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INSTITUTE of SOCIAL SCIENCE

DEPARTMENT OF BUSINESS ADMINISTRATION

INTERNATIONAL BUSINESS MANAGEMENT

MASTER'S PROGRAM

**ANALYSIS OF DEFENSE INDUSTRY COMPETENCE OF
UNIVERSITIES: THE CASE OF TÜRKİYE**

MASTER'S THESIS

PREPARED by

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ANKARA-2024

THESIS ACCEPTANCE AND APPROVAL

This study titled "Analysis of Defense Industry Competence of Universities: Türkiye Case Study" prepared by Harun ERGEN has been accepted as a Master's Thesis by our jury as a result of the defense exam held on 10/07/2024.

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Harun ERGEN

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ÖZ

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ÜNİVERSİTELERİN SAVUNMA SANAYİ YETKİNLİĞİNİN ANALİZİ: TÜRKİYE ÖRNEKLEMİ

Savunma sanayi, bilim ve teknolojinin en yoğun kullanıldığı alanlardan biri olup, teknolojik gelişmelerin savaş ve çatışma alanlarına yansımaları açısından büyük öneme sahiptir. Savunma sanayinin gelişiminde ülkelerin bilimsel altyapıları ve dolayısıyla üniversiteler önemli yere sahiptir. Bu çalışma, Türk üniversitelerinin savunma sanayii yetkinliklerini tespit etmek amacıyla gerçekleştirilmiştir. Bu kapsamda üniversitelerin ilgili alanlardaki yayın sayıları analizde temel veri olarak kullanılmıştır. Yayınların uluslararası ve üst düzeyde nitelikli olmaları arzu edildiğinden, çalışmada WoS (Web of Science) veri tabanında yer alanlara yer verilmiştir. Çalışma Türkiye’de faaliyet gösteren 209 üniversite ve yüksek öğretim kurumunu kapsamaktadır.

Çalışma, Savunma Sanayi Başkanlığı Savunma Sanayi Teknoloji Taksonomisi 2.0 (SSTT 2.0)’dan istifade edilerek yapılmıştır. SSTT 2.0’da yer alan 35 kırılım ve 375 tanım ile WoS’ta taranan makaleler anahtar kelimeler üzerinden alanında uzman on üç savunma sanayi mühendisi tarafından eşleştirilmiştir. Bu kapsamda, 305.566 makale tespit edilmiş, çalışmaya mühendislik ve fen Bilimleri alanında yer alan 30 kırılım, 314 tanım/anahtar kelime ve 267.854 makale ile devam edilmiştir. Tanım/anahtar kelime olarak bir kez yer alan yayınlar, tesadüfi olarak değerlendirilerek, 264.803 makale ile çalışmaya devam edilmiştir. Elde edilen veriler dağılım grafikleri ile analiz edilerek, üniversitelerin taksonomi alanlarındaki yetkinlikleri ortaya konulmuştur.

Araştırma sonucunda Türkiye’de faaliyet gösteren üniversitelerden, sırasıyla İTÜ ve ODTÜ’nün savunma sanayinde yayın kapsamında en yetkin iki üniversite olduğu tespit edilmiştir. Bu iki üniversitenin savunma sanayi kırılım ve tanımlarında %13,81 düzeyinde katkı sağladığı

görülmüştür. Ayrıca bu iki üniversite dışında 15 üniversitenin toplam 41 kırılda yayın yetkinliğı olduğı deęerlendirilmiştir.

Çalışmanın ikinci safhasında en yetkin iki üniversite uç deęerler olmaları kapsamında çalışma dışında bırakılmıştır. Sonuçta, İTÜ ve ODTÜ dışında 28 üniversitenin toplam 162 kırılda üst düzey yayın yetkinliğine sahip olduğı tespit edilmiştir.

Sonuç olarak Üniversite-Sanayi İş birliğı bağlamında Savunma Sanayi Başkanlığı'na ve üniversitelere, farkında oldukları veya olmadıkları yetkinlik düzeyleri ortaya konmuştur. Çalışmada üniversitelere, şirketlere, SSB'ye ve YÖK'e çeşitli önerilerde bulunulmuştur.

Anahtar Sözcükler: Savunma Sanayi, Üniversite Sanayi iş birliğı, yetkinlik, üniversite yetkinliğı,



ABSTRACT

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ANALYSIS OF DEFENSE INDUSTRY COMPETENCE OF UNIVERSITIES: TURKİYE SAMPLE

The defense industry is one of the fields where science and technology are used most intensively, and it is of great importance in terms of the reflection of technological developments on war and conflict areas. Scientific infrastructures of countries and therefore universities have an important place in the development of the defense industry. This study was conducted to determine the defense industry competencies of Turkish universities. In this context, the number of publications of universities in related fields was used as the basic data in the analysis. Since it is desirable for the publications to be international and of high quality, those included in the WoS (Web of Science) database were included in the study. The study covers 209 universities and higher education institutions operating in Türkiye.

The study was conducted by making use of the Presidency of Defense Industry Defense Industry Technology Taxonomy 2.0 (SSTT 2.0). Thirteen defense industry engineers, who are experts in their fields, matched the 35 categories and 375 definitions in SSTT 2.0 with the articles scanned in WoS based on keywords. In this context, 305,566 articles were identified, and the study continued with 30 categories, 314 definitions/keywords and 267,854 articles in the fields of engineering and science. Publications with one definition/keyword were evaluated randomly and the study was continued with 264,803 articles. The data obtained were analyzed with scatter plots and the competencies of universities in taxonomy areas were revealed.

As a result of the research, it was determined that ITU and METU are the two most competent universities in terms of publications in the defense industry. It was observed that these two universities contributed 13.81% in the breakdown and definitions of the defense industry. In

addition, it was evaluated that 15 universities other than these two universities have publication competence in a total of 41 categories.

In the second phase of the study, the two most competent universities were excluded from the study as they were outliers. As a result, it was determined that 28 universities, excluding ITU and METU, had high level publication competence in a total of 162 categories.

As a result, the competency levels that the Presidency of Defense Industry and universities are aware of or not aware of in the context of University-Industry Cooperation have been revealed. In the study, various recommendations were made to universities, companies, SSB and YÖK.

Keywords: Defense Industry, university-industry cooperation, competence, university competence,



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SYMBOLS and ABBREVIATIONS

ARWU	Shanghai Ranking
BC	Before Christ
BUU	Bursa Uludağ University
CWUR	Center for World University Rankings
IRDAC	European Union Research Directorate
ISO	Istanbul Chamber of Industry
ITU	Istanbul Technical University
KATU	Karadeniz Technical University
METU	Middle East Technical University
MKEK	Mechanical and Chemical Industry Corporation
NATO	North Atlantic Treaty Organization
NIM	National Innovation Model
NIS	National Innovation Systems
NUD-36	Training Aircraft Produced by Nuri Demirdağ Factory
NUD-38	6 Passenger Airplane Produced by Nuri Demirdag Factory
OSB	Organized Industrial Zones
PhD	Doctoral degree
QS	Quacquarelli Symonds
R&D	Research and Development
RUR	Round University Rankings
SSB	Undersecretariat for Defense Industries
SSTT 2.0	Defense Industry Technology Taxonomy 2.0
TSK	Turkish Armed Forces
THE	Times Higher Education Rankings

TOMTAS	Plane and Motor Corporation
TTO	Technology Transfer Offices
TUBITAK	Scientific and Technological Research Council of Turkiye
USI	University-Industry Cooperation
URAP	University Rankings by Academic Performance
USA	United States
WoS	Web Of Science
YÖK	Council of Higher Education



PREFACE

The defense industry is one of the sectors that plays the most critical role in ensuring a country's independence and security. In today's world, where technological developments are advancing rapidly, having innovative and advanced technologies in the defense industry plays a vital role in countries gaining strategic superiority. Any scientific and technological progress in this field has a direct impact on war and conflict environments and strengthens national security. In this context, the proverb, "A horse is worth a horse, a sword is worth a sword" is very meaningful to emphasize the importance of knowledge and expertise in the defense industry. Being successful in the defense industry requires expertise and knowledge, just like riding a horse or wielding a sword.

This thesis aims to examine the contributions of Turkish universities to the defense industry in depth and to determine the level of these contributions. The study is based on the Defense Industry Technology Taxonomy 2.0 (SSTT 2.0) prepared by the Presidency of Defense Industry, and through this taxonomy, the contributions of universities' scientific publications and technology personnel to the defense industry were analyzed in detail.

In our study, using the Web of Science (WoS) database, publications were scanned over 30 categories and 314 definitions determined within the scope of the SSTT 2.0 taxonomy and the results were analyzed with scatter plots using keywords. As a result of these analyses, the competency levels of universities in defense industry taxonomy areas were revealed and the areas in which these competencies are concentrated were determined.

As a result of the research, it was determined that 17 universities in total published 85 publications in sufficient sub-fields in the second breakdown. In these results, it was observed that ITU and METU's publications were generally dominant. When the data of these two universities are excluded, it is determined that 28 universities have published in 162 5 sufficient sub-fields in the second breakdown. In this way, in the context of UIC, both the Presidency of Defense Industry and universities have been provided with data on the level of competence they are aware of or not aware of, in order to make future projects and agreements more qualified. As a result of the study, various recommendations were made to universities, companies, SSB and YÖK.

Scientific knowledge produced at universities not only enables knowledge sharing in academic circles, but also has the potential to make concrete contributions to industry. Academic studies in areas of strategic importance such as the defense industry increase the technological capacity of our country and increase its global competitiveness. In this context, the importance of university publications and research on the defense industry once again becomes apparent.

This study aims to contribute to the development of university-industry cooperation, to improve the quality of defense industry projects and to increase Turkiye's technological and strategic competencies. Understanding the status and potential of Turkish universities in this field will be an important guide in the planning and execution of defense industry projects. "I hope that this study will be instrumental in taking the right steps in areas that require expertise and knowledge in the defense industry.



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1. INTRODUCTION

While the concept of security is explained in the dictionary as "the execution of the legal order in social life without disruption, the state in which people can live without fear, safety" (Türk Dil Kurumu, 2023) is defined in the Cambridge Academic Content Dictionary online dictionary as "bad change that threatens freedoms" (Cambridge dictionary, 2023). According to Maslow's hierarchy of needs theory for individuals, the need for security comes after physical needs such as eating, drinking and sleeping. (Kula & Çakar, 2015).

The concept of security, which is indispensable for individuals, is categorized under five main headings. National security can be defined as the existence of the state, territorial integrity and the right to self-governance; social security can be defined as national unity and solidarity; economic security can be defined as all kinds of commercial, production and financial relations; individual security can be defined as the welfare and quality of life of individuals; environmental security can be defined as the minimum possible fear and anxiety against threats from other states, terrorist groups, other societies, individuals against the sustainability of the ecosystem. (Çelik, 2023).

During the hunter-gatherer period, while people met their physical needs in the natural environment, they gave up their freedoms in order to meet their security needs and created public authority. Public authority, on the other hand, gave rise to the concept of state. The state ensured the security of individuals in accordance with the social contract. With this idea, the state has been the main actor providing security. Ensuring the security of the state is one of the main duties of the society that constitutes the state. (Oğuzlu, 2007). The functions of contemporary states are: security, representation of the people and the promotion of welfare. (Milliken & Krause, 2002) One of the primary and permanent duties of the State is National Defense. It is the duty of the State to organize the armed forces and equip them with weapons and equipment for national defense. This duty is in the public interest. (Öztekin, 2015). If the state fails to fulfill this duty, it is to the detriment of the entire public, i.e. society and even individuals.

The creation of defense policies for the security of states is possible with the balance of power between states according to the theory of stability realism in international relations, with the bipolar international system according to the neorealist perspective, and with multipolar and interstate peace organizations according to liberalism. (Çelik, 2023)

Under these policies, the concept of war has always existed and will continue to exist. The first wars are generally believed to have taken place around 6500 BC in western Asia between agricultural societies and hunter-gatherers. (Archer, Ferris, Herwig, & Travers, 2020). According to Clausewitz, war is "an act of using force to force the enemy against our will". (Clausewitz, 1827). Societies and states have fought at every opportunity to force their enemies to their will. According to Sorokin's study, he identified 862 wars between 1100 and 1925 (Yalçinkaya, 2010). Still today, wars continue throughout the world despite inter-state organizations such as the United Nations.

Sun Tzu said, "War is a matter of life and death. It is the way to attain security or to perish. Therefore, it is unthinkable to neglect it". He emphasized the importance of victory without fighting. (Tzu, 2008). This requires a deterrent force.

Deterrence is etymologically derived from the Latin word "terror", to frighten, and "deterre", to frighten away. Deterrence is the use of fear to deter others from taking action and to force other states to act in a desired direction through the threat of the use of force. (Mehmetcik, 2015). For deterrence, the armed forces must be strong. The arms embargo imposed by the US on our country from the Cyprus Operation until 1978, the Leopard tanks that could not be used in the Southeast for terrorist incidents until the agreement signed with Germany in 2009, and the statement made by US Deputy Secretary of State Richard Holbrooke to former Greek Foreign Minister Teodoros Pangalos after the Kardak Rocks crisis with Greece in early 1996; "The Americans have locked the entire Aegean with electronic devices to ensure that rockets and bombs launched from the warships of both countries do not hit the targets so that there are no casualties on either side during the crisis" (Kırbakı, 2011) reveals the importance of having national technology and design in the defense industry and equipping the Turkish Armed Forces with nationally developed weapons, tools, equipment and equipment. (Yaslıkaya, 2019)

2. LITERATURE REVIEW

2.1 Defense Industry

2.1.1. Definition

The defense industry is a collection of private and publicly owned organizations and enterprises that design, develop and produce the tactical, strategic, defensive and offensive weapon systems required for the armed forces of a country, and that are constantly intertwined with other branches of industry and all areas of economic activity. (Özlü, 2006)

According to another definition, the defense industry consists of all industrial complexes around the world that have research, development, design and production capabilities to meet the military needs of the Ministry of National Defense, the government and the private sector, and to maintain military weapon systems, subsystems, components and parts. (Dod, Joint Publication1-02, 2010)

The defense industry consists of private or state-owned companies. These companies produce and maintain defense and offensive systems and equipment needed by troops in war and conflict areas. (Akgül, 1987)

The defense industry is a sector that constitutes the industrial business line in general in connection with the production of war equipment and the provision of services required for the defense of the country. (Baran, 2018)

The defense industry is an industrial entity that produces the basic elements of military power. The defense industry consists of producers that create value, employment and technology related to the defense of the country and all companies that provide all kinds of defense-related systems and equipment to the Ministry of Defense. (Sezgin & Sezgin, 2018)

The common point of the definitions deals with the production, development and maintenance of defense systems. In general, the development of the defense industry is based on defense systems. The point to be considered here is that many developments from engines to stationery support the defense industry (Hartley, 2007).

2.1.2. History of Defense Industry in Türkiye:

The defense industry in the Ottoman Empire dates back to the 15th century. The cannon and navy were produced with domestic means, the "Tophane-i Hümayun" formed the basis of the Imperial arms industry, and the capacity to cast 1060 cannons at a time and to produce 360 kg

of gunpowder per month was reached. In addition, the production capacity and technological level of warships were far ahead of European countries in this period. We understand the production capacity of the shipyards of the period from the fact that the navy, which was completely destroyed after the Battle of Inebahtı, was built in a short period of five months. (Savunma Sanayi Başkanlığı, 2023)

The Ottoman Empire could not fully understand the renaissance in Europe due to its good economy, strong armies and victorious wars. Although it tried to catch up with the technological developments that started with the Renaissance in the 18th century, it was too late. The rifling-set and tail-loading system, which was introduced in Europe in 1850, was introduced in the Ottoman Empire only in 1889. (Akalin, 2009). Our defense industry, which was inadequate compared to the technology in Western countries, completely lost its effectiveness during the First World War. During the War of Independence, small workshops were established for military production, maintenance and repair purposes with materials smuggled from Istanbul. In 1921, the General Directorate of Military Factories was established. (Savunma Sanayi Başkanlığı, 2023).

The defense industry was considered an important part of the total development and industrialization movement initiated in the Republican era. For this reason, it was tried to be developed by the state. The main investments of the national defense industry were made in this period despite financial impossibilities. State investments are shown in Figure 2

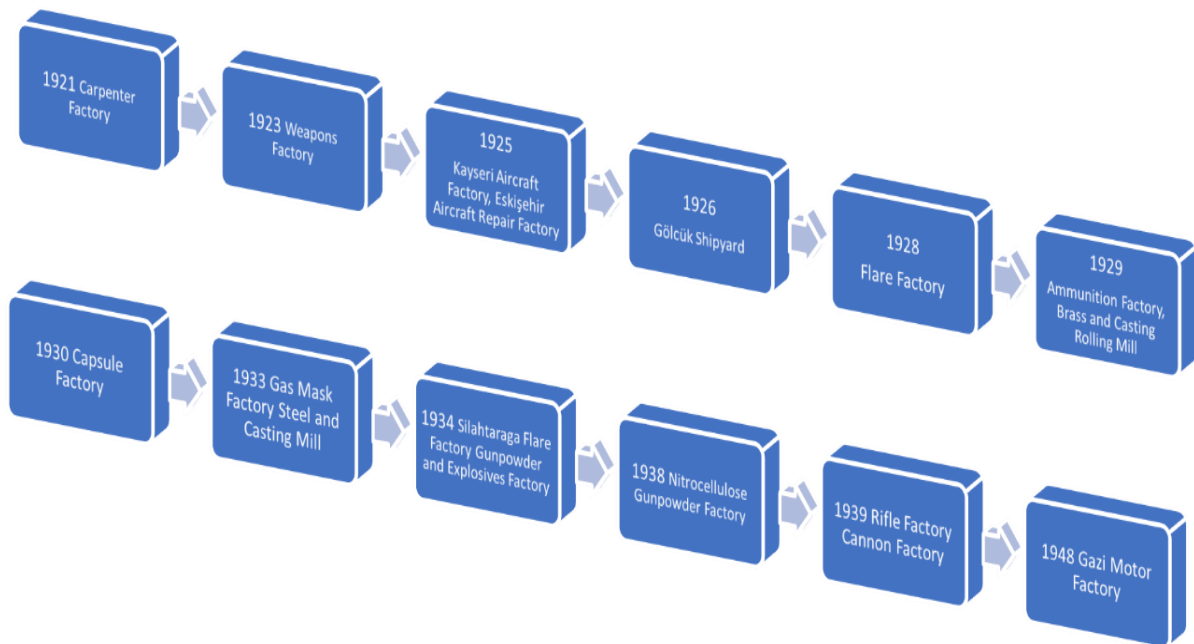


Figure 2.1. Timeline of Government Investments

In the same years, the private sector made defense industry investments. The first and largest of these was the Şakir Zümre Factory established in the Golden Horn in Istanbul. Turkish aviation industry activities started in 1926 with the establishment of Tayyare ve Motor Türk A.Ş. (TOMTAŞ) in partnership with the German Junkers company. (Akalin, 2009). The ammunition factory was established in 1927 and the rice factory in 1928. (Beriş & Yılmaz, 2013). In the 1930s, Nuri Killigil established the Pistol, Mortar and Ammunition Production Facilities in Istanbul, one of the first in the sector. In 1940, 24 NUD-36 training aircraft were manufactured by the Nuri Demirağ aircraft factory, and in 1944, NUD-38 six (6) passenger aircraft were produced. (Savunma Sanayi Başkanlığı, 2023). The factory started production in 1944. A large number of training aircraft, transport aircraft and gliders were produced. In 1945, the first aircraft engine factory was established. (Savunma Sanayi Başkanlığı, 2023). Although a national defense industry was targeted as part of the Republic of Türkiye's goal of full independence after the War of Independence and the above-mentioned organizations were established, TOMTAŞ was closed down within 1.5 years due to a dispute with the partners and the facilities started to operate under the name of Kayseri Tayyare Factory in 1932. Nuri Demirdağ Aircraft Company closed down in 1944 because it did not receive sufficient support from the State Airlines. (Akalin, 2009). Since 1947, it is seen that this goal was far from being realized and many initiatives were terminated, and the established factories were closed down. After 1947, due to Marshall Aid, Türkiye was unable to meet its military needs. (Akalin, 2009) It returned to a period of complete external dependence that would last for about 40 years. (Ermiş, 2023)

Although Türkiye did not actually enter World War II, it was adversely affected by the technological leap during the war and the changing international system after the war. While Türkiye was still trying to catch up with the military technology developed after World War I, World War II caused rapid transformations in the means of warfare that changed the paradigm in the five years it took place. This rapid transformation from cavalry troops to armored troops, from lightly armed two-man aircraft to heavy bombers and jet-powered fighter aircraft, from artillery to rocket and missile technology, and finally to the invention of the atomic bomb, had a devastating effect on the Turkish defense industry by distracting it from the goals it was supposed to achieve. (Ermiş, 2023). Marshall aid was accepted to contribute significantly to increasing the deterrent power of the Turkish Armed Forces (TAF) against the Soviet threat. Marshall aid was not paid for at any cost. Since the state budget allocated a large amount of

money, 400 million each year, for aid materials, no investment could be made for the defense industry. (Savunma Sanayi Başkanlığı, 2023)

In 1952, when Türkiye became a member of NATO, surplus defense equipment was donated by allied countries. This situation prevented the domestic production of defense products. With the ever-increasing foreign aid, the pace of investments required for the development of the defense industry slowed down. Due to the decrease in domestic orders of the Turkish Armed Forces, military factories lost their efficiency and became a burden on the national budget. For all these reasons, military factories were affiliated to the General Directorate of Machinery and Chemical Industry Corporation (MKEK). (Savunma Sanayi Başkanlığı, 2023).

In addition to these negative effects of the military aid provided by the US on the development of the defense industry and the economy, the provision in the agreement signed with the US under the Truman Doctrine, stating that the materials provided under military aid could not be used for purposes other than their intended purpose, proved to be a major obstacle for Türkiye 17 years later during the Cyprus crisis. (Savunma Sanayi Başkanlığı, 2023)

As a result of the national reaction to the embargo imposed after the Cyprus Peace Operation, the Land, Air and Naval Forces Empowerment Foundations were established. With the activities carried out by the Land, Naval and Air Force Empowerment Foundations, investments based on state capital such as ASELSAN, HAVELSAN and ASPIİSAN were realized in some basic fields. Among the companies established between 1974 and 1983 are HEMA Dişli Sanayii ve Ticaret A.Ş., Asil Çelik Sanayi ve Ticaret A.Ş., Barış Elektrik Endüstrisi A.Ş., İşbir Elektrik Sanayi A.Ş., ASMAŞ and Yüksek Teknoloji A.Ş. It was realized that the material and equipment deficit of the TAF, which had been accumulating since 1950, would not be closed with these factories. In 1983, the General Directorate of Defense Equipment Enterprises was established. In 1984, TAI, Aksa Makina Sanayi A.Ş. and ETA Elektronik Tasarım Sanayi ve Ticaret A.Ş. were commissioned and started production. (Savunma Sanayi Başkanlığı, 2023).

In the period between 1985 and 2006, in line with the policy determined in the field of defense industry, a large number of organizations started to operate, especially the companies listed below

- TAI Motor Sanayii A.Ş. (TEİ)
- MAN Truck and Bus Industry Inc.
- STFA Savronik Elektronik Sanayii ve Ticaret A.Ş.
- Turkish Armed Forces Foundation (TAFF)

- MİKES - Microwave Elektronik Sistemler Sanayii ve Ticaret A.Ş.
- FMC-NUROL Savunma Sanayii A.Ş. (FNSS)
- ROKETSAN TRANSVARO Elektron Aletleri Sanayii ve Ticaret A.Ş.
- MARCONİ Komünikasyon A.Ş. (SELEX)
- GATE Elektronik Aydın Yazılım ve Elektronik Sanayii ve Ticaret A.Ş. (AYESAS)
- HAVELSAN Technology Radar MTU Engine Turbine Industry and Trade Inc.
- ESDAŞ Elektronik Sistemler Destek Sanayii ve Ticaret A.Ş.
- Savunma Teknolojileri Mühendislik ve Ticaret A.Ş. (STM)
- NUROL Makine Sanayii A.Ş.
- TISAS Trabzon Arms Industry Inc.
- GIRSAN Silah Sanayii
- INFOTRON Elektronik ve Bilgisayar Sistemleri Üretim ve Tic. A.S.
- RMK Marine Shipbuilding Industry
- Alp Aviation Milsoft Software Technologies
- A.Ş.Yonca-Onuk Ordinary Partnership
- YALTES Elektronik ve Bilgi Sistemleri Üretim ve Ticaret A.Ş.
- Vestel Defense Global Teknik A.Ş.
- KALETRON Software Technologies San. ve Tic. A.S.
- SDT Space and Defense Technologies
- Meteksan Defense

In 2008, Aselsan ranked 97th in the list of the 100 largest defense industry companies prepared by Defencenews magazine every year worldwide, and in 2023 it ranked 47th. In 2023, TAI, Roketsan and Askeri Fabrikalar ve Tersaneler A.Ş. are on the list along with ASELSAN. (Defensenews, 2023)

2.1.3. Basic Characteristics of the Defense Industry

Defense industries are non-autonomous firms managed by the state. Defense industry sector, the product to be produced, quantity, price, distribution, etc. issues are shaped by the states (Sezgin & Sezgin, 2018). The state will decide what to produce, how much to produce, in how much time and in how much quantity. They cannot increase their profits, nor can they reduce costs. The needs of the army are certain and they cannot reduce costs when they produce

products to meet these needs. Since the state is at every stage of production, they cannot increase their profitability to a very high level. (Melman, 1972).

- Requires precision production techniques based on high technology,
- Require specific quality standards,
- Requiring trained manpower,
- Requires continuous use of the latest technologies and therefore requires a great deal of R&D activities,
- Requires a high level of investment,
- The necessity to produce for a single buyer and based on limited needs,
- The need to open up to foreign markets to ensure continuity,
- Having special conditions such as security and confidentiality (Yaslıkaya, 2019)

Technology and performance are more important than the cost of the products produced. This increases the cost of R&D. Production costs increase over time. The F-22 ended up costing 127% more than estimated. It is a long-term process. The F-22 aircraft development project started in 1986 and was targeted to be completed in nine years. The project was completed in 19 years. When the project was completed, two F-15s squadrons were replaced by one F-22 squadron. This resulted in savings in the cost of operations and the support of fleets. (Hartley, 2007).

2.1.4. Necessity of Defense Industry

Political and security concerns, the desire to be independent and self-sufficient, the arms race, economic reasons, regional effectiveness, and countries' bans on arms exports to major arms exporters are factors that force developing countries to produce arms. (Topaklı, 2023).

2.1.5. Defense Sector in Strategy Documents

2.1.5.1. First Development Plan

The Plan focused on the country's difficulties and ways out, and the defense industry was not examined under a special heading. In the manufacturing industry, it was aimed to produce all kinds of materials through domestic means. (SBB, 1963)

2.1.5.2. Second Development Plan

It stated that all arms and ammunition production, with the exception of hunting weapons, would be carried out by state institutions. In a way, it prevented the private sector from participating in the defense industry. (SSB, 1968)

2.1.5.3. Third Development Plan

For the first time in this plan, the defense industry began to be seen as a sub-heading of industrial production. The state was assigned the task of attempting to develop defense-related industries. Priority was given to the development of the machinery industry for the development of the defense industry.

Modernization of the army was seen as a need for national defense and it was stated that national freedom would be ensured through this modernization. The importance of taking steps to develop the national industry in modernization activities was emphasized. The decision to procure the high frequency communication devices of the Turkish Armed Forces domestically can be seen as the first steps of nationalization. While industrialization was being carried out, tools and equipment for National Defense would be provided in sufficient quantities, and a systematic link was requested to be established between national industrialization efforts and the provision of such equipment. (SSB, 1972)

2.1.5.4. Fourth Five-Year Development Plan

It is planned to procure defense vehicles, weapons and equipment from within the country, and to procure products that exceed the country's capabilities from international organizations that are partners. Efforts were initiated to increase production within the country. (SSB, 1979)

2.1.5.5. Fifth Five-Year Development Plan

The Fifth Five-Year Plan aims to develop the economic and social infrastructure within a structure that takes into account the requirements of national defense. The weight of investments in the defense industry was to be directed towards the development of this sector, and the development of the defense industry related to the non-electric machinery sector was targeted. In this plan period, the emphasis on the defense industry remained very weak (SBB, 1985)

2.1.5.6. Sixth Five-Year Development Plan

With this plan, a support fund was established to develop and modernize the defense industry. It was recommended that defense industry products be developed on the basis of the European Common Arms Market. As in every field, it was decided to support R&D in line with the needs of the defense industry (SBB, 1990).

2.1.5.7. Seventh Five-Year Development Plan

It was determined that public procurement policies to improve the country's R&D capability in advanced technology areas, especially in the defense industry and energy, should be reorganized. In a separate article, it is emphasized that initiatives to develop the national defense industry will be planned in such a way that raising the country's technological capability will be one of the main axes and resource allocation will be made according to this plan

2.1.5.8 Eighth Five-Year Development Plan

It was emphasized that foreign dependency in the defense industry continues. It is aimed to use the technological capability within the country for the needs of the defense industry, to reduce the dependence on foreign technology produced by domestic producers by taking part in this sector, to meet the needs of the defense industry from within the country by increasing the technological capability of the country through R&D and to become an exporting sector with the technology produced.

2.1.5.9. Ninth Five-Year Development Plan

In this plan, it was emphasized that a Defence and Space R&D support program was initiated by TÜBİTAK, but foreign dependency continued. One of the main objectives is to develop competitive, self-sufficient, flexible production in the defence industry in a structure that is integrated with the national industry, that provides effective participation in international cooperation activities in the fields of joint production-design and R&D, and to acquire the necessary technological structure competence for this purpose. In addition, it was emphasized that a system and legislation will be established for this whole structure and that special software products will be focused on in some sectors, including the defense industry.

2.1.5.10. Tenth Five-Year Development Plan

In the Plan, the defence industry is listed as one of the priority sectors, and defence technologies have been identified as one of the priority fields of study in thematic advanced research centres. In addition, emphasis was placed on ensuring that the competitive structure of the defence industry meets the defence system and logistics needs in a comprehensive and sustainable manner based on the original planning of the country's industry. It is also stated in the plan that the use of appropriate technologies for civilian purposes will be ensured to increase the localization rate and the share allocated to R&D, and that network and clustering structures will be supported in certain defense industry areas.

The Plan emphasizes the importance of increasing the rate of meeting defense needs from domestic sources from 54% (2011) to 85-95%. To this end, it is mentioned that projects for the design and production of warships, helicopters, tanks, unmanned aerial vehicles and satellites are being carried out in Türkiye in order to increase the domestic share in meeting defense industry needs, and that a Technology Acquisition Roadmap has been established to ensure the systematic follow-up of technological advances. It was also mentioned that cooperation and integration of the automotive sector with other sectors would be supported, and defense was mentioned as one of these sectors.

2.1.5.11. Eleventh Five-Year Development Plan

In addition to the general emphasis on the defense industry in different places in this Plan, some details are mentioned under the heading of defense industry. The main objective of the plan under this heading is to meet the needs of the TAF through domestic and national means. Some measures for this purpose are as follows. First of all, projects that will minimize imports will be implemented. Domestic production will provide a range of products that can be used in all types of operations. Foreign dependency will also be minimized in the subsystems of the products. For this purpose, a competence inventory will be created in the sector. In order to increase competence, financial support will be provided to companies for training, consultancy and guidance through the Industrial Competence Assessment and Support Program. Meetings within the sector such as companies, OIZs, etc. will be organized. The 2023 targets of the defense industry sector are to increase its turnover from 6.7 billion dollars (M\$) in 2018 to 26.9 M\$, its exports from 2.0 M\$ to 10.2 M\$, its qualification rate from 65% to 75%, and its 44,700 employees to 79,3,000. (SSB, 2018).

