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Some Strategic Critical Sizes of China

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ABSTRACT:
In this study, the academic and technology companies in the top 10, 20 and 30 rankings selected in the worldwide were evaluated. The reason for the acquisition of these companies is that they have both market dominances in free market conditions and companies that produce technology in their fields. Fort this purpose, in the field of academic science, CWUR-2017 science fields ranking has been given. In addition, by giving Nature index, CWUR and ARWU ranking indexes, by examining the cross-ranking of academic and non-academic companies and organizations, a relationship has been established between the success of academic institutions and companies for the training of human resources. Therefore, in this, it has been determined that the critical population size is the basis of the real reasons for the success of the leading countries. All of the technological and innovative countries in the world have been found to be leaders in certain fields of science and technology. As a result of the evaluation of the field for 100 in Natureindex 2019-2020, only 19 countries entered the rankings. Among these, the USA comes with 48%, China with 13% and Japan with 9%. The total of these three countries corresponds to 70% of the general rate. According to the ARWU-2019 ranking, USA: 85 and CHN: 76 universities were ranked in 22 fields. In the ARWU-2020 period, it decreased to CHN: 86 and USA: 76. On the basis of being a leading country, it is because they have strategically critical human resources and they make critical technological production. According to this rate of development, after the USA and Europe, Asia will be the third science and technology center based in China after 2034.
KEYWORDS: *China, Semiconductor, Optimization, Critical human sources, University*

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I. INTRODUCTION

China is one of the countries that has made great strides in every field in recent years. These breakthroughs have a great impact, especially in the field of production they have made to the world. Apart from that, it has a distinct impact in different areas of goods, services, technology and science. In recent years, due to these developments, China's distinct achievements in space and related technological fields have been seen in open resources. In the fields of science and technology, it has a significant success especially in the field of chemistry and measurement. This success of China has become very successful in higher education, especially in the field of engineering, in the last 5 years. Among these, it seems to be extremely successful in higher education in agriculture, perhaps as a private field. Another important critical area of success is seen as strategically investing in engineering. Success in higher education in the field of engineering and agriculture is seen in the rankings made according to the field of science. Success rates can be seen in Natureindex CWUR-2017 and AWUR indexes. One of the other areas where it is successful is that it is not a coincidence that 5 banks among the top 10 banks in the world in banking in 2020 are Chinese banks. In other words, China has created its own domestic and national capital capital and partially solved its financial problem. China is not particularly influential in healthcare and pharmaceuticals. Apart from that, it is not effective in some areas. But it is seen that it has become effective especially in the field of engineering in the last 5 years. Apart from this, the basic sciences physics, physics chemistry, biology and mathematics are not seen as effective. The biggest reflection of this is the lack of Chinese semiconductor field. 60% of the manufacturers or suppliers in the semiconductor market in China consist of foreign companies. These are Samsung, Intel, SK Hynix, TSMC, NXP, Infineon, ON, HiSilicon and Semiconductor Manufacturing International Corporation (SMIC) Semiconductor industry [1]. Apart from these, China may also be in many small companies. Today, the lack of semiconductor has deeply felt as a result of the USA's embargo and the Chinese embargo. As a result, we are experiencing embargoes in the field of 5G and IPHONE. For this, even in open sources, China is making all kinds of incentives to make up for its deficiency in the semiconductor field.

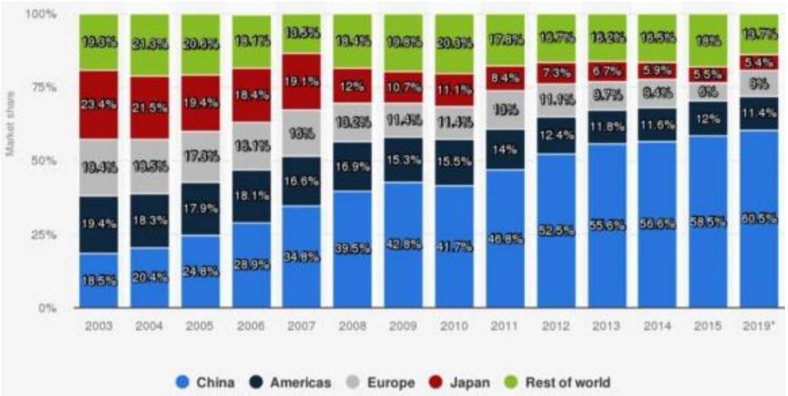

Figure 1. Semiconductor rates in 2019 market in China. Multinational companies in China are considered sourced because they produce in China. Therefore, the rate of imported goods seems to be low [2].

Table 1. Model distributions according to companies in semiconductor manufacturing industry Operation models of multinational semiconductor companies in China [3].

Integrated device manufacturer (IDM) model		
Intel, Micron, Samsung, Texas Instruments		
Fabless-foundry model		
Design (fabless)	**Manufacturing (foundries)**	**Assembly, test, and packaging (ATP)**
AMD, Broadcom, MediaTek, HiSilicon, Qualcomm	GlobalFoundries, SMIC, TSMC, UMC	Amkor, ASE, ChipPAC, JCET, J-Devices, Power-tech, SPIL

Source: Adapted from SIA, "Beyond Borders," May 2016.

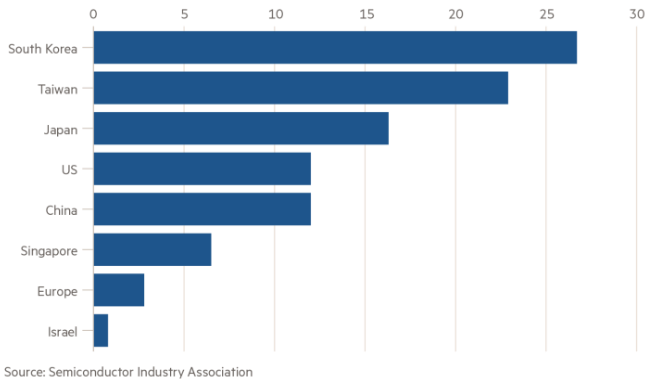

Figure. 2. 2019 semiconductor capacity of the countries in the world [4].

The main problems of China in today's semiconductor field are the fact that jeeps, which have their own high quality, are produced by multinational companies. This is the reason for the USA-China embargo and tension, especially between 2017-2020. China does not have the production of high quality chips. Therefore, it transfers great financial support to this area.

