Study Purpose – Quality of the ETH Domain patent portfolio

The analysis compares the research quality in terms of patents of the ETH Domain to other research institutions and the industry sector in Switzerland, and to a selection of ten international research institutions among the most important ones.

17 technologies were specifically designed, covering two thirds of the total ETH Domain patent portfolio as well as the strategic focus areas of the ETH Domain and the technology foci of each participating institution. The technologies cover a wide range of fields from Life Sciences, Energy, Materials, Manufacturing. Systems and Digitisation.

National Patent Analysis

How significant is the ETH Domain in world class patents in specific technologies for the science and research landscape in Switzerland?

1/3 of ETH Domain patents are world class

311 out of 910 ETH Domain patents analyzed can be considered world class patents. World class patents are the 10% of the highest rated patents in each technology worldwide.

ETH Domain in first place in 8 out of 17 Technologies

The national comparison of the ETH domain with Swiss companies in world class patents shows that the ETH Domain ranks in first place in 8 out of 17 technologies and in the top five in six additional technologies.

Patent structure is of very high quality

Structuring the patent portfolio into deciles, from the top-10% to the bottom-10%, it can be shown that the patent structure of the ETH Domain in each technology is of above average quality. In 12 technologies, at least 50% of the patents are of very high quality and in the case of the energy technologies, drones and radiation detectors, the top 2 deciles account for more than 70% of the patents. Furthermore, only very few patents can be found in the low-quality deciles.

International Patent Analysis

How does the ETH Domain compare to the most important international research institutions in the selected technologies?

ETH Domain with third highest research efficiency

Total patent numbers differ quite substantially between the institutions due to differences in national patenting regulation, or as in the case of China, because researchers are incentivized to patent as much as possible in order to increase the relevance of China as a research location. However, the institutions are comparatively close in terms of world class patents. Consequently, the patenting efficiency (share of world class patents in total patents owned) varies among the institutions. The ETH Domain has the third highest patenting efficiency behind Harvard and MIT.

ETH Domain among the leaders in more than one third of all technologies analyzed

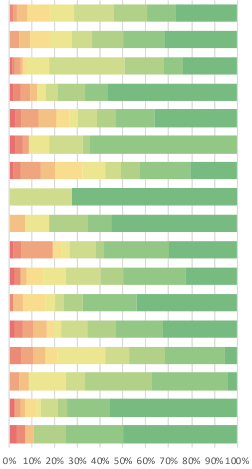
The international comparison of the ETH Domain with some of the most renowned universities and research institutions worldwide shows that the ETH Domain has clear advantages in system technologies such as mass spectroscopy, drones and radiation detectors. It is also ahead in security elements where there are almost no viable competitors. Another strong development can be observed in organic perovskite tandem photovoltaics. Overall, the ETH Domain is among the leaders in more than one third of all technologies analyzed.

ETH Domain ahead of European institutions

The international comparison shows the wide range of high quality patents at the US institutions MIT, Harvard, and the University of California System while the European institutions are significantly behind those in in the chosen technologies. The ETH Domain is positioned ahead of the European institutions but clearly behind those in the US. It has to be noted that the two Chinese institutions considered are well positioned in many technologies. Furthermore, their patenting activities in most areas started less than 10 years ago. Today they are ahead of the European institutions.

