Politechnika Warszawska – PSAA - EASN

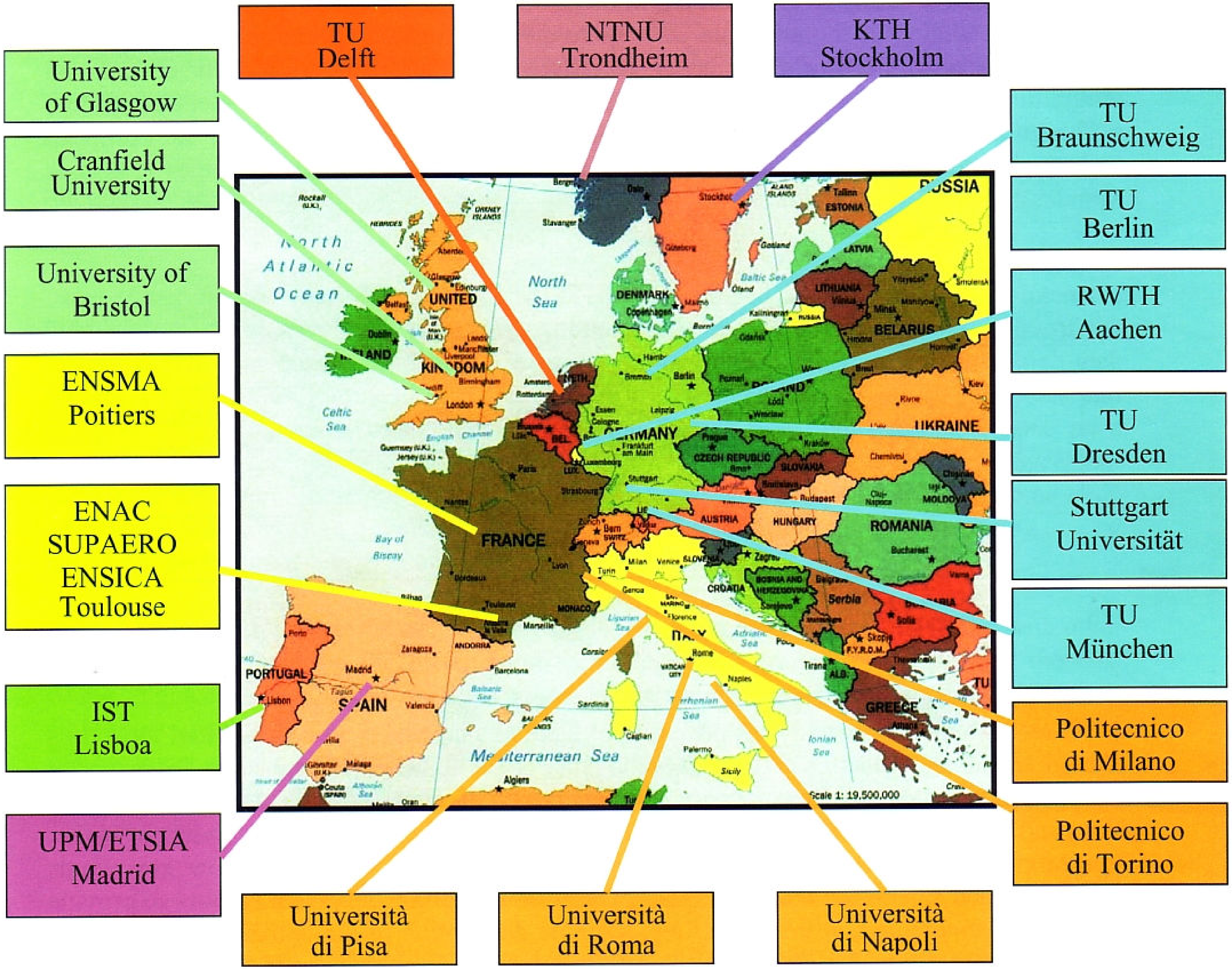
Kształcenie i badania w uczelniach europejskich – szanse wynikające z uczestnictwa w EASN i w projekcie PEGASUS

Zdobysław Goraj

I Seminarium p.t. „Kształcenie i badania naukowe w Lotnictwie i Kosmonautyce”

Warszawa 28.01.2011

Map of PEGASUS Members



Uwarunkowania

BACKGROUND: In Europe and worldwide, the aerospace industry is involved in an intense restructuring process that transcends national boundaries and interests. Increasingly the market polarises into two sectors, European and North American. At the same time in Europe, there is a move directed by the individual Ministers of Education to harmonise higher education (The Sorbonne / Bologna Declaration). For some nations this involves greater change than for others. For all, however, it involves only structure and not content of the education and training programmes. As a consequence, it does raise the question as to whether or not improvements can be made to those programmes offered by academia to the aerospace industry. Additionally, there remains the fact that our industry is in danger today of losing its appeal in the face of other growing industries, including services, with the possible consequence that there will soon begin a move of intellectual capital away from the aerospace programmes. Such a move has already begun within the USA and other places.

Cel główny

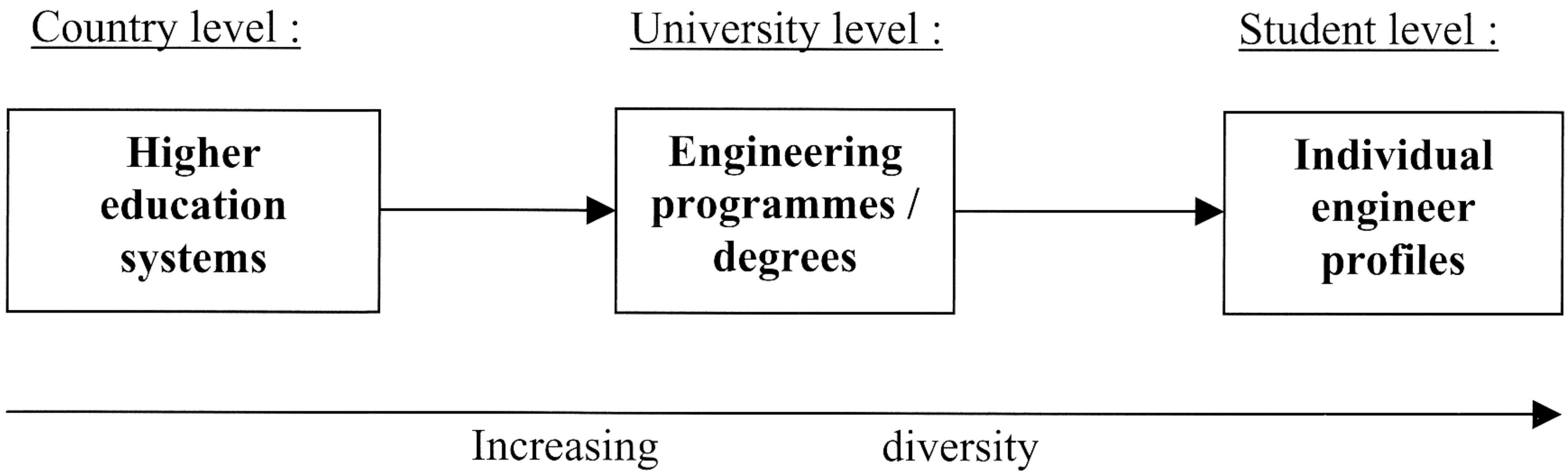
GENERAL OBJECTIVES OF PEGASUS: In full recognition of these facts, PEGASUS has been formed from an initiative taken by the four main French Grandes Ecoles involved in aerospace engineering. The general objective of PEGASUS is to optimise the services that its member institutions offer in the best interests of Europe both in terms of continuing to attract the best students and also to offer highly relevant educational and research programmes. Co-ordinated change and innovation will be required to achieve objectives to be defined through close links and interaction with our aerospace industry and relevant Government agencies. The founding partners of PEGASUS have collaborated for some years in an ad-hoc manner (largely supported by EU funding) but now wish to work more closely together in a manner that better satisfies the needs of their students and their employers across Europe. Today more than 2500 aeronautical engineers graduate from the member institutions of PEGASUS each year.

Cele szczegółowe

SPECIFIC OBJECTIVES: To achieve the general goals of PEGASUS, it is essential that there exists, on an on-going basis, a close working relationship with the European aerospace industry and Government Agencies. At the simplest level one aim would be to accelerate the process by which employers within each nation of Europe understand and fully appreciate the nature of the programmes of study offered outside their own country, and so assist in the 'European-isation' of employment opportunities. A more important aim would be that of tailoring the student experience so as to maximise the advantages that can be associated with the multi-language, multi-culture nature of our industry (as opposed to the single-language culture of the competition). Even more importantly, PEGASUS members must ensure that together they offer a range of high quality and efficient programmes of support. These programmes must include:

- Degree-awarding programmes
- Continuing Education
- Research
- International cooperation

Rosnąca indywidualizacja wykształcenia



1. **Nawet specjaliści mają problem z rozpoznaniem poziomu wykształcenia**

2. **Ambicja (cel) sieci PEGASUS: ustanowienie systemu do rozpoznawania i porównywania dyplomów Europejskich Uniwersytetów Lotniczych**

Dyplom - certyfikat

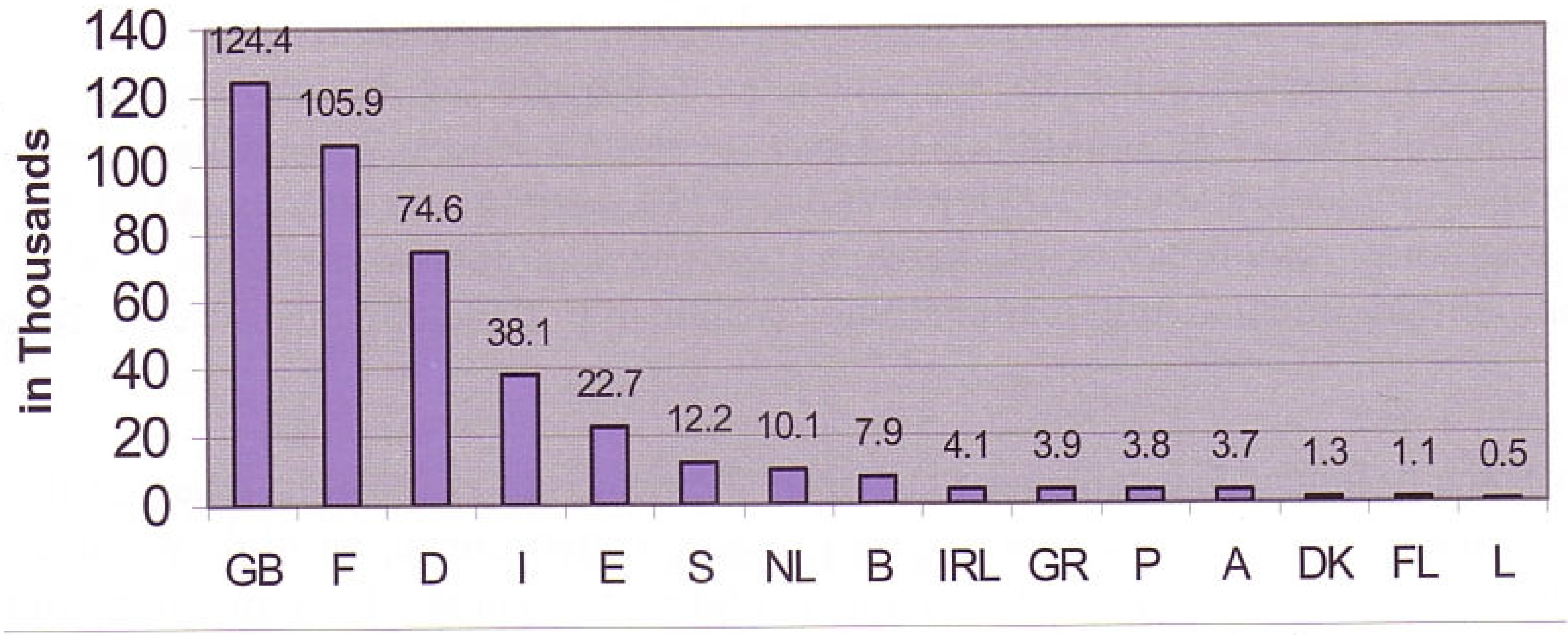
The PEGASUS Certificate is to be attributed to all graduates of the PEGASUS institutions. It states their successful completion, within one or several partner institutions of the PEGASUS network, of a prescribed programme of study giving them the skills required to the exercise of the engineering profession in aeronautics and aerospace. By attaching the PEGASUS Certificate to his demands for employment in Europe, a young engineer will be enabled to demonstrate that the quality of his studies is comparable to that of the PEGASUS home universities of the employing company. It is believed that the PEGASUS Certificate will encourage the European mobility in the aerospace domain.