II. SELECTED SECTORS

In this section, a selection was made between 10-30 companies based on the sector in their field. In the selection method, top companies in the stock exchange were taken. This includes information from Statista [5] and Value-today [6] database 1 January 2020. The information of all sectors is taken from these two databases. Statista was left open due to COVID-19 between 15-May and 1-July 2020. Thus, some data were taken from this database.

Table.2. The 20 top companies in the field of semiconductor jeep production, country, market value and number of employees are shown (source: Statista, value today-2020) or [5-6].

SEMICONDUCTORS
(1-Jan. 2020, USA-$ Bllion)

	Companies List	Market Value	Country	Employee
1	Samsung Elec.	320.01	KR	55,671
2	TSMC	293.32	TWN	51,292
3	Intel Corp.	263.81	USA	41,200
4	NVIDIA Corp.	145.97	USA	13,227
5	ASML HOLDIND	127.54	NLD	23,000
6	Broadcom	127.20	USA	19,000
7	Texas Instruments	126.27	USA	29,888
8	QUALCOMM	102.71	USA	37,000
9	Softbank Group	93.51	JPN	76,866
10	Micron Tech.	61.70	USA	37,000
11	Applied Materials	57.11	USA	22,000
12	Advanced Micro Devices	55.86	USA	11,400
13	SK HYNIX	55.71	KR	33,000
14	Analog Devices	44.98	USA	16,400
15	Lam Researh Corp.	44.35	USA	10,700
16	NXP Semiconductor	35.77	NLD	29,400
17	Tokyo Elecron Ltd	35.04	JPN	12,742
18	TE Connectivity	32.39	CHE	80,000
19	Mitsubishi Elec. Corp.	29.93	JPN	42,000
20	Infineon Tech. AG.	29.41	GER	41,400

Total number of employees: There are 647.090 employees. (Source: Statista-2020, Value-today website-2020) or [5-6]

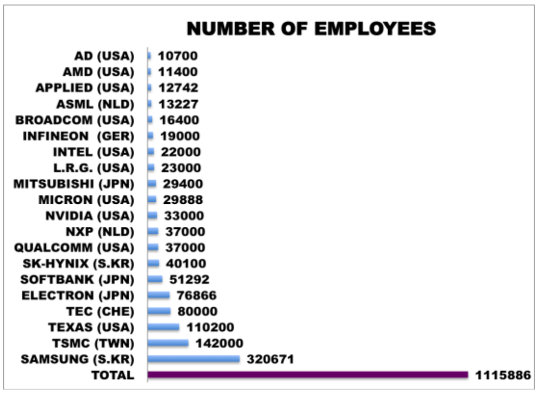

Fig.3. Countries and total number of employees of companies operating in the semiconductor field. However, the number of all employees of some Holding companies or companies is given [5-6]. Therefore, the number of employees is increasing.

According to the data in Table.2, the number of employees according to open sources in the Semiconductor sector section was 647.090. The distribution of 20 big Semiconductor producer companies according to countries is determined in Table.1: USA: 10, JPN: 3, NLD: 2, S.KR:2, GER: 1, TWN: 1, CHE: 1. According to this situation, we think that it would not be wrong to assume that at least 50% of the world's semiconductor production is produced or controlled by the USA.

Semiconductors has identified 647.090 employees in 20 large manufacturing companies. Among these employees, there are 1-26% scientists and many other qualified employees, depending on the technological level of the company. Among the other employees, there are at least 10-20% researcher doctorate or professional experts and scientists. Other employees are qualified white coat employees. In high technology companies, the number of people working in classic blue coats is almost non-existent. Unqualified or blue coats are employed in non-production areas. Because all employees are qualified and quantitative human resources since they produce in the field of high technology. Semiconductor sector does not only show the status of the sector that produces jeeps, it is also an indicator of the development of other basic sciences in the country. These basic sciences physics, chemistry materials and the production of precision mechanical systems are also indicators of the advanced machinery industry.

According to Fig.3, the total number of employees in this sector is 1.115.886. According to these numerical data, the scientist is 11.159 people for at least 1%, at most 290078 people for 26% and the average of simple arithmetic is around 150.618 people. The number of other researchers is between 150.618-223.177. Its simple arithmetic mean is calculated as 186.898. The total number of high-level qualified human resources in these critical technology producing companies is calculated around 337515 people. In other words, the number of people who have a say in this sector in the world is 1.116.000 people, and among them, the number of highly qualified human resources is around 338,000. With this number of human resources, companies with the ability and quality to direct all developments in this field are formed. The other 843.000 employees are qualified human resources in the field of production. Most of them are qualified human resources that develop the machines and techniques used in the production phase. With another approach, it is not human resources with a blue coat. Technological developments in this semiconductor industry affect all other areas or directly or indirectly. These are mainly sensors, artuators, GPU, APU, microcomputers, microprocessors and all other semiconductor components. Their wide applications enable the development of other sectors and the formation of the backbone of basic technologies.

Although semiconductor science is based on solid state physics, it is also directly within the scope of chemistry and materials science in the production stages and in gaining the semiconductor's temperature-related characteristics. In the production phase, in addition to these, it also includes the production of precision machines of mechanical engineering in order to produce the desired quality. For this reason, semiconductor production is not a simple chip production, but on the contrary, it is a very basic application of the industry using every field of complex high technology as well as the basic science fields. If we take into account organic semiconductors in recent years, even biology will soon enter this field. For this reason, it is an industry that hosts critical technology and critical human resources and has a critical economic size.

The leading countries with semiconductor technology are USA, Japan, South Korea, Germany, Switzerland, Holland, Taiwan and, in recent years, China. The export products unit prices (Kg / $) and competition coefficients of 7 countries with this technology are very high. For example, there are very few export products that can compete with the smart-phones that Apple has sold in Kg / $. Or there are very few products that perceive every segment of society as potential customers and force the society to consume. For this reason, it provides great gains to countries and companies. Most of the countries that are innovating in the Global-2020 year are countries with semiconductor technology. It is not accidental that these countries are innovative, either.

The software field is another most important and critical application segment of the semiconductor technology field. Software is also very important, especially for applications in the fields of APU, GPU, ALU or computing, graphics. Model Based Engineering is used to model these areas [7]. The main of these techniques is; 1. The needs are determined and the design is made according to the situation, 2. A hardware has been developed, appropriate software is made for this, 3. A software arising from the needs has been developed and the appropriate hardware is designed for this to work. As a result of these techniques, new products are created. Therefore, it is necessary to evaluate software, hardware and other electronic systems together. Much more qualified human resources are needed for these researches. Because the usage area of the developed software or hardware is theoretically unlimited. Application can be made for any area considered. Considering the limited skills of people, and considering the limited skills of software developers and hardware developers, the application areas are automatically limited, but application areas develop over time. In addition, model-based engineering applications have been made in many different areas. These are applications in the fields of optimization of higher education [8-10], restructuring of the state [11].