2.1.5.12. Twelfth Five-Year Development Plan

In this plan, the defense industry is also mentioned as a sector. It is aimed to increase the competencies to meet the defense industry needs of our country and friendly/allied countries with domestic production, with defense industry exports among the top five countries in Türkiye's 2053 vision. In order to achieve these goals, policies have been adopted to strengthen the training infrastructure to meet the personnel needs of the sector, to develop entrepreneurship and domestic procurement ecosystem competence, and to use the developed technology not only in military but also in civilian areas.

The sector achieved its 2018 targets in terms of employment and localization. In 2028, it is targeted to increase the turnover of the defense industry sector from \$12.2 billion (M\$) to \$26.0 M, exports from \$4.4 M to \$11 M, the qualification rate from 73% to 85%, and the number of 81,100 employees to 158,000. In order to achieve these targets, platforms will be established to strengthen cooperation among sector stakeholders.

Türkiye's defense industry strategy documents have undergone significant developments and changes since the first development plan. In the first development plans, no special emphasis was placed on the defense industry, and domestic production was encouraged within the framework of the general objectives of the manufacturing industry. However, with the subsequent development plans, the importance of the defense industry was emphasized more and the role of the state in this field became more prominent.

In the second development plan, the state's monopoly over the defense industry became more pronounced and the private sector's activities in this field were restricted. In the third development plan, the defense industry was accepted as a sub-heading of industrial production and the development of the machinery industry was prioritized. It was emphasized that the need for national defense would be met through the modernization of the army and that this process would be supported by national industry.

The fourth and fifth development plans aimed to procure defense industry products domestically and support them through international cooperation. However, the emphasis on the defense industry remained weak in the fifth development plan. The sixth and seventh development plans, on the other hand, emphasized the modernization of the defense industry and support for R&D activities.

The eighth and ninth development plans aim to reduce foreign dependency in the defense industry and increase domestic production. In the ninth plan, the importance of the Defence and Space R&D support program initiated by TÜBİTAK and initiatives to develop the national

defence industry were emphasized. In the tenth, eleventh and twelfth development plans, the defense industry was identified as one of the priority sectors, defense technologies were prioritized in thematic research centers, and it was aimed to make the defense industry competitive and sustainable.

The importance of national industry has been emphasized since the first plans, but a special approach to the defense industry has developed over time. The latest plans aim to support the defense industry with national technologies, reduce external dependence and increase international competitiveness. This process reflects Türkiye's goal of achieving an independent, strong and innovative structure in the defense industry.

2.1.6. Performance of the Defense Industry

Founded in 1989 and representing the defense industry since 2012, the annual performance reports prepared by the Association of Defense Industrialists (SaSaD) have been published since 2013.

SaSaD has undertaken the missions of reducing our country's foreign dependency, contributing to the formation of an industry that can compete in the international market, providing support for the development of the sector and developing R&D and innovation. As of 2023, 276 SMEs are currently operating.

Table 2.1. SASAD Performance Report

SASAD Performance Report								
Years	Unit	2016	2017	2018	2019	2020	2021	2022
World Military Expenditures	M\$	₺1.914.770,9	₺1.934.922,8	₺198.980,3	₺2.073.120,7	₺2.148.920,6	₺2.163.590,7	₺2.241.523,5
GDP	M\$	\$869.240	\$859.055	\$797.728	\$760.359	\$717.141	\$807.924	\$905.814
Turnover	M\$	5.968	6.693	8.761	10.884	8.855	10.159	12.196
Foreign Sales Revenues	M\$	1.953	1.824	2.188	3.068	2.265	3.224	4.395
R&D	M\$	1.254	1.237	1.448	1.672	1.240	1.639	2.061

The sector's turnover increased from USD 5,968 million in 2016 to USD 12,196 million over the years. It has an average annual turnover growth of 10.54%. International Sales revenues increased from USD 1,953 million to USD 4,395 million by the end of 2022, with an average annual growth rate of 16.81%.

Table2.2. Domestic Coverage Ratio

YEARS	2016	2017	2018	2019	2020	2021	2022
Turkiye	17827	17822	19648	20436	17478	15567	10644
	M\$	M\$	M\$	M\$	M\$	M\$	M\$
	23%	27%	33%	38%	38%	45%	73%

According to the Sipri 2022 report, Türkiye spent \$17,827 M\$ in military expenditures in 2016. Compared to SASAD data, the domestic coverage rate is around 23%. In 2022, this rate increased to 73%.

Table 2.3 Employee Productivity

YEARS	UNIT	2016	2017	2018	2019	2020	2021	2022
EMPLOYMENT	PERSO N	35.502	44.740	67.239	73.771	77.566	75.660	81.132
TURNOVER PER PERSON	\$	168.10 3	149.59 8	130.29 6	147.53 9	114.17 1	134.27 6	150.32 8
FOREIGN SALES REVENUE PER CAPITA	\$	55.011	40.769	32.541	41.595	29.212	42.622	54.183

The number of employees in the sector has increased since 2016 and reached 81,132 as of 2022. 29% of the employees are engineers, 11% are university graduates and 44% are technicians and operators. In other words, 40% of the employees are bachelor's degree graduates. There are qualified employees throughout the sector. The fact that 1% of the employees are managers indicates productivity and efficiency. Employees in the sector generate an average annual turnover of \$150,000. (SaSad, 2023)

According to the list of the 100 largest defense industry companies in the world, compiled annually by Defencenews magazine, the total profit of these companies is 533 billion 939.7 million dollars. The profit of the four Turkish companies on the list is 4 billion 809 million

dollars. The total profit of the 51 US-owned companies on the list is 316 billion 636 million dollars. Table 2.3. shows a comparison of the top five companies and Turkish companies (Defensenews, 2023).

Table 2.3. Turkish Companies in the Top 100 and Comparison

2022 Rank	Company	Country	2022 Defense Revenue (in millions)	2021 Defense Revenue (in millions)	2022 Total Revenue (in millions)	Revenue From Defense
1	Lockheed Martin	U.S.	\$63.334,00	\$64458,00	\$65984,00	96%
2	RTX ¹	U.S.	\$39.600,00	\$41852,20	\$67100,00	59%
3	Northrop Grumman	U.S.	\$32.435,00	\$31429,00	\$36602,00	89%
4	Aviation Industry Corporation of China	China	\$30.971,31	\$30155,22	\$82600,10	37%
5	Boeing	U.S.	\$30.843,00	\$35093,00	\$66608,00	46%
46	Oshkosh Corporation	U.S.	\$2.141,30	\$2525,60	\$8282,00	26%
47	Aselsan A.S.	Turkey	\$2.008,79	\$2250,39	\$2155,71	93%
48	Fincantieri S.p.A.	Italy	\$1.998,43	\$2338,69	\$7882,76	25%
57	Sierra Nevada Corp.	U.S.	\$1.556,00	\$1856,00	\$1656,00	94%
58	Turkish Aerospace Industries	Turkey	\$1.483,70	\$1302,95	\$1839,00	81%
59	Melrose Industries	U.K.	\$1.438,32	\$1544,57	\$10130,08	14%
79	Saudi Arabian Military Industries	Saudi Arabia	\$900,80	\$604,95	\$1082,33	83%
80	Roketsan	Turkey	\$873,35	\$814,16	\$873,35	100%
81	TTM Technologies	U.S.	\$870,00	\$742,08	\$2500,00	35%
99	Embraer	Brazil	\$447,60	\$594,40	\$4540,40	10%
100	Askeri Fabrika ve Tersane Isletme A.S.	Turkey	\$443,50	\$177,94	\$443,50	100%

* (Defensenews, 2023)

As of 2023, 850 projects are being carried out by the Presidency of Defense Industry and the total volume of the projects is 90 billion dollars. (SSB, 2024).

When all the above data and development are evaluated, the defense industry will continue to develop in the world and in our country. In this development, there is a greater need for university-industry cooperation in order to increase the number of leading companies in the world.



2.2. University Industry Cooperation

University-Industry Cooperation (UIC) describes the interactions that take place between higher education institutions and industry to support industry's exchange of knowledge and technology. This collaboration is a long-standing way of increasing the knowledge base of institutions. Many countries, such as the United States, Japan, Singapore and the European Union, have seen a significant rise in such collaborations between universities and industry. This rise is due to various challenges for both industry and universities. Challenges for industry include the rapid technological changes faced by companies, shortening product life cycles and increasing global competition. Universities, on the other hand, are struggling with the increasing amount of knowledge, rising costs and funding challenges. Pressures also include the perception of universities as drivers of economic development and increasing societal expectations to fulfill their traditional social missions (such as education and knowledge production). Such challenges have accelerated the development of UICs, which aim to increase innovation and economic competitiveness by promoting knowledge sharing between the academic and commercial sectors. UIC is also recognized as a promising tool to help organizations expand their organizational capacity in the area of open innovation, which supports institutions to develop innovation and knowledge using external networks as an alternative to traditional internal R&D efforts.

Today, UIC (UIC) is recognized as one of the cornerstones of knowledge and technology transfer and this cooperation plays a critical role in promoting sustainable development and innovative ecosystems. In Türkiye, efforts in this field have gained momentum, particularly through various action plans and projects supported and coordinated by the Council of Higher Education (YÖK).

Through the University-Industry Cooperation Commission (YÖK ÜSi), YÖK has taken important steps to increase universities' research capacities, promote workplace-oriented education and establish technology transfer offices. Such initiatives facilitate universities and industry to come together and exchange information for mutual benefit.

Institutions such as Bursa Uludağ University (BUU) provide concrete examples of UIC through TUBITAK-funded projects. BUU's project on cooling systems using carbon dioxide, developed in collaboration with Kaplanlar Cooling R&D Center, contributes to the development of products with low environmental impact and high energy efficiency.

The Istanbul Chamber of Industry's (ISO) UIC projects also work towards the establishment of effective and result-oriented collaborations between universities and industry. By assuming the role of a strong coordinator for knowledge and technology transfer, the ISO ensures that resources are used properly, and collaborations are carried out efficiently.

As a result, university-industry cooperation contributes significantly to Türkiye's advancement in science and technology and to increasing its global competitiveness. This cooperation lays the foundations for an innovative and sustainable economic growth model by accelerating the transfer and commercialization of academic knowledge to industry.

2.2.1. Definition

According to Tanış, (Tanış, 2023)"It is the whole of the systematic studies carried out for the scientific, technological and economic development of the universities by combining the existing facilities of the universities with the existing facilities of the industry. In other words, it is the whole of scientific, technological and economic activities that result from combining the knowledge and trained manpower of universities with the existing experience and financial power of the industry within a system."

To Dura (Dura, 1994) According to the Turkish government, UIC is the utilization of resources such as personnel, facilities, skills, competence and financial power in the hands of both parties for mutual gain and benefit to the society. It is the application of the philosophy of "strength in unity" on scientific grounds.

Universities are constantly changing. The addition of research as a function to the basic mission of universities, which is education, can be characterized as the first academic revolution that universities have undergone. Especially after the 1980s, the second revolution, which added the task of contributing to economic and social development to the basic missions of universities, brought the concept of entrepreneurial university to the agenda and made universities an active player in the national innovation system.

As a result of rapid technological developments, it has become necessary for the private sector, public sector and universities to make some transformations within their own organizations. Especially in the business world where there is fierce commercial competition, companies have started to closely follow scientific and technological developments in order to increase or maintain their efficiency and share in the market. Similarly, universities have started to need more financial resources in order to provide higher quality education and to contribute to social developments at regional and national level. As a result, it has become necessary for universities

that produce science and technology and the private sector, which uses them in production processes and has financial power, to come together and find solutions to their problems. While in the past it was criticized that non-profit universities entered into such close relations with the profit-oriented private sector, today it is accepted that the scientific studies resulting from such collaborations contribute to the development of university faculty members.

2.2.2. Historical Infrastructure of University-Industry Cooperation

16th Century European Scientific Academies and Institutional Structures: Etzkowitz et al. (Etzkowitz et al., 2000) As noted by Merton Merton, from the 16th century onwards, academies of science became important institutional structures that united the European scientific community at national and regional level. Merton (Merton, 1938) emphasized that most of the discoveries pioneered by universities in the 17th century were made to solve practical problems such as navigation and mining. Solving such practical problems with scientific methods has been a critical driver of Scientific progress. For example, in 17th century German Pharmaceutical Science (Gustin, 1975) advances demonstrate the relevance of scientific knowledge to practical applications. In this context, the evolution of university-industry collaborations is a model for today's national and international collaborations.

Integration of Research into the University Mission and Academic Revolutions: During the same period, innovations such as industrial consulting of scientists and the formation of scientific firms emerged at Harvard and MIT, but these developments received limited attention (Shimshoni, 1970).

Entrepreneurship and University-Industry Collaborations: By the late 1970s, more and more scientists prepared business plans, secured funding, rented space and hired staff to promote entrepreneurship(Blumenthal et al., 1986). In 1980, the Bayh-Dole Act transferred intellectual property rights from federally funded research to universities. During this period, universities continued to collaborate with industry, focusing on traditional research and education activities. The industrial group of the European Union Research Directorate (IRDAC) and the US University-Industry-Government Cooperation Desk positioned the relationship with universities as a source of labor supply and useful information for the firm.

Evolution and Mission Change of University-Industry Collaborations: While academia and industry have focused on their core areas, the relationship between them has remained within certain boundaries. Industry's demand from academic researchers has been basic research knowledge. However, the internalization of R&D in multinational companies and the

development of university-industry collaborations through consultancy activities have changed the mission of the university (Etzkowitz, 1998). Etzkowitz et al. (2000) They emphasized that the Bayh-Dole Act was as important as the Morrill Act in promoting innovation and economic development through technology transfer and increasing the dividends of innovative firms. Similar institutional changes have been observed outside the US, but differences in domain boundaries have affected the direction and speed of the process. The alignment between the dissemination and commercialization of knowledge has led to a normative shift in Science. Cognitive changes across disciplines and Scientific domains have enabled Scientists to simultaneously pursue the search for truth and the pursuit of profit. New cognitive and normative patterns have emerged as traditional norms of Science have shifted to allow for entrepreneurship and a different understanding of institutional structure(Etzkowitz, 1994).

Innovation and the Role of University-Industry Collaborations: The role of universities vis-à-vis public authorities and industry has been strengthened, with increased interest in collaborations at national and regional level for reasons such as innovation, competitive advantage and economic development. (Hayashi, 2003). The parallelism between academic revolutions and the development of university-industry collaborations suggests that these processes support each other.

2.2.3. Evolution in Academia

University-Industry Synergy The evolution of knowledge has integrated the institutional structures of universities and industry in developed and developing societies. Academic institutions in the US underwent a fundamental change in the mid-19th century with the First Academic Revolution, which adopted a pure Science approach, followed by the Second Academic Revolution in the early 20th century, which paved the way for the commercialization of university research. During these periods, the transformation of knowledge into material value made universities effective economic actors.

Starting in the 19th century in the US, the first academic revolution defined research as an academic function in addition to the traditional task of teaching(Jencks & Riesman, 1968). Research has emerged as the leading mission of this revolution. Universities have maintained their core mission, although they have expanded with new missions.

In the 18th century, the research activities that began in the field of philology gradually spread to other scientific disciplines. The methodological techniques developed for the study of Greek and Roman texts stimulated the production of new knowledge (Etzkowitz, 1990).

The establishment of new universities, such as Johns Hopkins and the University of Chicago, following old institutions like Harvard and Columbia, contributed to the progress of the first academic revolution. These new institutions remained faithful to the pure research model and positioned science as autonomous. Henry Rowland's work reinforced the pure research approach (Etzkowitz et al., 2000).

Until the late 19th century, there was no clear distinction between basic and applied research in the US. The transfer of industrial wealth to universities led to concerns about donors influencing the research agenda. The ideology of basic research was seen as an effort to create a financially secure space for science (Etzkowitz et al., 2000).

The knowledge-based economy can be viewed as a historical process. The adoption of German patent legislation and the rise of a young generation dedicated to pure Science supported the development of a culture of basic research. This approach, which lasted until the Second World War, contributed to the elucidation of theoretical issues of radio astronomy and cosmology (Leydesdorff & Etzkowitz, 2012).

In the late 19th century, universities were defined by the attributes of trustworthiness and virtue. Mode 1 defined the scientist as independent of society's expectations and promoted the ideology of pure research (Etzkowitz & Leydesdorff, 2000). Beesley (2003, 1520-1521) stated that a pure philosophy of Science developed when the theoretical scope became the absolute goal of research.

In the 19th century, academic institutions in the US struggled with a lack of resources. Research groups evolved into a firm-like structure through the entrepreneurship of professors, supported by foundation and industry funding. Under the influence of the first academic revolution, research-based economic development became an academic mission (Etzkowitz, 1990).

Etzkowitz and Leydesdorff (2000) As pointed out by the University of Science, universities in the early 20th century underwent a transformation on a scale comparable to the first academic revolution. As the first academic revolution spread across scientific fields, the

commercialization of findings from university laboratories formed the basis of the second academic revolution.

The entrepreneurial role of universities has encouraged the formation of new knowledge-based firms, and an understanding based on the sale of technology in national and international markets has developed. Universities' portfolio of industrial links has become an integral part of their institutional identity, with differences in research and education(Etzkowitz, 1990).

Clark Kerr's 1963 definition of 'multidiversity' for the University of California at Berkeley referred to the establishment of new interdisciplinary research centers alongside traditional disciplines. This new configuration marked a transformation based on the commercialization of academic research (Etzkowitz, 2001).

The commercialization of academic research has represented a new phase of university-industry relations, with firms established by academics. Technology transfer offices and academic innovative enterprises have become central to these relationships(Etzkowitz, 1990).

After the Second World War, researchers who adhered to the ideology of basic research continued their work, accepting public funding.

With the commercialization of research in the 1980s and 1990s, the academic role was conceptually redefined. Etzkowitz and Viale (2005)that institutions, organizations and roles evolve from specialization to integration.

The triple helix approach has facilitated the transformation of knowledge into innovation through cooperation between universities, industry and government. This approach has ensured that universities have a central role in the innovation process (Viale et al., 2005).

Griliches (1957)and Gibbons et al. (1994) The multidimensional knowledge emphasized by the University has replaced the traditional disciplines as well as Mode 2 knowledge created in the context of practice. This approach has enabled universities to contribute to economic and social development (Etzkowitz, 2013).

2.2.4. University-Industry Cooperation Models

2.2.4.1 National Innovation Systems

NIMs are one of the fundamental building blocks of national innovation systems and are considered as drivers of economic development as well as knowledge and technology transfer. The National Innovation Model (NIM) has a critical role in helping countries achieve their competitiveness and sustainable development goals.

National innovation systems (NIS) are the set of institutional structures and interactions that promote knowledge generation, diffusion and utilization (Lundvall, 1992). These systems involve cooperation between various actors such as universities, research institutes, companies and government. UIC, as one of the key components of the NIS, contributes to the development of innovative solutions by enabling knowledge and technology transfer (Etzkowitz & Leydesdorff, 2000).

UIC models offer various approaches to facilitate the application and commercialization of academic research to industry. These models can include structures such as technoparks, technology transfer offices (TTOs), joint research and development (R&D) projects, and industry doctoral programs.

For example, the METU Technology Transfer Office (TTO) is a model of UIC that aims to produce solutions for the needs of industry with academic expertise (METU TTO, n.d.). This model acts as an effective bridge between the industry and the university, professionally conducting R&D and innovation collaboration.

The National Innovation Model (NIM), as a subset of the NIS, aims to increase the innovation capacity and competitiveness of the country. NIM includes policies and mechanisms that support knowledge generation, technology development and commercialization processes (Göker, 2003). Türkiye's NIM implements various strategies to strengthen university-industry cooperation and develop the innovation ecosystem (Yigit, 2018).

In conclusion, UIC models and the National Innovation Model are important elements of innovation and economic development in knowledge-based economies. These models have a critical role in increasing the global competitiveness of countries and achieving sustainable development goals.

2.2.4.2. Mode 1: The Role of University-Industry Cooperation and Innovation

Mode 1, among UIC models, this approach involves innovation processes and knowledge and technology transfer. This model includes mechanisms that support the integration and commercialization of academic research into industry (Clark, 1998).

The role of universities in knowledge production underpins Mode 1. Academic institutions contribute to the emergence of new technologies and innovative solutions through research and development (R&D) activities (Etzkowitz, 2003). Industry takes this knowledge and integrates it into its products and services, thus increasing both economic growth and social welfare (Etzkowitz & Leydesdorff, 1997).

Mode 1 also takes into account the education and training activities of universities. Students have the opportunity to reinforce their knowledge with applications by taking part in projects carried out in cooperation with industry (Barnes et al., 2002). This enables graduates to be better prepared for the world of work and to engage as active participants in the innovation ecosystem.

In Türkiye, Mode 1 practices can be seen through universities' technology transfer offices (TTOs) and joint R&D centers with industry. These centers play an important role in transferring academic research to industry and developing national innovation capacity.

In conclusion, Mode 1 is an important model of university-industry cooperation and innovation. It promotes knowledge and technology transfer, while at the same time supporting economic and social development.

2.2.4.3. Mode 2: University-Industry Cooperation and Regional Development

Mode 2 is an approach among UIC models that targets regional development and the strengthening of local economies. This model fosters the development of local innovation ecosystems to channel university expertise and research capacity to regional industrial needs (Baykara et al., 2024).

Mode 2 is a model implemented especially in organized industrial zones (OIZ). In this model, universities and industrial organizations collaborate through joint R&D projects, training programs and technology transfer activities (YÖK, 2021). For example, the cooperation between Doğuş University and Dudullu OIZ can be shown as a successful application of Mode 2 (Baykara et al., 2024).

The main objective of Mode 2 is to meet the mutual expectations of industry and academia and to develop cooperation models that can respond to industry needs and requirements. This cooperation focuses on areas such as the organization of courses and general curricula, the training of qualified personnel and rapid adaptation to industry requirements (Baykara et al., 2024).

In conclusion, Mode 2 is an important model of university-industry cooperation and regional innovation. It supports the development of local economies and contributes to increasing national innovation capacity.

2.2.4.4. Mode 3: University-Industry Collaboration and Sustainable Innovation

Mode 3 is an approach that targets sustainable innovation and long-term collaborations among UIC models. This model is designed to ensure that academic research is transferred to industry and transformed into economic value, to direct companies in the region to R&D and innovation activities, and to encourage cooperation between academics and industrialists based on mutual trust.

Mode 3 ensures that the scientific work of academics is put into the service of the industry and commercialized. At the same time, it facilitates directing the needs of industrialists in R&D and innovation to academics specialized in the relevant field and facilitates cooperation.

Among the practices of this model are activities such as mediating the support of business ideas in the industry with national and international funds, organizing one-to-one meetings between industrialists and academics, providing industry-oriented professional development opportunities for academics, and providing interdisciplinary cooperation.

In conclusion, Mode 3 is an important model of university-industry collaboration and sustainable innovation. This model contributes to the development of regional and national economies by ensuring that scientific potential is transferred to industry and transformed into economic value.

2.2.5. Triple Helix Model: University, Industry and Government Cooperation

The Triple Helix Model is an innovation management model based on the interaction and cooperation between universities, industry and government. Developed by Henry Etzkowitz and Loet Leydesdorff in the 1990s, this model aims to improve the relationship between these three actors, which are bound by strict rules and have poor communication, and to contribute to technological development and innovation processes. (İZKA, 2024).

The model aims to integrate the scientific research of universities into the product development processes of industry and the policy-making processes of the state. This integration is achieved through tripartite relationships such as academic entrepreneurship, alliances between companies, government-university-company research collaboration and joint facility utilization (İZKA, 2024).

The Triple Helix Model consists of three elements: actors, institutions and regulations. Actors come together for a common purpose, exchange information and develop strategies to strengthen global competitiveness. Institutions include structures such as technoparks, technology transfer centers and incubation centers that bring academia and business together (İZKA, 2024).

The implementation of the Triple Helix Model contributes to increasing regional and national innovation capacity and supports economic development. In Türkiye, this model has been used to improve the efficiency of regional innovation ecosystems and to develop policy recommendations for private sector qualifications and interface partnerships in provinces with low economic development (Erkul & Kırankabeş, 2020).

2.2.6. Quadruple Helix Model

Today, the development of innovative ecosystems has increased the evolution and complexity of UIC models. In this context, the Quadruple Helix Model emerged as an extension of the triple helix model and encompasses the dimensions of innovation, art, creativity, environment and sustainable development (Keskin & Ovalı, 2022, pp. 447-461). While the triple helix model was based on cooperation between universities, industry and the state (Etzkowitz & Leydesdorff, 1990s), the quadruple helix model expanded this cooperation by including the public (civil society) spiral focused on media and culture.

The quadruple helix model emphasizes the co-evolution of art and innovation in the processes of knowledge generation and innovation and assumes a central role in these processes. The quadruple helix model is formed by adding the natural environment of society to the quadruple helix and aims for sustainable development.(Keskin & Ovali, 2022).

These models consist of three elements: actors, institutions and regulations to contribute to increasing regional and national innovation capacity. Actors, while having different characteristics, should come together for a common purpose, exchange information and strategize beyond their traditional roles. Institutions should include structures such as technoparks, technology transfer centers and incubation centers to bring academia and business together.

2.2.7. The Quintuple Helix Model

As an extended version of innovation ecosystems, the Quintuple Helix Model promotes sustainable development by taking into account the natural environment of society. aims to(Keskin & Ovali, 2022). This model incorporates the key elements of the quadruple helix - university, industry, government and civil society - as well as environmental factors into the innovation process. By combining knowledge, expertise, innovation and ecology in an interdisciplinary framework, the quintuple helix aims to ensure environmental sustainability as well as economic development.

The model seeks to maximize the positive impacts of these interactions on society and nature by considering the environmental impacts of academic research and industrial applications, especially in areas such as green technologies and sustainable energy solutions. The five-spiral approach also provides a comprehensive view of innovation, encompassing not only economic but also social and environmental dimensions.

Implementing this model requires universities and industry to integrate environmental factors into strategic decision-making processes to achieve sustainable development goals. It also encourages various stakeholders - especially policy makers and community leaders - to become more aware and proactive in environmental sustainability.

2.2.8. Research on Türkiye:

According to the results of the research conducted by Bulut in the organized industrial zone of Diyarbakır province, programs, incentives and support activities are carried out to develop UIC

in Türkiye. However, 75% of enterprises do not know the added value that UIC will provide, 72% do not allocate resources for R&D, they do not take intern students, those who do are not satisfied with the students, and there is no way to transfer the activities of universities directly to industrialists.(Bulut, 2022).

The R&D activities of academic staff employed in higher education institutions in Istanbul have been analyzed. As a result of the research, it was determined that the share of Higher Education in R&D expenditures has decreased over the years. It was determined that the number of academicians operating in UIC is low with 30%.(Baydeniz et al., 2023).

In the study conducted by Yaşar, it was found that doctoral students with high R&D university-industry cooperation received more citations, had higher entrepreneurship indicators, and had lower non-innovation sales expenditures. Yaşar also stated that sufficient resources should be provided for long-term, basic and applied research(Yaşar, 2020).

In his study conducted in 2020, Abar found that the UIC relationship has a positive effect on the stock market index in the long run.(Abar, 2020).

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- Inadequate knowledge transfers
 - Late disbursement of funding support
 - Lack of communication
 - Length of time for evaluation of their projects
 - Too much bureaucracy
 - Funding support is interrupted more than specified
 - Low project support rates
 - The referees involved in the project evaluation processes have expertise in fields different from the project subject
 - Inadequacy of universities' research infrastructures
 - High cost of testing and analysis services

problems were identified. In order to overcome these problems, it was suggested that academics should be encouraged to take part in cooperation projects, project support rates and upper limits should be increased, more activities should be carried out to increase UIC, and a common portal should be established to ensure communication between academics and businesses.(Yücel & Özgül, 2020).

In the research conducted in the province of Van, it was determined that the ratio of the number of employees working in R&D to the total number of employees was 0.48% and there was no need for R&D activities, and only 7% met with academic staff and conducted joint studies.(Yücel & Özgül, 2020).

The study investigated the effects of public-university-industry cooperation on regional development in Çankırı, Sinop and Kastamonu provinces of TR82 region between 2011-2013. It has been determined that unemployment has decreased in the region and universities have made a great contribution to regional development with their number of students, academic and administrative staff. In addition, in terms of raising qualified manpower demanded by industrialists, the fact that there are many vocational schools of higher vocational education in universities in the TR82 region has provided an advantage in providing qualified personnel for the industry.(Mountains, 2018).

In a survey conducted with 162 firms in the woodworking and furniture sector in Kütahya, it was found that UIC is weak. The high number of small family-owned companies, the lack of a professional management approach throughout the sector, and the very low level of R&D are among the reasons.(Ciritcioglu et al., 2017).

According to the research conducted in the medical field, it was determined that firms are inclined to innovation, try to innovate by using their own resources, but are closed to pre-competitive cooperation. Since firms do not attach importance to human capital, an innovative culture has not been formed(Topcu, 2018).

2.2.9. Benefits and Disadvantages of University-Industry Cooperation

University-industry collaborations are complex interdisciplinary and transdisciplinary processes, and the importance of these processes varies by geographical location, depending on the institutional differences that shape the collaborations ((Carayannis & Campbell, 2012). Hemmert, Bstieler and Okamuro (2014) As he notes, these differences vary from country to country and region to region.

When the results of university-industry collaborations are analyzed in terms of the benefits obtained and the disadvantages encountered, it is seen that these results vary (Lin & Bozeman, 2006; Boardman & Corley, 2008; S. N. Ankrah et al., 2013; Caloghirou et al., 2003; S. Ankrah & AL-Tabbaa, 2015; Lee & Win, 2004); Siegel et al., 2004). In this section, the economic and financial contributions of university-industry collaborations (UICs), organizational and social impacts, quality issues, conflicts, risks and disadvantages such as mission deviations are discussed.

UIC plays a key role not only in terms of knowledge and technology transfer but also in terms of economic development. Approximately 10% of new products and technologies are developed through this collaboration (ISO, 2024). By matching R&D centers of companies with relevant faculty members of universities, UIC enables the establishment of R&D consultancy collaborations and encourages the expansion of contract R&D projects.

2.2.9.1. Benefits:

Economic Utility and Patent Outcomes; Welsh et al. (2008) As noted, the biggest advantage of university-industry collaborations for universities is that they provide an additional source of income that reduces financial pressure. Industrial collaborations provide training, financial support and career opportunities for students and new job opportunities for researchers (Bekkers, Freitas, 2008). Research support is provided by the state, local governments and the private sector, together with technology transfer, licensing and patenting activities. Seeking alternative sources of funding to reduce dependence on public funds, universities turn to commercialization, patents and intellectual property rights (Sapsalis et al., 2006).

Collaborative research between universities and industry increases firms' sales potential, R&D productivity and patenting activities. Firms seeking to improve their financial performance and competitive advantage collaborate with universities. Collaborative research programs are conducted at lower costs than in-house research and provide firms with access to a variety of resources at affordable prices. This contributes to lower knowledge production costs for the industry (Bekkers & Bodas Freitas, 2008)).

By increasing the innovative capacity of firms, collaborations accelerate economic output through patented or licensed new products and processes. Patents and licenses increase the speed at which products are brought to market and the firm's market share (George et al.,

2002a). However, the lack of public funding can negatively affect cooperation development ((Muscio & Pozzali, 2013)). Moreover, the uncertainty of long-term returns and complex financing models may limit industry investment in cooperation ((Lambert, 2003)).

Mueller (2006) According to the analyses conducted by the University of Economics, universities and industrial organizations collaborate by using each other's organizational capabilities as complementary. Industrial collaboration enables academics to receive feedback on applied problems, the latest technologies and research results. Such collaborations make it possible for university researchers to gain valuable insights that help them understand and find solutions to a company's specific problems.

University-industry collaborations facilitate universities' access to the latest research equipment, encouraging academic entrepreneurship and the formation of innovative businesses (spinoffs). Cohen et al. (2002) in a study conducted by the University of Technology, it was observed that industrial research managers valued university contributions to complement existing projects rather than ideas for new projects. Firms expand their absorptive capacity through research alliances and these alliances increase the potential for collaboration by enabling universities and industry to complement each other in many ways (Santoro & Betts, 2002).