Pegasus AWARD

Differently from the Certificate, the PEGASUS AWARD ("special **A**chievement through **W**orking **A**broad for academic **R**esearch or industrial **D**evelopment projects") is to be attributed only to those students spending at least five months in either an international exchange programme in a partner institution or in an industrial or research project conducted in a partner company or laboratory. The PEGASUS AWARD is therefore a statement of recognition of the successful activity conducted by the student in an international environment under PEGASUS responsibility. This is an important point, because through the AWARD label PEGASUS certifies an international experience for which its own institutions have provided to the students the necessary conditions. It is expected that a young graduate engineer able to display the PEGASUS AWARD will already be in possession of a European vision, which will make him particularly attractive for employment in the aerospace world.

All issued PEGASUS AWARDs are registered in a central database by the PEGASUS Administrative Office in Toulouse, where their complete list is regularly updated.

Zatrudnienie w europejskim przemyśle lotniczym (stan na 2003)



Average 3-year value 2002-2004 PER YEAR			
University		+5 level (Masters included)	+8 level (Doctorate, PhD)
ENAC Toulouse	(F)	225[4]	5
SUPAERO Toulouse	(F)	280	30
ENSICA Toulouse	(F)	210[2]	5
ENSMA Poitiers	(F)	150	26
RWTH Aachen	(D)	42	13
TU Berlin	(D)	58	14
TU Braunschweig	(D)	40	10
TU Dresden	(D)	36	5
U. Stuttgart	(D)	125	22
TU Munich	(D)	77	13
Politecnico di Milano	(I)	153	8
U. Pisa	(I)	85	5
U.Napoli	(I)	100	10
U.Roma	(I)	130	10
Politecnico di Torino	(I)	120	8
TU Delft	(NL)	130	25
NTNU Trondheim	(N)	11	2
ETSIA Madrid	(E)	200	10
IST Lisboa	(P)	30	3
KTH Stockholm	(S)	40	5
U. Bristol	(UK)	143	9
Cranfield U.	(UK)	153	38
U. Glasgow	(UK)	60	3
TOTAL		2518	279

Absolwenci kursu +5 i +8 (dane średnie za lata 2002-2004)

[4] including 50 Chinese Masters taught on-site in China. Since ENAC, ENSICA and SUPAERO have several Master programmes in common, whose students should not be counted twice, the total number of +5 level students from the 3 schools is only 635.

Bilateral exchange agreements within the PEGASUS (ERASMUS, double-degrees, stunentd and professors mobility, ...)

	ENAC Toulouse	ENSICA Toulouse	ENSMA Poitiers	SUPAERO Toulouse	RWTH Aachen	TU Berlin	TU Braunschweig	TU München	Universität Stuttgart	TU Dresden	Politecnico di Milano	Politecnico di Torino	Università di Pisa	Università di Roma I	Università di Napoli I	Cranfield University	University of Bristol	University of Glasgow	KTH Stockholm	TU Delft	NTNU Trondheim	ETSIA Madrid	IST Lisboa
ENAC Toulouse						x	x	x	x		x	x		x		x	x	x	x	x		x	
ENSICA Toulouse					x		x	x	x		x	x				x	x	x	x	x	x	x	x
ENSMA Poitiers									x		x	x		x		x	x			x	x	x	
SUPAERO Toulouse						x		x	x		x	x	x	x	x	x		x	x			x	x
RWTH Aachen											x	x							x	x	x	x	
TU Berlin											x					x	x		x	x		x	
TU Braunschweig																x			x				
TU München											x	x		x	x	x		x	x	x		x	x
Universität Stuttgart											x	x	x			x	x		x	x		x	
TU Dresden												x	x				x		x		x		
Politecnico di Milano																x		x	x	x		x	x
Politecnico di Torino																x	x	x	x	x	x	x	x
Università di Pisa																x			x	x			
Università di Roma I																x		x		x		x	
Università di Napoli I																x		x		x			
Cranfield University																				x		x	
University of Bristol																			x				
University of Glasgow																				x		x	
KTH Stockholm																						x	
TU Delft																						x	x
NTNU Trondheim																							
ETSIA Madrid																							
IST Lisboa																							

Comparative scheme of the Engineering programmes' structure in continental Europe

Country	***University***	***Year 1***	***Year2***	***Year3***	***Year 4***	***Year 5***
FRANCE						
	ENAC Toulouse	Scientific preparatory classes + national entrance exam		Ingénieur diplômé		
	SUPAERO Toulouse			Ingénieur diplômé		
	ENSICA Toulouse			Ingénieur diplômé		
	ENSMA Poitiers			Ingénieur diplômé		
GERMANY						
	RWTH AACHEN	Vordiplom		Diplom- Ingenieur		
	TU BERLIN	Vordiplom		Diplom- Ingenieur		
	TU BRAUNSCHWEIG	Vordiplom		Diplom- Ingenieur		
	U. STUTTGART	Vordiplom		Diplom- Ingenieur		
	TU MUNICH	Vordiplom		Diplom- Ingenieur		
	TU DRESDEN	Vordiplom		Diplom- Ingenieur		
ITALY						
	Politecnico MILANO	Laurea			Laurea magistrale	
	Univ. di NAPOLI				Laurea magistrale	
	Univ. di PISA				Laurea magistrale	
	Univ. di ROMA				Laurea magistrale	
	Politecnico TORINO				Laurea magistrale	
THE NETHERLANDS	TU DELFT	BSc. AE			MSc. AE	
NORWAY	NTNU TRONDHEIM	MSc. Mechanical Engineering				
PORTUGAL	IST LISBOA	Licenciatura engenheria aeroespacial				
SPAIN	ETSIA MADRID	Ingeniero aeronáutico				
SWEDEN	KTH STOCKHOLM	MSc. Engineering (Civilingenjör)				
Nominal Student Age:	18	19	20	21	22	23

Poziomy kształcenia i typy dyplomów

Struktura programów studiów

FS : <u>FUNDAMENTAL SCIENCES</u> Przedmioty Podstawowe – matematyczno-fizyczne

They are the background scientific knowledge required to understand and utilise techniques and methods used in aerospace engineering. FS include courses such as mathematics, physics, chemistry, computer science basics, etc…

ES : <u>ENGINEERING SCIENCES</u> Przedmioty Podstawowe - Inżynieryjne

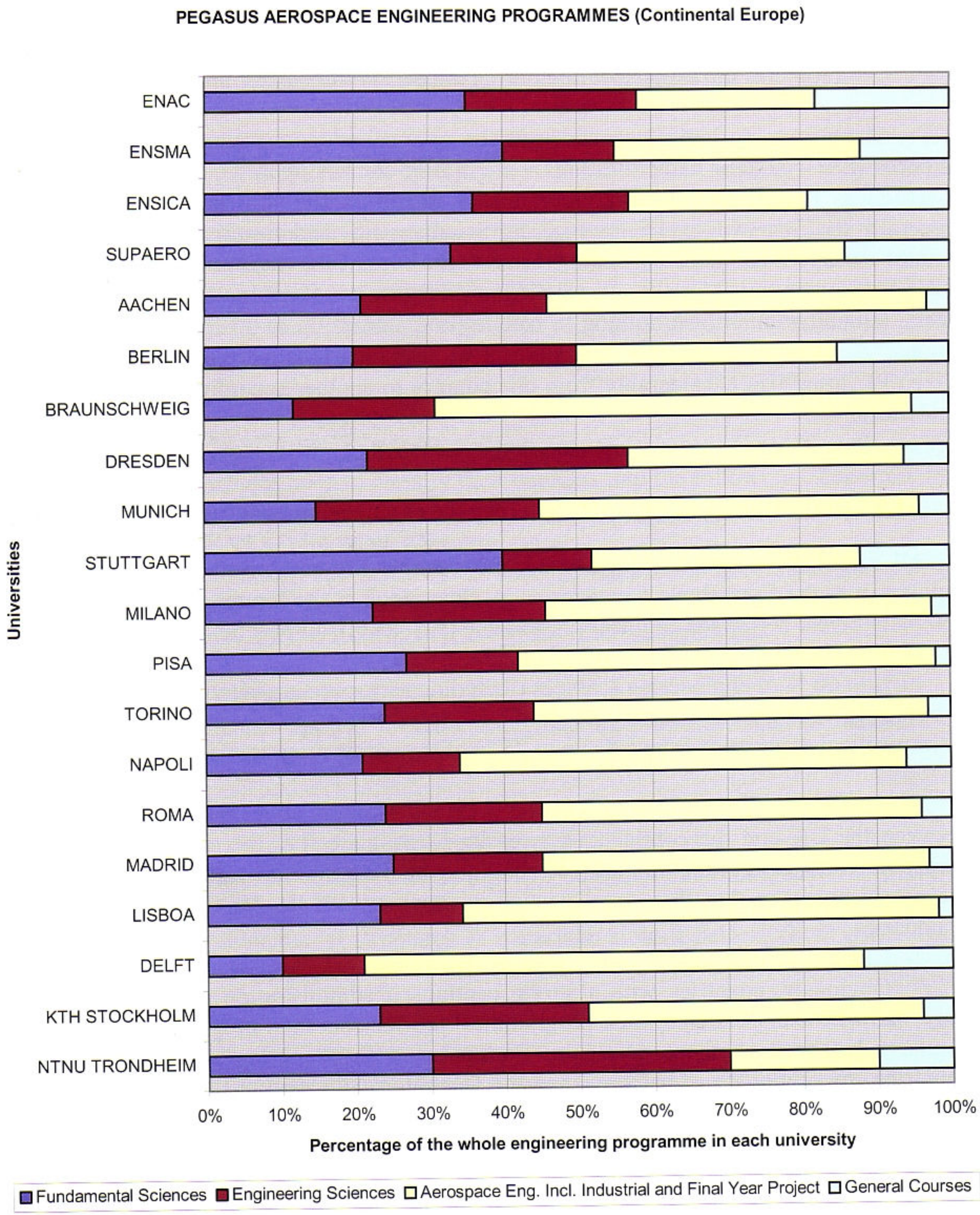
They are sciences applied to general engineering purposes, such as mechanics, fluid mechanics, gas dynamics, electronics, telecoms, software engineering, simulation tools and techniques, etc…

AE : <u>AEROSPACE ENGINEERING SCIENCES</u> Przedmioty Kierunkowe

Among engineering sciences, those having a strong orientation towards aerospace have been identified separately. They include: aerodynamics, propulsion techniques, aeronautical structures & materials, aircraft design, flight dynamics, air traffic control, aircraft operations, aviation safety, avionics, space engineering, others…

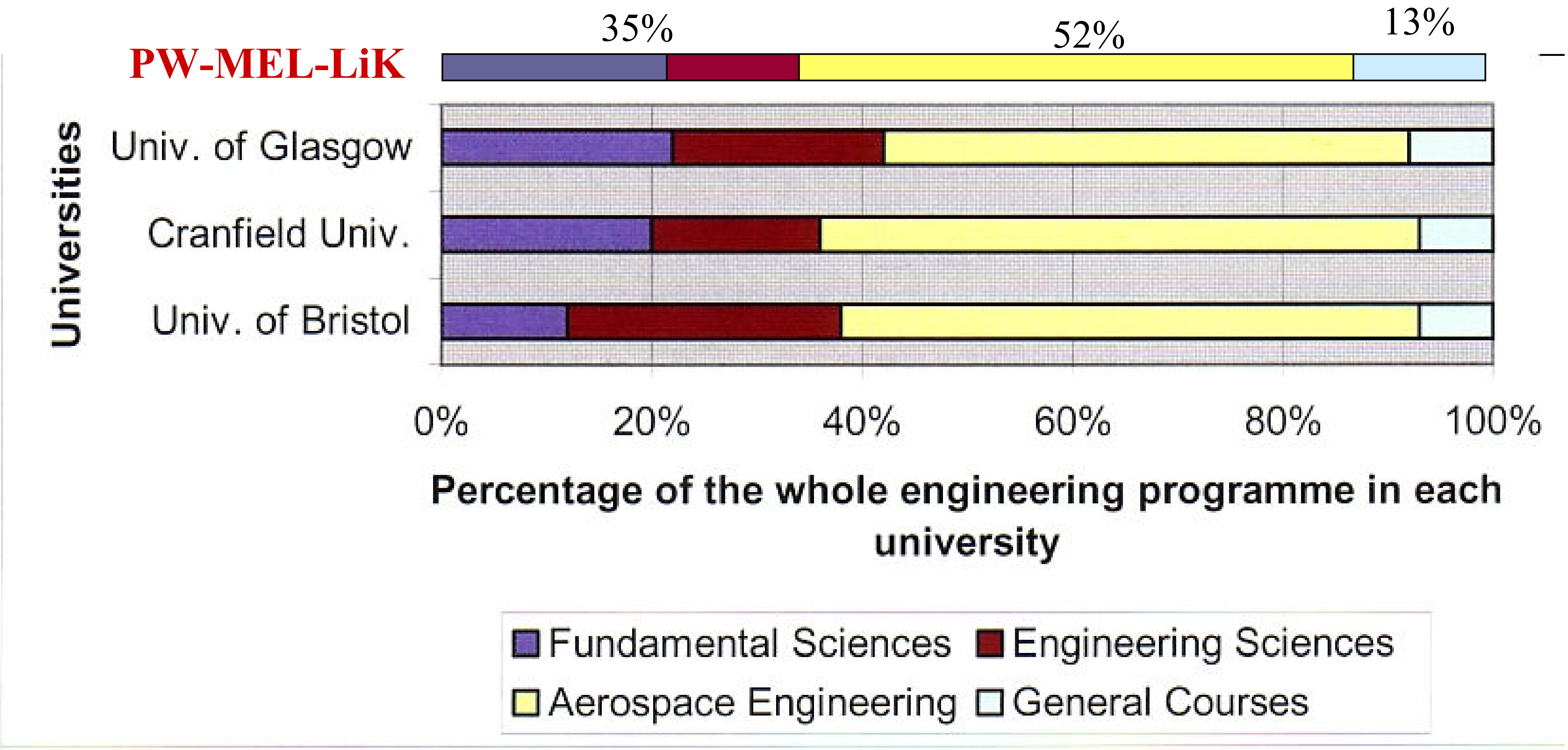
GC : <u>GENERAL COURSES</u> HES

Today, engineers can no longer limit themselves to purely technological projects, and they are in need of knowledge and skills in various "soft" sciences domains. These general courses include a large variety of topics (often proposed as optional courses) such as economics, finance, management, project management, history of aviation & industry, foreign languages, etc…