In the fields of technology, electronics, software, hardware, IT and AI, they usually work together with the subsidiaries of semiconductor companies or companies with which they are closely related or partnered. Apart from these, few companies achieve success independently. In the country ranking, USA is by far the leader in technology, electronics, software-hardware-IT. Next comes China, Germany and Ireland. In recent years, India should also be taken into consideration. 17 companies were taken into consideration in the software field shown in Fig.4. The proportion of employees in these companies is not specified as personnel working only in the fields of software, hardware, IT and AI. This information has been obtained from different sources [5-6]. Details of the working personnel could not be obtained from open sources. The reasons for this are that companies avoid giving clear information due to some commercial concerns. However, the number of employees is thought to be much higher than the semiconductor field. The total number of employees of the companies here has been determined as 2.757.963. If all of these employees are considered as qualified employees, it corresponds to approximately 2.758.000 employees. Considering that the employees in the semiconductor field are 647,090 people, it is estimated that the number of employees in other fields is estimated to be around 2.110.910 or we think it would not be wrong to accept 2.758.000 employees in general. If this section accepts highly qualified employees as 2% for software and 10% for hardware, it is calculated that the average of high quality human resources will be 55.160 for software and 275.800 for hardware and other fields. Regardless of the situation, we think that all people working in high technology companies are qualified human resources. Therefore, we separate these human resources from other sectors. In addition, we consider this area as the locomotive area for the development of countries and also as a critical technology.

Fig.4. Number of countries and companies in the field of software, hardware and IT produced from source data [5-6].

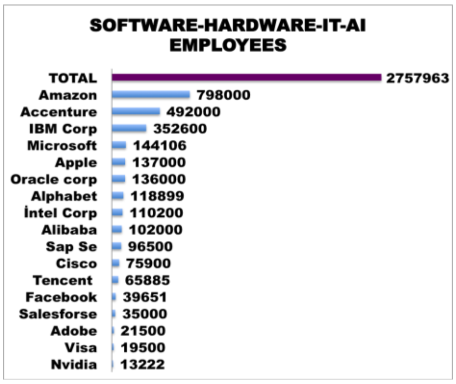

Fig.5. Companies in the field of software, hardware, IT and AI produced from resource data and the total number of employees [5-6].

Communication technology companies are highly qualified for the development of countries. While very few of these companies produce communication technology, many of them provide service in the service sector. For this reason, the number of employees of manufacturing companies is very low. In the graphic in Fig.6, the total employees of the selected companies are around 1.955.000. We can consider all of these employees as technicians or we can consider them all in the field of R&D and production. All of these assumptions would be partially true. However, it is not easy to proportionally distinguish real R&D employees from those in other fields. The reason is that companies avoid providing very specific information. However, if the general characteristic of technology companies is that it is necessary to consider 5-6% highly qualified project manager employees, 117.180 people are needed for highly qualified human resources. In some companies, this rate goes up to 15-26%. However, in these companies, it is seen in highly qualified R&D and extraordinary new technology generating companies, which generally have less than 10,000 employees. For example, 26% of the total 4972 employees at Google are scientists and the others are researchers [12] and 15% of the employees at Huawei [13]. For this reason, the qualified human resources in selected industries here can be averaged as 10% of R&D employees.

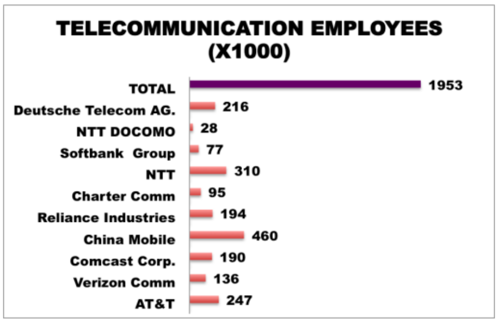

Fig.6. The number of companies and employees in the field of communication can be seen. Graph is produced from source data [5-6].

In order for the countries to be independent and sustain their independence, the organizations in the aviation-defense fields as a strategic sector come to mind primarily or the companies that produce public or private sector defense technology that countries have. In this field, the technology of countries in the field of defense varies depending on the production and the qualifications of the employee. The dream of every independent country is to have high technology and a sufficient level of defense power to be a deterrent and to dry their interests as a soft power without using hot conflict. The most valid situation for this is to have an adequate qualified defense and aviation sector. What makes the aviation and defense sector truly qualified is primarily the production made with qualified human resources. Qualified human resources are very important for all areas of the real economy and industry. However, this situation is of vital importance for the sectors with strategic characteristics.

For example, by applying a newly produced sensor and chip to many different areas of the industry, they provide products that add great added value by leading the development of other sectors. More importantly, these companies contribute greatly to the collective development of the country, increase in income level and decrease in unemployment. Apart from this, the other important result is that they give strategic power to the countries they are located in, as the production of new technologies makes a great contribution to the formation of qualified and trained human resources. In addition, these technological companies increase the welfare of the people in the military and economic terms of the countries they are located in, and make their situation in the world a leader in terms of soft power. The main ones are the USA, Russia, China, Canada, France, England, Germany, Japan and South Korea, and recently they can be added to China.

In technology companies, the ratio of scientists and researchers working in the R&D department according to the type of technology produced is usually 1/15, while in technology companies that produce new products, this rate is 26% scientists and other employees are researchers. So all of them are qualified human resources. The rate of scientists and researchers in the smartphone R&D of Huwai reaches up to 26% [12] and 48% [13]. Again, in semiconductor companies, almost all of them are qualified human resources, especially in areas such as R&D and testing and quality. According to the information obtained from open databases, the number of employees in this sector is calculated as 1.937.000. The ratio of 6% of the total R&D employees in the sector should be around 129,130. We consider that qualified human resources in total of these organizations are between 150.000-200.000. Another feature of these companies is that some of them have markets between 10-80% of the market in their fields. In these, Intel is the major producers of microprocessor and WiFi chip production, Qualcomm smartphone processor production, Microsoft in many products, Apple own operating system and Android operating system in many software. These products are also qualified technological products.