Companies collaborating with university stakeholders, providing access to research networks (George et al., 2002a) Click or tap here to enter text. and participate in university-industry relationships to build complex collaborative relationships through consortia involving a large number of companies and universities. Collaborations provide firms with opportunities to develop and promote specific areas of university research. At the same time, university research guides firms in solving complex problems (Bramwell & Wolfe, 2008). Universities that transform knowledge into commercial value through scientific research contribute to the local and regional economy, and collaborations that support entrepreneurship create new business areas and increase employment, thus positively affecting economic development. (Nicotra et al., 2018).

Societal expectations for the economic contributions of universities stand out as a factor that encourages university-industry cooperation through knowledge and technology transfer (Siegel et al., 2004). These collaborations provide flexibility in the coordination and diversification of R&D activities (Thorn et al., 2007). Practices such as student internship programs, the

involvement of companies in postgraduate education and the supervision of companies in university research strengthen the impact of the cooperation ecosystem at the regional level. New local and regional cooperation networks increase social benefit and improve environmental impacts (Siegel et al., 2004).

For academics, recognition through publications, presentations at prestigious conferences and research grants is an important source of motivation. Collaborations with industry offer academics the opportunity to collaborate with industry personnel (Tijssen, 2006) Furthermore, industry support allows academics to conduct research that will enhance their academic reputation.

Cultural activities supported by the cooperation ecosystem contribute to regional cultural development through the creation and dissemination of new cultural insights. The entrepreneurial spirit fostered by collaborations has a positive impact on economic growth as well as social and cultural sustainability (Ovali, 2022).

Apart from this, some of the remaining advantages are as follows.

- UIC enables patents and utility models to be issued from scientific projects that will provide economic benefits. This increases the innovative output of both universities and companies.
- **Education and Career Planning:** UIC enables students to enter the business world from their second year and spend their internship periods more efficiently. Thus, students can set their career goals earlier.
- **Research Infrastructure:** Universities, in cooperation with industry, strengthen their research infrastructure and combine their scientific studies with practical applications.
- **Increased Research and Development (R&D) Activities:** Research conducted at universities offers innovative solutions to industry and accelerates product development processes.
- **Increase in Quality and Productivity:** Scientific studies at universities raise the quality and productivity standards of industry.
- **Proximity to Technological Developments:** Industry has the chance to develop its own technology and compete in the international market thanks to technological developments in universities.

- **Qualified Human Resources:** University-industry cooperation enables the training of qualified human resources through applied training.

2.2.9.2. Disadvantages:

- **Slow Decision Making Processes:** UIC can be hampered by bureaucracy and slow decision-making processes. This can be an obstacle, especially for fast-moving industrial sectors.
- **Limiting Academic Freedom:** Universities must be careful to protect their academic freedom and research mission when collaborating with industry.
- **Limited Resources:** Industry workloads and limited financial resources can limit the time and resources available for collaboration.

The success of UIC should be balanced to meet the expectations of both parties. Universities should protect their academic freedom and research missions when collaborating with industry, while industry should invest in research and development processes and consider the long-term benefits.

2.2.10. Actors in University-Industry Cooperation: An Effort to Create Synergy

UIC is critical for accelerating knowledge and technology transfer, commercializing innovative ideas and supporting sustainable development. This collaboration promotes economic growth and contributes to increased social welfare by enabling the application of academic research to industry.

In today's knowledge-based economies, universities are considered the center of knowledge production and innovation. Industry, on the other hand, plays a key role in the translation of this knowledge into practice and the development of new products and processes. The interaction between universities and industry increases the competitiveness of both parties and contributes to socio-economic development.

The main actors in UIC are universities, industrial organizations and governments. Universities generate knowledge through research and development (R&D) activities, while industrial organizations transform this knowledge into product and service innovations. Governments facilitate the process by developing policies that encourage this collaboration and providing appropriate financial support.

Universities generate new knowledge through basic and applied research and transfer this knowledge to industry through patents, licenses and publications. They also provide qualified human resources to industry through students and academics.

Industrial organizations develop innovative products and processes using knowledge gained from universities. By investing in R&D and carrying out joint projects with universities, these organizations have the opportunity to transform knowledge into commercial success.

Governments create the necessary legal and regulatory framework to promote UIC. They also support collaboration by offering financial incentives such as tax breaks, grants and loans for R&D activities.

University-industry collaboration is seen as the driving force of the knowledge economy and its success depends on the quality of interaction between the actors. For an effective collaboration, actors need to clearly understand their roles and fulfill them in harmony.

2.2.11. Various Barriers to University-Industry Cooperation

The concept of University-Industry Cooperation (UIC) is a form of interaction between the academic and industrial sectors that aims to promote the exchange of knowledge and technology. This collaboration is an old and effective way of expanding the knowledge base of organizations. However, despite the potential and advantages of UIC, there are also a number of barriers and challenges that can lead to its failure. These barriers can arise along cultural, organizational and operational dimensions and can be caused by factors such as different missions, goals, language and assumptions, conflicting interests regarding confidentiality and intellectual property rights. There are also operational barriers, such as perceptions of the nature and results of R&D, structural and responsibility changes, lack of knowledge about partnership and processes, inadequate coordination and project management, and lack of acceptance of partner-generated results.

For academics, barriers such as internal and external bureaucracy, insufficient funds for UIC and lack of external resources stand out. For industry, there are challenges such as lack of financial resources and lack of awareness of university activities in the business community. These barriers can limit the effectiveness of UIC and affect indirect (for society) and direct (for actors) outcomes.

To overcome barriers to UIC, issues such as bureaucracy and funding need to be addressed. A table of factors and barriers affecting the effectiveness of UIC is presented below:

Table 2.5. Factors Affecting UIC Success

Factors	Barriers	Situational Factors	Drivers	Support Mechanism	Key Stakeholders
Cultural	Different tasks and goals	Privacy and Intellectual Property Rights	Innovation and Knowledge Sharing	Funding and Resources	Academics and Industry
Corporate	Bureaucracy and Structure Changes	Responsibility Changes	Economic Competition	Policies and Regulations	Universities and Companies
Operational	Inadequate Coordination and Project Management	Partnership and Process Knowledge	Organizational Capacity	Collaboration Platforms	Researchers and Entrepreneurs

This table summarizes the various factors and barriers affecting the success of UIC, their relationship with situational factors, drivers of collaboration, support mechanisms and key stakeholders involved in this process. To enhance the effectiveness of UIC, it is important to carefully assess these factors and barriers and implement appropriate support mechanisms.

2.3. Competence

David C. McClelland defined competence as an individual underlying characteristic that is causally related to an individual's superior performance in a job or situation. These characteristics are those that can predict a person's behavior over a wide range of situations and predict performance on work tasks. McClelland identified five main characteristics that determine a person's competence: motivation, trait, self-concept, knowledge and skill. According to McClelland, these characteristics are considered "mastery traits" that help people predict their long-term performance in their jobs. McClelland argued that competencies predict work behavior and performance and are therefore important for hiring, promotion and training decisions. (McClelland, 1993)

Richard E. Boyatzis defines competence as a combination of individuals' emotional, social and cognitive skills. A person's competence is the integrated use of the knowledge, skills and attitudes required to perform a task. The competencies that individuals use in performing a task help them to succeed in a particular field or profession. Competencies can contribute to improving individuals' job performance, job adaptation and career development (Boyatzis, 1982)

Competencies are characteristics that enable a person to perform superiorly at work. These characteristics consist of a person's behaviors, motivation, abilities and other individual characteristics. Competencies have an important place between the strategic vision of the organization and its competitiveness and effectiveness. On the other hand, competence is a distinction between the results expected to be achieved and the behaviors used to achieve these results. (Ünsar, 2009) A company's technology competence is accumulated knowledge. (Ertem, Üçer, Temiz, & Yiğit, 2011)

From the definitions above, we can say that a competency index is a measure of how competent a person or an organization is in a particular area. This index usually includes a number of factors and shows how well the measured person or organization performs according to these factors.

2.3.1. Academic Ranking of Universities

Based on the definitions of competence, university competence refers to the ability to have the knowledge, skills, resources and infrastructure necessary to engage in academic activities and research in higher education. University competence includes the capacity to provide the

resources necessary to offer high quality education to students, to conduct scientific research and to serve society.

Universities have felt the need for branding for reasons such as attracting the attention of students, families and companies and allocating more share to research budgets. (Nardalı & Tanyeri, 2011) They have to compete to attract more students and to differentiate themselves in education. (Butt & Rehman, 2010) Therefore, administrators use university rankings to show that their universities are successful. (Özbaşı & Uslu, 2018)

World university rankings are made by companies/agencies such as Times Higher Education (THE), Quacquarelli Symonds (QS), Shanghai Ranking (ARWU), Center for World University Rankings (CWUR), Consejo Superior de Investigaciones Científicas (Webometrics), US News, uniRank, Round University Ranking (RUR) and academic units such as Leiden University in the Netherlands and University Ranking by Academic Performance (URAP) in Türkiye. (Hazelkorn, 2011)

Times higher education (THE) has categorized the indicators used for the world university ranking into five areas. The main headings of teaching, research and citations are each weighted at 30%, international perspective at 7.5% and collaboration with industry at 2.5%. The most important sub-heading of teaching is the Academic Reputation Survey conducted by THE with 15%. Other sub-headings include staff-student ratio, PhD-to-degree ratio, PhD awarded to academic staff, and institutional income. The most important sub-heading of the research is the reputation among peers based on the responses in the Academic Reputation Survey with 18%, income from research and productivity are other sub-headings. Citations were also counted as the rate of utilization of publications by the university (World University Rankings 2023: methodology, 2023).

The QS World University Rankings use a set of criteria to measure the academic performance of universities. Since 2011, QS's ranking methodology uses five main criteria, with sub-criteria underneath. These criteria are

- Academic reputation (40%): This criterion measures the value placed on universities by academics and employers around the world.
- Teaching (20%): This criterion takes into account factors such as student-faculty ratios, student participation in out-of-class activities, languages used in teaching, student satisfaction and opportunities for postgraduate study to measure teaching quality.

- Research (20%): This criterion takes into account factors such as faculty members' publication performance, citation rates and research grants to measure the research quality of universities.
- Internationalization (10%): This criterion takes into account factors such as international student and faculty ratios, international research collaboration, international student and staff support.
- Industrial income (10%): This criterion takes into account factors such as collaboration with companies, patent applications and industrial consultancy services to measure universities' industrial income. (QS, 2023)

The ARWU (Academic Ranking of World Universities) university ranking is a ranking published annually by Shanghai Jiao Tong University. The ranking evaluates universities based on five main categories: quality of education, quality of faculty, research impact, international perspective and industry income. Each category is measured by different criteria and each criterion is weighted differently. The criteria used to create the ranking are as follows:

- Quality of education Nobel laureate alumni
- Faculty quality: Nobel laureates
- Research impact: highly cited papers
- International perspective: proportion of international students and faculty
- Industry income: industry-sponsored research income per faculty member (ShanghaiRanking's Academic Ranking of World Universities Methodology 2022, 2023)

CWUR (Center for World University Rankings) uses a different method to rank universities. The CWUR ranking is based on a university's research performance and the ranking of universities is based on the sum of the following eight criteria:

- Quality of Education
- Employment Opportunities
- Faculty Member Quality
- Research Performance
- Performance of Higher Education Students
- Publication Performance

- Citation Impact
- Industry Revenue

CWUR evaluates and ranks more than 19,000 universities. (METHODOLOGY , 2023)

The Consejo Superior de Investigaciones Científicas (Webometrics) creates a ranking of universities based on their web performance. The ranking takes into account the accessibility, visibility, timeliness and effectiveness of the university websites. The criteria for the Webometrics ranking include the following:

- Number of web pages worldwide
- Number of documents published worldwide
- Number of citations on Google Scholar
- Total number of web pages
- Number of international web pages
- Number of external links (backlinks) (Webometrics. (2021). Methodology. , 2023)

The RUR (Round University Ranking) university rankings are prepared by the RUR Rankings Agency, a Moscow-based ranking organization. The RUR ranking evaluates universities around the world based on factors such as quality of education, research activities, international cooperation and use of financial resources. The criteria and weights used in the RUR rankings are as follows:

- Quality of Education- 40%
 - Student-faculty ratio (20%)
 - Graduate student-faculty ratio (10%)
 - Foreign language skills of academic staff (5%)
 - Employer satisfaction (5%)
- Research Activities- 40%
 - Research activities (20%)
 - Scientific publications (20%)
- International Cooperation- 10%
 - Foreign student ratio (5%)
 - Proportion of foreign academic staff (5%)

- Use of Material Resources - 10%
 - Research budget per faculty (5%)
 - External funding per faculty (5%) (RUR Round University Ranking, 2023)

URAP (University Ranking by Academic Performance) is a university ranking system developed by Middle East Technical University (METU). URAP ranks universities using various performance criteria to compare them with other universities around the world. URAP's performance criteria include factors such as international scientific publications, number of citations, number of foreign researchers, number of international projects, and number of publications per faculty member. (METU, 2023)

2.3.2. University competence:

In Türkiye, competency analysis studies are conducted by individual companies and universities. TÜBİTAK initiated the competence survey of universities in 2016 and last updated and published the data in 2023. The purpose of this report is not to compare universities by sector. Graphs were created for the field data in Report 130. Reporting indicators are based on reporting, volume and quality indicators, where quality indicators have a weight of 60% and volume indicators have a weight of 40%. The report includes seven quality indicators with a total weight of 60%. The relative impact of attribution on the world; the number of university publications in the top 10% most cited in the world; the productivity of researchers' research work, the quality of research and development activities and innovative projects; Quality indicators include the number of cited patent publications and international collaborations and indicators related to the internationalization of our country/university. The volume meter has four indicators. These include contribution to the world knowledge base, the share of the critical mass that creates academic value in this field in Türkiye at this university, the number of R&D and innovation projects, and the university's relative focus on Türkiye. (TÜBİTAK, 2023).

3. METHOD

As explained above, the defense industry is an important sector that continues to grow in Türkiye and is supported by the state. As stated in the twelfth development plan, increasing the competencies of the defense industry is important for the stakeholders of the sector. In order to determine the competence levels of stakeholders who are aware of this importance, the Defense Industry Technology Taxonomy, which was prepared by the Presidency of the Defense Industry in order to determine the competence levels of the stakeholders, was published in 2020 under the name SSTT 2.0. Based on the idea of determining the competencies targeted in the eleventh development plan, the answer to the question of how competent our universities, which are among the defense industry stakeholders, are according to SSTT 2.0 was sought.

Relational survey model was used as the research model. In general terms, the survey model reveals the current situation as it exists. In the survey, the purpose of the research is expressed with question sentences. In the thesis, our aim was put forward with the question sentence “What are the competencies of universities in Turkey in the field of defense industry?”. In relational scanning, the connection between two variables is tried to be revealed. In this study, SSTT 2.0 and the publications of universities were matched (Karasar, 2018).

Scientific publications are reports of all kinds of scientific research and are evaluated by peer reviewers who are knowledgeable in the subject. (Tiryaki, 2014). If the project and research is completed, it is publishable (Çetinkaya, 2019). It can be said that there is a direct correlation between scientific explanations and publications and scientific progress. (Salgar, 2015). From this perspective, the publication output data of universities were taken to measure the competence in taxonomy definitions.

No sector-based study was conducted for universities. The competency index prepared by TÜBİTAK was prepared for general branches of Science, and it was evaluated that it did not meet the more detailed sub-definitions of a sector such as the defense industry, which needs every branch of Science. Universities need to know their competencies in order for graduates to find a job, to cooperate with SMEs, to provide experience, experience, contribution to scientific development and financial contribution for university and academic staff, and to assign tasks in SSB projects. In this context, the thesis titled "Analysis of Universities' Defense Industry Competence: The Case of Türkiye" will seek an answer to the question "What are the competencies of universities in Türkiye in the field of defense industry".

The thesis considers the number of articles published in Web of Science as the main data. Web of Science is recognized as a reliable data source in the academic world and the articles published on this platform represent the research outputs of universities.

The research is based on the Taxonomy 2.0 prepared by the Presidency of Defense Industry in 2020. The limitation of the research is that SSTT 2.0 is a dynamic publication. With SSTT 2.0;

- To characterize and classify defence technologies so that they can be more easily understood and compared by all stakeholders of the defence industry, such as industrial organizations, universities and public institutions,
- To be able to systematically identify the technologies needed when preparing project proposals for the domestic development of platforms and systems that will give our country technological superiority,
- Encouraging the use of a common term for technology forecasts, technology forecasts, technology roadmaps, determination of technology policies, investment and infrastructure needs to be carried out within the scope of technology management activities,
- The categorization of technologies is intended to provide a basis for determining the inventory of infrastructure, skills and human resources.

The SSTT 2.0 consists of three (A, B, C) first level breakdowns by 561 domain experts.

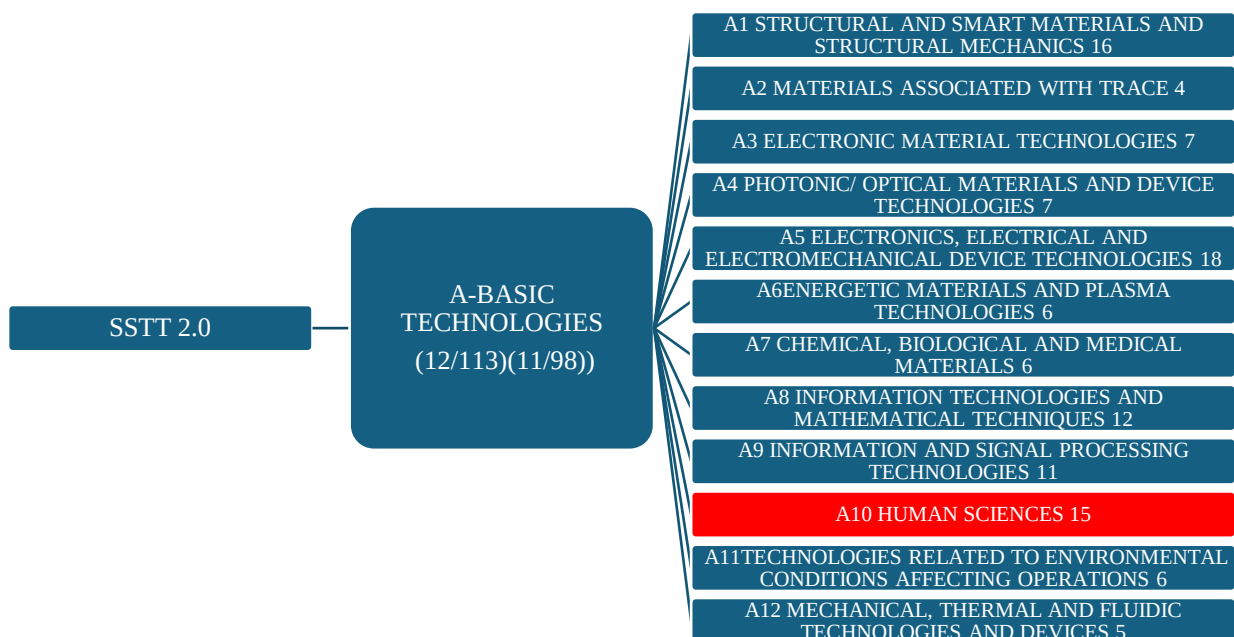


Figure 3.1. SSTT 2.0 “A” Main Area

The first level breakdown A is the basic technologies used in the defense industry and there are 13 second level breakdowns and 113 definitions related to them. When human sciences, which are humanities shown in red, are excluded, 98 definitions were analyzed in 11 second level breakdowns.

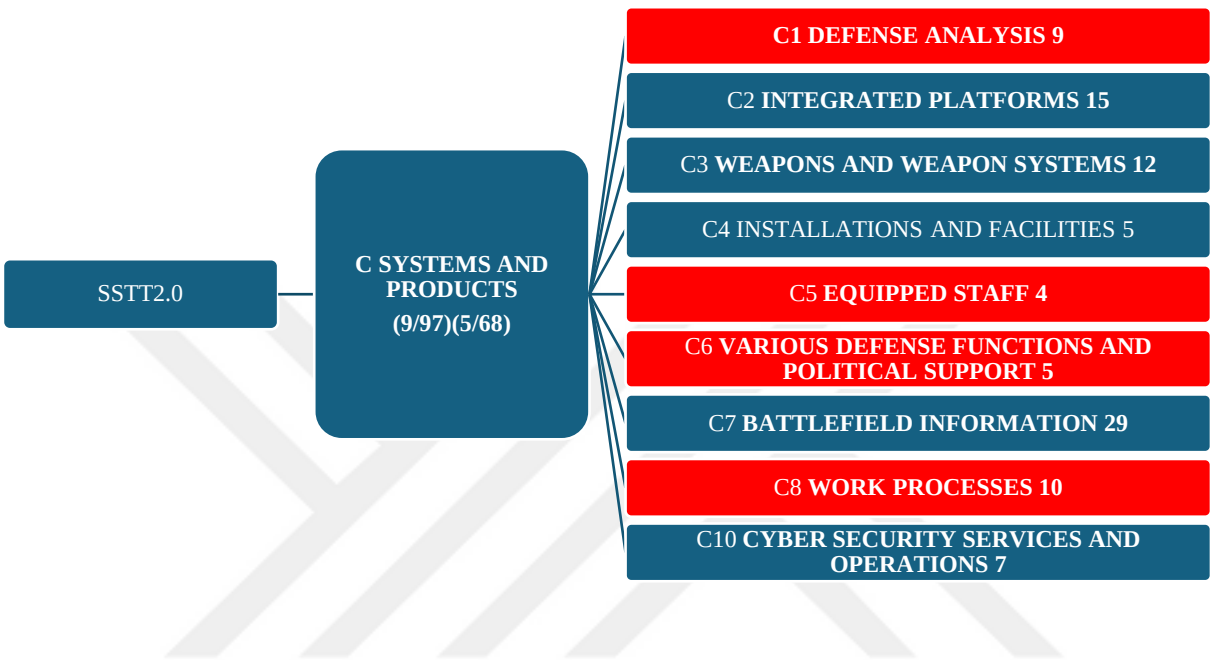


Figure 3.2. SSTT 2.0 “B” Main Area

The first level breakdown B is the basic technologies used in the defense industry, and there are 10 second level breakdowns and 156 related definitions.

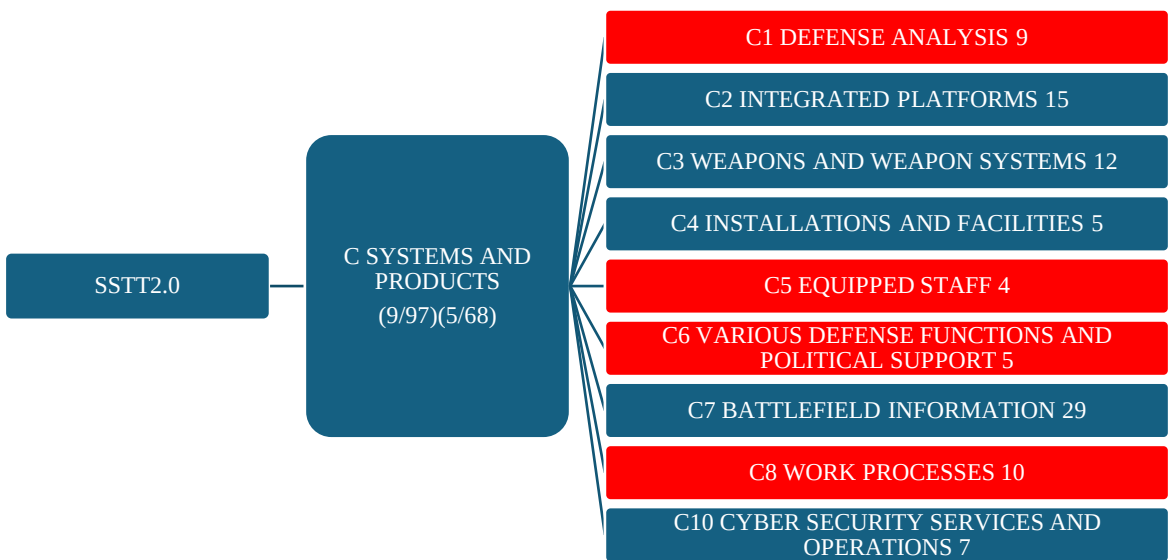


Figure 3.3. SSTT 2.0 “C” Main Area

The first level breakdown C is the basic technologies used in the defense industry and there are 10 second level breakdowns and 105 definitions related to them. When the humanities shown in red are excluded, 68 definitions were analyzed in five second level breakdowns.

In total, Web of Science (WoS) was searched for a total of 375 definitions in three first-level categories and 35 second-level categories. The definition title was used as the keyword in the search. In the search results, 305,568 publications were identified. This number was used as the general total in all analyzes and calculations. Since B04.08 and B04.15 were searched with the keyword “Communications”, the results were combined under the definition of B04.08.

The taxonomy was compared with the product catalog of the Presidency of Defense Industry by a committee consisting of one system engineer, one industrial engineer, four mechanical engineers, two electrical and electronics engineers, three mechatronics engineers and two computer engineers.

With this comparison, out of the 375 definitions that make up the taxonomy, 5,526 publications belonging to the A10 second level breakdown, 1,485 publications belonging to the C1 breakdown, 15,476 publications belonging to the C5 breakdown, 12,936 publications belonging to the C6 breakdown, and 2991 publications belonging to the C8 breakdown, 37,714 publications were excluded from the analysis since they constitute humanities and do not directly benefit in the production and development of defense industry products, and the analysis was made on 267,152 publications. Comparison results and taxonomy main breakdowns are in Annex-1.

The other data source is publications by universities. Publications include the number of publications within the scope of the SSB taxonomy and the total number of fields in which publications were made within the taxonomic categorization.

Higher Education Council (YÖK) records of 209 universities and colleges were taken. During the research, Ankara Music and Fine Arts University and four colleges (Istanbul Vocational School of Health and Social Sciences, Istanbul Şişli Vocational School, Ataşehir Adıgüzel Vocational School, Izmir Kavram Vocational School) that did not have a faculty with the Defense Industry were excluded from the list.

By analyzing the information received, the adequacy of the SSTT 2.0 Level 2 specifications was assessed at this stage. A spread was created from the data. A scatter plot uses a series of points positioned using Cartesian coordinates to display the values of two variables. By showing

one variable on each axis, you can determine whether there is a relationship or correlation between two variables (Dağılım Grafiği, 2024). It was analyzed by the following method.

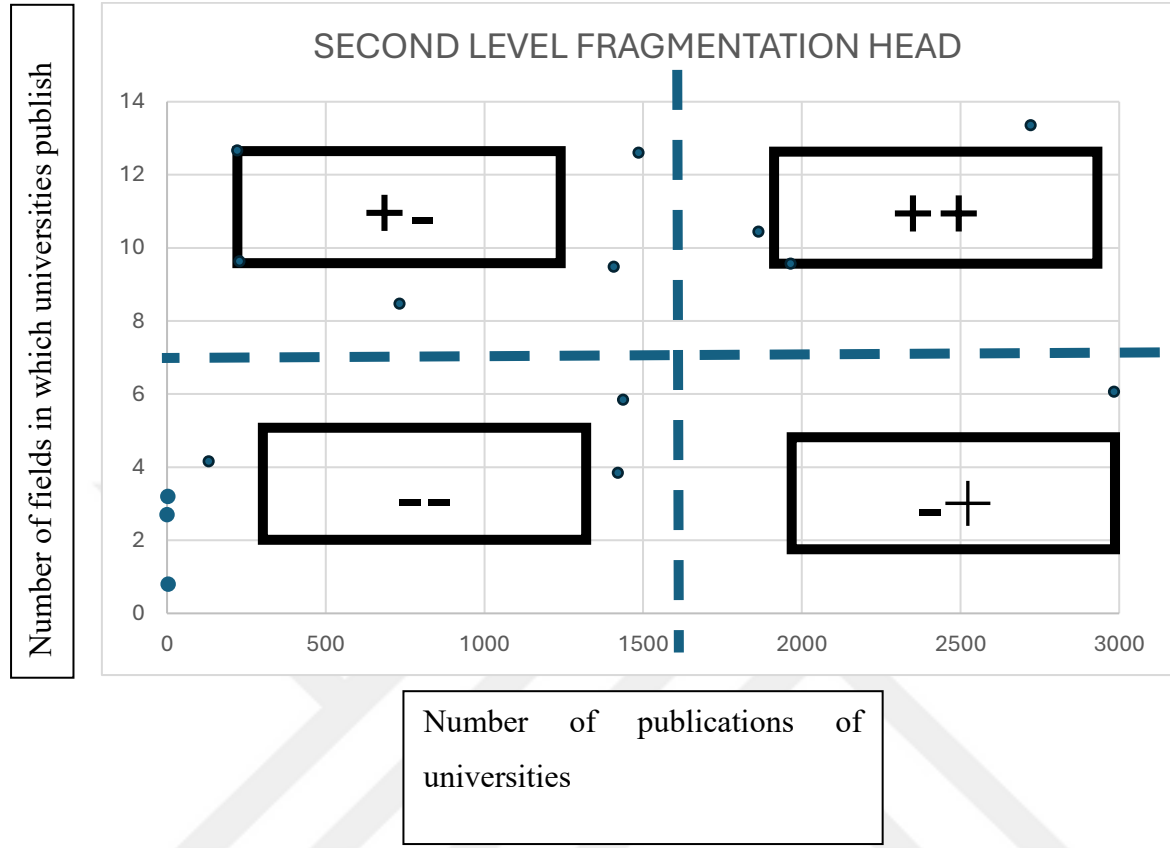


Figure 3.4. Scatter Plot Analysis Method

In the graph, the horizontal axis (X axis) shows the number of publications of universities and the vertical axis (Y axis) shows the number of fields in which universities publish. The graph is divided into four sections by cutting the axes at the median value. The universities in the section on the upper right side of the scatter plot and indicated with "++" are considered to be sufficient in this field and only this section is shown in the graph. The names of the universities that need to increase the number of Field "+-" and Publication "-+" are written as text at the bottom of the graph.

4. RESEARCH and ANALYSIS

Below are the graphs for the three main taxonomy breakdowns and 30 second order breakdowns.