Relacje pomiędzy grupami przedmiotów - Europa kontynentalna, członkowie sieci PEGASUS

Relacje pomiędzy grupami przedmiotów – Wielka Brytania, członkowie sieci PEGASUS



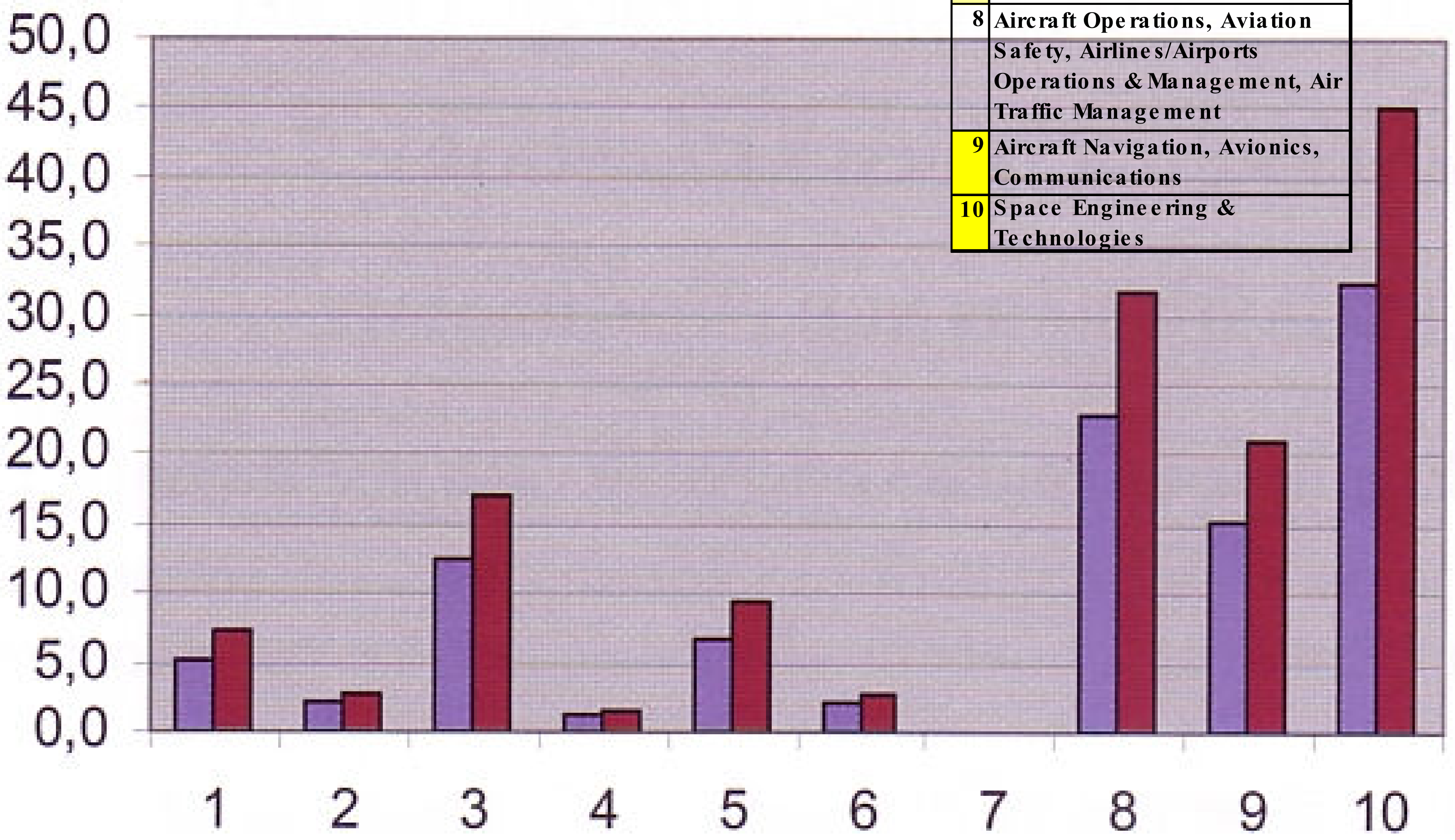
Course's Categories

1	Aerodynamics, Gas Dynamics, Heat Transfer
2	Structures, Materials
3	Aircraft Design, Subsystems & Integration
4	Rotary Wing Systems & Non-Convential Aircraft
5	Performance, Stability & Control, Flight Dynamics
6	Propulsion & Combustion
7	Production & Maintenance
8	Aircraft Operations, Aviation Safety, Airlines/Airports Operations & Management, Air Traffic Management
9	Aircraft Navigation, Avionics, Communications
10	Space Engineering & Technologies

ENIAC - specjalizacja

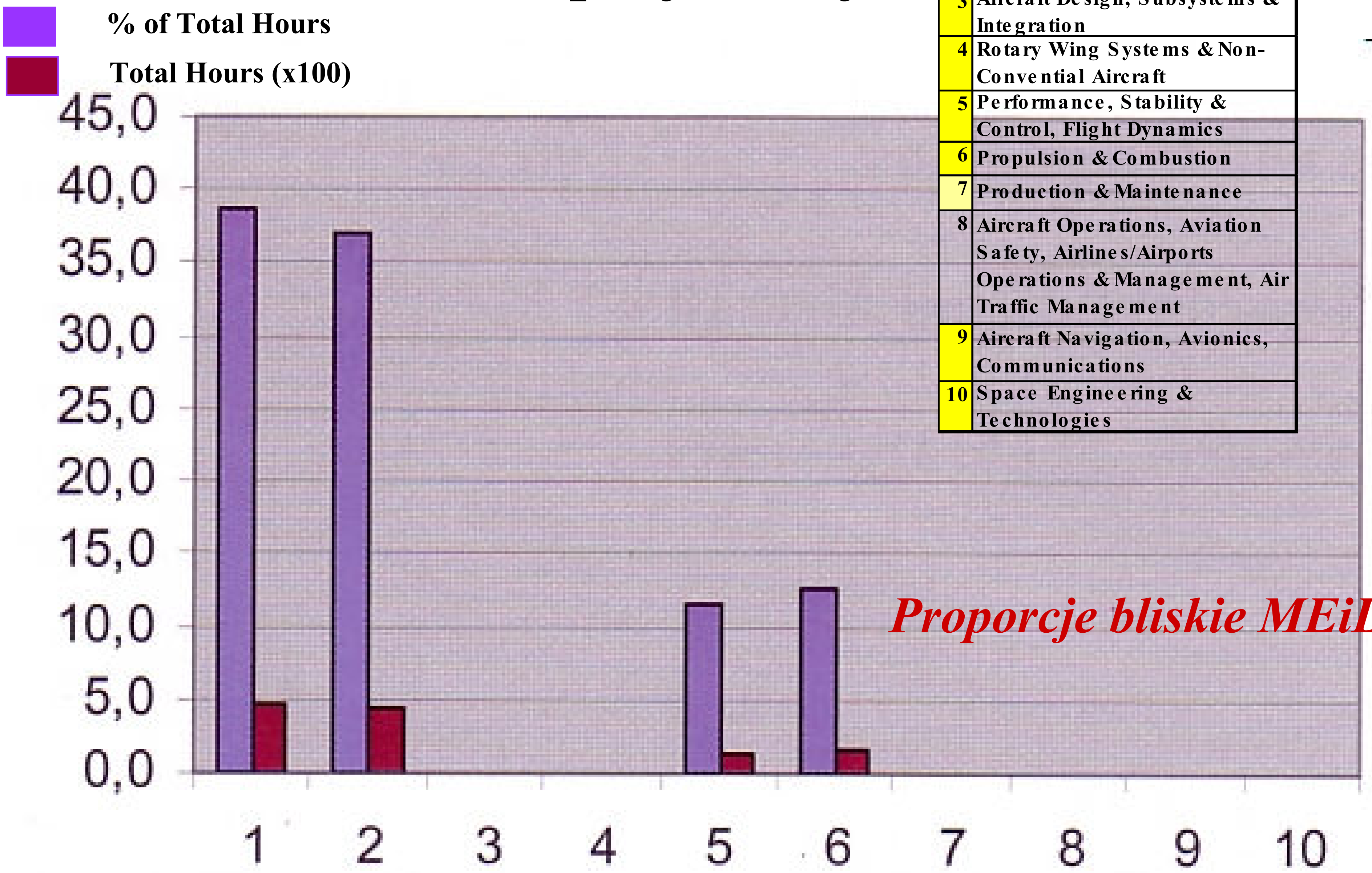
% of Total Hours

Total Hours (x100)



1	Aerodynamics, Gas Dynamics, Heat Transfer
2	Structures, Materials
3	Aircraft Design, Subsystems & Integration
4	Rotary Wing Systems & Non-Convential Aircraft
5	Performance, Stability & Control, Flight Dynamics
6	Propulsion & Combustion
7	Production & Maintenance
8	Aircraft Operations, Aviation Safety, Airlines/Airports Operations & Management, Air Traffic Management
9	Aircraft Navigation, Avionics, Communications
10	Space Engineering & Technologies