Patent Portfolio of the ETH Domain

Technology Field	Technology	Total Patents	World Class Pat.	Patenting Efficiency	Rank in CH	Patent structure quality 2017
Digital / Data	Security Elements	63	17	27%	4	
Digital / Data	Quantum Technologies	22	7	32%	1	
Digital / Data	Digital Image Analysis	81	19	23%	1	
Manuf /Materials	Advanced Materials	100	57	57%	1	
Manuf /Materials	Nanostructures	132	48	36%	1	
Manuf /Materials	Additive Manufacturing	34	0	0%	-	
Systems	Mass Spectroscopy	59	12	20%	2	
Systems	Drones	11	8	73%	1	
Systems	Radiation Detectors	29	16	55%	1	
Life Sciences	Biosensors/Lab-on-a-Chip/Bioprinting	53	16	30%	2	
Life Sciences	Wearables Bionics	40	9	23%	1	
Life Sciences	Radiation Diagnosis and Therapy	50	22	44%	1	
Life Sciences	Protein Engineering	122	40	33%	4	
Life Sciences	Drug Discovery Systems Biology	19	1	5%	7	
Life Sciences	Pharmaceutically active Subs.	24	1	4%	45	
Energy	Organic Perovskite Tandem PV	43	24	56%	2	
Energy	Waste Water/Biomass/Carbon Capt.	28	14	50%	2	
Total		**910**	**311**	**34%**		



The table shows total patents, world class patents, the share of world class patents (patenting efficiency) and the ETH Domain rank in world class patents compared to other research institutions and companies in Switzerland (Additive Manufacturing not ranked due to lack of world class patents in this technology). The patent structure quality shows patent portfolio in deciles, from the top-10% (dark green) to the bottom-10% (dark red). It can be shown that the shares of higher quality deciles (in green) are significantly larger.

International Comparison of the Patent Portfolio

	ETH Domain	CNRS	Fraunho-fer	Oxford University	Stanford University	Harvard University	MIT	California Univ. Syst	Japan STA	Chinese Acad. Sc.	Tsinghua University
Security Elements	17	0	58	0	0	1	0	1	0	0	0
Quantum Tech.	7	6	1	6	3	21	39	23	3	12	3
Digital Image Analysis	19	7	29	19	22	5	19	35	4	17	35
Advanced Materials	57	60	15	7	23	58	126	151	28	138	173
Nanostructures	48	76	21	22	36	147	203	260	44	95	209
Addit. Manufacturing	0	3	9	0	5	70	47	13	1	8	3
Mass Spectroscopy	12	6	6	7	10	11	12	18	3	12	19
Drones	8	0	0	1	1	0	4	0	0	0	1
Radiation Detectors	16	0	2	0	0	0	4	1	1	4	12
Biosensors, Bioprint.	16	19	5	10	22	123	61	74	7	8	9
Wearables Bionics	9	0	5	1	6	11	32	24	1	3	0
Radiation Diag/Ther.	22	7	2	3	15	7	16	33	0	6	25
Protein Engineering	40	86	10	47	86	288	218	232	15	25	12
Drug Discovery Sys.	1	1	0	0	15	42	28	23	0	0	1
Pharmac. Act. Subst.	1	12	0	1	0	15	4	11	0	5	0
Perovskite Tandem PV	24	10	6	16	4	6	13	17	0	11	2
Waste Water,Biomass	14	26	15	2	7	2	42	33	3	97	27
Total World Class Pat.	**311**	**319**	**184**	**142**	**255**	**807**	**868**	**949**	**110**	**441**	**531**
Total Patents	**910**	**2925**	**1820**	**431**	**1728**	**1563**	**2308**	**5164**	**1158**	**19124**	**4968**
Patenting Efficiency	**34%**	**11%**	**10%**	**33%**	**15%**	**52%**	**38%**	**18%**	**9%**	**2%**	**11%**

The heat map is organized horizontally and labels the institutions with the highest number of world class patents within a technology in green colour gradients and the institutions with the lowest numbers in red colour gradients. Vertically the number of green coloured cells indicate the number of high rankings (green) and low rankings (red) per institution. The large number of green fields shows the leading positions of the US institutions in the majority of technologies.

Background – Focus on World Class Patents

Traditionally, patent analyses focused on the number of patents per institution or company, there was no classification of the relevance of each invention - each patent is counted. For the first time, the application of big-data methods allow for a completely new use and analysis of patents where patent quality is evaluated for each individual patent worldwide by technological relevance (based on third party citations of each patent) and market coverage (number of countries covered by the patent protection). This approach also reduces the distorting effects due to country specific differences in the patenting systems (Japan: very early patenting; China: incentivized patenting to increase Chinas relevance as a research location).