The number of personnel working in the field of technology is 3,724,000. However, the staff here also pass in other areas. We think the actual number of employees is less. If the number of employees in electronics is subtracted from this numerical value, it is understood that the actual number of employees is 1,783,000. Again, if an average of 6% of the employees work for R&D, 106,980 personnel work in R&D in other fields. The total staff in this department should be superior to others. We accept these numerical values as subbase. In real high technology companies, the number of highly qualified human resources varies between at least 10% and 26%. In any case, we consider the personnel working in these companies as qualified personnel. Only those in the scientist or research group may differ from others in terms of their work. Consequently, it represents human resources within the scope of critical population size.

Selected sectors are from 12 sectors and 151 companies, including semiconductor, computer IT-AI-hardware-software, electronics, technology, aviation-defense, healthcare, medicine, banking, automobile, healthcare, nuclear-energy-oil-gas, food and beverage production. consists of. However, as many companies operate in more than one sector, the actual number of companies was found to be 121. The relations and partnerships of these companies with other companies according to open sources are not taken into consideration. The total number of employees is 21,567,000. However, 91 companies affecting our technology world and a total of 13.264.000 personnel work in these technology companies. According to open sources, although there are 6-25% employees in the R&D department of technology companies, this rate exceeds 55% for some companies. The R&D employee average employs a total of 1.989.000 employees for 15.5%, 795.840 employees for the lower limit value of 6%, and 172.432 scientists for the minimum limit of 1.3%. As the technology level increases, the number of scientist employees increases proportionally. The stock market value of selected companies is more than $ 43 trillion compared to January 1, 2020. In other words, it is more than half of today's gross national product of the world.

III. RANKING ACADEMIC AND NON-ACADEMY BY SCIENCE FIELDS

Analyzes of academic and non-academic ranking data of organizations in the world were made. According to these data, priority industrial sectors/areas and their relationship with human resources have been investigated for the development of a country. The main purpose of this research is to determine the priority sectors for the development of third world countries and to answer the question of how to develop as a whole or collectively. For this, first of all, the data of all institutions and organizations that train qualified human resources were analyzed. While doing this analysis, measurability was taken as the basic measure. Therefore, the information of different databases has been used. These databases have been used from different databases such as Natureindex, ARWU-Shangaiuniversity ranking, CWUR (Center for World University Rankings, org), Value-today and Statista, OECD and EU-Statistics [14-19]. Information was collected by making use of the fact that some of these databases were open periodically. The data were obtained between 15-May-15 June-2020.

3.1. SUCCESS RANKING IN THE FIELD OF SCIENCE

CWUR (Center for World University Rankings, org) ranks the academic achievement of universities in the world [14-15]. According to CWUR sources, the number of universities in the world is more than 20,000. However, most of the time, only 2000 of them are included in the university rankings. The other 18,000 universities are either not included in the ranking or deemed worthless for various reasons. Whatever the outcome, higher education has now become a different sector of commerce. For this, it is either traded by selling services or by selling books and laboratory materials to be used in education.

CWUR ranked the science area in 2017 by conducting 227 field searches in the database Thomson Reuters and Journal Citation Reports (JCR) [16]. In this study, the first 10 universities for each field were taken and their countries were determined. According to the field of science research, a total of 2042 universities in 2017 consist of field units. The proportional distribution according to the prominent countries among these is USA: 46.22% - CHN: 13.12% - UK: 10.57% - CAN: 4.55% - NLD: 4.21% - AUS: 2.29% -SGP: 2.10%-FRA: 1.76% -JPN: 1.66%-CHE: 1.56%. Of these, USA + CHN + UK + NLD = 74.09%. In other words, 74.09% of world science is produced by only 4 countries. According to more than 200 countries that are members of the United Nations, only 2% of the world countries produce 74.09% of world science, while the remaining 98% world countries or 196 countries produce 26% of the world science. For this reason, it is clear why countries develop and develop. While some countries invest in human resources, it is seen that some countries do not openly or are busy setting the day. On behalf of this, it is possible to consider it as an unbalanced science / development distribution. As a result, the world domination of these 4 countries also gives the answer to the question of why they differ from other 196 countries. In addition, these 4 countries show and feel the softpower effect among other countries in the world.

According to the information obtained from the CWUR-2017 assessment, 2042 university units in total were identified in Fig.7. The distribution of these by country is shown in Fig.7. This distribution is also striking, about half of these fields of science belong to the USA. The total of USA+CAN is more than 50% of the total science area. This situation draws attention.

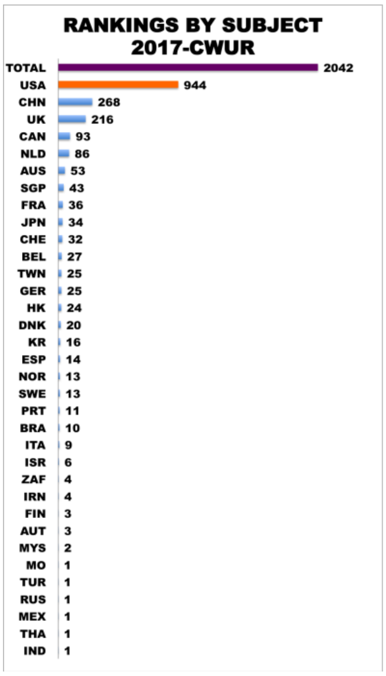

Fig.7. The distribution of world universities according to countries made according to 227 scientific fields is given. Only 34 countries in the world could enter this ranking. It is possible to evaluate effective education in 34 countries according to the fields of science. The proportional values of the distribution according to some countries; USA: 46.229% - CHN: 13.124%, UK: 10.54% - NLD: 4.19% - JPN: 1.66% and GER: 1.22% [14].

In Fig.8, the regional distribution of world science is given. It is distributed proportionally to North America 51.322%, Europe 25.367% and Asia and other countries 23.310%. Accordingly, 4,617% of the world population produces more than half of the science produced in the world, such as 51,322%. This is the importance of well-trained human resources. If you invest in science and people, there is no reason not to be a leader in the world.

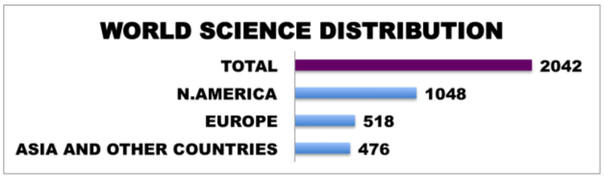

Fig.8. Intercontinental distribution generated from data in the CWUR-2017 ranking. Distribution: N. America: 51,322%, Europe: 25,367% Asia and other countries: 23,310%

In Fig.9, the dispersion of science in European countries is seen. Among the 17 countries of Europe, UK ranks first with 41,698% and NLD is ranked second with 16.98%. Among these, two countries draw attention. These countries are Israel and Russia. The situation in Israel with a very small population is 6 times better than the situation in Russia. We consider this to be a very important area worth exploring its reasons and reasons.