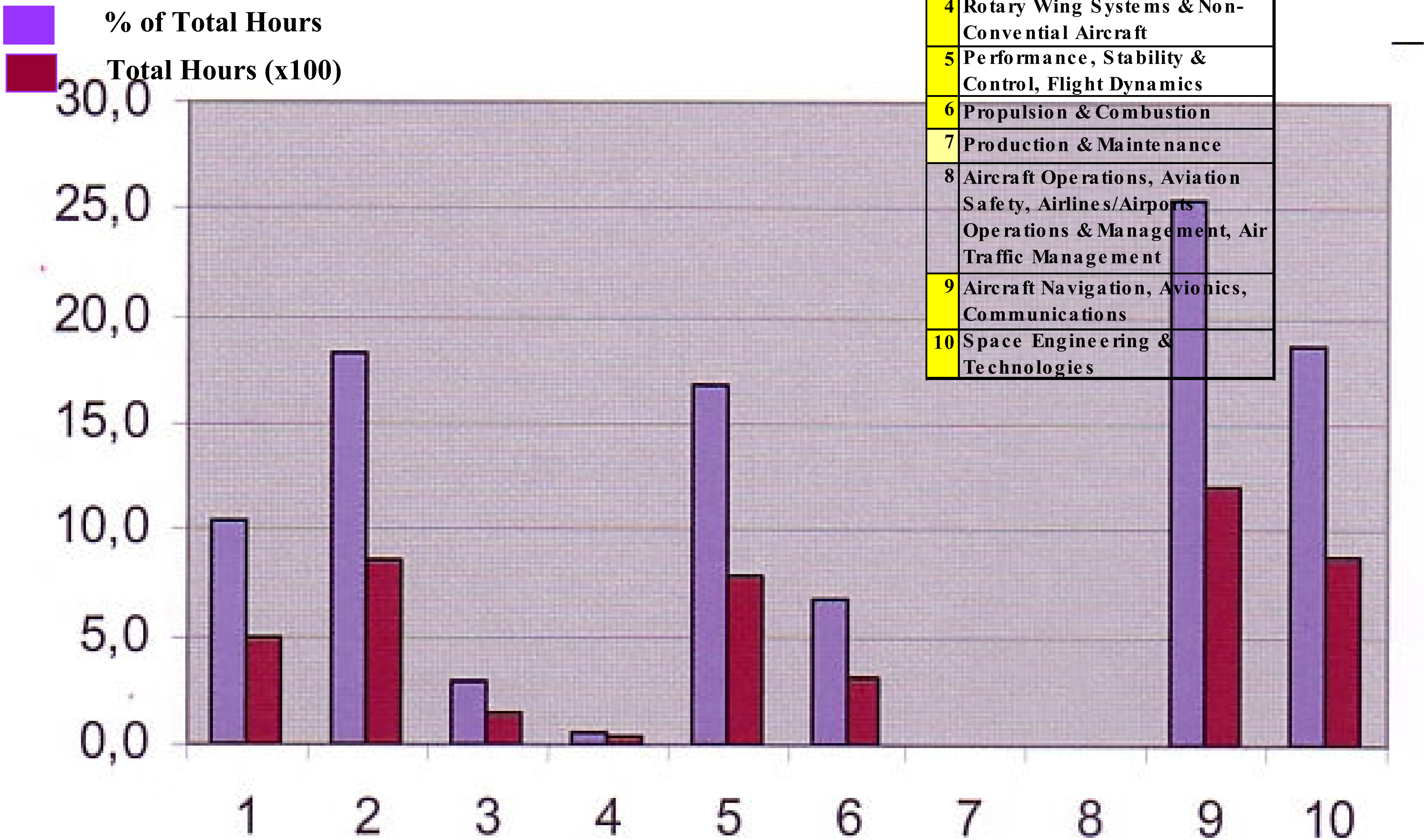
ENSMA - specjalizacja



1	Aerodynamics, Gas Dynamics, Heat Transfer
2	Structures, Materials
3	Aircraft Design, Subsystems & Integration
4	Rotary Wing Systems & Non-Convential Aircraft
5	Performance, Stability & Control, Flight Dynamics
6	Propulsion & Combustion
7	Production & Maintenance
8	Aircraft Operations, Aviation Safety, Airlines/Airports Operations & Management, Air Traffic Management
9	Aircraft Navigation, Avionics, Communications
10	Space Engineering & Technologies

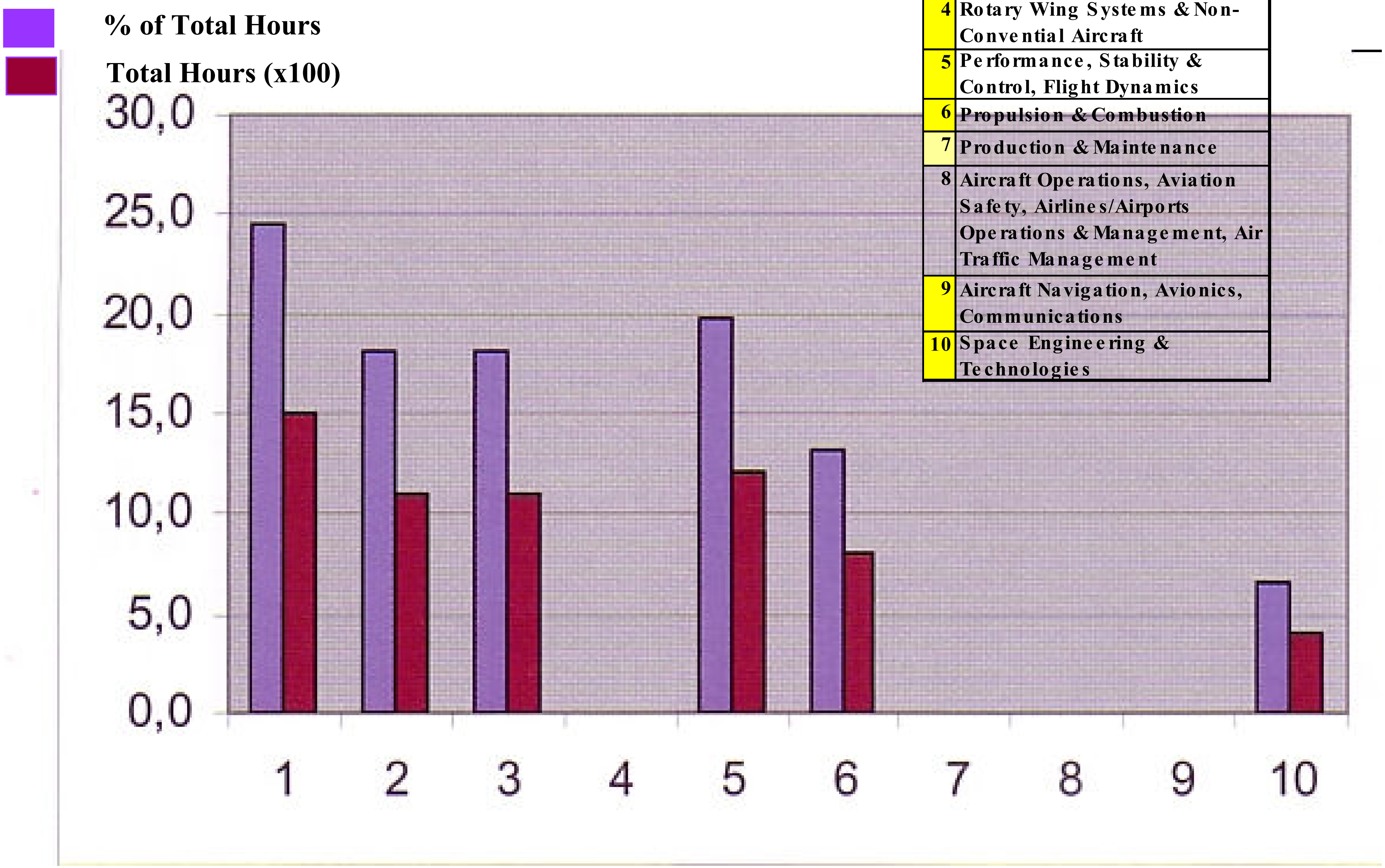
Proporcje bliskie MEiLu

SUPAERO - specjalizacja



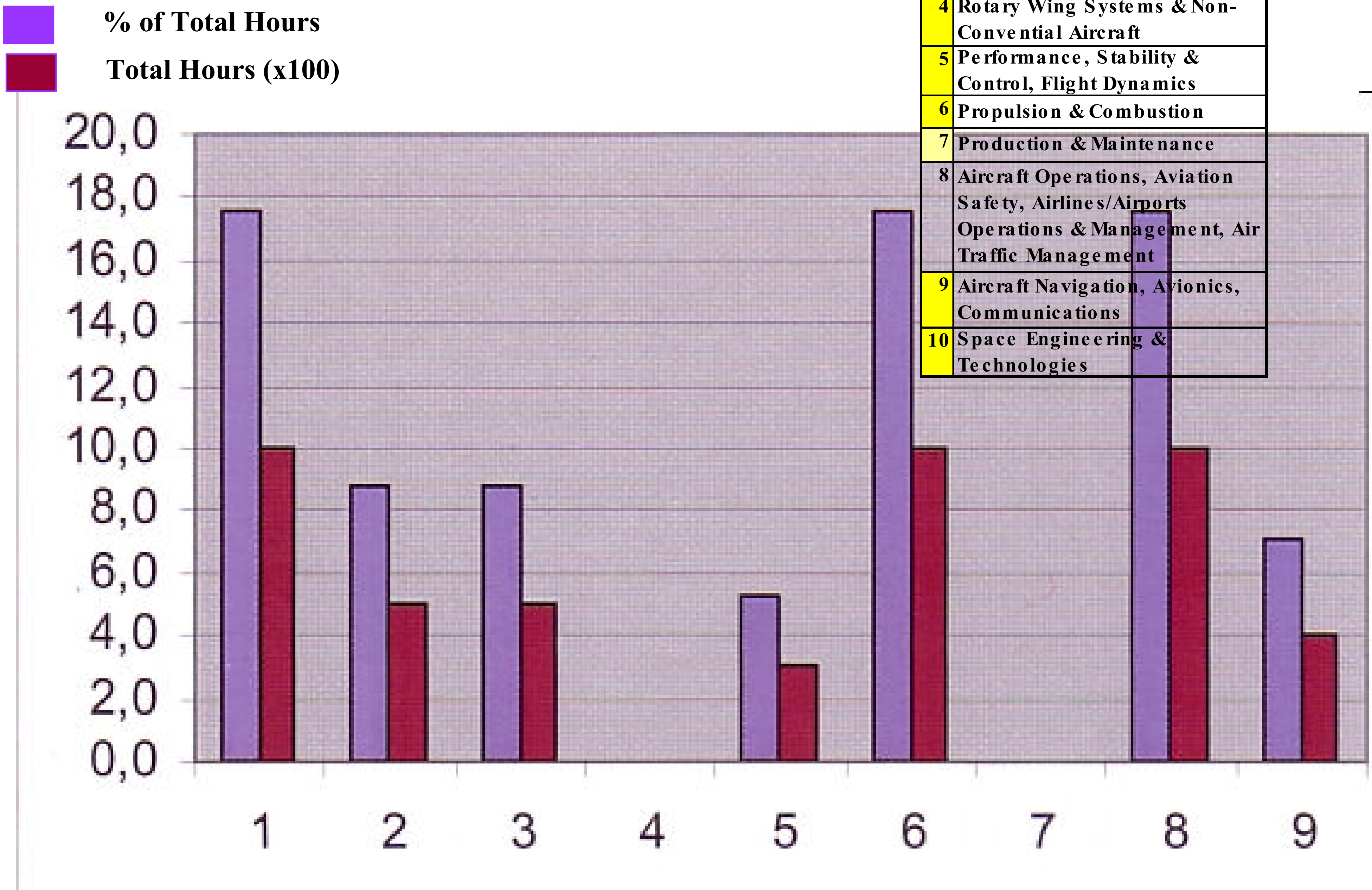
1	Aerodynamics, Gas Dynamics, Heat Transfer
2	Structures, Materials
3	Aircraft Design, Subsystems & Integration
4	Rotary Wing Systems & Non-Conventional Aircraft
5	Performance, Stability & Control, Flight Dynamics
6	Propulsion & Combustion
7	Production & Maintenance
8	Aircraft Operations, Aviation Safety, Airlines/Airports Operations & Management, Air Traffic Management
9	Aircraft Navigation, Avionics, Communications
10	Space Engineering & Technologies

AACHEN - specjalizacja



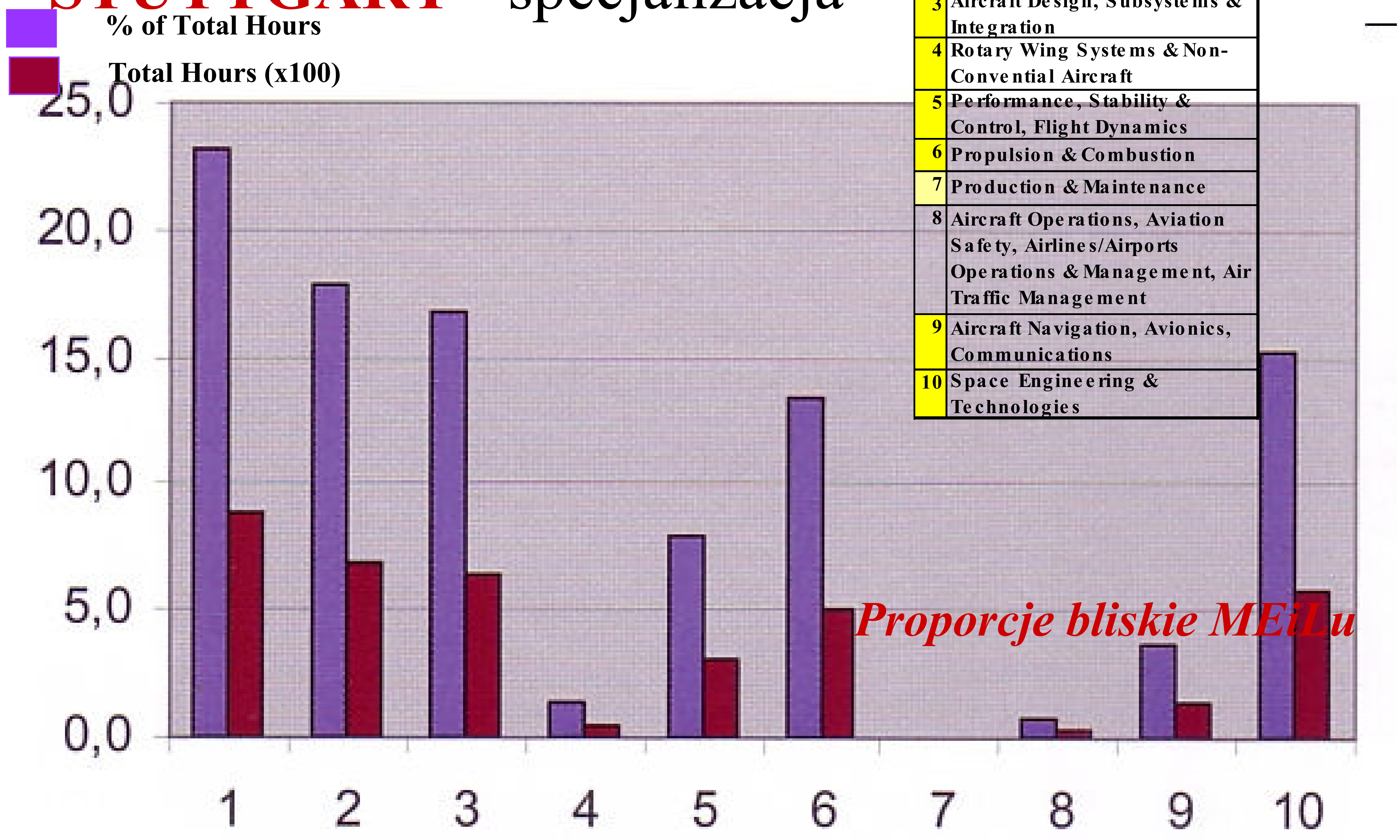
1	Aerodynamics, Gas Dynamics, Heat Transfer
2	Structures, Materials
3	Aircraft Design, Subsystems & Integration
4	Rotary Wing Systems & Non-Convential Aircraft
5	Performance, Stability & Control, Flight Dynamics
6	Propulsion & Combustion
7	Production & Maintenance
8	Aircraft Operations, Aviation Safety, Airlines/Airports Operations & Management, Air Traffic Management
9	Aircraft Navigation, Avionics, Communications
10	Space Engineering & Technologies