4.1. Adequacy of universities by field:

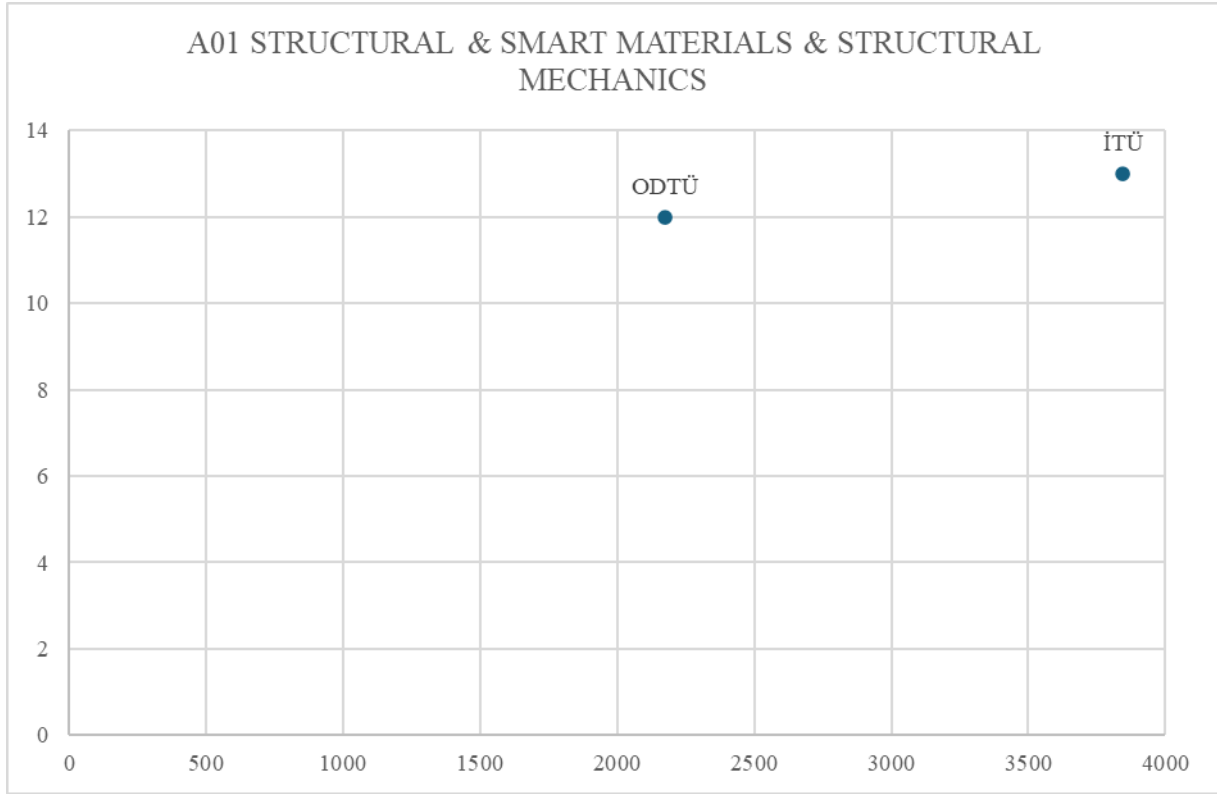


Figure 4.1. A1 Structural and Smart Materials and Structural Mechanics Area Competency Graphic

A1 In the field of structural and smart materials and structural mechanics proficiency, Gazi, Yıldız Technical, Atatürk, Marmara, Sakarya, Gebze Technical, Boğaziçi, Dokuz Eylül, Fırat, Ankara, 18 Mart, İstanbul, Eskişehir Osmangazi, Kocaeli, Koç, Sabancı, Karadeniz Technical, Bilkent, Hacettepe, İzmir Institute of Technology, Anadolu, Selçuk, Çukurova, Ege, 19 Mayıs, Süleyman Demirel, Pamukkale, İnönü, Kırıkkale, Karabük, Erciyes, Mersin, Afyon Kocatepe, Bursa Teknik, Manisa Celâl Bayar, Bolu Abant İzzet Baysal, Balıkesir, Sivas Cumhuriyet, Bartın, Yalova, Dicle, Gaziantep, Aksaray, İzmir Katip Çelebi, Van Yüzüncü Yıl, Kütahya Dumlupınar, Hitit, İstanbul-Cerrahpaşa, Karamanoğlu Mehmetbey, Necmettin Erbakan, Muğla Sıtkı Koçman, Düzce, Tekirdağ Namık Kemal, TOBB Economy and Technology, Atılım, Harran, Recep Tayyip Erdoğan, Bursa Uludağ, Eskişehir Teknik, Zonguldak Bülent Ecevit,

Trakya, Erzurum Teknik, Aydın Adnan Menderes, Bilecik Şeyh Edebali, Akdeniz, Erzincan Binali Yıldırım, Konya Teknik, Bahçeşehir, Bingöl, Adana Alparslan Türkeş, Hatay Mustafa Kemal, İskenderun Teknik, Uşak, Yeditepe, Abdullah Gül, Kastamonu, Özyeğin, Munzur, Niğde Ömer Halisdemir, Giresun, Kafkas, Burdur Mehmet Akif Ersoy, İstinye, Ankara Yıldırım Beyazıt, Sinop, Osmaniye Korkut Ata, Çankaya, Kırklareli, Adıyaman, Fatih Sultan Mehmet Vakıf, Nevşehir Hacı Bektaş Veli, Sakarya Applied Sciences, Gümüşhane, Sütçü İmam, İstanbul Gedik, Hakkari, Başkent, Nişantaşı Universities are sufficient in the number of fields and it would be beneficial to increase the number of publications. The sub-field with the highest number of publications is A1.3 Polymers and Polymer Matrix Composite Technologies and 18 Mart, Gazi, Istanbul Technical, Middle East Technical, Yıldız Technical are the five universities with the highest number of publications.

A2 In the field of materials related to trace competence; since there are 37 publications by 10 universities in two fields, it is beneficial for all universities to increase the number of publications and fields for this breakdown.

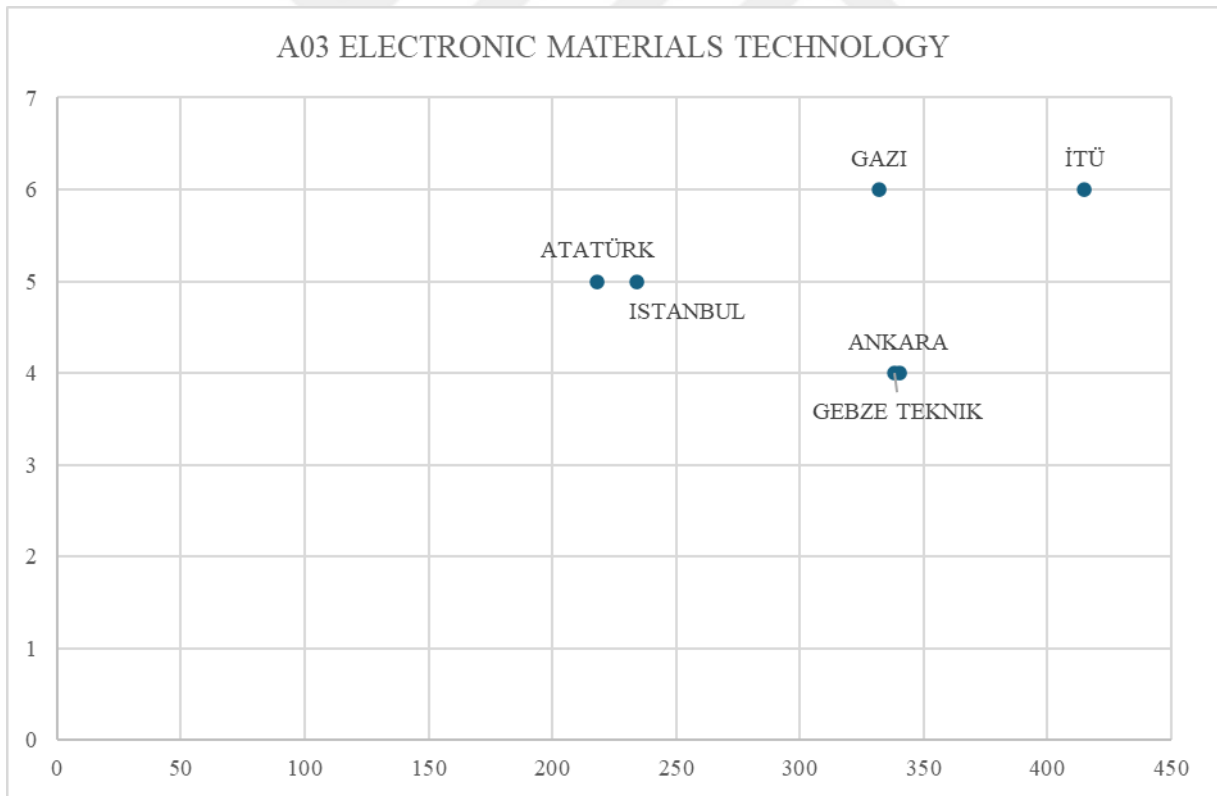


Figure 4.2. A3 Electronic Material Technologies Area Competency Graphic

A3 Electronic materials technologies area sufficiency Ege and 9 Eylül Universities, Izmir Institute of Technology, Adana Alparslan Türkeş Science and Technology, Çanakkale On sekiz

Mart, İstinye, Manisa Celâl Bayar, Selçuk, TOBB Economy and Technology, Trakya, Üsküdar, İzmir Institute of Technology, İzmir Institute of Technology, Çanakkale On sekiz Mart, İstinye, Manisa Celâl Bayar, Selçuk, TOBB Economy and Technology, Trakya, TOBB Economy and Technology, Üsküdar. The sub-field with the highest number of publications is A3.7 Magnetic Materials and Ankara, Gazi, Gebze Technical, Istanbul Technical, Istanbul universities are the five universities with the highest number of publications in this field.

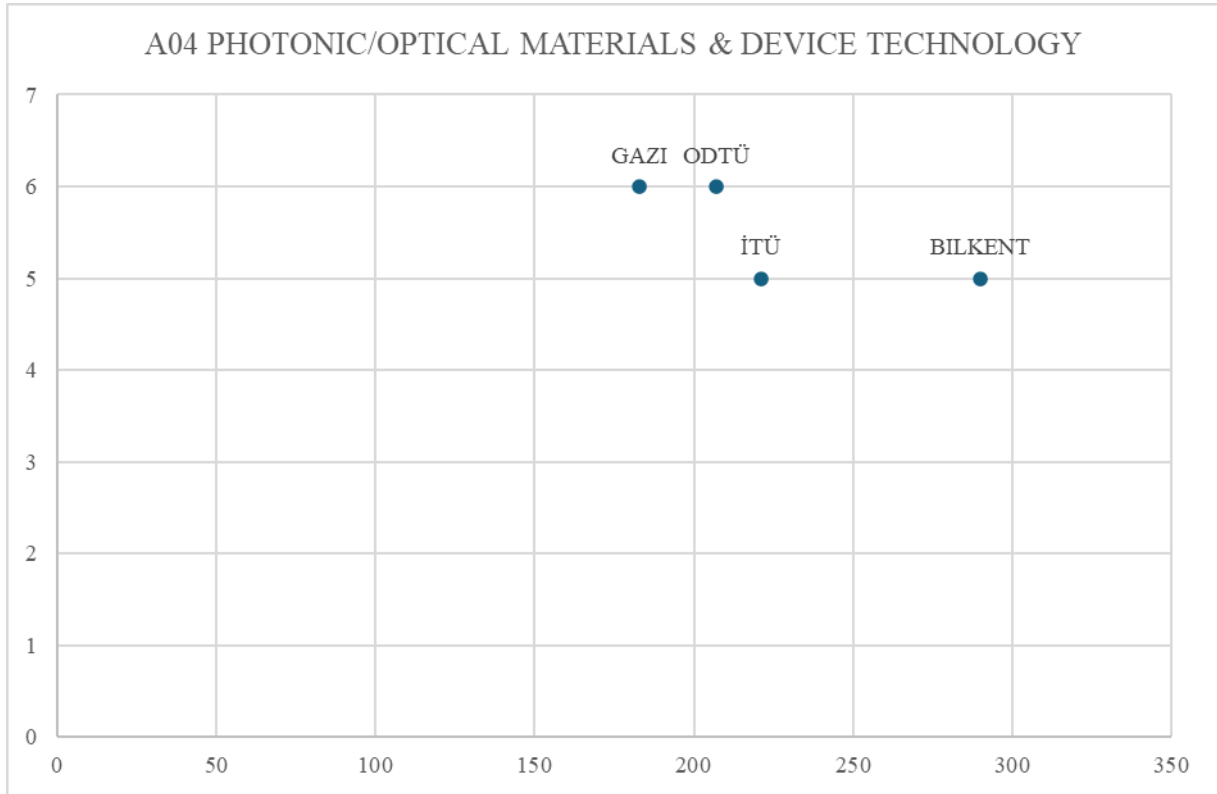


Figure 4.3. A4 Photonics/Optical Materials and Device Technologies Area Competency Graphic

Koç, Ankara, Ege, Yıldız Technical, Atatürk, Marmara, Erciyes, Fırat, Boğaziçi, Selçuk, TOBB Economy and Technology, Sakarya, Sabancı, Çukurova, Süleyman Demirel, Gebze Technical, Akdeniz, Aydın Adnan Menderes, Sivas Cumhuriyet, Dokuz Eylül, Başkent, Hatay Mustafa Kemal, Eskişehir Osmangazi, Bursa Uludağ, Bingöl, Mersin, Kafkas universities should increase the number of publications. The sub-area with the highest number of publications is A4.4 Instrumentation Materials and Instruments, and Gas, Ihsan Doğramacı Bilkent, Istanbul Technical, Istanbul, Middle East Technical Universities are the five universities with the highest number of publications in this sub-area.

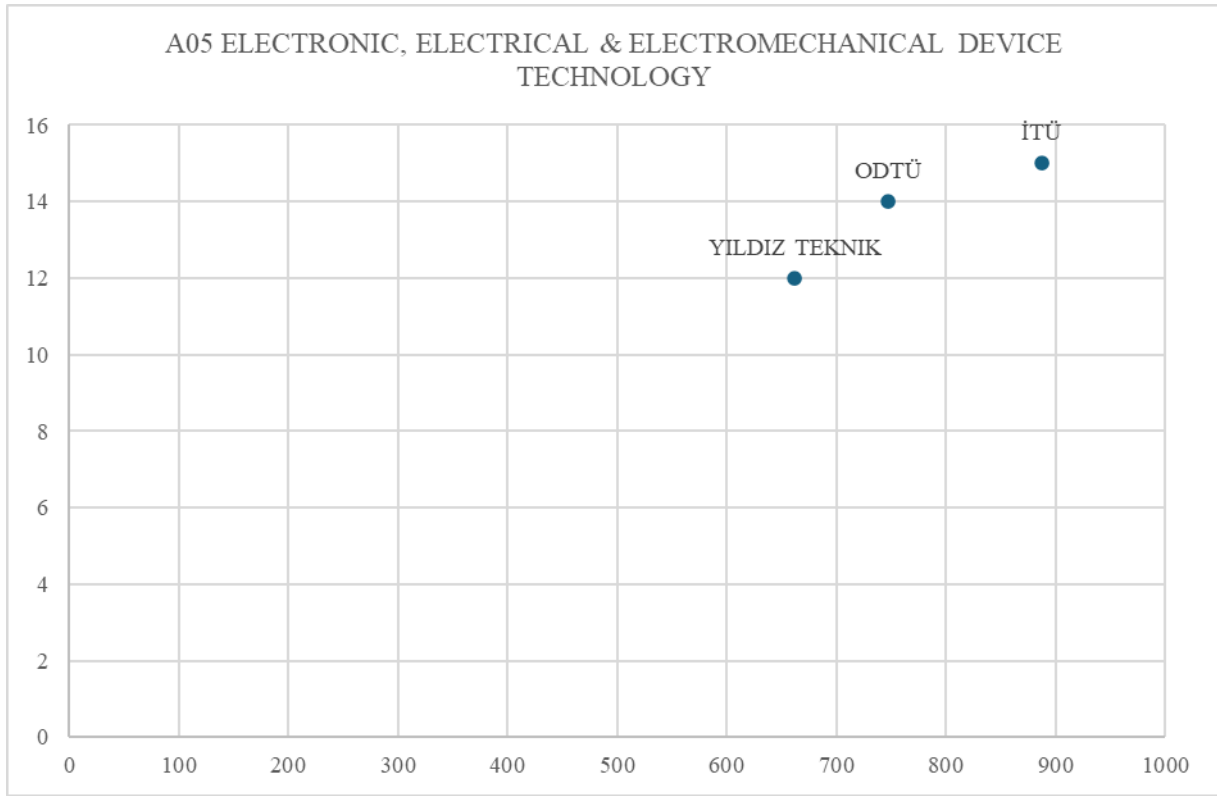


Figure 4.4. A5 Electronic, Electrical and Electromechanical Device Technologies Area Qualification Graphic

A5 Proficiency in electronic, electrical and electromechanical device technologies Gazi, İhsan Doğramacı Bilkent, İstanbul, Marmara, Pamukkale, Fırat, Kocaeli, Selçuk, Koç, Sabancı, Hacettepe, Dokuz Eylül, Karabük, Sakarya, Karadeniz Technical, Ege, Ankara, Boğaziçi, Niğde Ömer Halisdemir, Gaziantep, Gebze Technical, Düzce, Çukurova, Atatürk, Akdeniz, TOBB Economy and Technology, Süleyman Demirel, Özyeğin, Erciyes, Atılım, Bursa Uludağ, Bahçeşehir, İskenderun Teknik, Ondokuz Mayıs, Mersin, Eskişehir Osmangazi, İstanbul-Cerrahpaşa, İzmir Institute of Technology, İzmir Katip Çelebi should increase the number of publications. The sub-field with the highest number of publications is A5.16 Electronic Component Technologies and Istanbul Technical, Middle East Technical, İhsan Doğramacı Bilkent, Yıldız Technical, Istanbul, Pamukkale universities are the five universities with the highest number of publications in this field.

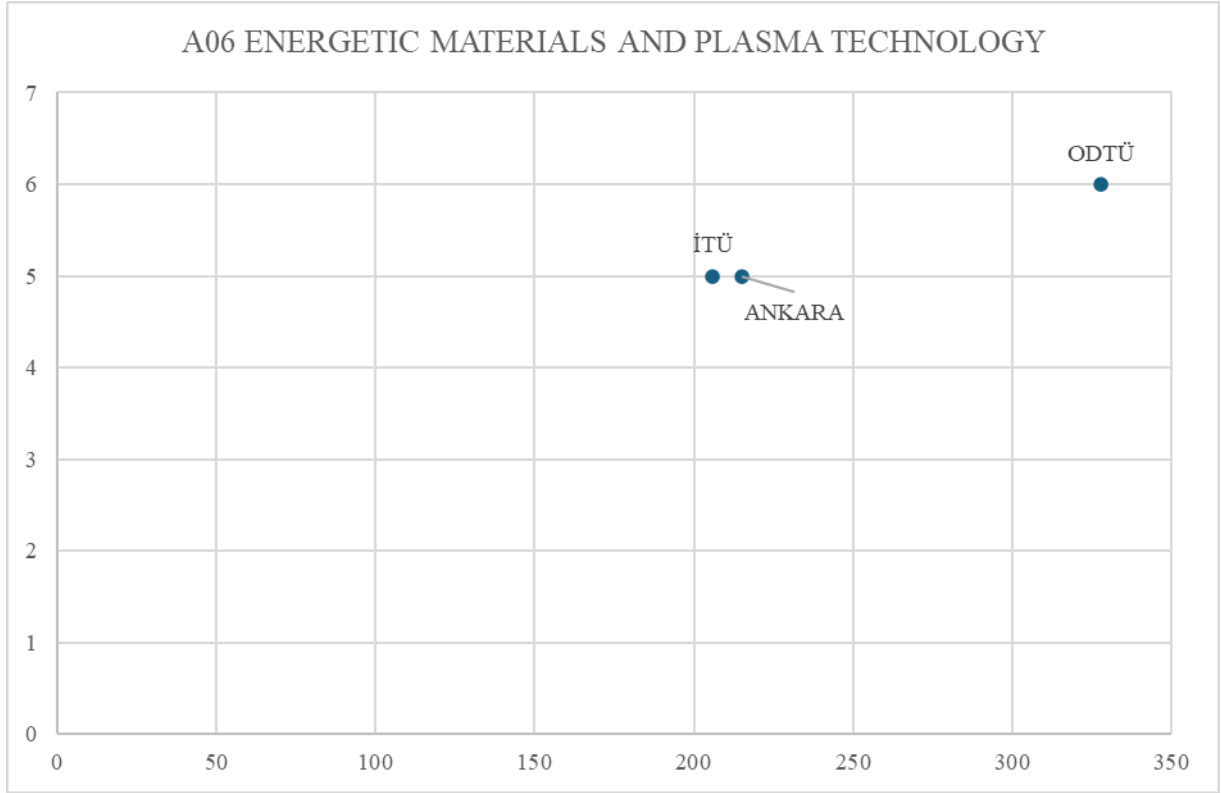


Figure 4.5. A6 Energetic Materials and Plasma Technologies Area Competency Graph

In A6 Energetic materials and plasma technologies, it would be beneficial for Istanbul, Gazi, Boğaziçi, Hacettepe, Istanbul-Cerrahpaşa, Sabancı universities to increase the number of publications. The sub-field with the highest number of publications is A6.5 Plasma Techniques and Ankara, Middle East Technical, Istanbul Technical, Istanbul, Marmara universities are the five universities with the highest number of publications in this field.

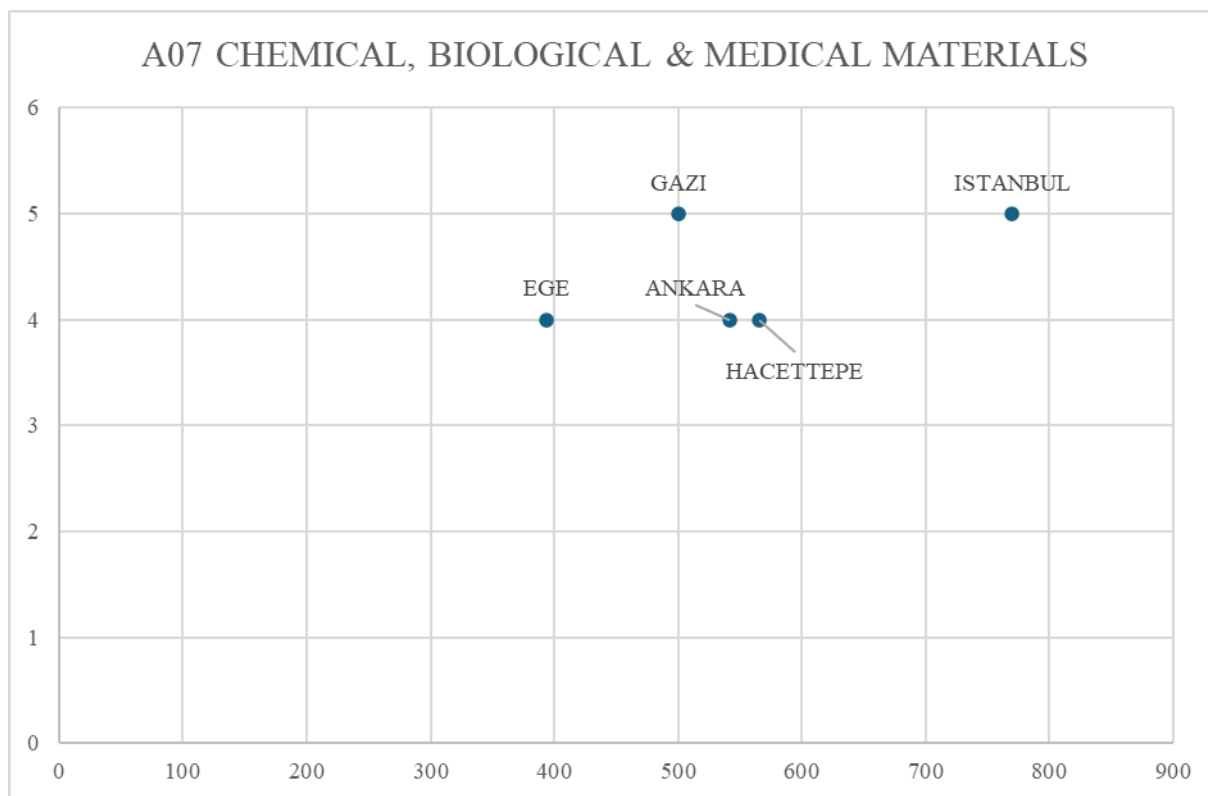


Figure 4.6. A7 Chemical Biological and Medical Materials Area Qualification Graphic

Erciyes, Bursa Uludağ, Dokuz Eylül, Aydın Adnan Menderes, Aydın Adnan Menderes, Health Sciences, Mersin, Koç, Çanakkale Onsekiz Mart, Middle East Technical, Mersin, Koç, Çanakkale Onsekiz Mart, Middle East Technical would benefit from increasing the number of publications in A7 Chemical Biological and Medical Materials. The sub-area with the highest number of publications is A7.6 Medical Products and Materials and Istanbul, Hacettepe, Ankara, Gas, Ege, Ege universities are the five universities with the highest number of publications in this field.

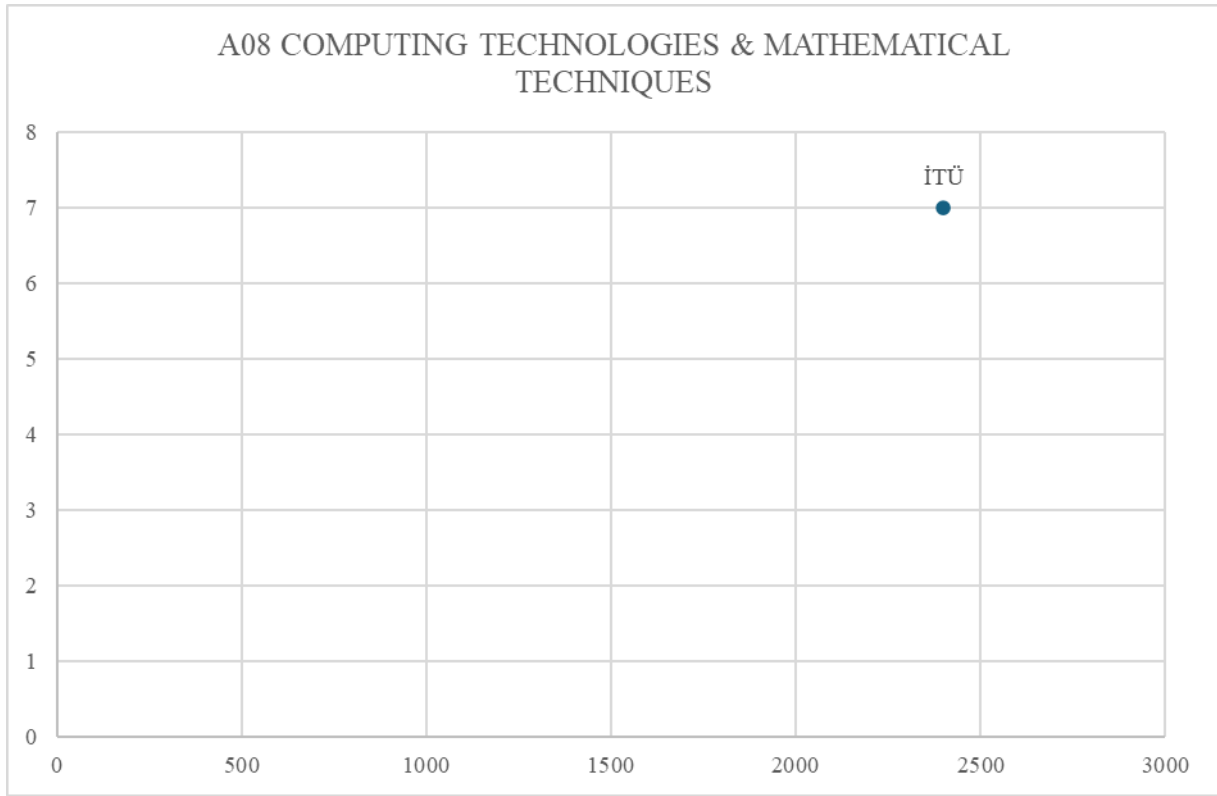


Figure 4.7. A8 Information Technologies and Mathematical Techniques Area Competency Graphic

Izmir Institute of Technology, Boğaziçi, Middle East Technical, Ankara, Gazi, Fırat, Karadeniz Technical, İhsan Doğramacı Bilkent, Ege, Dokuz Eylül, Koç, Hacettepe, Kocaeli, Marmara, TOBB Economics and Technology, Manisa Celâl Bayar, Erciyes, Süleyman Demirel, Bursa Uludağ, Anadolu, Zonguldak Bülent Ecevit universities should increase their number of publications. The sub-area with the highest number of publications is A8.1 Software Engineering, and Middle East Technical, Fırat, Yıldız Technical, Gazi and Boğaziçi universities are the five universities with the highest number of publications in this sub-area.

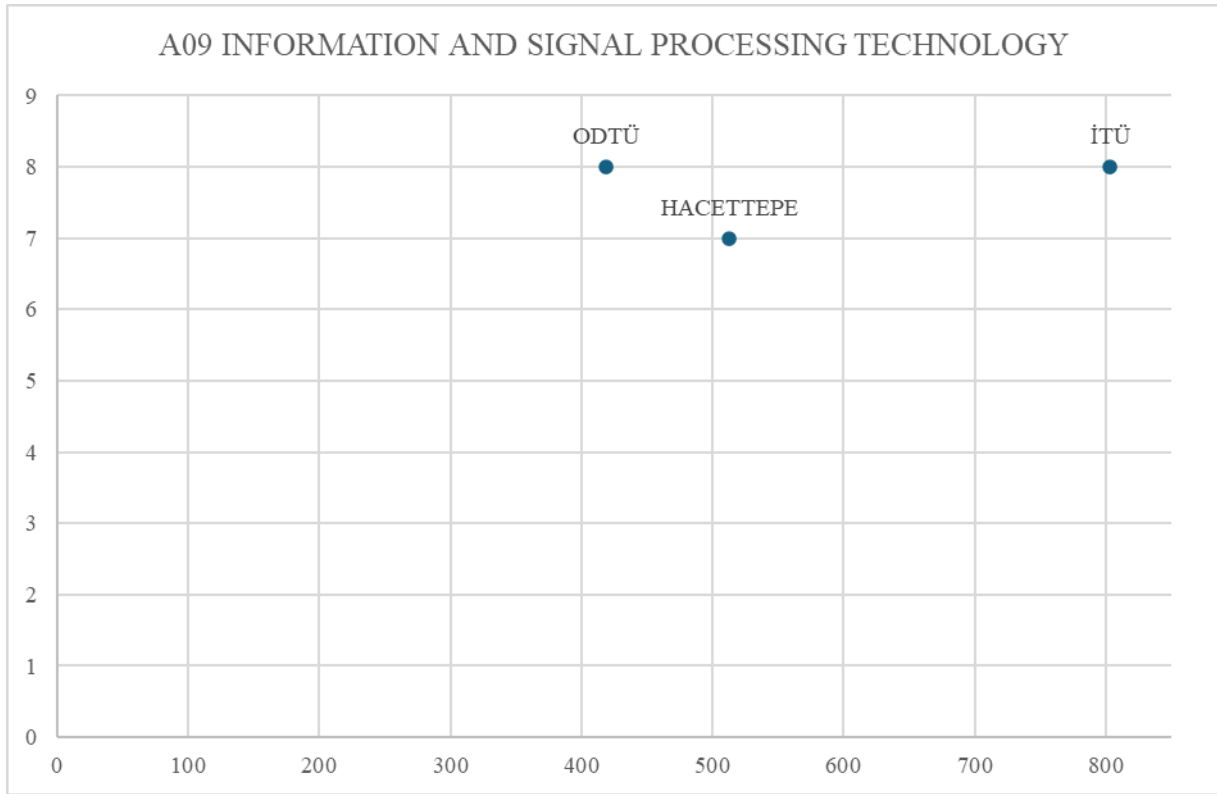


Figure 4.8. A9 Information and Signal Processing Technologies Area Competency Graphic

A9 In the field of information and signal processing technology competency, Boğaziçi, Karadeniz Technical, Ankara, İhsan Doğramacı Bilkent, Yıldız Technical, İstanbul, Ege, Dokuz Eylül, Fırat, Koç, Gazi, Akdeniz, Kocaeli, İzmir Economy, Çukurova, TOBB Economy and Technology, Selçuk, Sabancı, Anadolu, İstanbul-Cerrahpaşa, Bahçeşehir, Marmara, Atatürk, Sakarya, Gebze Technical, Süleyman Demirel, On dokuz Mayıs, Gaziantep, Atılım, Bursa Uludağ, Eskişehir Osmangazi, Başkent, Erciyes, İnönü, Düzce, Özyeğin, Pamukkale, Ankara Yıldırım Beyazıt, Zonguldak Bülent Ecevit, Manisa Celâl Bayar, Mersin, İzmir Katip Çelebi, İstanbul Medipol, Necmettin Erbakan, Kadir Has, Kahramanmaraş Sütçü İmam, İstanbul Aydın, İstanbul Bilgi, İzmir Institute of Technology would benefit from increasing their publication numbers. The sub-area with the highest number of publications is A9.1 Data & Information Management Technology and Istanbul Technical, Hacettepe, Istanbul, Ege, Ankara universities are the five universities with the highest number of publications in this sub-area.