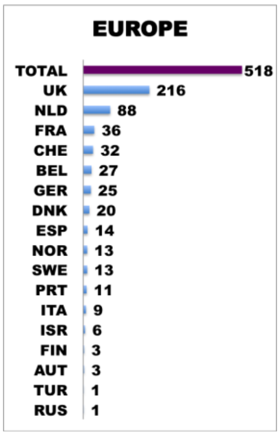

Fig.9. The distribution of the number of science fields in European countries produced from CWUR-2017 data is seen.

In Fig.10, the number of science fields according to countries in North America can be seen. Here too, USA is clearly ahead. The other important country seems to be CAN. The influence of other Brazil and Mexico is very low. This situation also shows the investment made by these countries in human resources. These indicators are not just simple distributions. It is also an indirect indicator of its development.

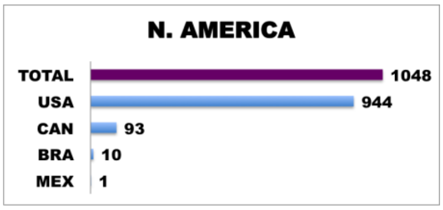

Fig.10. Distribution of science in North America, produced from CWUR-2017 data, by country.

In Fig.11, the distribution according to Asia and other parts of the world is given. There are only 13 countries within this distribution. Among these countries, China ranks first with a proportional value of 56,302%. The proportional value of China and the countries around it in the total corresponds to 86.34%. Another meaning of this is that a new development zone is forming in Asia with a focus on China in the world. What should it be called? The development regions in the world are USA and its surroundings and Europe. The third is China-based Asia. In the future, if our world appears as three poles and if it effectively spreads to three regions in development, many political and economic balances will change.

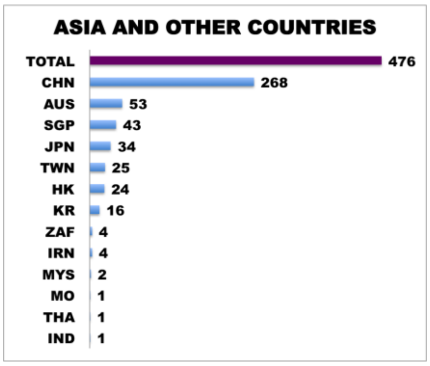

Fig.11. Contribution of Asia and 13 other countries to science, reproduced from CWUR-2017 data

In Fig.12, the countries of 80 universities in computer science are given as a result of the CWUR-2017 research. The number of these countries is 14. In this study, Switzerland, Honkong, Taiwan, Singapore, and Israel especially draw attention with their small geography and population. These countries are very small geographically. Many of the other same-scale countries in the world are not even names known.

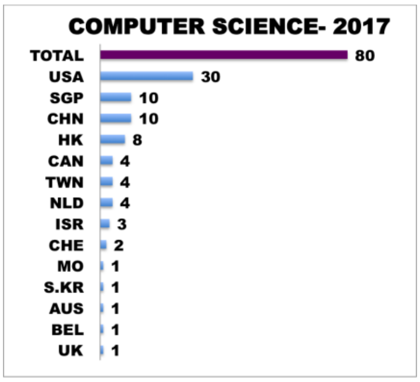

Fig.12. Source: The distribution of computer science produced from the data of the CWUR-2017 research by country can be seen.

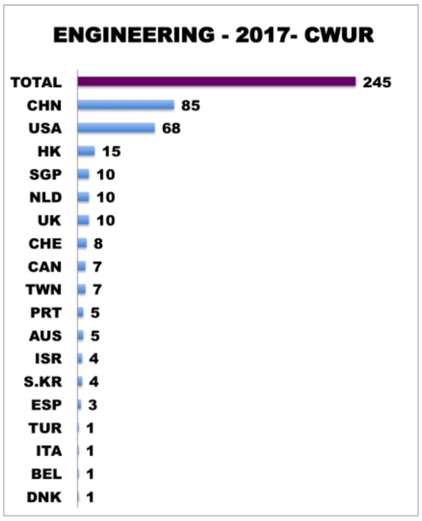

Fig.13. The distribution of 245 engineering in 22 fields in universities produced from the results of the CWUR-2017 research can be seen. 18 countries are included in this ranking.

In Fig.14, the distribution of universities in the CWUR-2020 study by countries providing education in 22 engineering fields can be seen. situations

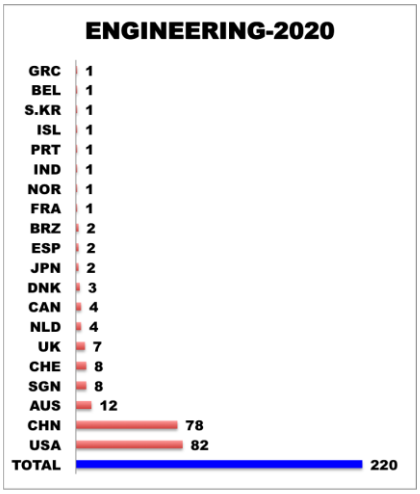

Fig.14. The distribution of 22 engineering fields in universities produced from the research results for CWUR-2020 can be seen. 20 countries are included in the list here.

Another area that needs to be investigated is that China is seen to be investing heavily in engineering. Although China is very weak in natural sciences, it is very close to the USA in engineering fields. It is seen that it is more effective in engineering field than European countries combined. In Europe, especially CHE-8, NLD-4 top universities are quite high compared to their population. Another interesting country is that it is SNG-8. CHE-NLD-SNG draws much attention to the population and geographical size of the three countries.

In Fig.15, USA: 86 and CHN: 78 are in good condition in the field, compared to the ones produced according to ARWU-2019-2020 results. Ignoring the development or science in many areas of China, it has chosen engineering as its priority area. For China, this may be a strategic decision, or it can be a strategic priority choice for development. Engineering areas where China is better than USA; It is ahead of USA in fields of measurement science (8), communications (7), biomedical (5), food (5), transportation (5), ocean science (6), mining (6) and metallurgy (5). China must have both trained human resources and given great encouragement and support in the formation of industrial organizations in these engineering fields that they have chosen, so that they have reached this state. Otherwise, they cannot be ahead in other ways. The other third is Australia (12), CHE (8) and Singapore (8). Considering the population, how can CHE and Singapore rank even though they are small? This situation should be seriously investigated. There are countries that are very large in terms of population, but they cannot be included in this list, but these two small countries do. In addition, we think that there are products with a very high competitive coefficient in export products in these countries.