BERLIN - specjalizacja



1	Aerodynamics, Gas Dynamics, Heat Transfer
2	Structures, Materials
3	Aircraft Design, Subsystems & Integration
4	Rotary Wing Systems & Non-Conventional Aircraft
5	Performance, Stability & Control, Flight Dynamics
6	Propulsion & Combustion
7	Production & Maintenance
8	Aircraft Operations, Aviation Safety, Airlines/Airports Operations & Management, Air Traffic Management
9	Aircraft Navigation, Avionics, Communications
10	Space Engineering & Technologies

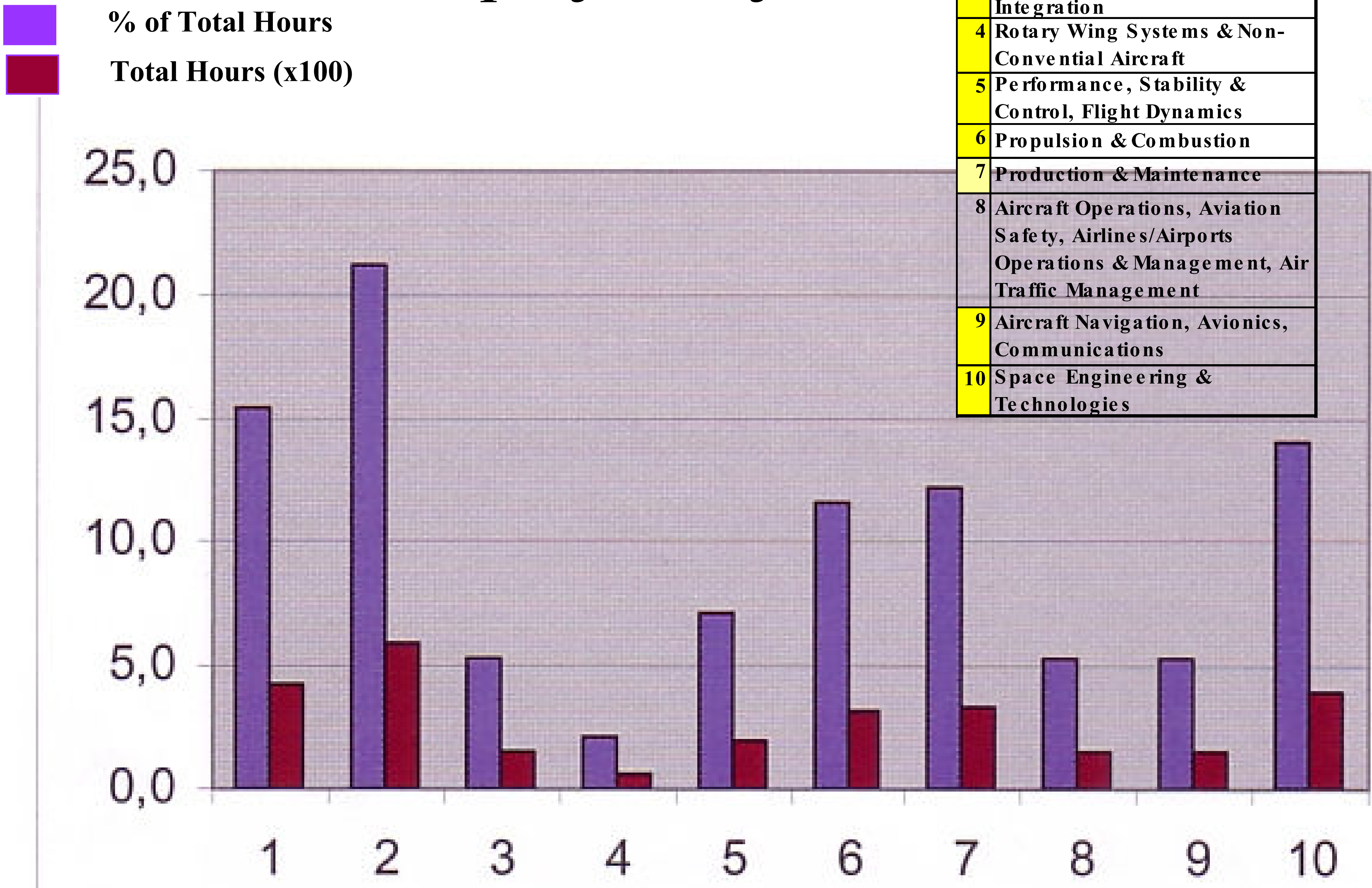
STUTTGART - specjalizacja



1	Aerodynamics, Gas Dynamics, Heat Transfer
2	Structures, Materials
3	Aircraft Design, Subsystems & Integration
4	Rotary Wing Systems & Non-Convential Aircraft
5	Performance, Stability & Control, Flight Dynamics
6	Propulsion & Combustion
7	Production & Maintenance
8	Aircraft Operations, Aviation Safety, Airlines/Airports Operations & Management, Air Traffic Management
9	Aircraft Navigation, Avionics, Communications
10	Space Engineering & Technologies

Proporcje bliskie MEiLu

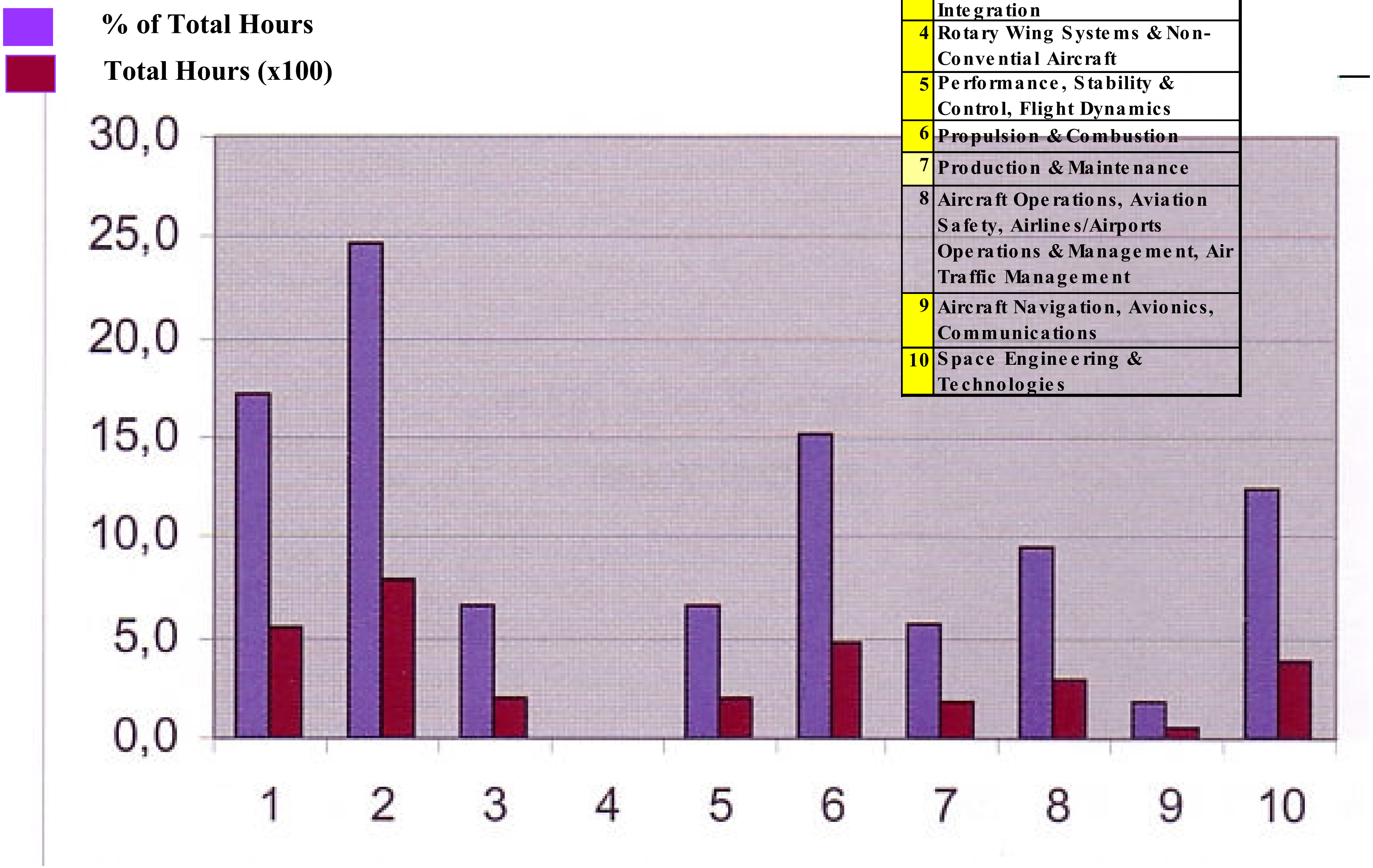
MUNICH - specjalizacja



1	Aerodynamics, Gas Dynamics, Heat Transfer
2	Structures, Materials
3	Aircraft Design, Subsystems & Integration
4	Rotary Wing Systems & Non-Conventíal Aircraft
5	Performance, Stability & Control, Flight Dynamics
6	Propulsion & Combustion
7	Production & Maintenance
8	Aircraft Operations, Aviation Safety, Airlines/Airports Operations & Management, Air Traffic Management
9	Aircraft Navigation, Avionics, Communications
10	Space Engineering & Technologies

Wszystkie specjalizacje!