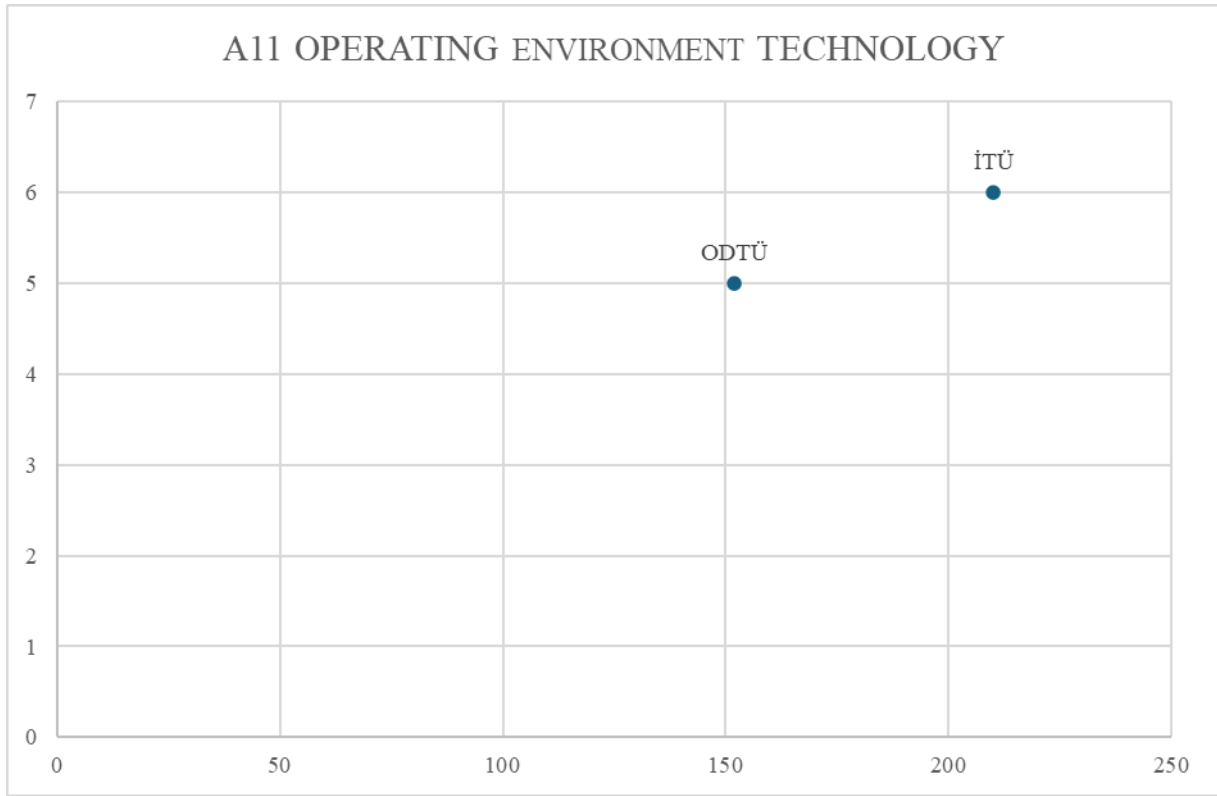


Figure 4.9. A11 Technologies Related to Environmental Conditions Affecting Operations
Area Competency Graphic

Gebze Technical, Istanbul, Yıldız Technical, Dokuz Eylül, Çukurova, Ankara, Marmara, Sabancı, Ege, Selçuk, Gazi, Pamukkale, Ankara, Marmara, Sabancı, Ege, Selçuk, Gazi, Pamukkale universities should increase the number of publications in the A11 Technologies related to environmental conditions affecting operations. The sub-field with the highest number of publications is A11.6 Electromagnetic Propagation of Air and Water and Ihsan Doğramacı Bilkent, Istanbul Technical, Doğuş, Gebze Technical, Çankaya universities are the five universities with the highest number of publications in this field.

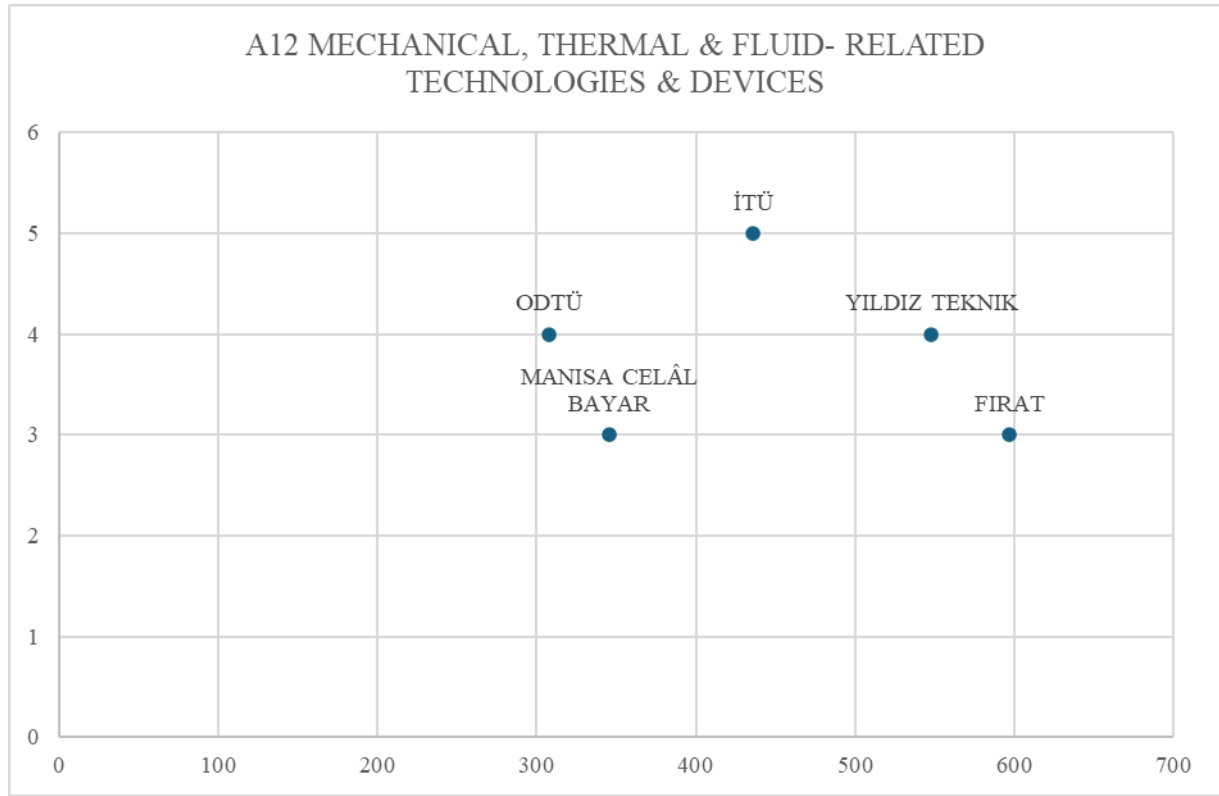


Figure 4.10. A12 Mechanical, Thermal and Fluid-Related Technologies and Devices Area Competency Graphic

A12 In the field of mechanical, thermal and fluid technologies and devices, Karadeniz Technical, Koç, Erciyes, Sakarya, Gazi, Dokuz Eylül, Çukurova, Atatürk, Ege, Karabük, İzmir Institute of Technology, Marmara, Sabancı, Çankaya, Boğaziçi, Hacettepe, Eskişehir Osmangazi, Süleyman Demirel, Gaziantep, Niğde Ömer Halisdemir, Bursa Uludağ, Selçuk, Yeditepe, Gebze Technical, İstanbul, Kocaeli, Adana Alparslan Türkeş Science and Technology, Van Yüzüncü Yıl, Akdeniz, Mersin, Necmettin Erbakan, Anadolu, Osmaniye Korkut Ata, İhsan Doğramacı Bilkent, Düzce, Kütahya Dumlupınar, Kırıkkale, Bartın, Pamukkale, Zonguldak Bülent Ecevit, İzmir Katip Çelebi, Bursa Teknik, Sivas Cumhuriyet, Trakya, Ankara Yıldırım Beyazıt, İnönü, On dokuz Mayıs, İskenderun Teknik, Aydın Adnan Menderes, Munzur, İstanbul Aydın, Bayburt, Hitit, Konya Technical, Atılım, Bahçeşehir, Başkent, Siirt, İstinye, Gümüşhane, Batman, Dicle, Erzincan Binali Yıldırım, Kahramanmaraş Sütçü İmam, Karamanoğlu Mehmet Bey, Bingöl universities should increase the number of publications. The sub-field with the highest number of publications is A12.4 Fluid Mechanics - Phenomenological and Experimental definition and Fırat, İstanbul Technical, Yıldız Technical, Manisa Celâl Bayar, Middle East Technical Universities are the five universities with the highest number of publications in this field.

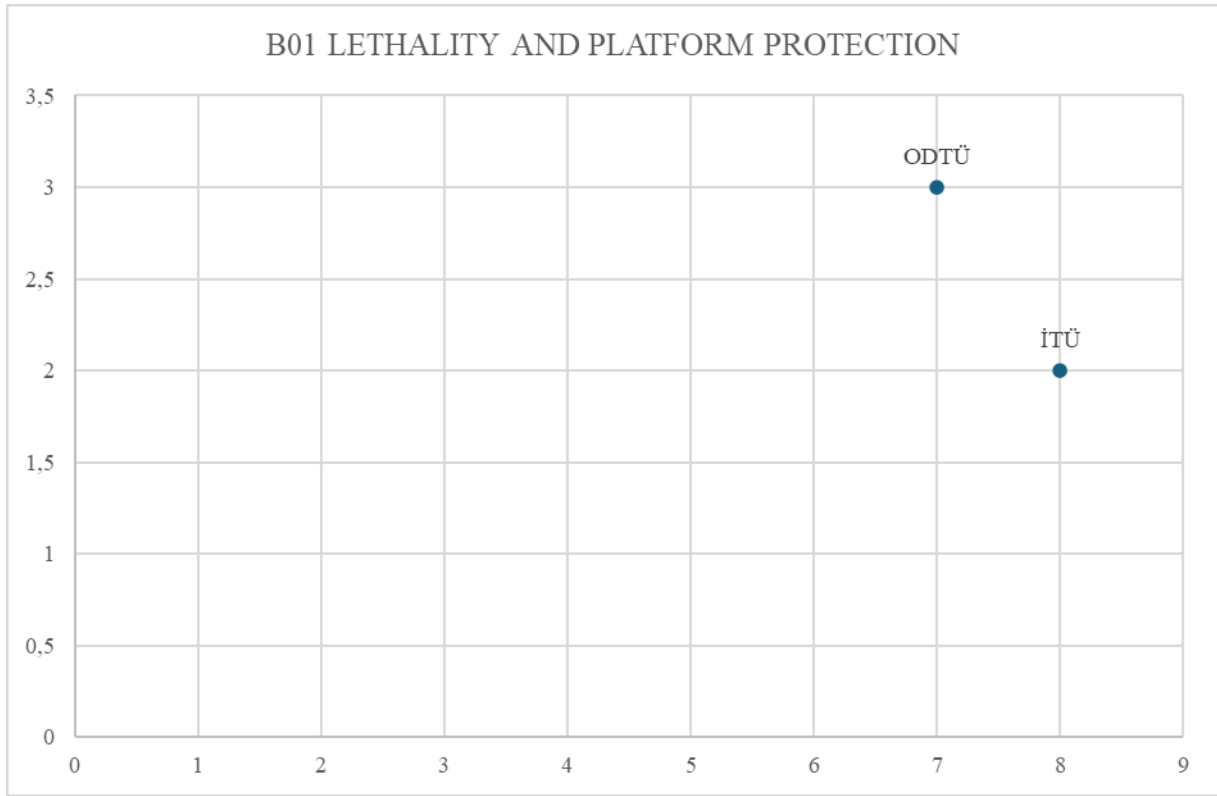


Figure 4.11. B1 Lethality and Platform Protection Area Competency Graphic

Although there are very few publications in B1 lethality and platform protection area adequacy in general, Yıldız Technical, Koç, Gazi, TOBB Economy and Technology, Trakya, Dokuz Eylül, Marmara, Hacettepe, Gebze Technical, Erciyes, Ankara, Ege, İzmir Institute of Technology, Çankaya, İstanbul, Afyon Kocatepe, Akdeniz, Anadolu, Osmaniye Korkut Ata, Atılım, Başkent universities should increase the number of publications and areas.

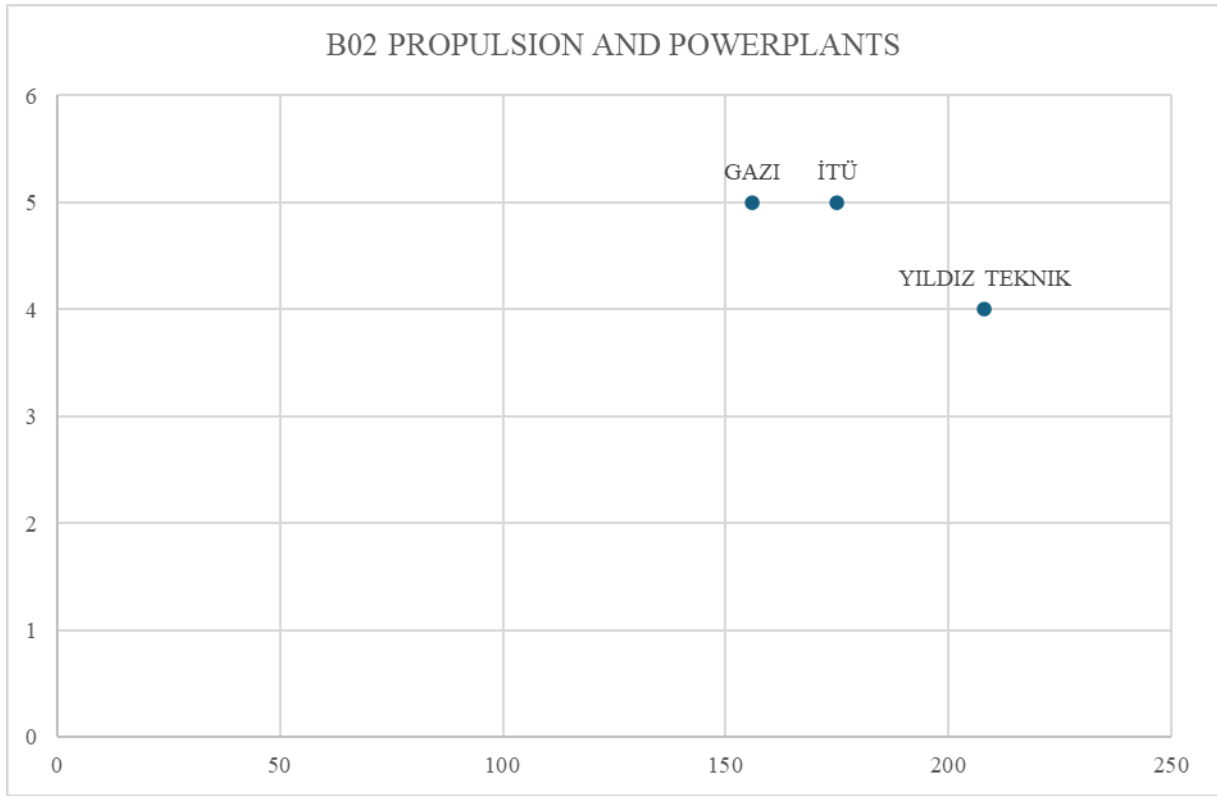


Figure 4.12. B2 Propulsion and Power Systems Area Qualification Graphic

Middle East Technical, Sakarya, Anadolu, Fırat, Karabük, Düzce, Kocaeli, Karadeniz Technical, Hacettepe, Süleyman Demirel, Erciyes, Eskişehir Technical, Isparta Applied Sciences, Sabancı, Gebze Technical, Atatürk, Ankara Yıldırım Beyazıt, İstanbul, Bursa Uludağ, Uşak, Koç, Eskişehir Osmangazi, Marmara, Özyeğin, Dokuz Eylül, Akdeniz, İstanbul-Cerrahpaşa, Necmettin Erbakan, Zonguldak Bülent Ecevit, Kastamonu, Erzincan Binali Yıldırım universities should increase the number of publications. The sub-field with the highest number of publications is B2.13 Hybrid Power Systems, and Yıldız Technical, Gas, Istanbul Technical, Ege, Düzce universities are the five universities with the highest number of publications in this field.

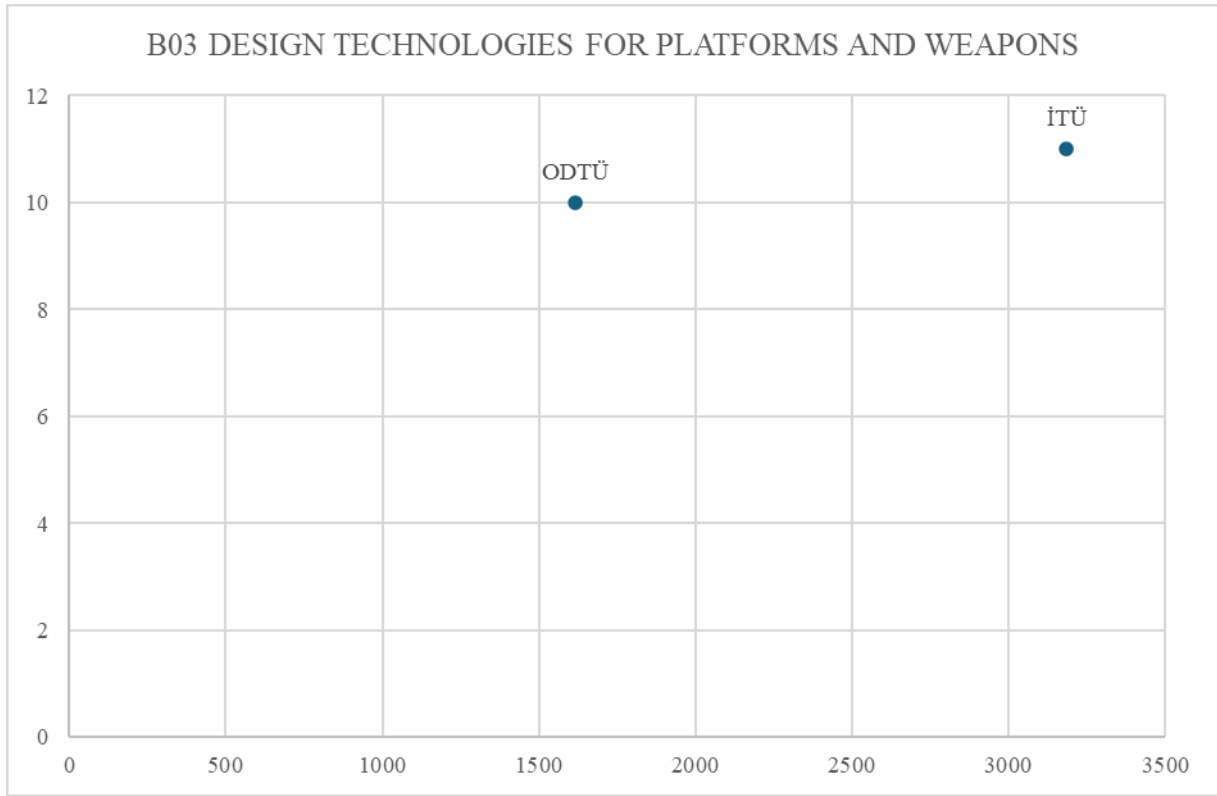


Figure 4.13. B3 Design Technologies for Platforms and Weapons Area Competency Graphic

B3 In the field of design technologies for platforms and weapons, Yıldız Technical, Gazi, İhsan Doğramacı Bilkent, Hacettepe, Erciyes, Kocaeli, İstanbul, Koç, Fırat, TOBB Economy and Technology, Karadeniz Technical, Boğaziçi, Marmara, Atatürk, Sabancı, Bursa Uludağ, Ege, Dokuz Eylül, Sakarya, Ankara, Pamukkale, İzmir Institute of Technology, Özyeğin, Karabük, Eskişehir Osmangazi, Çukurova, Selçuk, Akdeniz, Niğde Ömer Halisdemir, Gaziantep, Atılım, İnönü, Süleyman Demirel, İskenderun Teknik, On dokuz Mayıs, Gebze Teknik, Ankara Yıldırım Beyazıt, Bahçeşehir, Trakya, Balıkesir, Düzce, Manisa Celal Bayar, Karamanoğlu Mehmet Bey, Aksaray, Yeditepe, İzmir Katip Çelebi, Bursa Teknik, Zonguldak Bülent Ecevit, Başkent, İstanbul-Cerrahpaşa, Kahramanmaraş Sütçü İmam, Necmettin Erbakan, Hatay Mustafa Kemal, Afyon Kocatepe, İstanbul Bilgi, Anadolu, Bolu Abant İzzet Baysal, Bitlis Eren should increase the number of publications. The sub-field with the highest number of publications is B3.4 Mechanical Design, and Istanbul Technical, Middle East Technical, Yıldız Technical, Gazi, Bursa Uludağ universities are the five universities with the highest number of publications in this field.

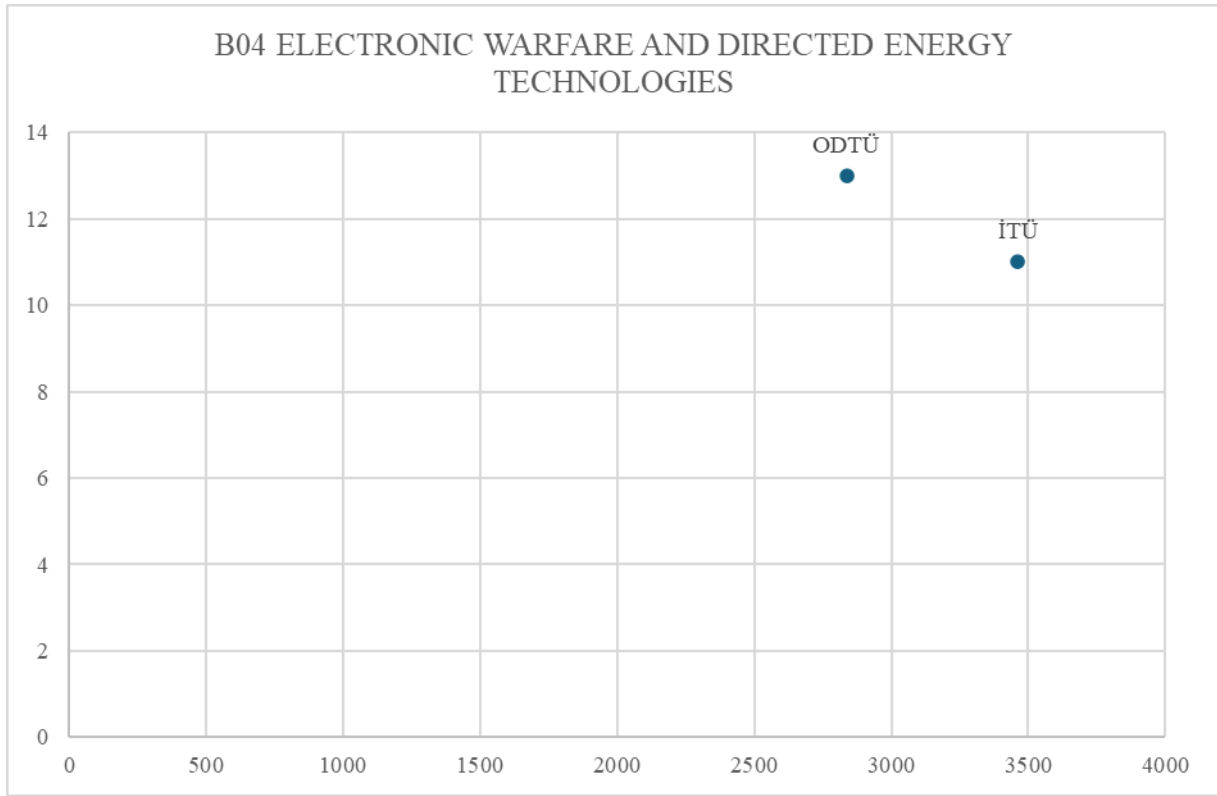


Figure 4.14. B4 Electronic Warfare and Directed Energy Technologies Area Competency Graphic

B4 In the field of electronic warfare and directed energy technologies, İhsan Doğramacı Bilkent, Erciyes, Yıldız Technical, İstanbul, Koç, Fırat, Gebze Technical, Dokuz Eylül, Karadeniz Technical, Kocaeli, Anadolu, Ankara, Sakarya, Sabancı, Hacettepe, İstanbul-Cerrahpaşa, Selçuk, Gazi, Çankaya, Çukurova, Marmara, Bursa Uludağ, Süleyman Demirel, Akdeniz, İzmir Institute of Technology, Boğaziçi, Gaziantep, Başkent, TOBB Economics and Technology, Bahçeşehir, Zonguldak Bülent Ecevit, Atılım, Ege, Atatürk, Pamukkale, Karabük, İstanbul Bilgi, Sivas Cumhuriyet, Özyeğin, On dokuz Mayıs, Manisa Celal Bayar, Çanakkale On sekiz Mart, Kırıkkale, Kırşehir Ahi Evran, Hitit, Abdullah Gül universities should increase their number of publications. The sub-area with the highest number of publications is B4.8 Electronic Support Measures - Communication and İstanbul Technical, Middle East Technical, Erciyes, İstanbul, Koç Universities are the five universities with the highest number of publications in this sub-area.

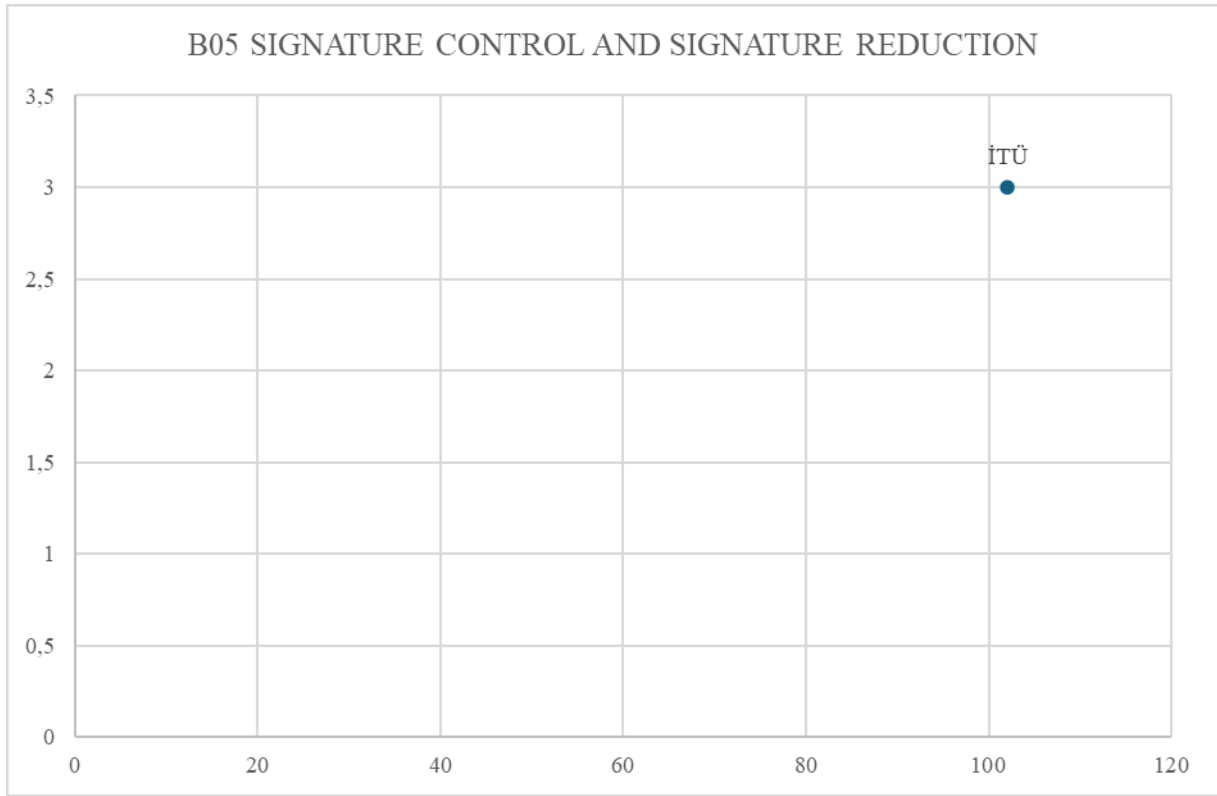


Figure 4.15. B5 Trace Control and Trace Reduction Area Proficiency Graphic

It would be beneficial for Çukurova, Adıyaman, Boğaziçi, Kafkas, Middle East Technical and İhsan Doğramacı Bilkent Universities to increase their number of publications in the field of B5 Trace control and trace reduction. The sub-field with the highest number of publications is B5.4 Infrared Traces and Boğazcı, Istanbul Technical, Çukurova, Kafkas, Adıyaman universities are the five universities with the highest number of publications in this field.

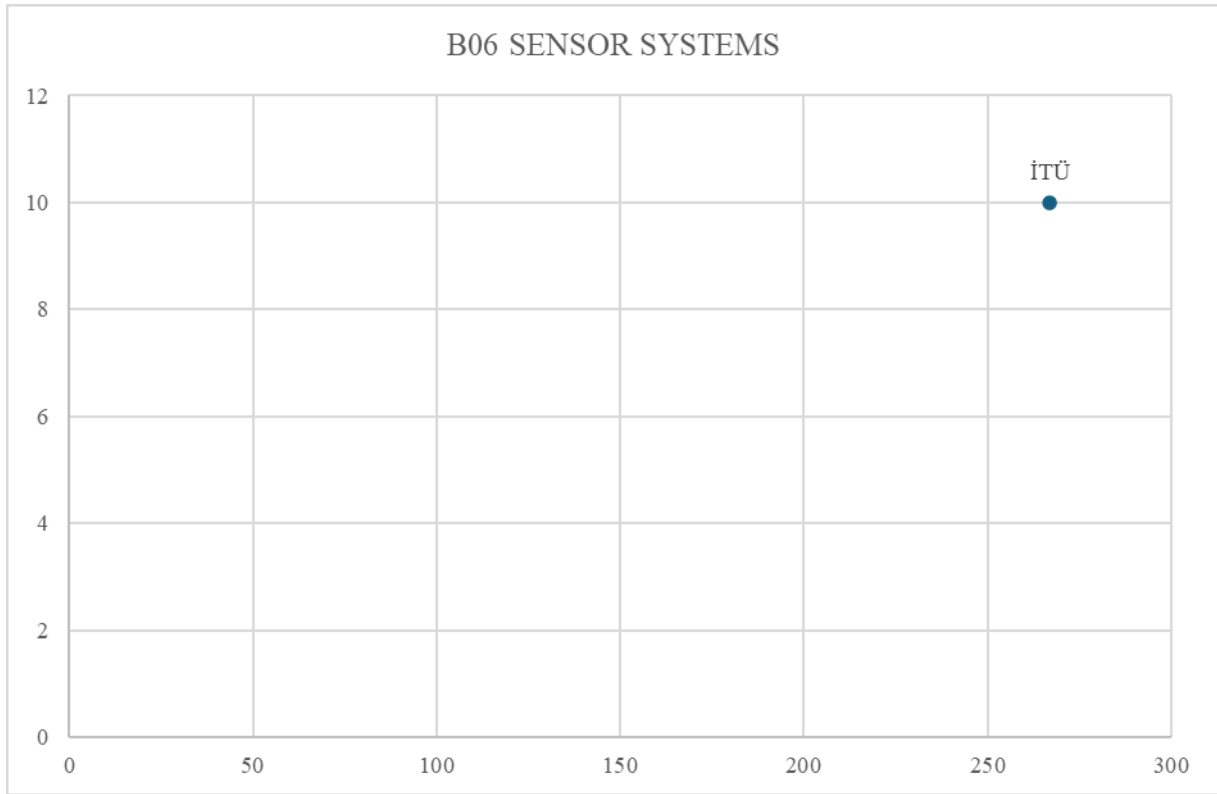


Figure 4.15. B5 Trace Control and Trace Reduction Area Proficiency Graphic

Hacettepe, Ege, Middle East Technical, Boğaziçi, İhsan Doğramacı Bilkent, Gebze Technical, Ankara, Gazi, Marmara, Sabancı, Ege, Middle East Technical, İhsan Doğramacı Bilkent, Gebze Technical, Ankara, Gazi, Marmara, Sabancı universities should increase the number of publications in B6 Sensor Systems. The sub-field with the highest number of publications is B6.17 Environmental Monitoring Systems and Istanbul Technical, Istanbul, Hacettepe, Dokuz Eylül, Yıldız Technical Universities are the five universities with the highest number of publications in this field.