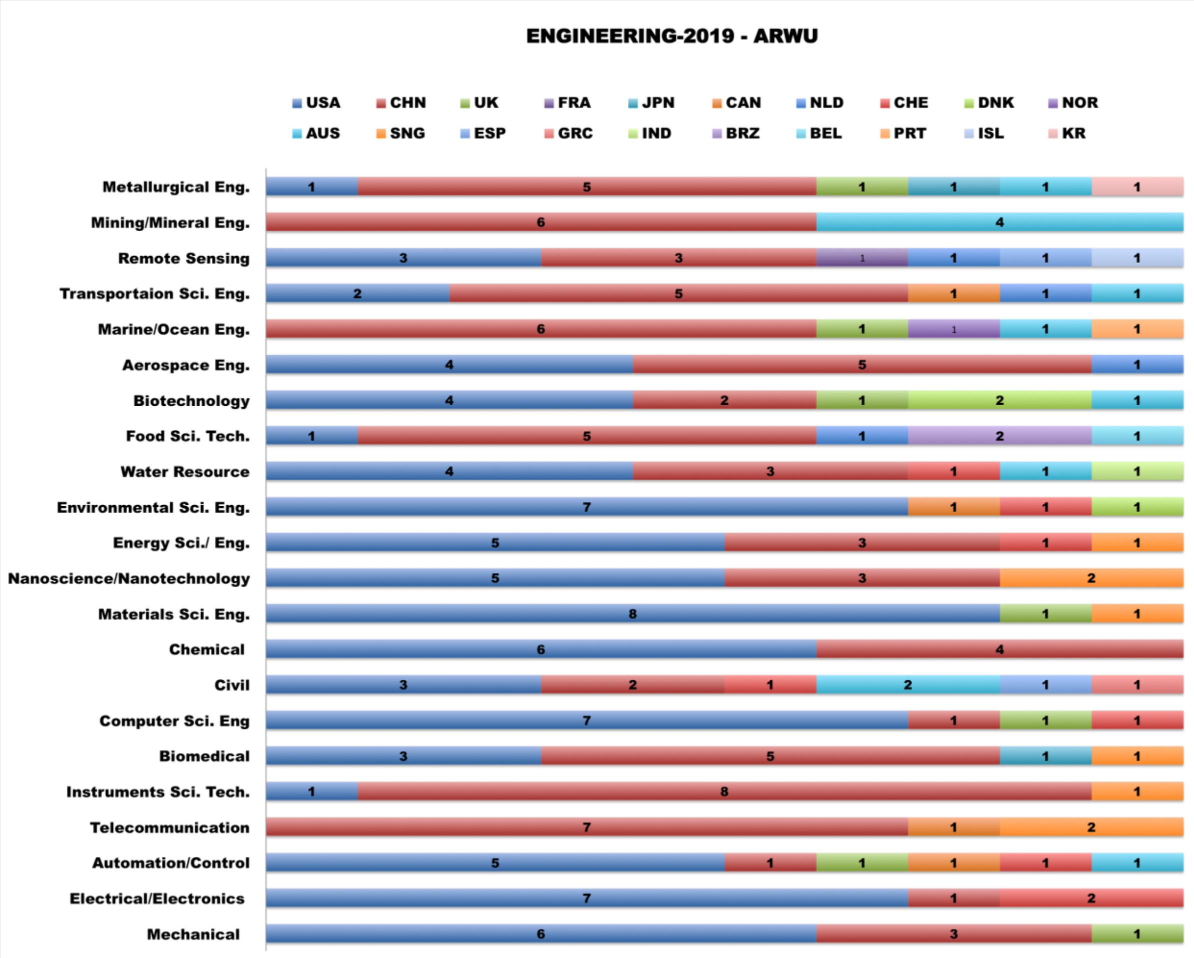

Fig.15. Distribution of 22 engineering fields of universities produced from ARWU-2019-2020 data by countries [17].

Table.3. Distribution of engineering areas

SCIENCE	ENGINEERING																				
	COUNTRIES																				
	USA	CHN	UK	FRA	JPN	CAN	NLD	CHE	DNK	NOR	AUS	SNG	ESP	GRC	IND	BRZ	BEL	PRT	ISL	KR	TOTAL
Mechanical	6	3	1																		10
Electrical/Electronics	7	1						2													10
Automation/Control	5	1	1			1		1			1										10
Telecommunication		7				1						2									10
Instruments Sci. Tech.	1	8										1									10
Biomedical	3	5			1							1									10
Computer Sci. Eng	7	1	1					1													10
Civil	3	2						1			2		1	1							10
Chemical	6	4																			10
Materials Sci. Eng.	8		1									1									10
Nanoscience/Nanotechnology	5	3										2									10
Energy Sci./ Eng.	5	3						1				1									10
Environmental Sci. Eng.	7					1		1	1												10
Water Resource	4	3						1			1				1						10
Food Sci. Tech.	1	5					1									2	1				10
Biotechnology	4	2	1						2		1										10
Aerospace Eng.	4	5					1														10
Marine/Ocean Eng.		6	1							1	1							1			10
Transportaion Sci. Eng.	2	5				1	1				1										10
Remote Sensing	3	3		1			1						1						1		10
Mining/Mineral Eng.		6									4										10
Metallurgical Eng.	1	5	1		1						1									1	10
TOTAL	86	78	7	1	2	4	4	8	3	1	12	8	2	1	1	2	1	1	1	1	220

The distribution of 22 engineering fields produced from the data of the top 10 universities produced in ARWU-2019-2020 by country is seen [17].

According to computer science-2017, if China and Hong-Kong are valued together, it corresponds to 50% of the USA. We think that it would not be wrong to evaluate that they are in a very good condition if evaluated in proportion to other CAN, TWN, NLD and Israeli populations. We think it is interesting that small countries are ranked in terms of population and geography.

In Fig.16, the distribution by country in the field of ARWU-2019-2020 engineering is given. Only 18 countries entered the ARWU-2019-2020 ranking. Intensively, the countries in the first 6 correspond to 89% of the total. Another meaning of this is the countries that lead the studies in the field of engineering. These countries are also leading countries in new inventions and products.