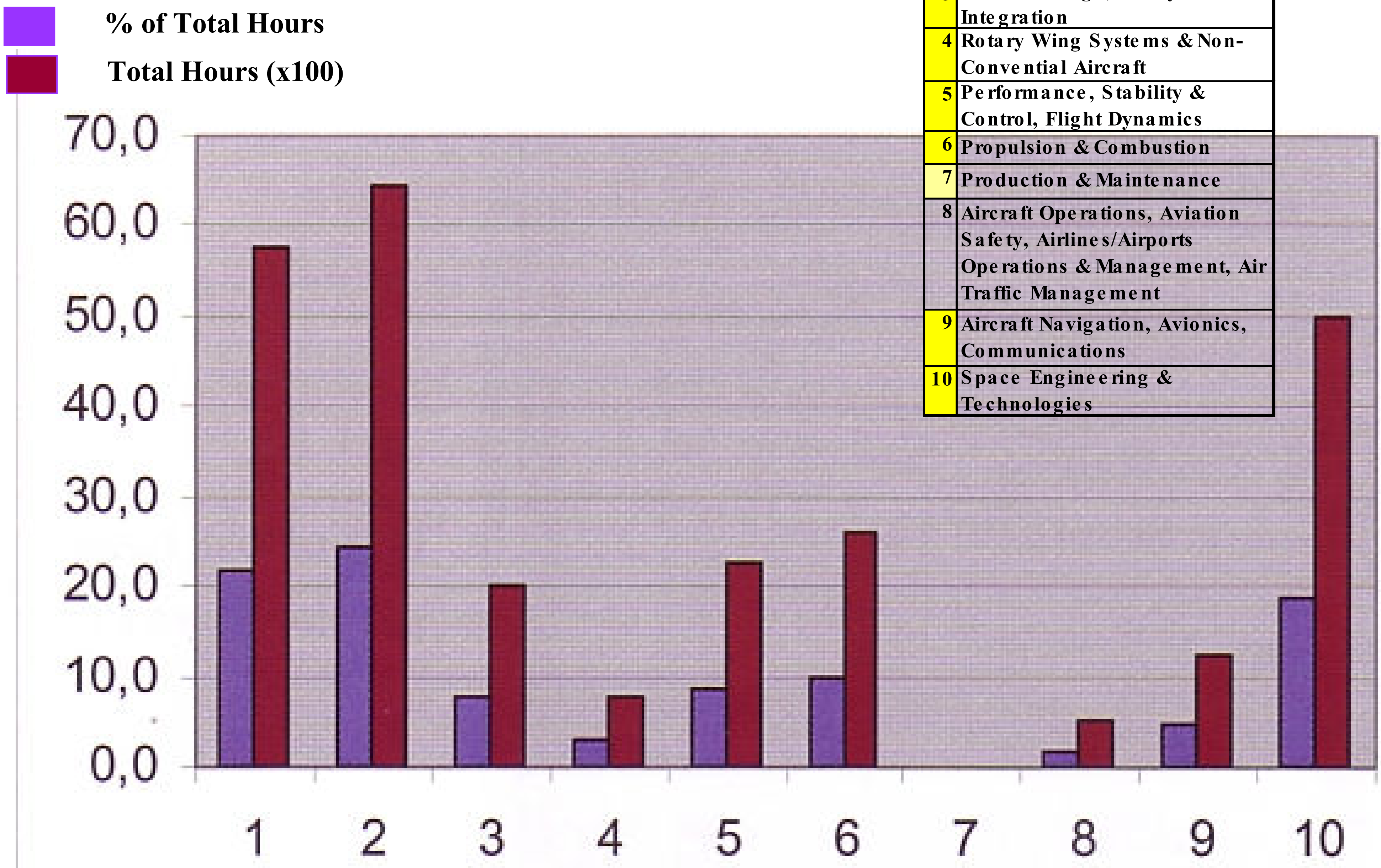
DRESDEN - specjalizacja



1	Aerodynamics, Gas Dynamics, Heat Transfer
2	Structures, Materials
3	Aircraft Design, Subsystems & Integration
4	Rotary Wing Systems & Non-Conventional Aircraft
5	Performance, Stability & Control, Flight Dynamics
6	Propulsion & Combustion
7	Production & Maintenance
8	Aircraft Operations, Aviation Safety, Airlines/Airports Operations & Management, Air Traffic Management
9	Aircraft Navigation, Avionics, Communications
10	Space Engineering & Technologies

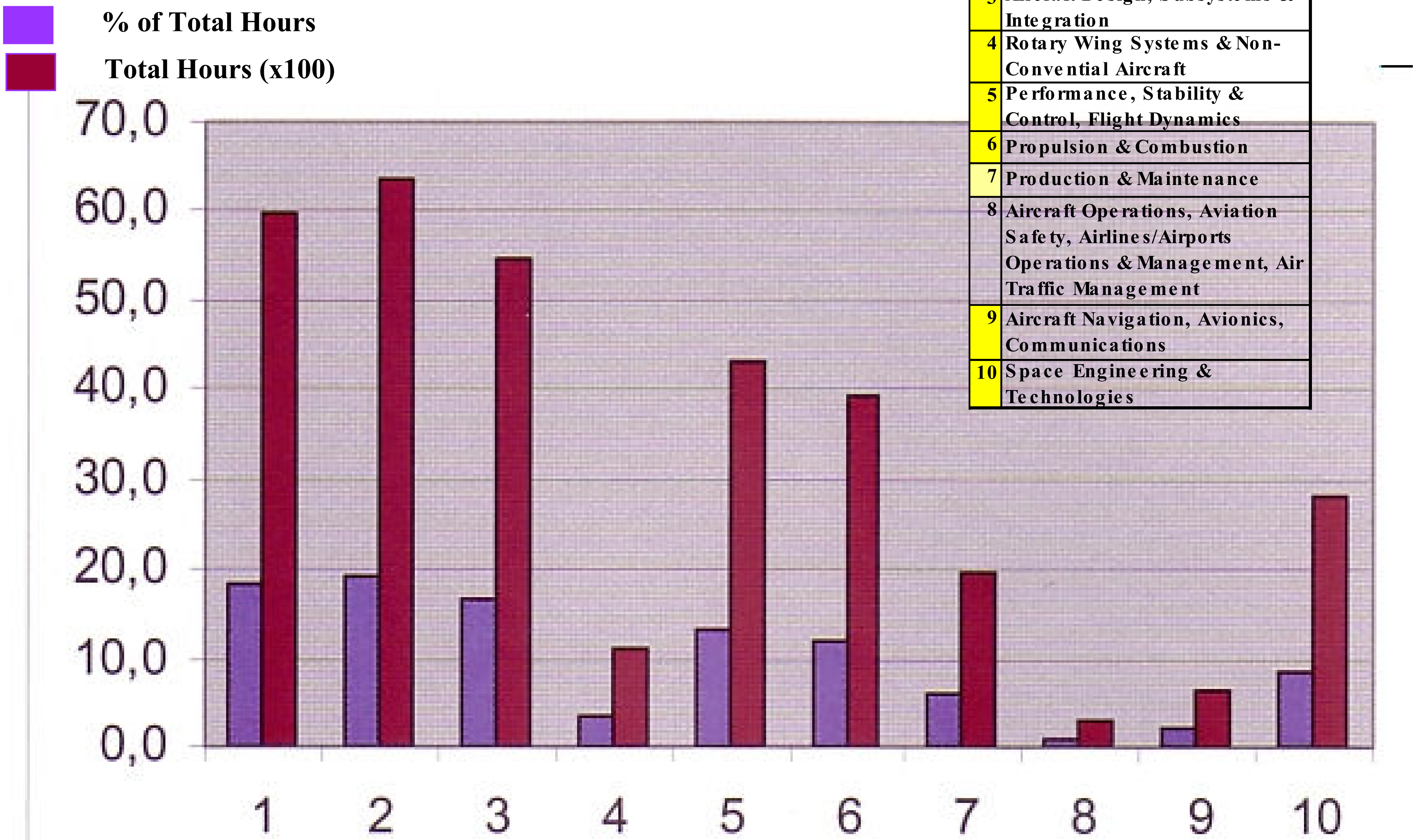
MILAN - specjalizacja

1	Aerodynamics, Gas Dynamics, Heat Transfer
2	Structures, Materials
3	Aircraft Design, Subsystems & Integration
4	Rotary Wing Systems & Non-Convential Aircraft
5	Performance, Stability & Control, Flight Dynamics
6	Propulsion & Combustion
7	Production & Maintenance
8	Aircraft Operations, Aviation Safety, Airlines/Airports Operations & Management, Air Traffic Management
9	Aircraft Navigation, Avionics, Communications
10	Space Engineering & Technologies



TURIN - specjalizacja

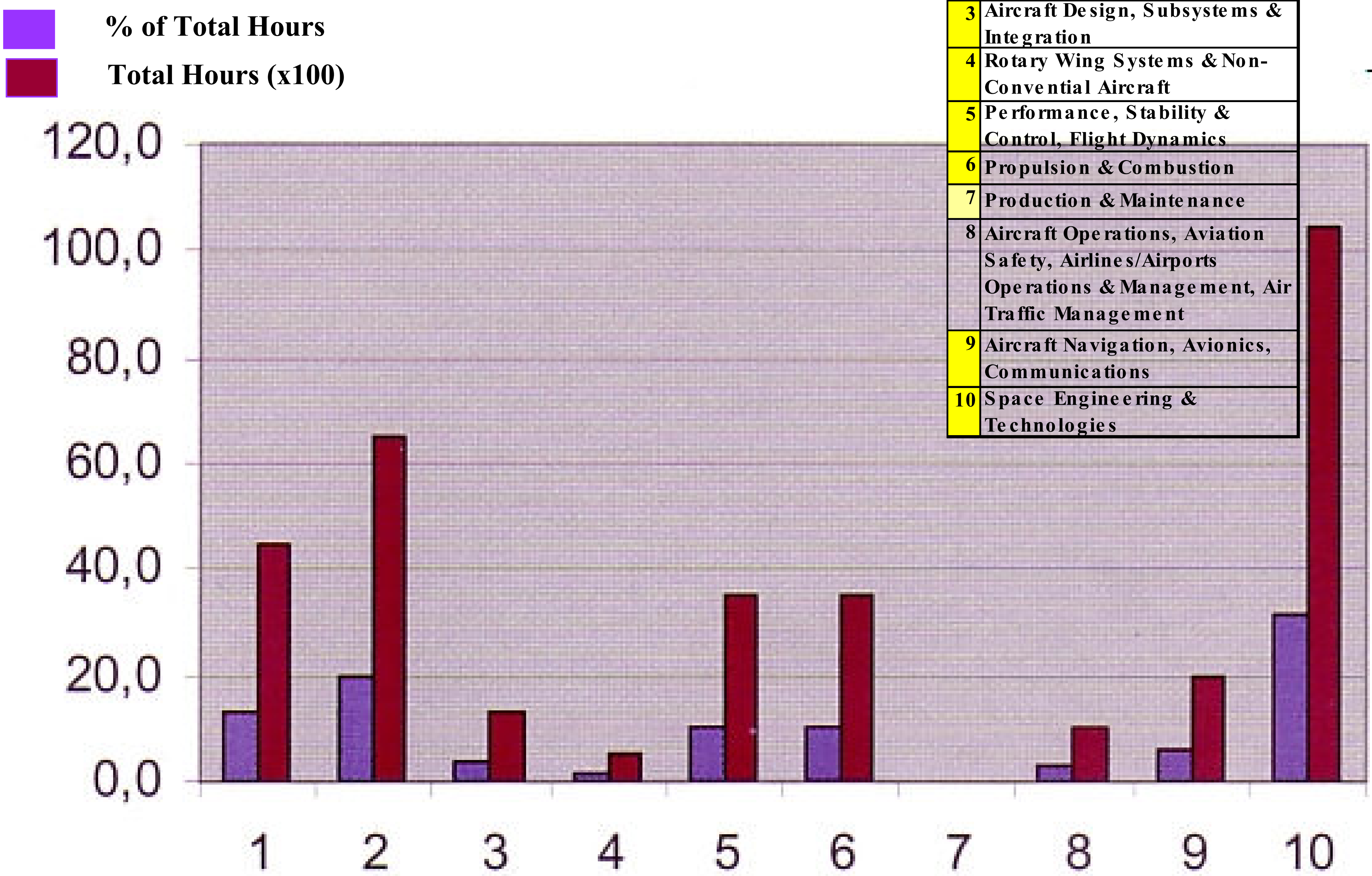
1	Aerodynamics, Gas Dynamics, Heat Transfer
2	Structures, Materials
3	Aircraft Design, Subsystems & Integration
4	Rotary Wing Systems & Non-Convential Aircraft
5	Performance, Stability & Control, Flight Dynamics
6	Propulsion & Combustion
7	Production & Maintenance
8	Aircraft Operations, Aviation Safety, Airlines/Airports Operations & Management, Air Traffic Management
9	Aircraft Navigation, Avionics, Communications
10	Space Engineering & Technologies



Wszystkie specjalizacje!