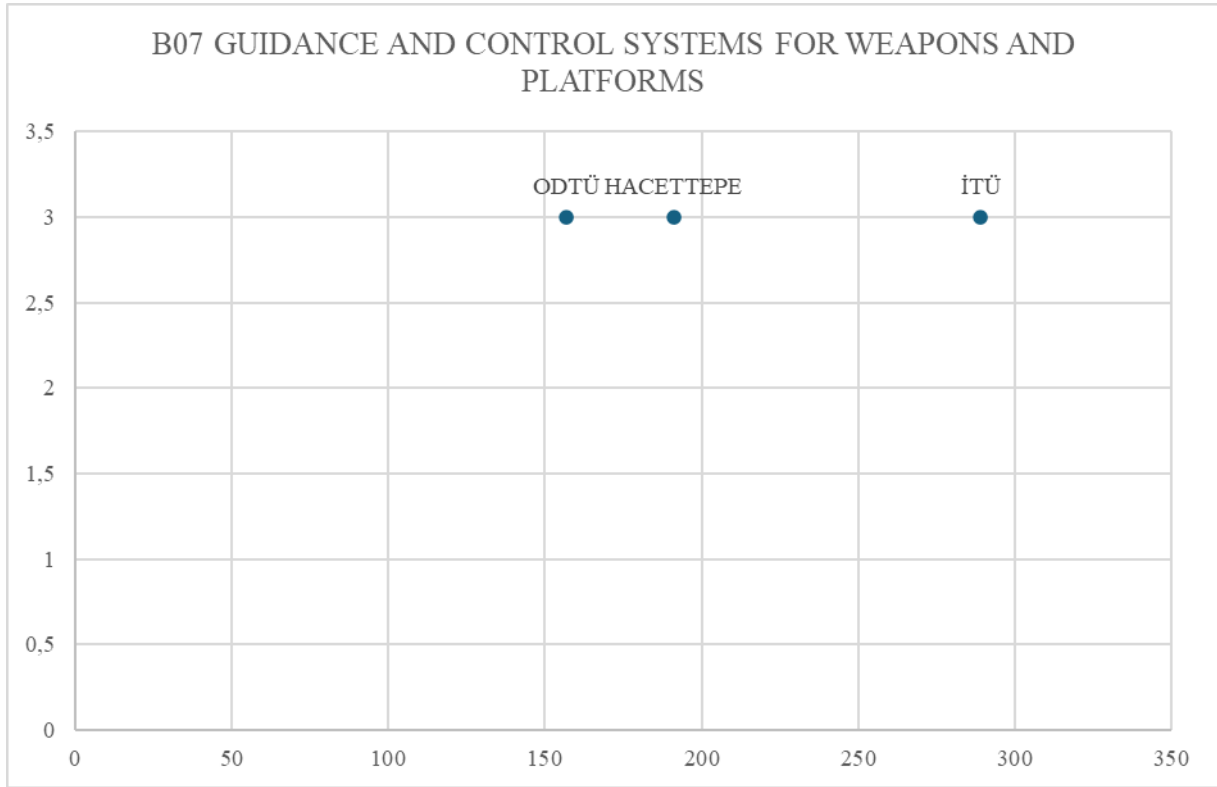


Figure 4.17. B7 Guidance and Control Systems for Weapons and Platforms Area Qualification Graphic

In B7 Guidance and control systems for weapons and platforms, Yıldız Technical, Boğaziçi, Gazi, Ankara, Dokuz Eylül, Marmara, Karadeniz Technical, Gebze Technical, Akdeniz, Atatürk, İhsan Doğramacı Bilkent, On Dokuz Mayıs, İstanbul, Bahçeşehir, İzmir Katip Çelebi, İstanbul Medeniyet, Doğuş universities should increase the number of publications. The sub-field with the highest number of publications is B7.5 Image Systems Technologies and Middle East Technical Hacettepe, Istanbul Technical, Gazi, Erciyes universities are the five universities with the highest number of publications in this field.

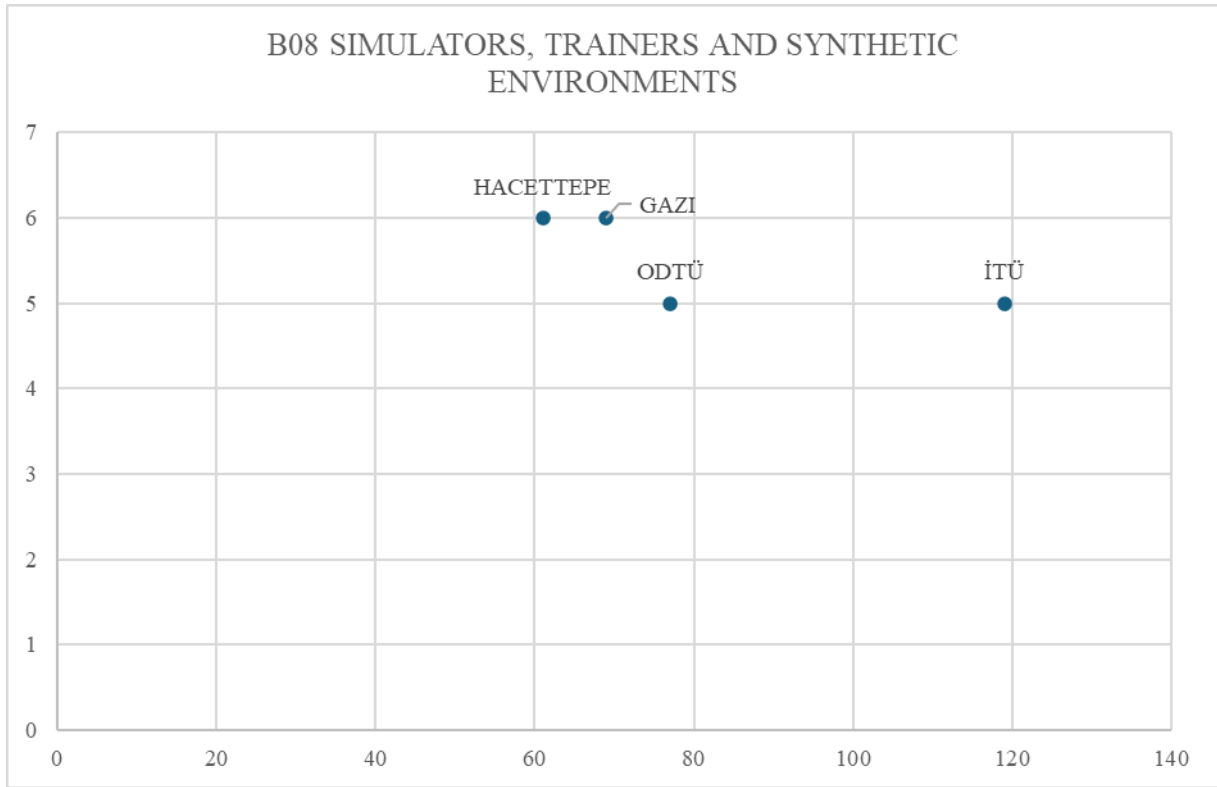


Figure 4.18. B8 Simulators, Trainers and Synthetic Environments Area Competency Graphic

In B8 Simulators, trainers and synthetic environments, Yıldız Technical, Marmara, Dokuz Eylül, Koç, Sabancı, İstanbul, Ege, Selçuk, İstanbul-Cerrahpaşa, Akdeniz, Bahçeşehir, Atatürk, Boğaziçi, Erciyes, Bursa Uludağ, Süleyman Demirel, Gebze Technical, İhsan Doğramacı Bilkent, Çukurova, Sakarya, On dokuz Mayıs, Kocaeli, Bolu Abant İzzet Baysal, Karadeniz Technical, Karabük universities should increase the number of publications. The sub-area with the highest number of publications is B8.5 Virtual Reality, and Middle East Technical, Istanbul Technical, Dokuz Eylül, Koç, Gazı universities are the five universities with the highest number of publications in this field.

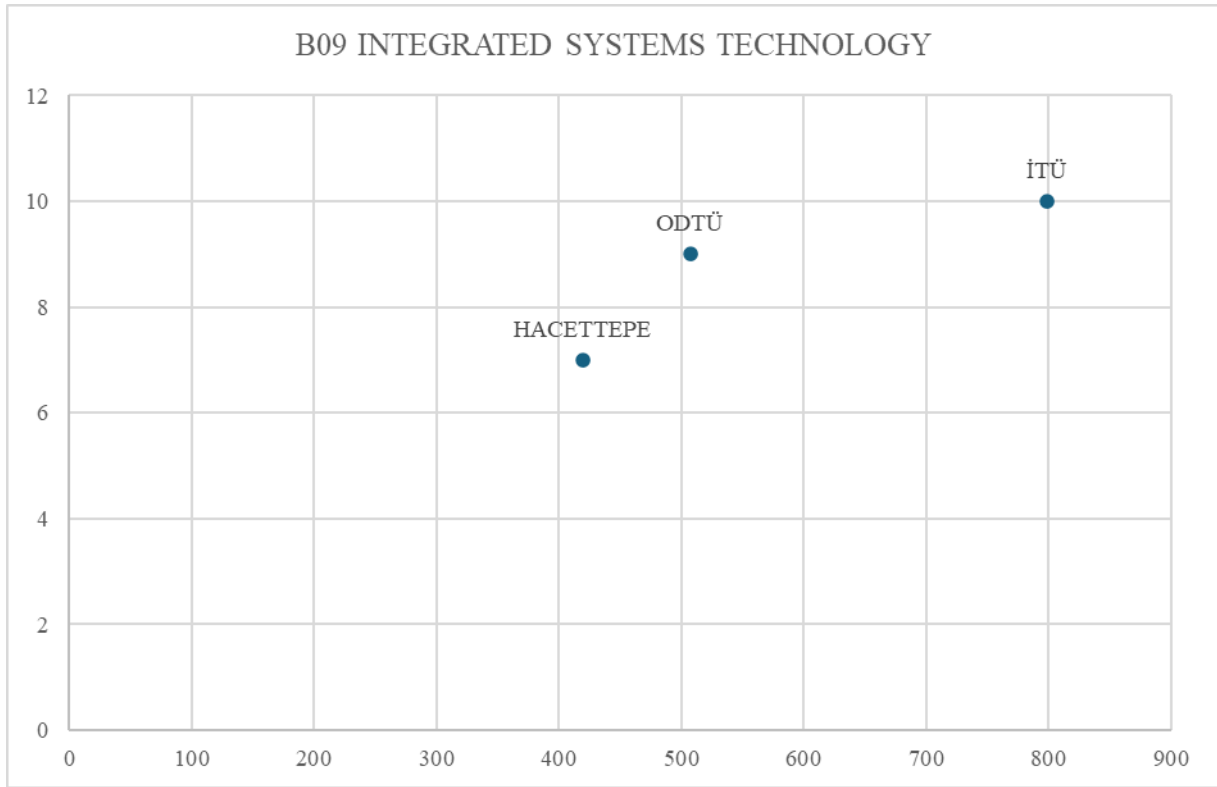


Figure 4.19. B9 Integrated System Technology Area Competency Graphic

In B9 Integrated System Technology, Boğaziçi, Dokuz Eylül, Ege, Eskişehir Osmangazi, Gazi, İhsan Doğramacı Bilkent, İstanbul, Kocaeli, Koç, Marmara, Sabancı, Yıldız Technical Universities should increase the number of publications. The sub-field with the highest number of publications is B9.7 Safety Systems, and Istanbul Technical, Hacettepe, Middle East Technical, Istanbul, Gazi universities are the five universities with the highest number of publications in this field.

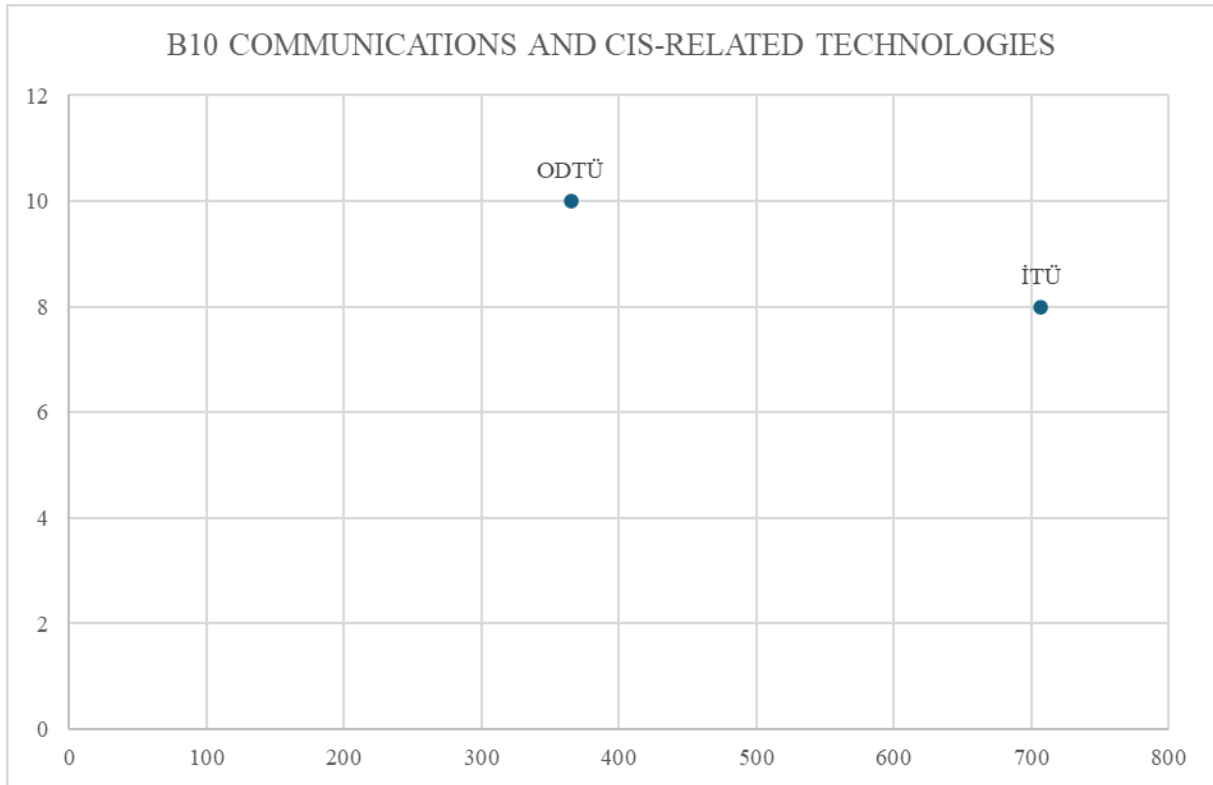


Figure 4.20. B10 Communication and Command and Information Systems and Related Technologies Area Qualification Graphic

In B10 Communication and command and information systems (CIS) related technologies, Hacettepe, Gazi, Boğaziçi, Karadeniz Technical, Dokuz Eylül, İstanbul, Yıldız Technical, İhsan Doğramacı Bilkent, Ege, Koç, Marmara, Sakarya, İstanbul-Cerrahpaşa, Kocaeli, Ankara, Sabancı universities should increase the number of publications. The sub-area with the highest number of publications is B10.14 Network Management Systems and Istanbul Technical, Boğaziçi, Middle East Technical, Hacettepe, Gazi universities are the five universities with the highest number of publications in this sub-area.

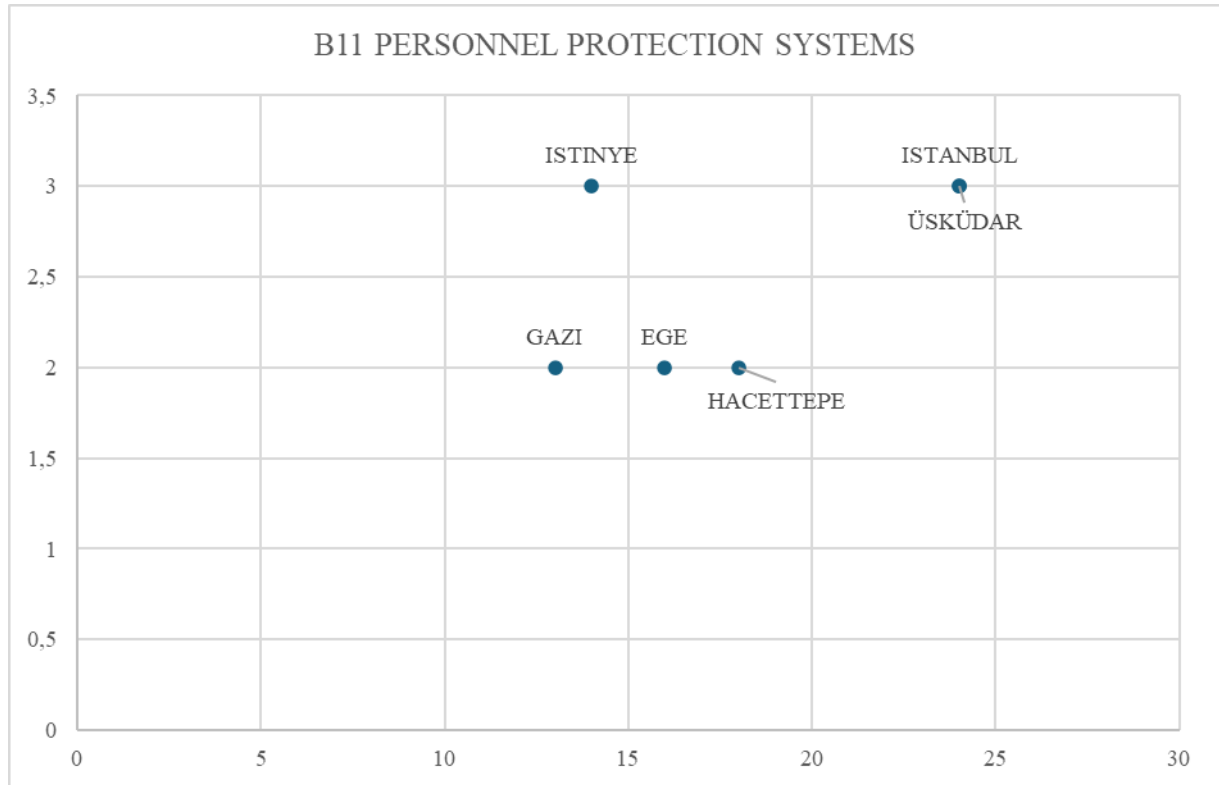


Figure 4.21. B11 Personnel Protection Systems Area Qualification Graphic

Ankara, Eskişehir Osmangazi, Istanbul Technical, Dokuz Eylül, Middle East Technical, Atatürk, Afyon Kocatepe, Koç Universities should increase the number of publications in B11 Personnel protection systems. The sub-field with the highest number of publications is B11.4 Chemical, Biological and Nuclear (CBN) Countermeasures - Medical definition and Istanbul, Hacettepe, Üsküdar, Ege, Istanbul -Cerrahpaşa universities are the five universities with the highest number of publications in this field.

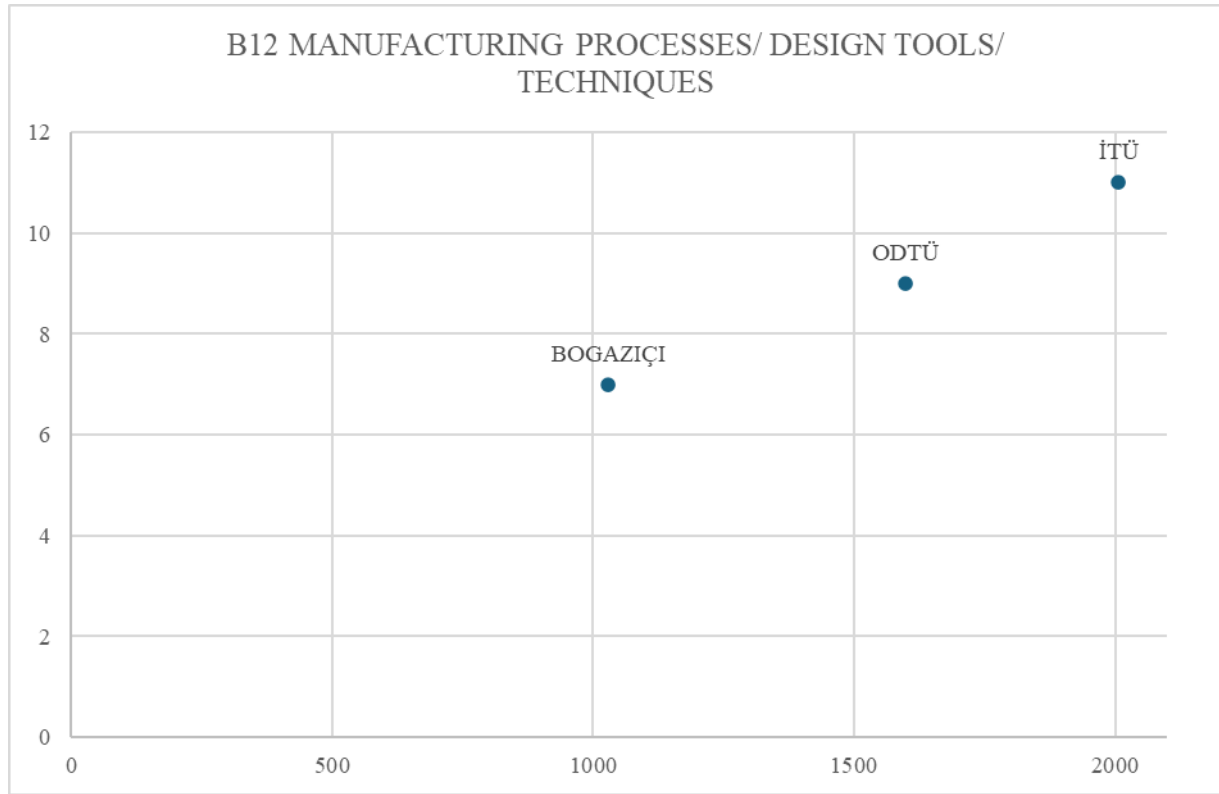


Figure 4.22. B12 Manufacturing Processes/Design Tools/Techniques Area Competency Graphic

B12 Manufacturing processes/design tools/techniques field qualification Gazi, İhsan Doğramacı Bilkent, Ankara, İstanbul, Sabancı, Koç, Hacettepe, Gaziantep, Erciyes, Bahçeşehir, Selçuk, Gebze Technical, Sakarya, Süleyman Demirel, Karadeniz Technical, İstanbul Aydın, Yıldız Technical, Marmara, Ege, Çukurova, Dokuz Eylül, Kocaeli, On dokuz Mayıs, Atatürk, Akdeniz, Fırat, İstanbul University-Cerrahpaşa, Eskişehir Osmangazi, Atılım, Bursa Uludağ, Anadolu, TOBB Economy and Technology, İzmir Institute of Technology, Başkent, Yaşar, Özyeğin, Bartın universities should increase their number of publications. The sub-area with the highest number of publications is B12.2 Cost Engineering and İstanbul Technical, Middle East Technical, Boğaziçi, İhsan Doğramacı Bilkent, Gazi universities are the five universities with the highest number of publications in this field.

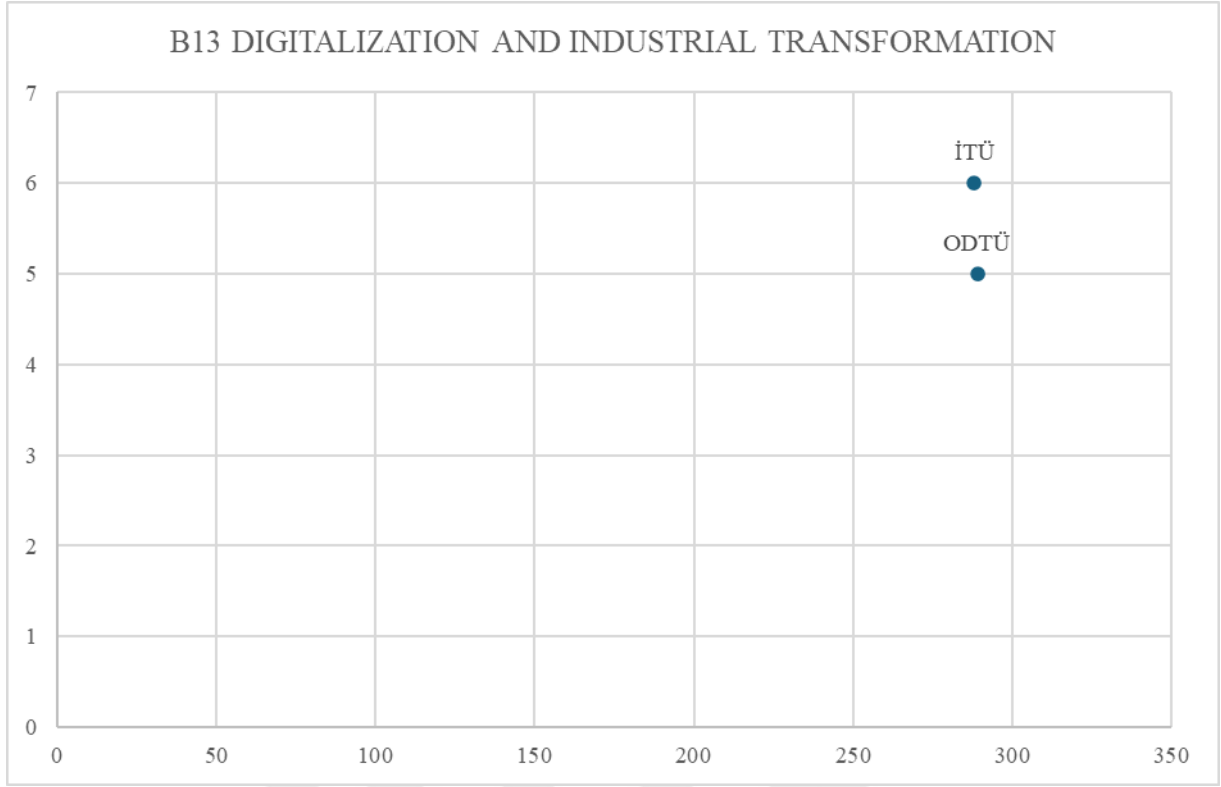


Figure 4.23. B13 Digitalization and Industrial Transformation Area Competency Graphic

In B13 Digitalization and industrial transformation, Çankaya University should increase the number of fields, Boğaziçi, Yıldız Technical, Gazi, İhsan Doğramacı Bilkent, Koç, Dokuz Eylül, Sabancı, Hacettepe, Sakarya, Bahçeşehir, Ege, Erciyes, Özyeğin, İnönü, Kadir Has, Kütahya Dumlupınar, İstinye, İstanbul Ticaret Universities should increase the number of publications. The sub-field with the highest number of publications is B13.3 Modeling and Simulation Solutions, and Middle East Technical, Istanbul Technical, Çankaya, Fırat, Boğaziçi universities are the five universities with the highest number of publications in this field.

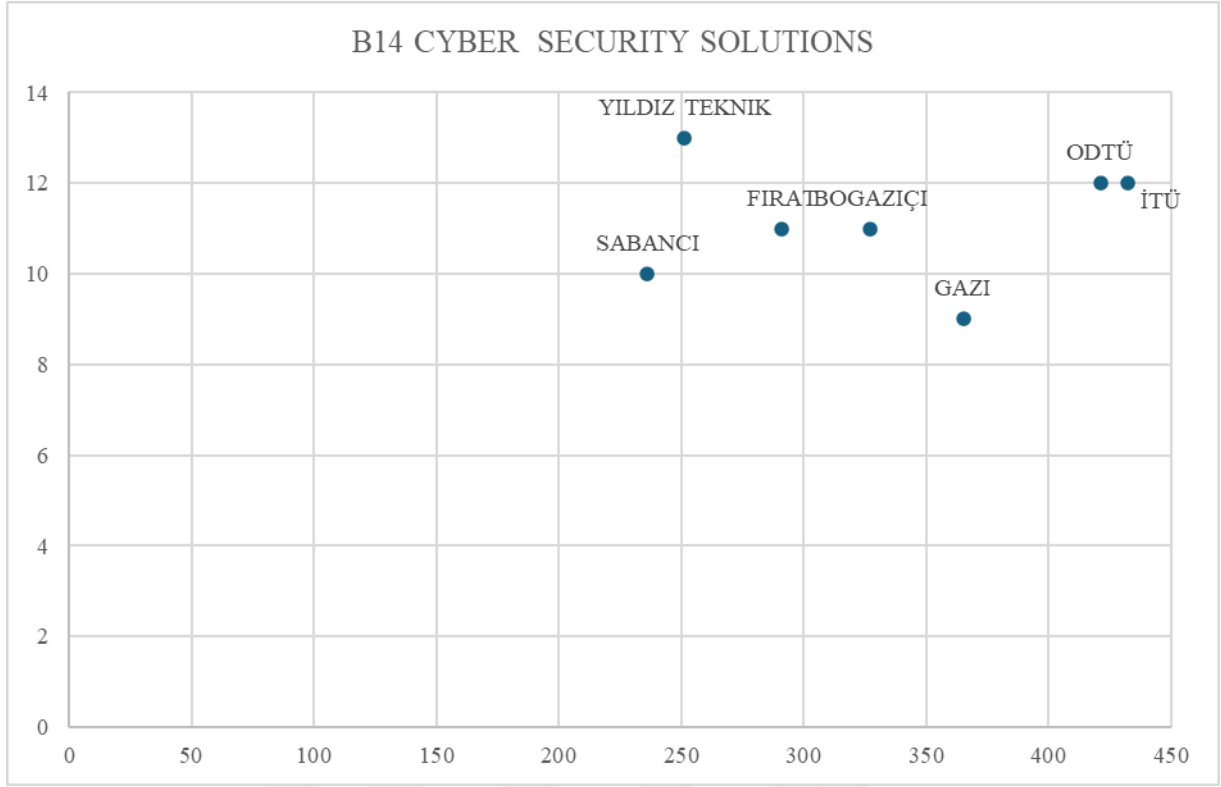


Figure 4.24. B14 Cyber Security Solutions Area Competency Graph

Hacettepe, Sakarya, TOBB Economy and Technology, İhsan Doğramacı Bilkent, Dokuz Eylül, Koç, Ege, Ankara, İstanbul, İstanbul Gelişim, Bahçeşehir, Atılım, Marmara, Kocaeli, Gebze Teknik, Yaşar, İstanbul Ticaret, Kadir Has, İstanbul Medipol, On dokuz Mayıs, Anadolu, Ankara Yıldırım Beyazıt, İstanbul Kültür, Trakya, Gaziantep, İzmir Institute of Technology, Haliç, Abdullah Gül, Özyeğin, Erciyes universities should increase the number of publications. The sub-area with the highest number of publications is B14.5 Data Security and Gas, Istanbul Technical, Middle East Technical, Fırat, Boğaziçi universities are the five universities with the highest number of publications in this field.