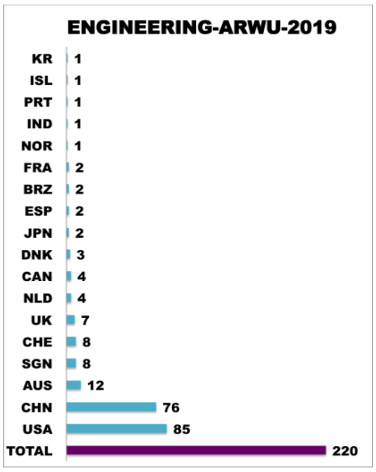

Fig.16. Ranking of top 10 engineering countries reproduced from ARWU-2019-2020 data

3.2. SUCCESS STATUS ACCORDING TO NATURE INDEXS 2019-2020

The data of the studies in this section were taken from the source "Nature Index-2020 Annual Tables, Vol: 580 N0: 7805-2020" [18] and produced. In the resource, a general classification is made in the fields of global, government, All and corporate and NPO / NGO. In this study, these data were processed.

In Table 4, only the institutions-organizations ranking in the first 20 are given. Considering all academic and non-academic centers in the country, the top 20 institutions were included. Among these institutions, all universities, research centers, R&D and similar institutions established by the private sector, and all R&D and human resources formed by non-profit foundations or similar organizations in the country. “Https://www.natureindex.com/annual-tables/ 2020 / institution / all / all” address.

The general ranking in all fields is given in Table.4.2019-2020 [18].

2020 TABLE / INSTITUTIONS: TABLE CRITERIA: GLOBAL / ALL / ALL								
	INSTITUTIONS / COUNTRIES	USA	CHN	GER	FRA	UK	JPN	CHE
1	Chinese Academy of Sciences (CAS)		1					
2	Harvard University	1						
3	Max Planck Society			1				
4	French National Centre for Scientific Research (CNRS)				1			
5	Stanford University	1						
6	Massachusetts Institute of Technology (MIT)	1						
7	Helmholtz Association of German Research Centres			1				
8	University of Science and Technology of China (USTC)		1					
9	University of Oxford					1		
10	Peking University (PKU)		1					
11	The University of Tokyo (UTokyo)						1	
12	Tsinghua University		1					
13	Nanjing University (NJU)		1					
14	University of Cambridge					1		
15	University of Chinese Academy of Sciences (UCAS)		1					
16	Swiss Federal Institute of Technology Zurich (ETH Zurich)							1
17	National Institutes of Health (NIH)	1						
18	University of California, Berkeley (UC Berkeley)	1						
19	University of Michigan (U-M)	1						
20	University of California, San Diego (UC San Diego)	1						
	TOTAL	7	6	2	1	2	1	1

According to these data, there is no clear difference between USA and CHN in terms of institutional structure. This does not mean too small. There is a clear difference between USA and CHN's others. There are only 7 countries in this ranking, USA, CHN, GER, FRA, JPN, UK and CHE. 13/20 of them are owned by USA and CHN. The most important of all is Switzerland. It is a big surprise if the evaluation is made in proportion to the CHE population. Because we think that achieving such a high level of success with such a small population is an area that needs to be researched. We consider the reasons for this success worthy of investigation.

The rankings of 500 academic institutions are given in this data source. Table.5 shows only those in the top 20.

Table.5. 2019-2020 academic rankings.

2020 TABLE / INSTITUTIONS: TABLE CRITERIA: GLOBAL / ACADEMIC / ALL						
	INSTUTIONS / COUNTRIES	USA	CHN	UK	JPN	CHE
1	Harvard University	1				
2	Stanford University	1				
3	Massachusetts Institute of Technology (MIT)	1				
4	University of Science and Technology of China (USTC)		1			
5	University of Oxford			1		
6	Peking University (PKU)		1			
7	The University of Tokyo (UTokyo)				1	
8	Tsinghua University		1			
9	Nanjing University (NJU)		1			
10	University of Cambridge			1		
11	University of Chinese Academy of Sciences (UCAS)		1			
12	Swiss Federal Institute of Technology Zurich (ETH Zurich)					1
13	University of California, Berkeley (UC Berkeley)	1				
14	University of Michigan (U-M)	1				
15	University of California, San Diego (UC San Diego)	1				
16	Yale University	1				
17	University of California, Los Angeles (UCLA)	1				
18	Zhejiang University (ZJU)		1			
19	Cornell University	1				
20	Northwestern University (NU)	1				
	TOTAL	**10**	**6**	**2**	**1**	**1**

In the ranking system in Table.6, there are only academic institutions or universities. Other institutions and organizations are excluded from the assessment. According to this evaluation criteria, USA and CHN are the first and the second. USA is 40% more than China as a university. However, these two countries have 16/20 of the total universities. Approximately 80% of the total is from two countries. The world trade and technology production of these two countries cannot be coincidence.

Table.6. 2019-2020 academic ranking in Chemistry

2020 TABLE / INSTITUTIONS : TABLE CRITERIA : GLOBAL / ACADEMIC / CHEMISTRY						
	INSTITUTIONS / COUNTRIES	CHN	USA	CHE	JPN	SGP
1	University of Science and Technology of China (USTC)	1				
2	Nanjing University (NJU)	1				
3	University of Chinese Academy of Sciences (UCAS)	1				
4	Tsinghua University	1				
5	Peking University (PKU)	1				
6	Nankai University (NKU)	1				
7	Sichuan University (SC)	1				
8	Zhejiang University (ZJU)	1				
9	Soochow University	1				
10	Stanford University		1			
11	Northwestern University (NU)		1			
12	The University of Tokyo (UTokyo)		1			
13	Massachusetts Institute of Technology (MIT)	1				
14	Xiamen University (XMU)	1				
15	Swiss Federal Institute of Technology Lausanne (EPFL)			1		
16	Swiss Federal Institute of Technology Zurich (ETH Zuric)			1		
17	Kyoto University				1	
18	Sun Yat-sen University (SYSU)	1				
19	Fudan University	1				
20	Nanyang Technological University (NTU)					1
	TOTAL	**13**	**3**	**2**	**1**	**1**

In Table.6, the ranking of top 20 organizations in the field of chemistry is given. In the field of chemistry, China has 13/20 or 65% overwhelming weight. China has attached special importance to the field of chemistry, placing strategic emphasis on training human resources. In practice, this situation is intended to meet the industrial application or the human resource needs in the industry. Chemistry seems to be an industrial sector with special meaning for China. China should be expected to become a leader in the chemical industry in the coming years. We think it is necessary to examine chemical industry products or innovations in this field and to determine the characteristics of the products in China's exports. In Fig.17, the distribution of science by country is given.