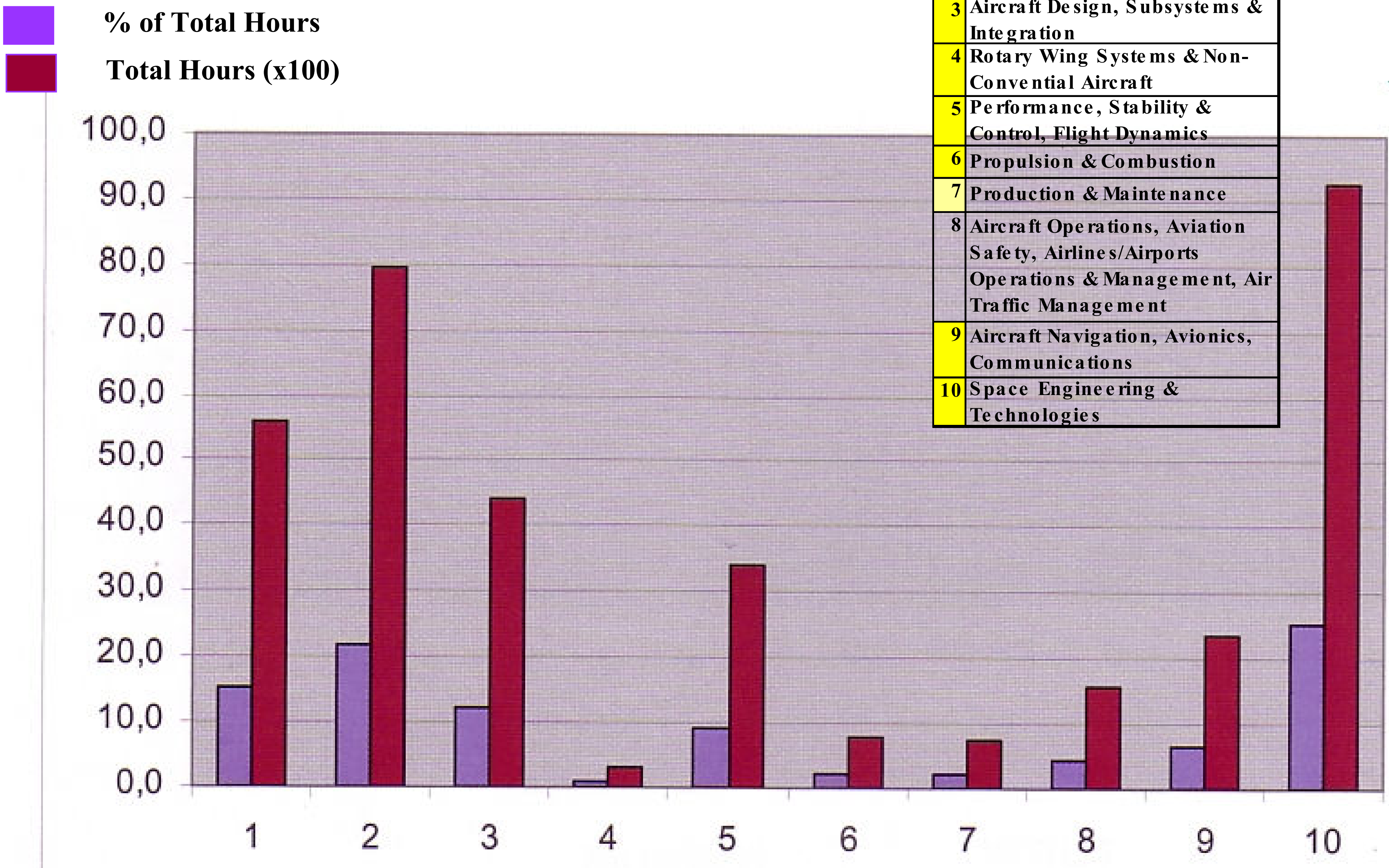
ROME - specjalizacja

1	Aerodynamics, Gas Dynamics, Heat Transfer
2	Structures, Materials
3	Aircraft Design, Subsystems & Integration
4	Rotary Wing Systems & Non-Convential Aircraft
5	Performance, Stability & Control, Flight Dynamics
6	Propulsion & Combustion
7	Production & Maintenance
8	Aircraft Operations, Aviation Safety, Airlines/Airports Operations & Management, Air Traffic Management
9	Aircraft Navigation, Avionics, Communications
10	Space Engineering & Technologies



DELFT - specjalizacja

1	Aerodynamics, Gas Dynamics, Heat Transfer
2	Structures, Materials
3	Aircraft Design, Subsystems & Integration
4	Rotary Wing Systems & Non-Convential Aircraft
5	Performance, Stability & Control, Flight Dynamics
6	Propulsion & Combustion
7	Production & Maintenance
8	Aircraft Operations, Aviation Safety, Airlines/Airports Operations & Management, Air Traffic Management
9	Aircraft Navigation, Avionics, Communications
10	Space Engineering & Technologies



Wszystkie specjalizacje!

Kto może ubiegać się o członkostwo w sieci PEGASUS

The members of Pegasus are European Institutions of higher education, training engineers which meet the following criteria:

- provision of high level scientific education in aerospace engineering related fields, which corresponds to the standard of duration of studies which is the longest in the concerned country (*poziom kształcenia*);
- national and international recognition of the quality of the aerospace engineering disciplines tuition level (*jakość kształcenia*);
- internationally recognised research achievements (*poziom badań*);
- a firmly established tradition of student mobility within Europe (*międzynarodowa wymiana studentów*).

ADMISSION CRITERIA - General

1. Be a public and/or non-profit institution of higher education in aeronautical / aerospace engineering.

2. Have its main base of operations in a EU country.

3. Demonstrate the willingness to sign the PEGASUS Charter and to actively commit to the PEGASUS network activities including working groups.

ADMISSION CRITERIA - Excellence

4. Have a good reputation and quality recognition (e.g. national accreditation by an official body) in education and research, nationally and internationally.

5. Deliver one or several degrees in aeronautical / aerospace engineering in compliance with the European Bologna orientation (LMD, +5 level or M for Aerospace Engineering or higher).

6. The main curriculum in aeronautical / aerospace engineering should comprise a sufficient base in Fundamental Sciences (minimum 15%), General Courses including foreign languages, and Engineering Sciences (minimum 40%) of which at least 50% should be Aeronautical / Aerospace Engineering Sciences (that is: minimum 20% of the overall program, or 60 ECTS for a 5-year programme).

7. Have or plan to reach a sufficient volume of activity in terms of student output: 30 graduates per year at the +5 level or higher in Aeronautical / Aerospace should be considered as the minimum target volume.

8. (supporting, non-mandatory criterion) Produce a record of first employment of the graduates in industry over the last 3 years, showing the relevance of the engineering programme for the aerospace industry.

ADMISSION CRITERIA -
International Cooperation

9. Produce a list of active partnership agreements with aeronautical / aerospace faculties or departments of foreign partner universities recognised at the international level, including at least 3 members of the PEGASUS network from at least 2 different countries. ***???***

10. Produce a record of student and faculty exchanges with foreign universities over the last 3 years.

11. (supporting, non-mandatory criterion) Produce a record of research activities involving international partnership.

End of criteria list

PEGASUS Questionnaire

<u>Criterion C/10</u> : **Produce a record of student and faculty exchanges with foreign universities over the last 3 years (average)**

Number of incoming and outgoing students per year (average) at the “graduate”level (5-year programs listed before)				
	Graduate level			
	Within PEGASUS		Outside PEGASUS	
Incoming students (total)				
Outgoing students (total)				
….out of which:	University	Flux	University	Flux
- main incoming flux :				
- main outgoing flux :				

Number of incoming and outgoing professors per year (average)			
Nature of activity	Average Duration	Direction	Number of profs
Teaching		Incoming	
		Outgoing	
Research		Incoming	
		Outgoing	
Both Teaching & Research		Incoming	
		Outgoing	
Other (specify…)		Incoming	
		Outgoing	

Programy kształcenia w USA: 51 wydziałów cywilnych, 5 wojskowych, 9 specjalnych (zastrzeżonych)

Aeronautical & Aerospace Engineering at the University of Florida

Table 2. Sample aeronautical/aerospace engineering curricula

Topic	1948	1973*	2003
English including composition	8	6	6
Humanities and social science	16	14	15
Math through differential & integral calculus	16	13_	12
Additional engineering math including num. meth.	0	8_	10
Chemistry with lab	8	5_	4
Physics with lab	8	8	8
Science elective	0	2_	3
Physical education or military science	4	2	0
Elective	6	6_	0
Computer programming	0	1_	2
Intro. to engineering	0	_	0
Engineering drawing _ computer-aided graphics	4	2	3
Elementary design	3	0	0
Mechanisms & kinematics	3	0	0
Statics, dynamics & mechanics of materials	9	6_	9
Thermodynamics	3	3_	3
Electrical engineering	6	3_	4
Materials behavior & selection	3	2	3
Engineering lab courses	9	2	5
Manufacturing operations	6	0	1
Specifications & industrial safety	3	0	0
Elements of aeronautics & astronautics	0	2	0
Fluid mechanics	0	2_	3
Aerodynamics	6	12	3
Astrodynamics	0	0	3
Structures	6	9_	3
Stability & control of aircraft	0	0	3
Propulsion	5	3_	3
Control systems	0	0	3
Electives restricted to approved technical or aerospace courses	5	12_	12
Professional development	2	_	1
airplane design _ aerospace design	6	4	6
Total semester hours	145	134_	128

* Quarter system being used this year, credits converted to semester hours.

_ Denotes change in nomenclature between 1946 and 1973, but topics seem comparable.

Aerospace Engineering at the University of Kansas, 1942

Table 2 Aeronautical Engineering Curriculum in 1942

Common Freshman Year

First Semester	Hrs	Second Semester	Hrs
Math. 2a, College Algebra	3	Math. 4, Analytical Geometry	5
Math. 3, Plane Trigonometry	2	Engl. 2E, Rhetoric II	2
Engl. 1E, Rhetoric I	3	Chem. 3E, Inorg. Chem. and Qual. Anal.	4
Chem. 2E, Inorganic Chemistry	4	Engr. Dr. 2, Machine Drawing	2
Engr. Dr. 1, Lettering and F.H. Draw	2	Engr. Dr. 3, Descriptive Geometry	3
C.E. 5, Engineering Lectures	1	M.C. 8, Metal Working	1
Gym. or ROTC	--	Gym. or ROTC	--
Total	15	Total	17

Sophomore Year

First Semester	Hrs	Second Semester	Hrs
Math. 5E, Calculus I	4	Math. 7E, Calculus II	4
Phys. 7a, General Engrg. Physics	5	Phys. 7b, General Engrg. Physics	5
Econ. 1E, Introductory Economics	3	A.M. 1, Statics	2
M.C. 1, Foundry Practice	1	M.C. 2, 6, Pattern and Mach. Tool Work	2
A.E. 1, Aeronautics	2	M.E. 3, Mechanisms	3
A.E. 2, Navigation and Meteorology	3	M.E. 154, Heating and Air Conditioning	2
Total	18	Total	18

Junior Year

First Semester	Hrs	Second Semester	Hrs
M.E. 151, Thermodynamics	3	M.E. 150, Machine Design	5
A.M. 50, Dynamics	3	A.M. 55, Hydraulics	3
A.M. 51, Strength of Materials	4	M.E. 159, I.C. Engines	3
A.M. 52, Testing of Materials	1	Engl. 56, Technocal Report II	0.5
M.C. 50, Heat Treatment	1	A.E. 101, Aerodynamics II	3
Engl. 59, Advanced Composition	3	A.E. 102, Aerodynamics Laboratory I	2
Engl. 6, Technical Report I	0.5	A.E. 105, Aircraft Matl's and Proc.	2
A.E. 100, Aerodynamics I	3		
Total	18.5	Total	18.5

SeniorYear

First Semester	Hrs	Second Semester	Hrs
E.E. 71, Direct Currents	3	A.E. 151, Airplane Design II	5
E.E. 91, Electrical Laboratory	1	M.E. 53, Seminar	0.5
A.E. 162, Aero Structures	3	A.E. 166, Aero Engine Laboratory	1.5
A.E. 163, Aero Structures Laboratory	2	C.E. 267, Statically Indeterminate Struct.	3
A.E. 150, Airplane Design I	3	E.E. 72, Alternating Currents	3
C.E. 56, Industrial Administration	3	Nontechnical option	2
Nontechnical option	3	Technical option	2
Total	18	Total	17

Grand Total 140 hours

Aerospace Engineering at the University of Kansas, 2002

Table 3 Aerospace Engineering Curriculum in 2002

Freshman Year

First Semester	Hrs	Second Semester	Hrs
Math. 121, Calculus I	5	Math 122, Calculus II	5
Engl. 101, Composition	3	Engl. 102, Composition and Literature	3
Chem. 184, Chemistry I	5	Phys. 211, Physics I	4
AE 245, Introd. To Aerospace Engrg.	3	HSS* Elective	3
AE 290, Aerospace Colloqiem	0.2	CPE 121, Fortran	3
		AE 291, Aerospace Colloqiem	0.3
Total 16.2		Total	18.3

Sophomore Year

First Semester	Hrs	Second Semester	Hrs
Math. 250, Math. Of Engrg. Systems	5	Math 124, Calculus III	3
CE 301, Statics and Dynamics	5	AE 445, Aerodynamics	3
Phys. 212, Physics II	4	Phys. 351, Physics III	3
AE 345, Fluid Mechanics	2	ME 312, Thermodynamics	3
AE 290, Aerospace Colloquiem	0.2	CE 310, Strength of Materials	4
		AE 291, Aerospace Colloquiem	0.3
Total 16.2		Total	16.3

Spostrzeżenie: brak przedmiotów szczegółowych, wąsko ukierunkowanych

Junior Year

First Semester	Hrs	Second Semester	Hrs
Ae 507, Aero Structures I	3	AE 508, Aero Structures II	3
AE 550, Dynamics of Flight I	3	AE 551, Dynamics of Flight II	4
AE 571, Reciprocating Engines	3	AE 572, Jet Propulsion	3
AE 545, Aerodynamics	5	AE 421, Computer Graphics	4
EECS 319 Circuits	4	AE 430, Aero Instrumentation	3
AE 290, Aerospace Colloquiem	0.2	AE 291, Aerospace Colloquiem	0.3
Total 18.2		Total	17.3