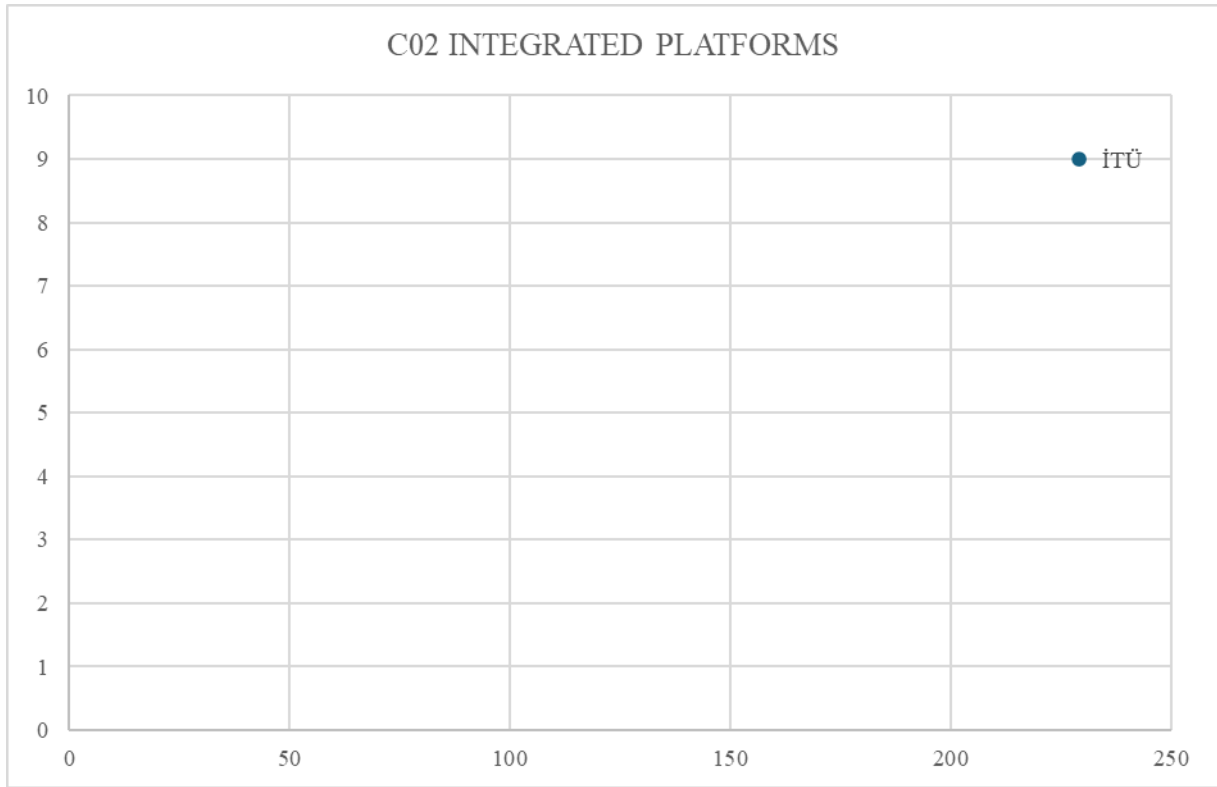


Figure 4.25. C2 Integrated Platforms Area Competency Graphic

It would be beneficial for Middle East Technical and Sabancı universities to increase the number of publications in C2 Integrated Platforms. The sub-area with the highest number of publications is C2.12 Other Satellites, and Istanbul Technical, Middle East Technical, Hacettepe, Yıldız Technical and Istanbul universities are the five universities with the highest number of publications in this field.

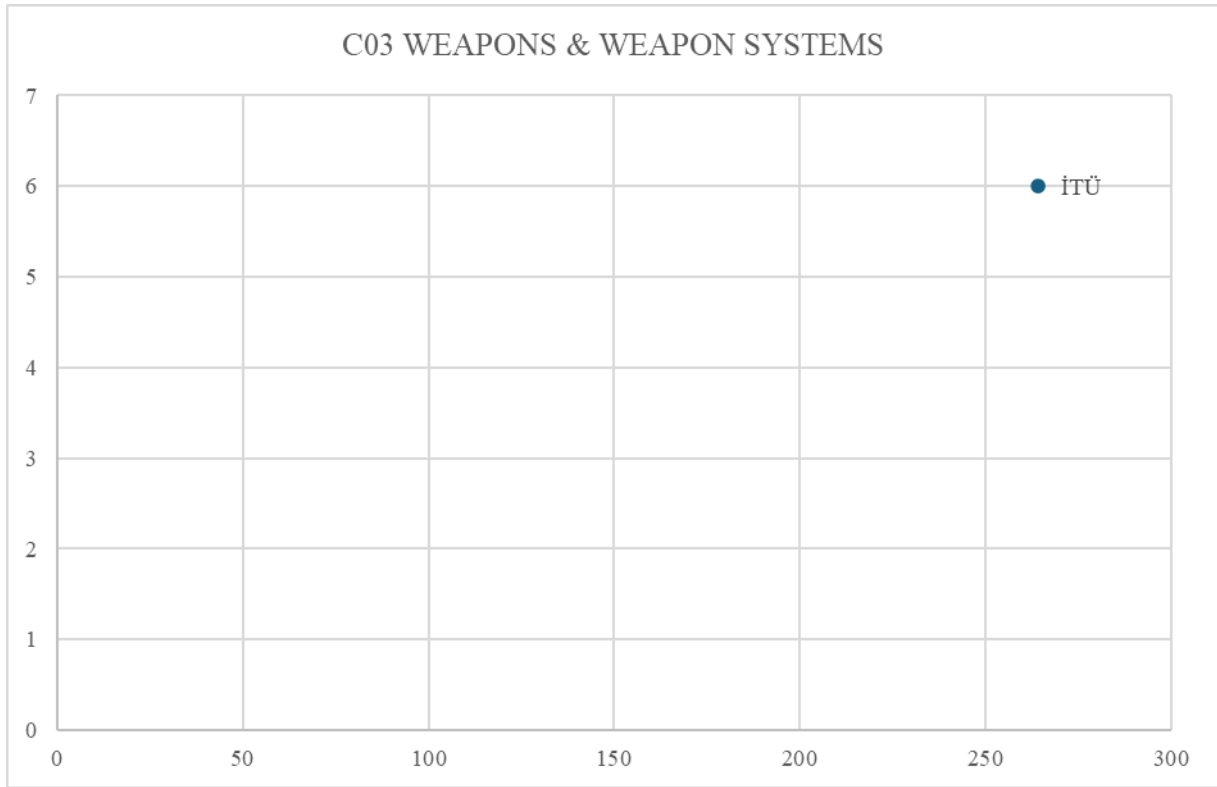


Figure 4.26. C3 Weapons and Weapon Systems Area Competency Graphic

It would be beneficial for Gazi, Middle East Technical, Çukurova and Yıldız Technical Universities to increase the number of publications in C3 Weapons and weapon systems. The sub-area with the highest number of publications is C3.12 Sea Mines, and Istanbul Technical, Karadeniz Technical, Dokuz Eylül, Boğaziçi, Zonguldak Bülent Ecevit universities are the five universities with the highest number of publications in this field.

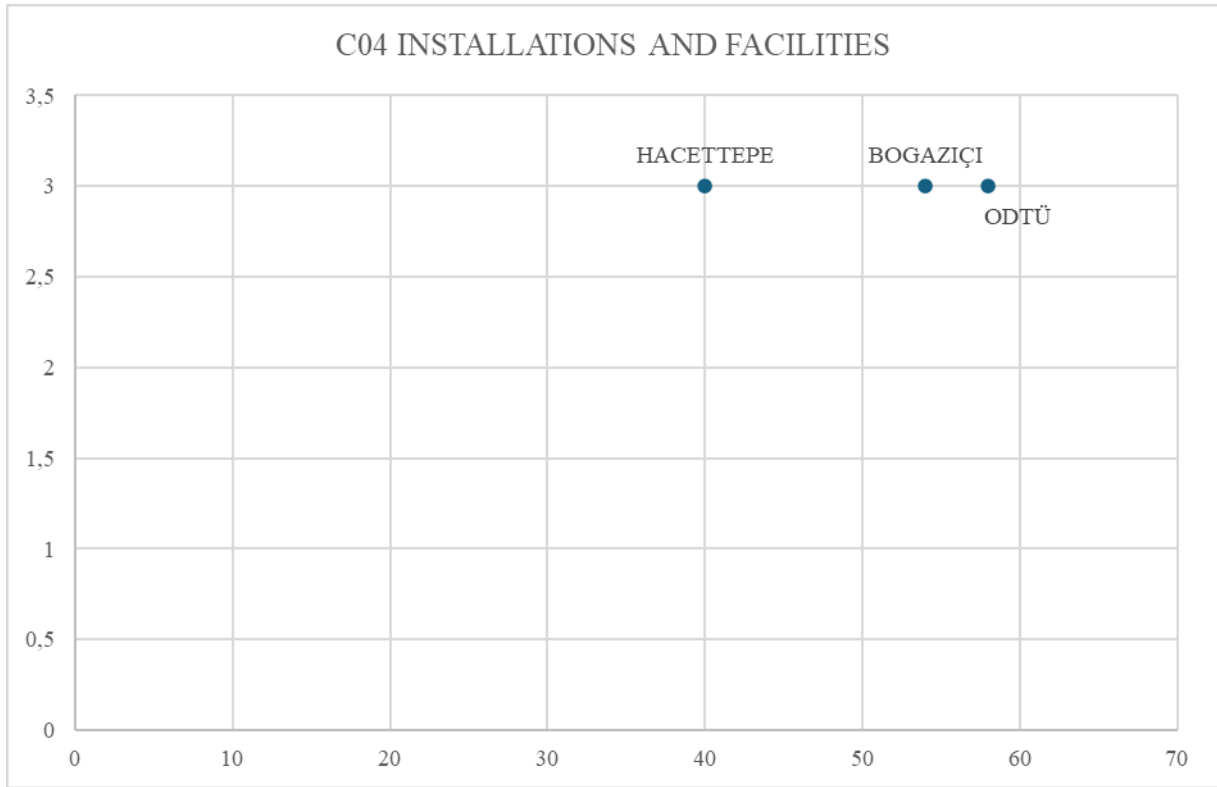


Figure 4.27. C4 Plumbing and Installations Area Competency Graphic

It would be beneficial for Istanbul Technical University to increase the number of fields, Istanbul, Selçuk, Ege, Gazi, Kocaeli, Ankara, Çanakkale On sekiz Mart, Koç, On dokuz Mayıs, Anadolu, Erciyes, Sakarya, Akdeniz, Istanbul-Cerrahpaşa, Eskişehir Osmangazi, Gümüşhane, Marmara, Pamukkale, Eskişehir Technical, Gaziantep universities to increase the number of publications. The sub-area with the highest number of publications is C4.1 Ground Stations, and Istanbul Technical, Middle East Technical, Boğaziçi, Çukurova, Istanbul universities are the five universities with the highest number of publications in this field.

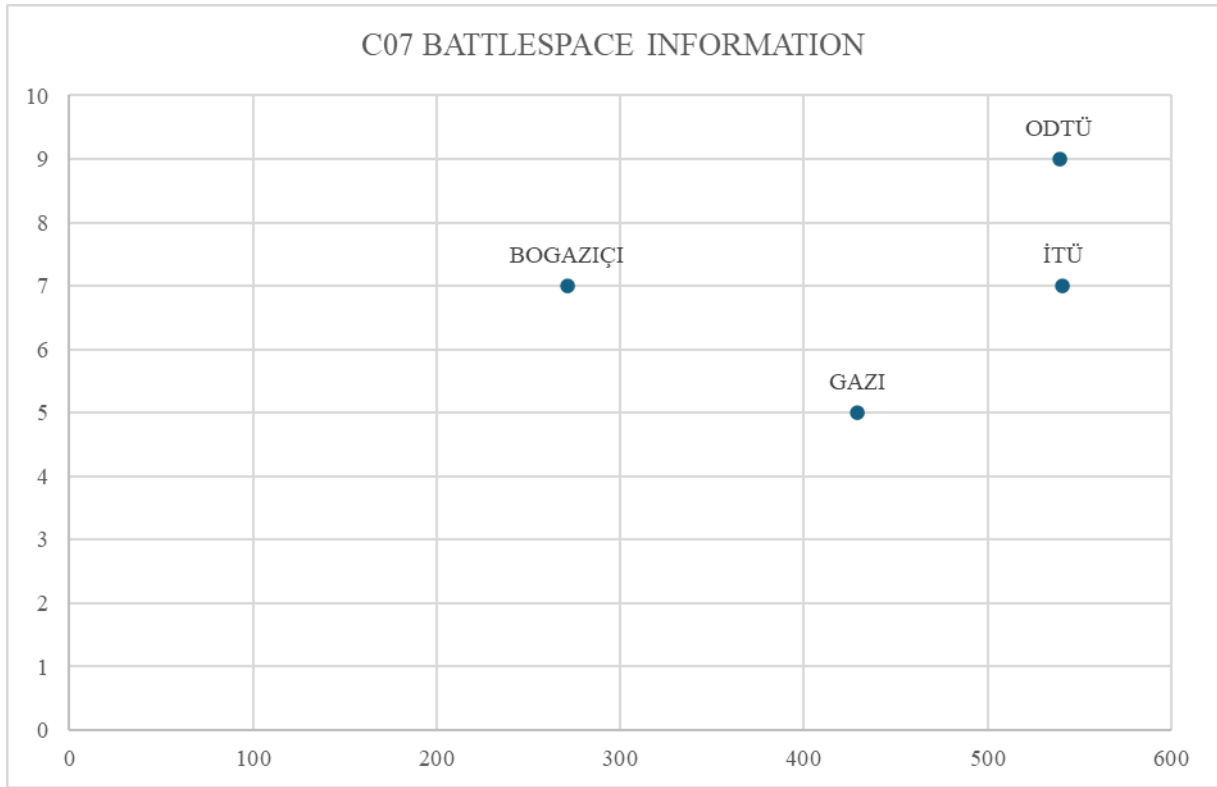


Figure 4.28. C7 Battlefield Information Area Proficiency Graph

Hacettepe, Yıldız Technical, Ege, Ege, İstanbul, Karadeniz Technical, Ankara, Sabancı, Marmara, İzmir Institute of Technology, Mersin, TOBB Economics and Technology and National Defense Universities should increase the number of publications in the C7 Battlefield information competency. The sub-area with the highest number of publications is C7.25 Time Distribution Systems, and Istanbul Technical, Middle East Technical, Hacettepe, Boğaziçi and Gazi universities are the five universities with the highest number of publications in this area.

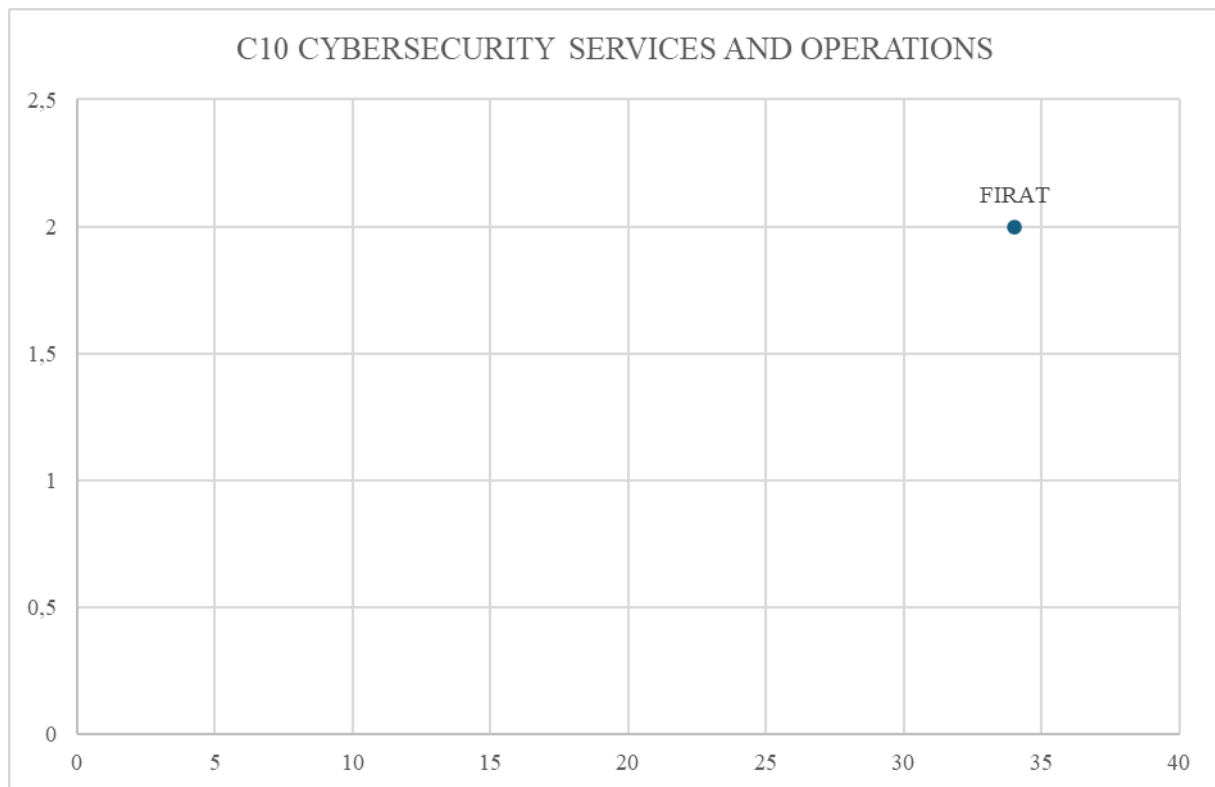


Figure 4.29. C10 Cyber Security Services and Operations Area Competency Graph

In C10 Cyber security services and operations, Gazi, Istanbul-Cerrahpaşa, Çankırı Karatekin, Abdullah Gül, Sakarya universities should increase the number of publications. The sub-area with the highest number of publications is C10.2Cyber Intelligence and Gazi, Fırat, Yasar, Istanbul Technical, Istanbul-Cerrahpaşa universities are the five universities with the highest number of publications in this field.

4.2. Ranking of Universities by Adequacy

When the graphs above are analyzed according to the areas in which universities are competent, the following table emerges.

Table 4.1. Table of Qualification Areas of Universities

Qualification Areas of Universities			
Row	University Name	Number of Adequate Spaces	Areas of Competence
1	Istanbul Technical University	25	A1 Structural and Smart Materials and Structural Mechanics
			A3 Electronic Material Technologies
			A4 Photonic/Optical Materials and Device Technologies

Qualification Areas of Universities			
Row	University Name	Number of Adequate Spaces	Areas of Competence
			A5 Electronic, Electrical and Electromechanical Device Technologies
			A6 Energetic Materials and Plasma Technologies
			A8 Information Technologies and Mathematics Techniques
			A9 Information and Signal Processing Technologies
			A11 Technologies Related to Environmental Conditions Affecting Operations
			A12 Mechanical, Thermal and Fluid-Related Technology and Devices
			B1 Lethality and Platform Protection
			B2 Propulsion and Power Systems
			B3 Design Technologies for Platforms and Weapons
			B4 Electronic Warfare and Directed Energy Technologies
			B5 Track Control and Track Reduction
			B6 Sensor Systems
			B7 Guidance and Control Systems for Weapons and Platforms
			B8 Simulators, Trainers and Synthetic Environments
			B9 Integrated System Technology
			B10 Communication and Command and Information Systems (CIS) Related Technologies
			B12 Manufacturing Processes/Design Tools/Techniques
			B13 Digitalization and Industrial Transformation
			B14 Cyber Security Solutions
			C2 Integrated Platforms
			C3 Weapons and Weapon Systems
			C7 Battlefield Information
2	Middle East Technical University	19	A1 Structural and Smart Materials and Structural Mechanics
			A4 Photonic/Optical Materials and Device Technologies
			A5 Electronic, Electrical and Electromechanical Device Technologies
			A6 Energetic Materials and Plasma Technologies
			A9 Information and Signal Processing Technologies
			A11 Technologies Related to Environmental Conditions Affecting Operations
			A12 Mechanical, Thermal and Fluid-Related Technology and Devices
			B1 Lethality and Platform Protection
			B3 Design Technologies for Platforms and Weapons

Qualification Areas of Universities			
Row	University Name	Number of Adequate Spaces	Areas of Competence
			B4 Electronic Warfare and Directed Energy Technologies
			B7 Guidance and Control Systems for Weapons and Platforms
			B8 Simulators, Trainers and Synthetic Environments
			B9 Integrated System Technology
			B10 Communication and Command and Information Systems (CIS) Related Technologies
			B12 Manufacturing Processes/Design Tools/Techniques
			B13 Digitalization and Industrial Transformation
			B14 Cyber Security Solutions
			C4 Installations and Facilities
			C7 Battlefield Information
3	University of Gas	8	A3 Electronic Material Technologies
			A4 Photonic/Optical Materials and Device Technologies
			A7 Chemical Biological and Medical Materials
			B2 Propulsion and Power Systems
			B8 Simulators, Trainers and Synthetic Environments
			B11 Personnel Protection Systems
			B14 Cyber Security Solutions
			C7 Battlefield Information
4	Hacettepe University	7	A7 Chemical Biological and Medical Materials
			A9 Information and Signal Processing Technologies
			B7 Guidance and Control Systems for Weapons and Platforms
			B8 Simulators, Trainers and Synthetic Environments
			B9 Integrated System Technology
			B11 Personnel Protection Systems
			C4 Installations and Facilities
5	Bogazci University	4	B12 Manufacturing Processes/Design Tools/Techniques
			B14 Cyber Security Solutions
			C4 Installations and Facilities
			C7 Battlefield Information
6	Yildiz Technical University	4	A5 Electronic, Electrical and Electromechanical Device Technologies
			A12 Mechanical, Thermal and Fluid-Related Technology and Devices
			B2 Propulsion and Power Systems
			B14 Cyber Security Solutions
7	Ankara University	3	A3 Electronic Material Technologies
			A6 Energetic Materials and Plasma Technologies
			A7 Chemical Biological and Medical Materials

Qualification Areas of Universities			
Row	University Name	Number of Adequate Spaces	Areas of Competence
8	Euphrates University	3	A12 Mechanical, Thermal and Fluid-Related Technology and Devices
			B14 Cyber Security Solutions
			C10 Cyber Security Services and Operations
9	Istanbul University	3	A3 Electronic Material Technologies
			A7 Chemical Biological and Medical Materials
			B11 Personnel Protection Systems
10	Ege University	2	A7 Chemical Biological and Medical Materials
			B11 Personnel Protection Systems
11	Ataturk University	1	A3 Electronic Material Technologies
12	Gebze Technical University	1	A3 Electronic Material Technologies
13	İhsan Doğramacı Bilkent University	1	A4 Photonic/Optical Materials and Device Technologies
14	İstinye University	1	B11 Personnel Protection Systems
15	Manisa Celâl Bayar University	1	A12 Mechanical, Thermal and Fluid-Related Technology and Devices
16	Sabancı University	1	B14 Cyber Security Solutions
17	Üsküdar University	1	B11 Personnel Protection Systems

When the above data is analyzed, it is seen that 17 universities are competent in a total of 75 breakdowns. ITU, METU, Gazi Hacettepe, Boğaziçi universities are competent in the defense industry, while Adıyaman, Atatürk, Çukurova, Erzincan Binali Yıldırım, Gebze Technical, İhsan Doğramacı Bilkent, İstinye, İzmir Institute of Technology, Kafkas, Manisa Celâl Bayar, Mersin, Sabancı, Tokat Gaziosmanpaşa, Üsküdar universities are competent in only one area.

4.3. Adequacy of universities by field

When the total number of publications and universities are analyzed in light of the above data, the following table emerges.

Table 4.2. Top 20 Universities Number and Percentage of Publications

Top 20 Universities Number and Percentage of Publications			
Sequence Nu	University Name	Number of Publications	Percentage Rate
1	Istanbul Technical University	22437	8,40%
2	Middle East Technical University	14442	5,41%
3	University of Gas	9874	3,70%
4	Yildiz Technical University	9561	3,58%
5	Bosphorus University	6958	2,60%
6	Ihsan Doğramacı Bilkent University	6884	2,58%
7	Istanbul University	6841	2,56%
8	Hacettepe University	6514	2,44%
9	Ankara University	6311	2,36%
10	Euphrates University	5796	2,17%
11	Koç University	5456	2,04%
12	Karadeniz Technical University	5139	1,92%
13	Dokuz Eylul University	5089	1,90%
14	Cukurova University	4720	1,77%
15	Erciyes University	4704	1,76%
16	Marmara University	4649	1,74%
17	Ege University	4597	1,72%
18	Sakarya University	4498	1,68%
19	Sabancı University	4345	1,63%
20	Gebze Technical University	4106	1,54%
	Total	142921	53,50%

Since there are 209 universities in Turkiye in the total publications of universities, they should not publish approximately 0.5% of the total publications per university. 161 universities were found to publish below this average. seven universities were found not to publish in any of the 307 titles in this taxonomy. The whole list is in appendix 2. The top 20 universities accounted for 53.50% of the entire list with 142,921 publications. Here, Istanbul Technical and Middle East Technical Universities are outlier universities and many universities do not appear as competent due to the above methodology. For this reason, when ITU and METU were removed from the data set, the following results were obtained with the same methodology.

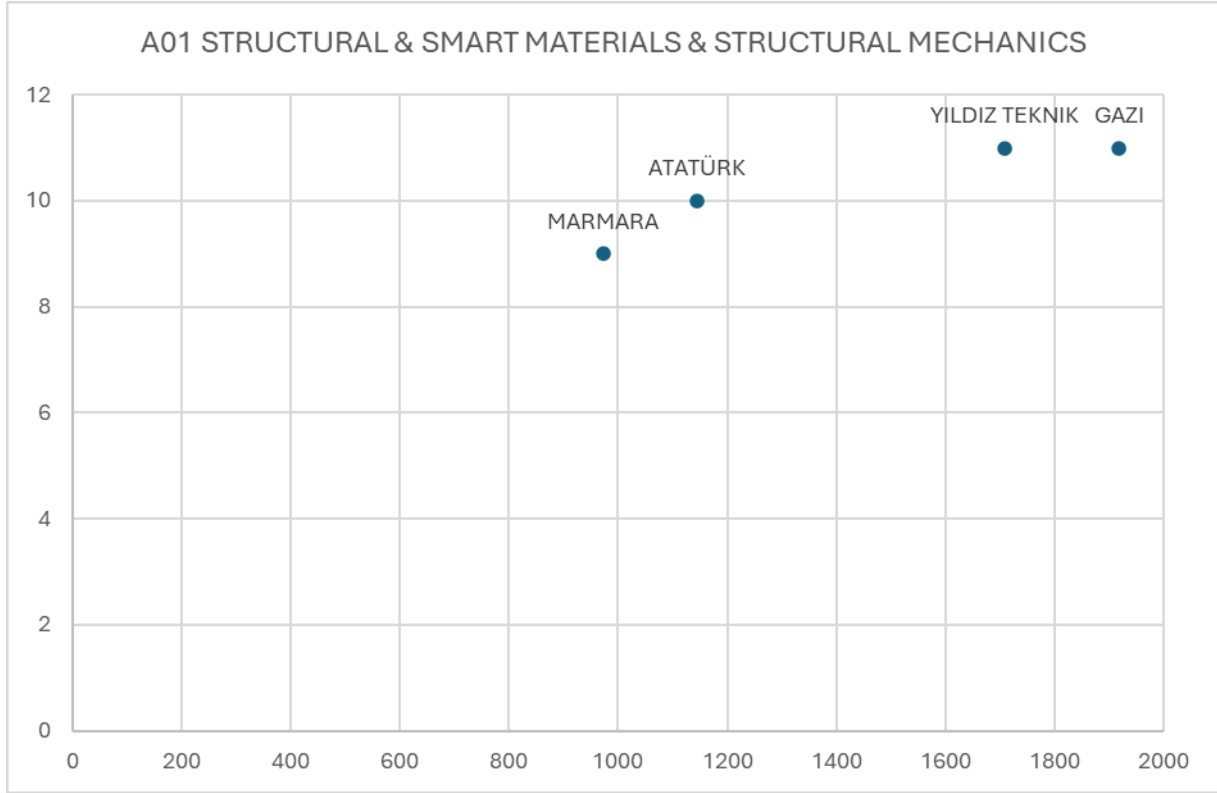


Figure 4.30. A1 Structural and Smart Materials and Structural Mechanics Area Competency Graphic

A01 structural & smart materials & Sakarya, Gebze Technical, Boğaziçi, Dokuz Eylül, Fırat, Ankara, Çanakkale On sekiz Mart, İstanbul, Eskişehir Osmangazi, Kocaeli, Koç, Sabancı, Karadeniz Technical, İhsan Doğramacı Bilkent, Hacettepe, İzmir Institute of Technology, Anadolu, Selçuk, Çukurova, Ege, On Dokuz Mayıs, Süleyman Demirel, Pamukkale, İnönü, Kırıkkale, Karabük, Erciyes, Mersin, Afyon Kocatepe, Bursa Teknik, Manisa Celâl Bayar, Bolu Abant İzzet Baysal, Balıkesir, Sivas Cumhuriyet, Bartın, Yalova, Dicle, Gaziantep, Aksaray, İzmir Katip Çelebi, Van Yüzüncü Yıl, Kütahya Dumlupınar, Hitit, İstanbul-Cerrahpaşa, Karamanoğlu Mehmet Bey, Necmettin Erbakan, Muğla Sıtkı Koçman, Düzce, Tekirdağ Namık Kemal, TOBB Economy and Technology, Atılım, Harran, Recep Tayyip Erdoğan, Bursa Uludağ, Eskişehir Technical, Zonguldak Bülent Ecevit, Trakya, Erzurum Technical, Aydın Adnan Menderes, Bilecik Şeyh Edebali, Akdeniz, Erzincan Binali Yıldırım, Konya Technical, Bahçeşehir, Bingöl, Adana Alparslan Türkeş Science and Technology, Hatay Mustafa Kemal, İskenderun Technical, Uşak, Yeditepe, Abdullah Gül, Kastamonu, Özyeğin, Munzur, Niğde Ömer Halisdemir, Giresun, Kafkas, Burdur Mehmet Akif Ersoy, İstinye, Ankara Yıldırım Beyazıt, Sinop, Osmaniye Korkut Ata, Çankaya, Kırklareli, Adıyaman, Fatih Sultan Mehmet Vakıf, Nevşehir Hacı Bektaş Veli, Sakarya Applied Sciences, Gümüşhane, Kahramanmaraş

Sütçü İmam, İstanbul Gedik, Hakkâri, Başkent, Nişantaşı universities should increase their number of publications.

A2 In the field of materials related to trace competence; since there are 33 publications by eight universities in two fields, it is beneficial for all universities to increase the number of publications and fields for this breakdown.