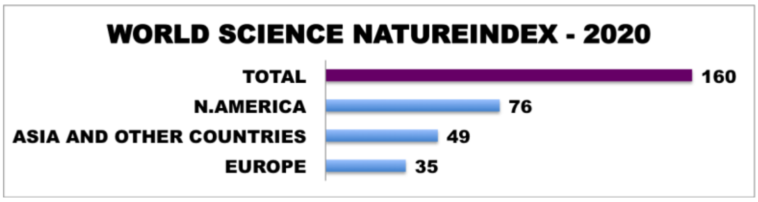

Fig.17 distribution of science according to continents: N. Amarica: 47,00% Asia and other countries: 30,625% and Europe: 21,875.

Table.7. The rate of change in the top 100 institutions of the countries between 2017-2020 [18-19].

	COUNTRIES																	
	USA	UK	CHN	CAN	JPN	CHE	S.KR	GER	NZL	FRA	ESP	IND	ITA	RUS	BEL	AUT	CZE	%
2017	58	6	4	2	5	3	1	5	1	4	3	2	3	1	1	1	-	100
2020	54	6	10	-	5	4	2	4	1	4	2	2	3	1	1	-	1	100
Δ	-4	0	+6	-2	0	+1	+1	-1	0	0	-1	0	0	0	0	-1	+1	
Δ %	-7,4	0	+150		0	+33,3	+100	-20			-33,3							

According to the evaluation in Table.7, while USA and European countries GER and ESP decreased by -7.4%, S.KR + 100%, CHN + 150% or total 6%. In total, countries outside the USA and Europe grew by 13%. For this reason, if Asia and other countries grow at this speed, which they took in 4 years, the difference between them will close in 14 years and in 15 years or 2035 Asia will take the lead with at least + 1% growth. In this case, the world becomes a three-centered technology production center. The strategic aspect of this is that our world turns into three poles. These are USA centered north America, Germany centered Europe and China-India based Asia. It should be noted that all kinds of policies of South Korea and Japan in Asia are in line with the USA. Considering that of the world population lives in Asia and neighboring continents, our world after 2035 will be very colorful.

IV. CONCLUSION AND EVALUATION

In this study, the top 10, 20 30 companies of some sectors we selected around the world were evaluated. The reason for the acquisition of these companies is that they have both market dominances in free market conditions and companies that produce technology in their fields. Therefore, the relationship of human resources with sectors has been investigated. The most prominent and formal training of human resources is primarily from universities, institutes and R&D centers, which are institutional institutions. In order to train the most effective human resources, the first stage starts with universities and then institutes where graduate and doctorate degrees are held. For this reason, we think that these institutions and organizations are very important for raising human resources, shaping young generations, and providing young people with science, research skills and philosophy. For this, it was ensured that the relationship between the training of human resources in countries and the success of the companies was established by cross-examining the CWUR-2017 science fields and Natureindex, CWUR, ARWU evaluation ranking organizations and giving the results in them. Within this, it has been determined that critical population sizes are the basis of the real reasons for the success of the leading countries. Technological, innovative and countries in the world have all been found to be leaders in certain fields of science and technology. For Natureindex 2019-2020, only 19 countries out of 100 were ranked in the evaluation of all fields. Among these, the USA comes with 48%, China with 13% and Japan with 9%. The total of these three countries corresponds to 70% of the total. In other words, we think that it would not be wrong to evaluate that the market effect of these three countries as world trade in selected sectors is 70%. The reasons for their leadership are based on their strategic critical scale human resources and critical technological production.

The ranking of ARWU in 2019 and 2020 in the field of engineering can be seen. The locations of this ranking may vary, but it does not change much across countries. In 2019, 18 countries ranked in 22 fields of engineering and 20 countries in 2020. These countries are in this situation because they have resources of critical scale. The most important of these is the population size at critical scale. If you do not have scientists, especially in your universities, it means that you do not have human resources. If you do not have human resources, it means that the industry does not exist. According to the ARWU-2019 evaluation, USA: 85 and CHN: 76 universities ranked in 22 areas, while CHN: 86 and USA: 76 decreased in the ARWU-2020 period. It is seen that China accepts engineering as a strategic sector that gives special importance to engineering field. This may be a development model or a strategic choice for China.

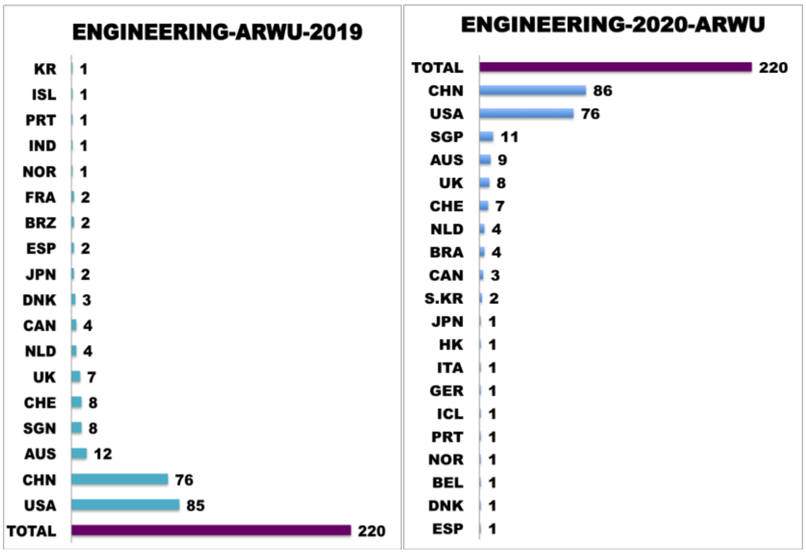

Fig.18. According to the ARWU-2019 and 2020 ranking, the total distribution of the top 10 universities in 22 engineering fields by country is seen.

In this study, China's deficiency in the field of Semiconductor stands out, which is the most problematic area. In this, it is stated in open sources that SMIC (Semiconductor Manufacturing International Corporation), which is a Chinese semiconductor company, is very exclusively supported by the Chinese government. According to open media sources, SMIC has transferred more than 150 scientists and expert engineers from Taiwan and some other countries. He will see the results of this as a positive effect on the economy in the coming years. Thus, the US embargo on China will be neutralized.

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