Senior Year

First Semester	Hrs	Second Semester	Hrs
AE 521, Aircraft Design I	4	AE 522, 523 or 524 Design II	4
AE 510, Materials and Manufacturing	4	TE/HSS* Electives	12
TE/HSS* Electives	9	AE 291, Aerospace Colloquiem	0.3
AE 590, Senior Seminar	1		
AE 290, Aerospace Colloquiem	0.2		
Total	18.2	Total	16.3

Grand Total 137 hours

* TE stands for Technical Electives, HSS stands for Humanity or Social Science Electives
TE electives must total 10 hours, HSS electives must total 14 hours

Aerospace Engineering at the University of Missouri-Rolla, 2003

Freshman Year

Basic Engineering 10	1	Basic Engineering 20	3
Chemistry 5[1]	5	Math 15[4]	4
English 20	3	Physics 23[4]	4
Math 14[4]	4	H/SS Economics elective[3]	3
H/SS History elective[2]	3		
Semester Hours	16	Semester Hours	14

Sophomore Year

Comp Sci 73-Basic Scientific Programming	2	AE 180-Intro to Aerospace Design	2
Comp Sci 77-Computer Programming Lab	1	EMech 160[5]-Eng Mechanics-Dynamics	3
Bas Eng 50 or 51-Eng Mech-Statics	3	ME 219[4,5]-Thermodynamics	3
Math 22[4]-Calculus/Analytic Geometry III1	4	Math 204-Elementray Differential Equations	3
Physics 24-Engineering Physics II	4	Bas Eng 110-Mechanics of Materials	3
AE 161-Aerospace Vehicle Performance	3	Elective/Literature	3
Semester Hours	17	Semester Hours	17

Junior Year

AE 213[4]-Aerospace Mechanics	3	AE 251[4]-Aerospace Structures I	3
AE 231[4,5]-Aerodynamics I	3	AE 261-Flight Dynamics and Control	3
AE 377-Principles of Engineering Materials	3	AE 271-Aerodynamics II	3
EE 281-Electrical Circuits	3	AE 282-Experimental Methods in AE I	2
Elective/Advanced Math/Computer Science[6]	3	Elective/Free[10]..........3	
		Elective/Communications[8]	3
Semester Hours	15	Semester Hours	17

Senior Year

AE 210-Seminar	1	AE 233-Intro to Aerothermochemistry	3
AE 235-Aircraft & Space Vehicle Propulsion	3	AE 281-Aerospace Systems Design II	3
AE 253-Aerospace Structures II	3	Elective/Technical[7]	3
AE 280-Aerospace Systems Design I	2	Elective/Technical[7]	3
AE 283-Experimental Methods in AE II	2	Elective/Free[10]	3
Elective/Technical[7]	3	Elective/Humanities/Social Sciences[9]	3
Elective/Humanities/Social Sciences[9]	3		
Semester Hours	17	Semester Hours	15

Figure (4) UMR team with their winning aircraft at the Society of Automotive Engineers Heavy Lift Competition *[DeLland, Florida, April 1999]*

Table1: A comparison of Aeronautical Engineering Curriculum from 1934 and Aerospace Engineering curriculum from 2003.

1934 COURSE OUTLINE	2002 COURSE OUTLINE
FIRST TERM	SEMESTER I
Aerodynamics I	Engineering Chemistry
Engineering Drawing I	Advanced Writing for Professionals
Aircraft Materials	Freshmen Engineering I
Metals Lecture /Lab	Engineering Calculus I
Welding Lecture / Lab	Theological Foundations
Instruments Lecture / Lab	
SECOND TERM	SEMESTER 2
Woodworking Lecture / Lab	Intro to Computer Science
Parachutes	Intro to Computer Aided Design
Radio	Engineering Calculus II
Fabric & Finishing Lecture / Lab	Engineering Physics I / Lab
Air Law	Humanities/Social Sciences Elective
Assembly and Rigging	
THIRD TERM	SEMESTER 3
Primary Engines	Engineering Shop Practice
Primary & Advanced Engines	Small Group Presentation
Advanced Engines	Statics
Propellers / Lab	Engineering Physics II / Lab
Electrical Equipment / Lab	Engineering Calculus III
FOURTH TERM	SEMESTER 4
Mathematics I	Introduction to Aero & Astro
Mathematics II	Electrical Engineering / Lab
Engineering Drawing II	Dynamics
Physics I	Fluid Dynamics / Lab
Air Transport Operation	Differential Equations
FIFTH TERM	SEMESTER 5
Mathematics III	Performance
Engineering Drawing III	Mechanics of Solids / Lab
Physics II	Machine Design
Elements of Mechanism	Linear Vibrations
Mechanics I	Advanced Mathematics for Engineers
	Probability and Statistics
SIXTH TERM	SEMESTER 6
Mathematics IV	Gas Dynamics
Mechanics II	Aerodynamics
Machine Design	Astrodynamics
Business English	Aerospace Structures I
Commercial Law	Linear Systems

Aerospace Engineering at the Parks College of Engineering & Aviation, 2003, 1/2

Aerospace Engineering at the Parks College of Engineering & Aviation, 2003, 2/2

	Ethics
SEVENTH TERM	SEMESTER 7
Mathematics V	Propulsion
Industrial Engineering	Aerospace Lab
Aerodynamics II	Stability & Control
Airplane Design I	Aerospace & Structures II
Airplane Design II	Flight Vehicle Analysis & Design I
10 hours of dual & solo flying instructions	Engineering Ethics
EIGHTH TERM	SEMESTER 8
Propellers II	Heat Transfer
Thermodynamics	Flight Vehicle Analysis & Design II
Stress Analysis	Cultural Diversity
Dynamics of Airplane	Technical Elective
Airplane Design III	Technical Elective
10 hours dual & solo flying instructions	

San Diego State University

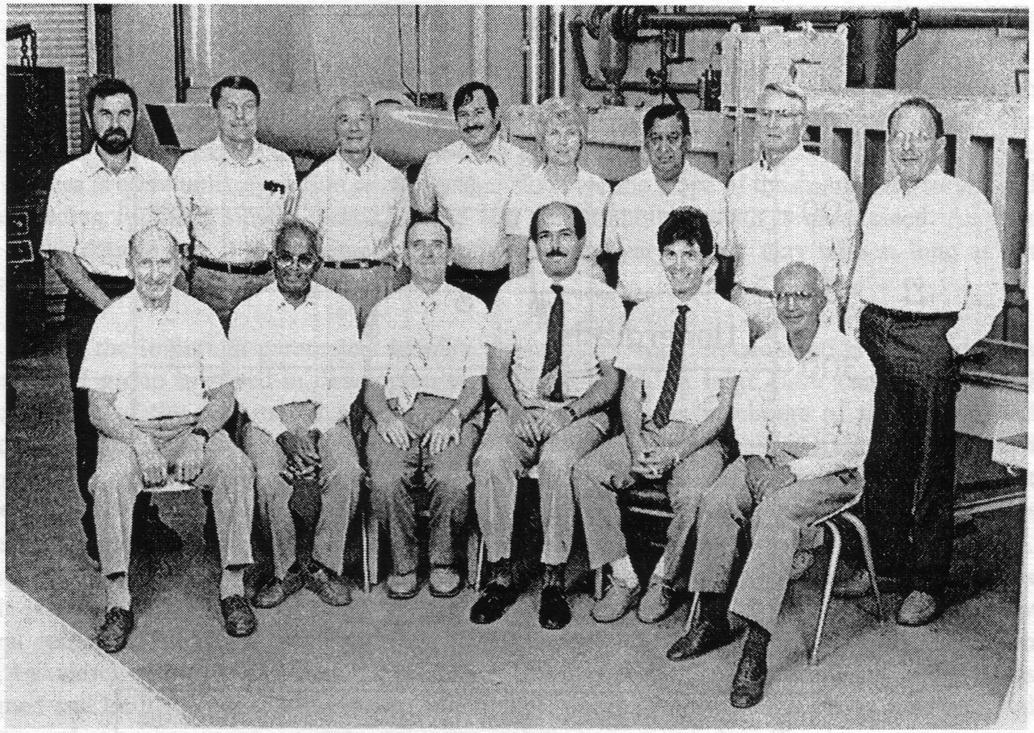


Fig. 2 The AE department in the midst of the 'good years', circa 91. From left to right, sitting: Prof. Faulkner, Prof. Dharmarajan, Prof. Pierucci, Prof. Nosseir, Prof. Lyrintzis, Prof. Narang. Standing, from left: Prof. Katz, Prof. Conly, Prof. Wang, Prof. Plotkin, secretary Helen, Prof. Krishnamoorthy, Prof. McGhie, and technical director Johansson.

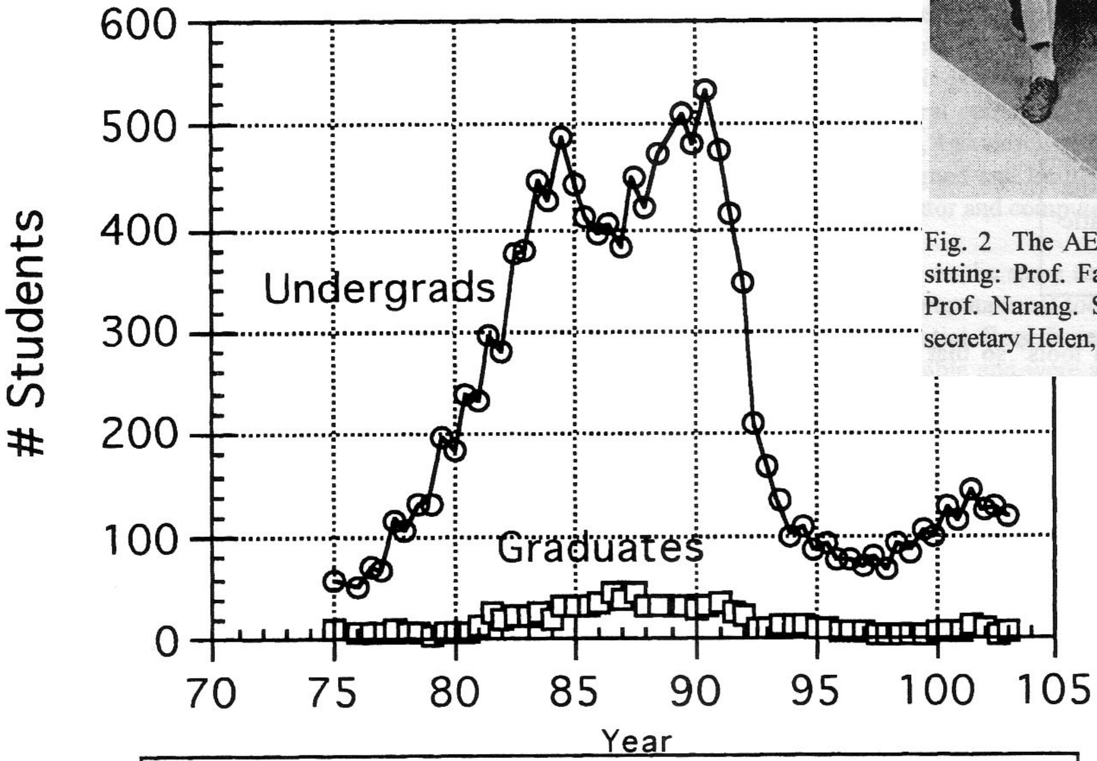


Fig 1. Student enrollment in the AE department. Note the sudden increase between 1975 –85 and then the dramatic drop after 1991.

13 prof.+ 3 tech.+4 admin.officers

Num.of stud.per 1 staff member=

500/20=**25**

Wnioski

•PW-MEiL-LiK posiada wiele atrybutów dobrego programu na poziomie europejskim czy amerykańskim (porównywalne grupy przedmiotów; akredytacja; mobilność studentów; badania w obszarze LiK; ...). Słabe strony: niska mobilność kadry; rozdrobnienie przedmiotów; niski wskaźnik studenci/pracownicy;

•**Konieczny kolejny krok**: przystąpienie do sieci PEGASUS, poprawa jakości kształcenia; poszerzenie partnerstwa z czołowymi Uniwersytetami; ...

•Czy stać nas na wiele specjalności? Czy specjalności mają być dopasowane do potrzeb przemysłu zachodniego działającego na obszarze Polski, czy do potrzeb przemysłu europejskiego na obszarze Europy, czy do strategii rozwoju polskiego przemysłu?

Materiały źródłowe

1. PEGASUS – Partnership of a European Group of Aeronautics and Space Universities, 2nd Edition, Toulouse, March 2005.

2. Aerospace Engineering Education During the First Century of Flight, Edited by B.McCormick, C.Newberry, E.Jumper, AIAA, Reston USA, 2004, ISBN 1-56347-710-6.