average 56.8%), while the percentage of students who enroll in MAS out of the number enrolled at UAS is about 26-42% (average 28.9%)
- The number of students at MPS is constant and is in the range of 17-20 (exception in 2023/24).

- The passing rate of students from the 1st to the 2nd year of MPS is quite high and ranges from 62-95% (average 82%)

This analysis is very useful for the creation of enrollment policy and the implementation of the teaching process, with numerous aspects such as the number and structure of students for enrollment in study programs (number of budget and self-financing students), planning the number and structure of teaching staff in the future, analysis of bottlenecks and passing of students and enrollment in the following years of study, the possibility of satisfying the number of mechanical engineers according to the needs of the industry, etc.

The above data can be very useful as a basis for creating an enrollment policy at all levels of study and for implementing the teaching process at the Department of Production Engineering of the Faculty of Technical Sciences. The Faculty of Technical Sciences is currently in the process of re-accreditation of study programs, which should be completed during the next year, and students will be accepted from the academic year 2027/28. educated on newly accredited study programs. The Department of Production Engineering initiated the reaccreditation of all the mentioned study programs (UAS, MAS, MPS and DAS) with significant improvements that partially resulted from the subject analysis presented in this paper.

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