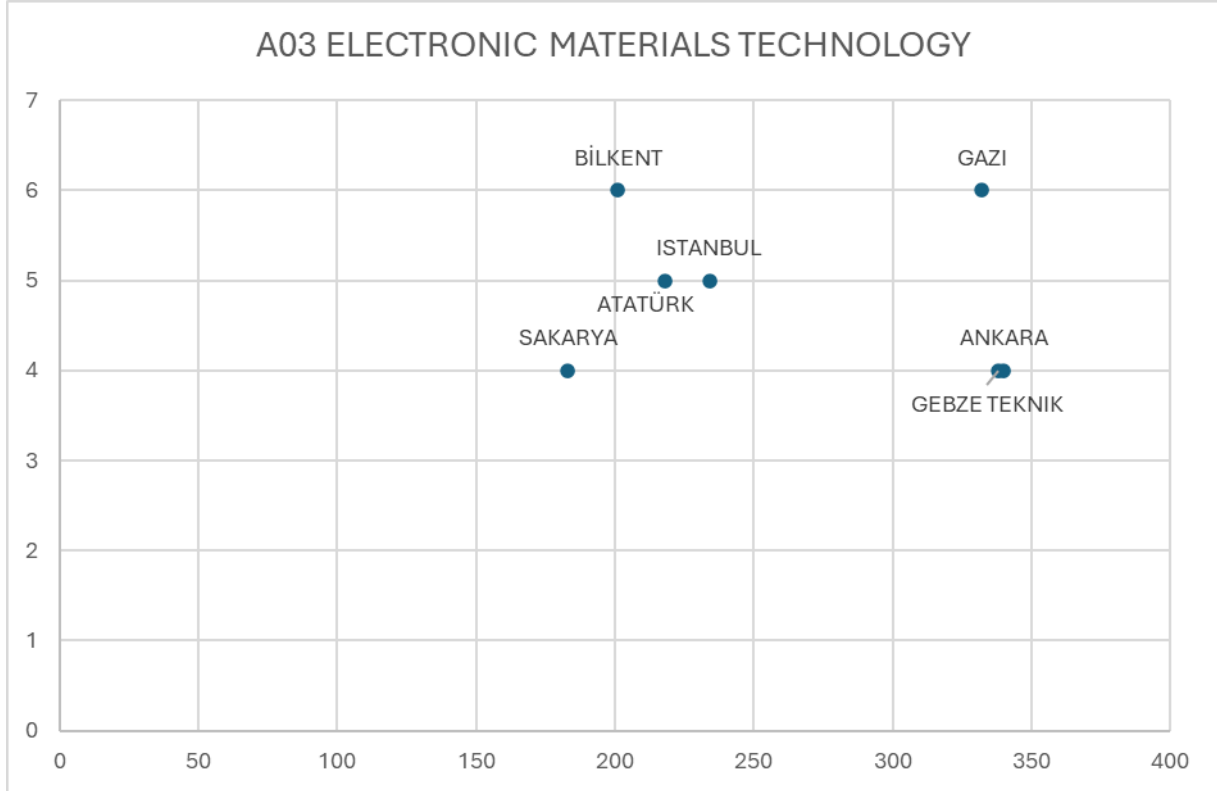


Figure 4.31. A3 Electronic Material Technologies Area Qualification Graphic

A03 In the field of electronics materials technology, Bursa Uludag, Dokuz Eylül, Ege, Selçuk, Fırat, Çanakkale On sekiz Mart, Kocaeli, İzmir Institute of Technology Anadolu, Çankırı Karatekin, Balıkesir, İzmir Katip Celebi, Van Yüzüncü Yıl, Düzce, Sinop, Yıldız Technical Universities should increase their number of publications.

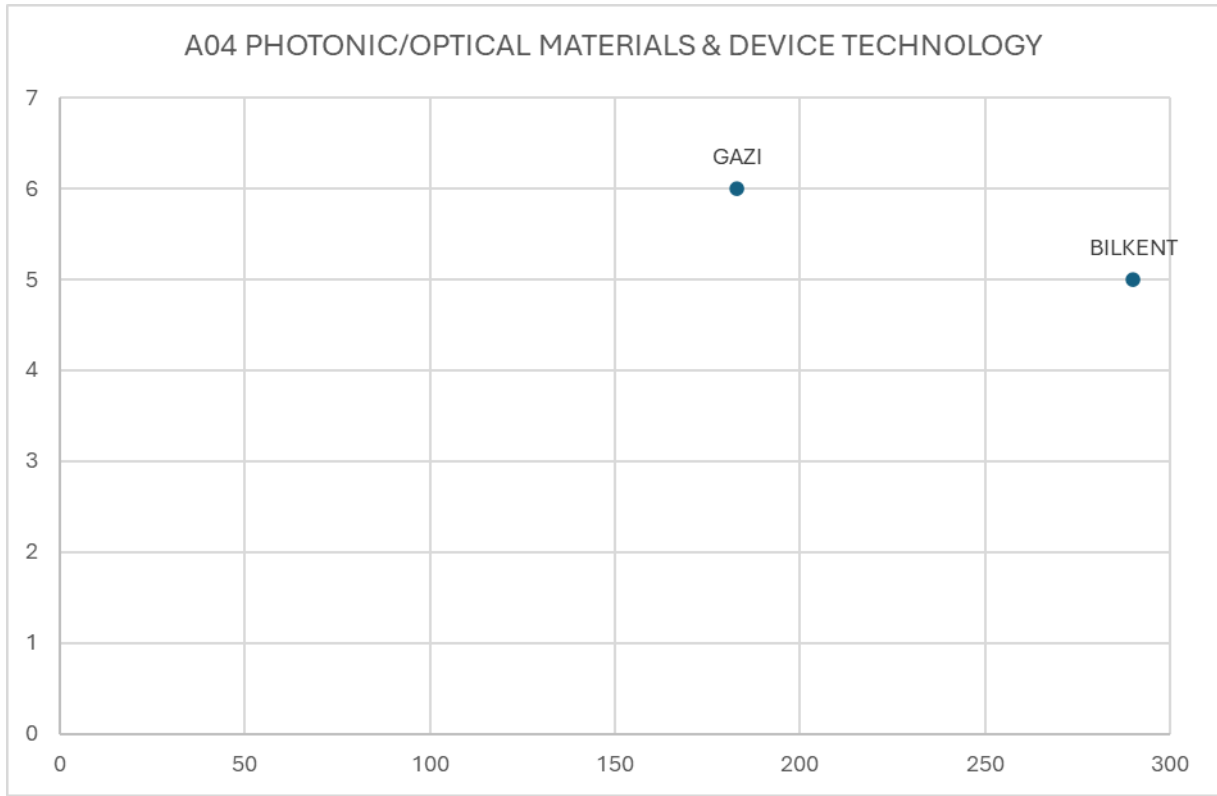


Figure 4.32. A4 Photonics/Optics Materials and Device Technologies Area Qualification Graphic

In A04 Photonic/optical materials & device technology, Koç, Ankara, Ege, Yıldız Technical, Atatürk, Marmara, Erciyes, Fırat, Boğaziçi, Selçuk, TOBB Economy and Technology, Sakarya, Sabancı, Çukurova, Süleyman Demirel, Gebze Technical, Akdeniz, Aydın Adnan Menderes, Sivas Cumhuriyet, Dokuz Eylül, Başkent, Hatay Mustafa Kemal, Eskişehir Osmangazi, Bursa Uludağ, Bingöl, Mersin, Kafkas Universities should increase the number of publications.

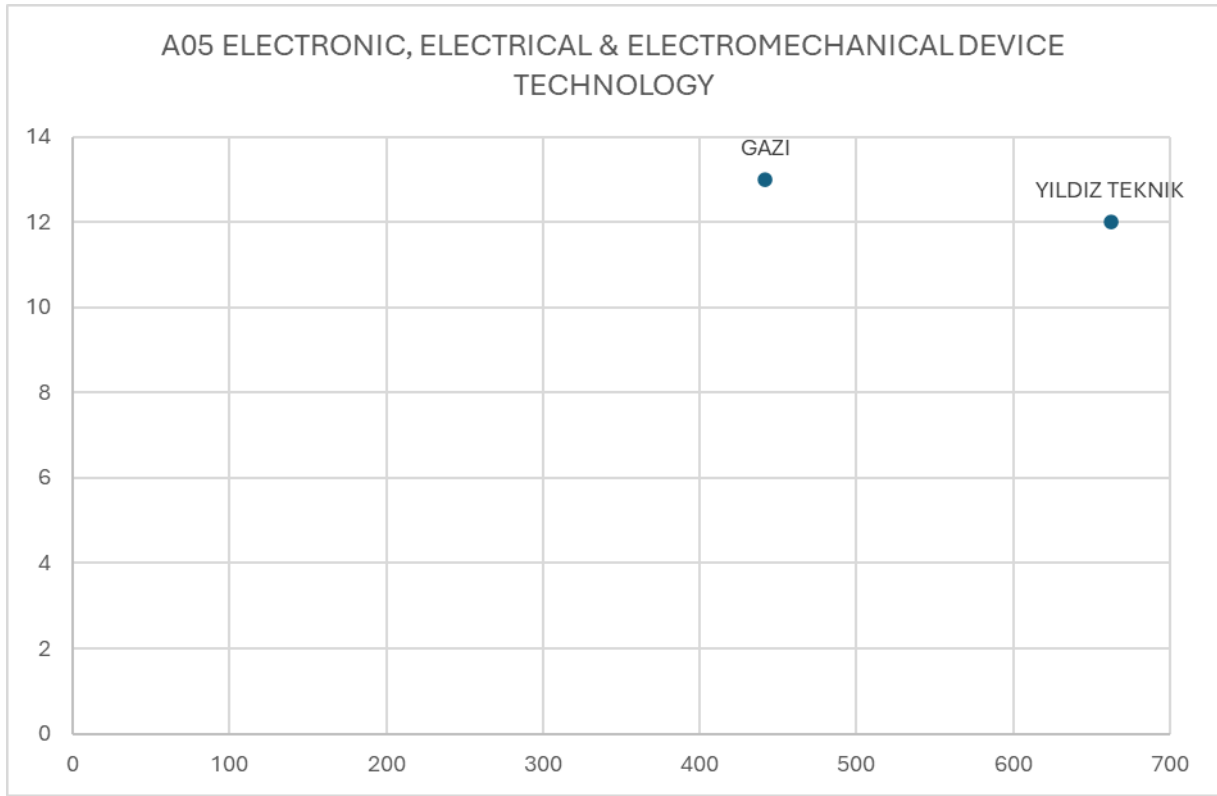


Figure 4.33. A5 Electronic, Electrical and Electromechanical Device Technologies Area Qualification Graphic

A05 Electronic, electrical & İhsan Doğramacı Bilkent, İstanbul, Marmara, Pamukkale, Fırat, Kocaeli, Selçuk, Koç, Sabancı, Hacettepe, Dokuz Eylül, Karabük, Sakarya, Karadeniz Technical, Ege, Ankara, Boğaziçi, Niğde Ömer Halisdemir, Gaziantep, Gebze Technical, Düzce, Çukurova, Atatürk, Akdeniz, TOBB Economy and Technology, Süleyman Demirel, Özyeğin, Erciyes, Atılım, Bursa Uludağ, Bahçeşehir, İskenderun Teknik, On Dokuz Mayıs, Mersin, Eskişehir Osmangazi, İstanbul-Cerrahpaşa, İzmir Institute of Technology, İzmir Katip Çelebi universities should increase their publication numbers.

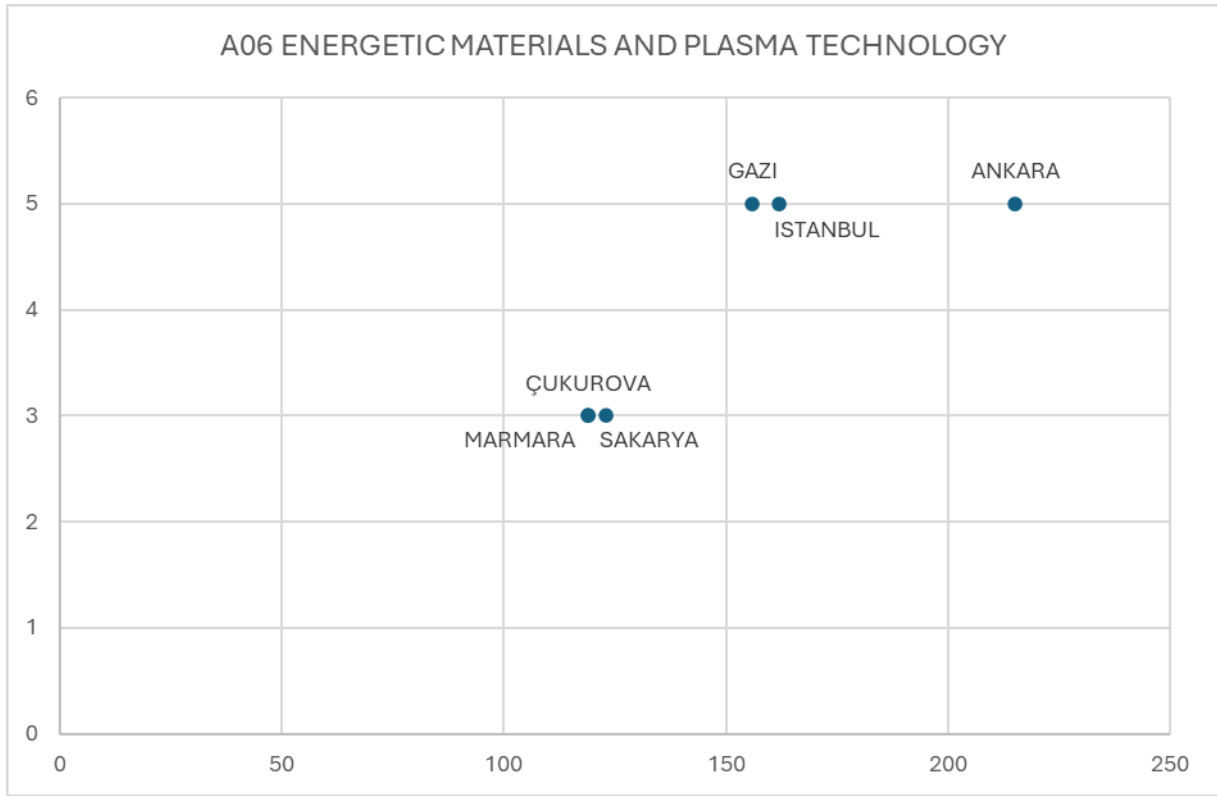


Figure 4.34. A6 Energetic Materials and Plasma Technologies Area Competency Graph

A06 Energetic materials and plasma technology, Boğaziçi, İzmir Institute of Technology, Atatürk, Hacettepe, Mersin, Gebze Teknik, İstanbul-Cerrahpaşa, Selçuk, Kahramanmaraş Sütçü İmam, Balıkesir, Bursa Uludağ, Sabancı, Koç, Kırıkkale, Kırşehir Ahi Evran, Sivas Cumhuriyet, Eskişehir Osmangazi, Ardahan, Ankara Yıldırım Beyazıt, Milli Savunma, Tekirdağ Namık Kemal universities should increase their publication numbers.

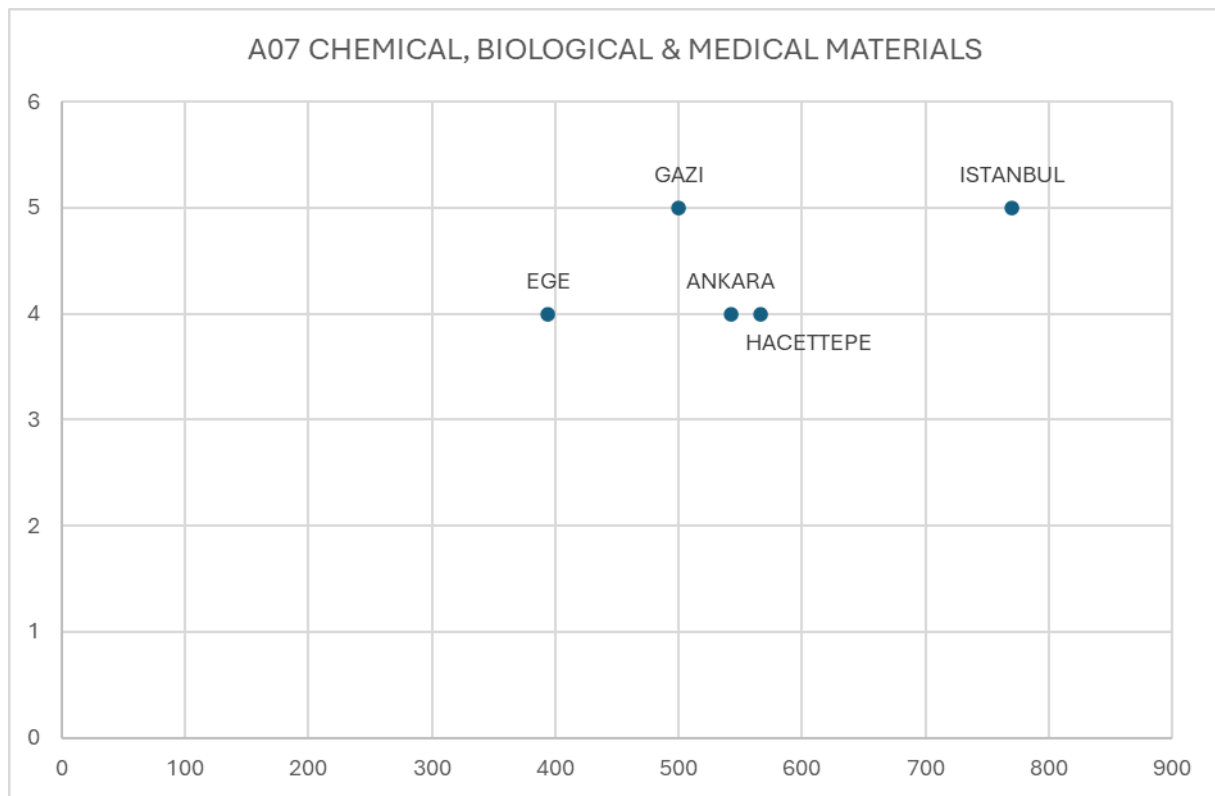


Figure 4.35. A7 Chemical, Biological and Medical Materials Area Qualification Graphic

In the A07 Chemical, biological & medical materials field competency, Erciyes, Aydın Bursa Uludağ, Dokuz Eylül, Adnan Menderes, Mersin, Health Sciences, Koç, Çanakkale 18 Mart, Universities should increase their number of publications.

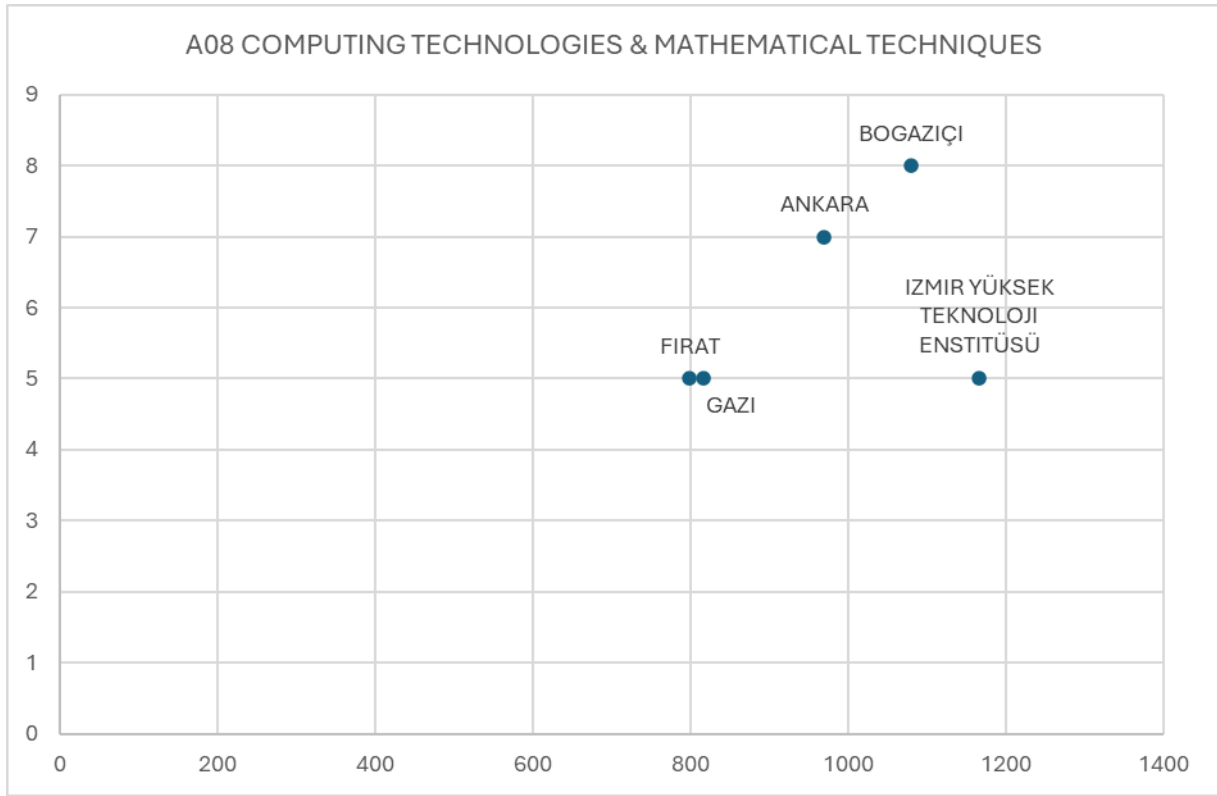


Figure 4.36. A8 Information Technologies and Mathematical Techniques Area Competency Graphic

In the A08 Computing technologies & mathematical technologies competency, Karadeniz Technical, İhsan Doğramacı Bilkent, Ege, Dokuz Eylül, Koç, Hacettepe, Kocaeli, Marmara, TOBB Economy and Technology, Manisa Celal Bayar, Erciyes, Süleyman Demirel, Bursa Uludağ, Anadolu, Zonguldak Bülent Ecevit universities should increase their number of publications.

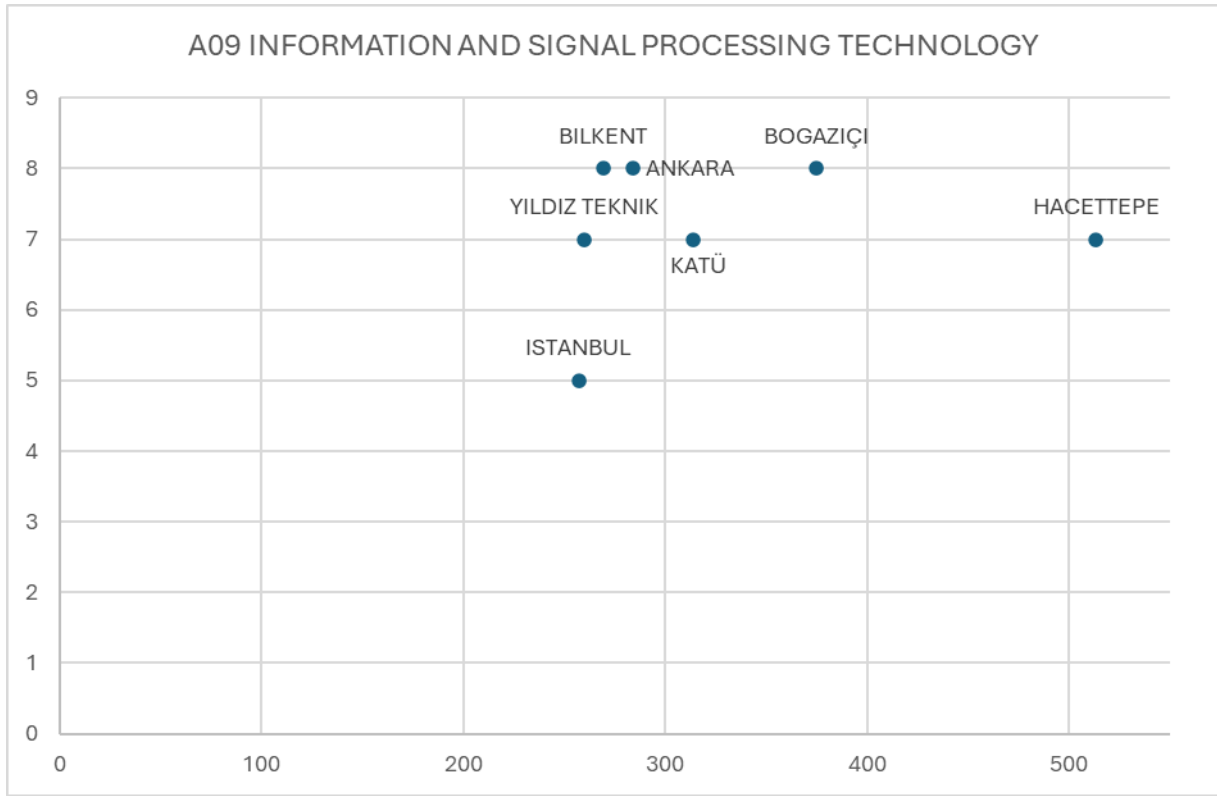


Figure 4.37. A9 Information and Signal Processing Technologies Area Competency Graphic

A09 Information and signal processing technology field qualification Aegean, Dokuz Eylül, Fırat, Koç, Gazi, Akdeniz, Kocaeli, İzmir Ekonomi, Çukurova, TOBB Economy and Technology, Selçuk, Sabancı, Anadolu, İstanbul-Cerrahpaşa, Bahçeşehir, Marmara, Atatürk, Sakarya, Gebze Teknik, Süleyman Demirel, On Dokuz Mayıs, Gaziantep, Atılım, Bursa Uludağ, Eskişehir Osmangazi, Başkent, Erciyes, İnönü, Düzce, Özyeğin, Pamukkale, Ankara Yıldırım Beyazıt, Zonguldak Bülent Ecevit, Manisa Celal Bayar, Mersin, İzmir Katip Çelebi, İstanbul Medipol, Necmettin Erbakan, Kahramanmaraş Sütçü İmam, Kadir Has, İstanbul Aydın, İstanbul Bilgi, İzmir Institute of Technology Universities should increase their number of publications.

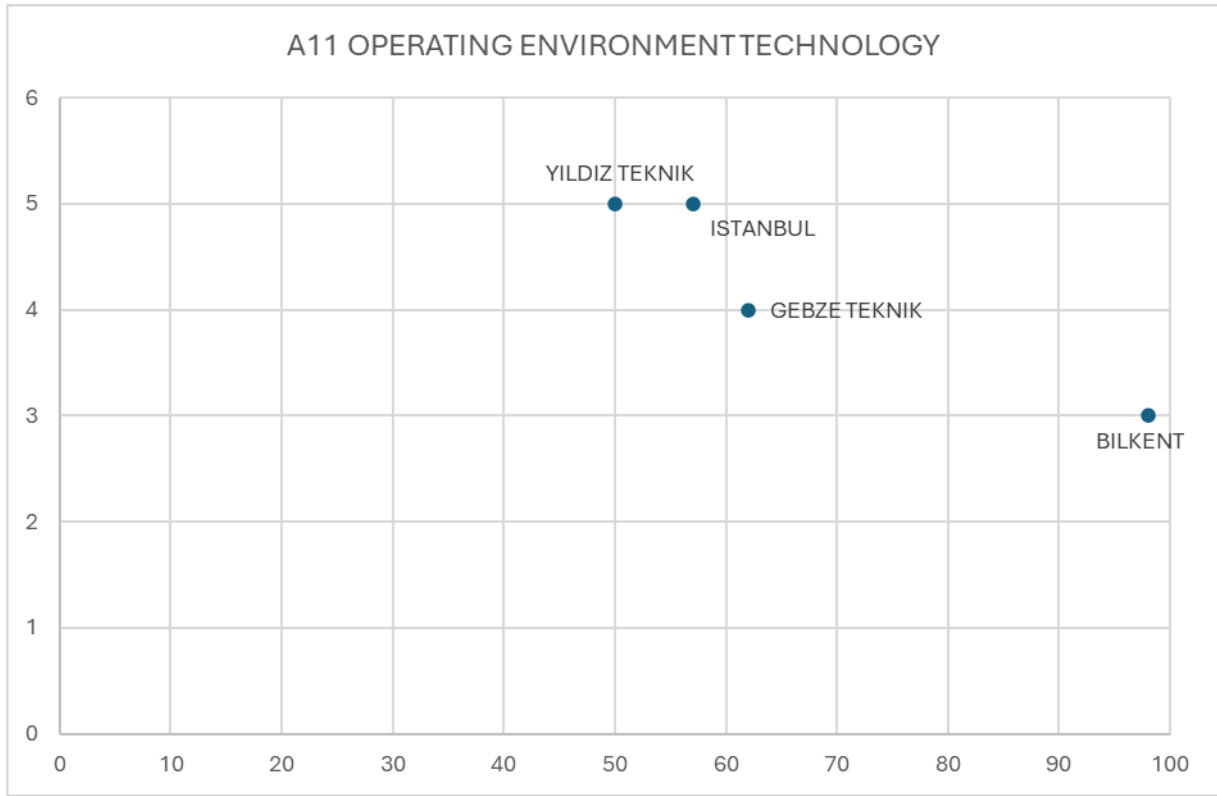


Figure 4.38. A11 Technologies Related to Environmental Conditions Affecting Operations
Area Competency Graphic

In the A11 operating environment technology field qualification, Doğuş University has the highest number of fields, followed by Dokuz Eylül, Hacettepe, Boğaziçi, Koç, Çukurova, Ankara, Fırat, Kocaeli, Işık, Marmara, TOBB Economy and Technology, Karadeniz Technical, Sabancı, Zonguldak Bülent Ecevit, Akdeniz, Ege, Selçuk, Gazi, Çanakkale On sekiz Mart, Bursa Uludağ, Pamukkale, Hatay Mustafa Kemal, Niğde Ömer Halisdemir, Gaziantep, Mersin, İzmir Ekonomi, Biruni, Anadolu, Yeditepe, Trakya, İzmir Institute of Technology, İstanbul-Cerrahpaşa universities should increase their number of publications.

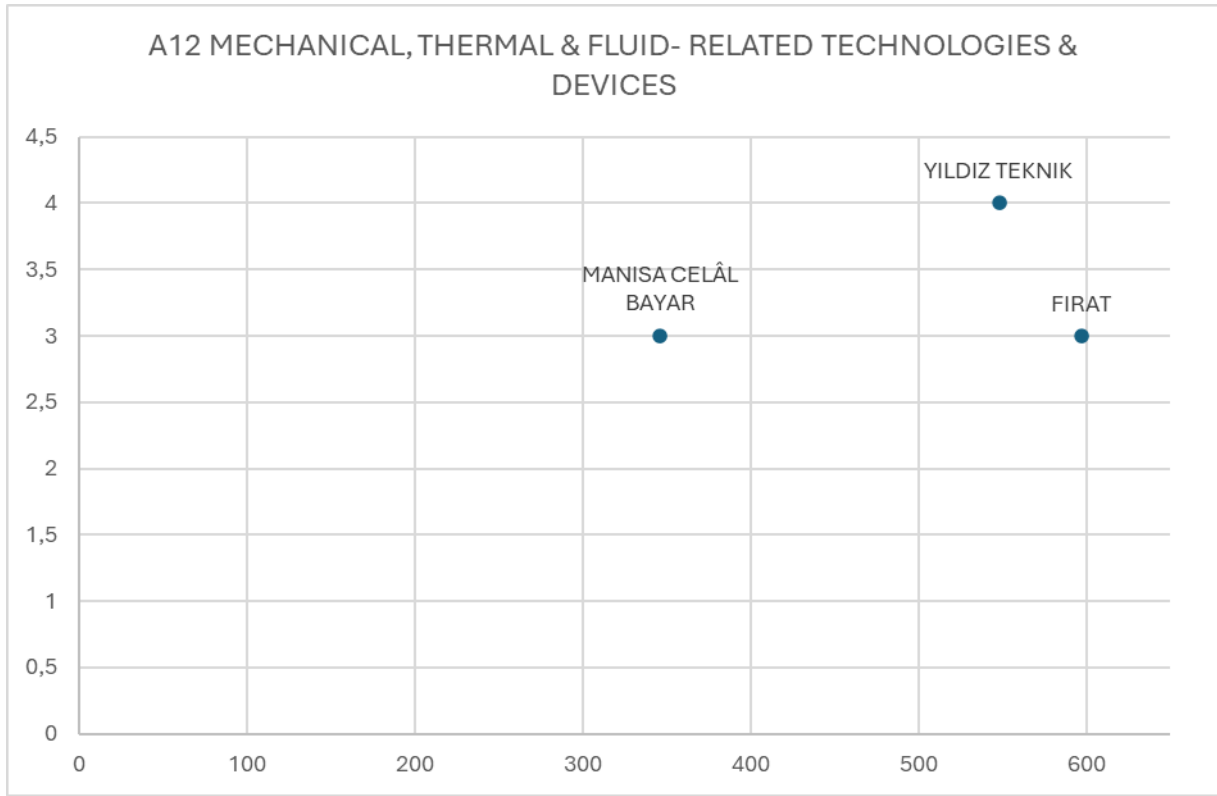


Figure 4.39. A12 Mechanical, Thermal and Fluid-Related Technology and Devices Area Competency Graphic

A12 mechanical, thermal & fluid- related technologies & devices in the sufficiency of the area, Karadeniz Technical, Koç, Erciyes, Sakarya, Gazi, Dokuz Eylül, Çukurova, Atatürk, Ege, Karabük, İzmir Institute of Technology, Marmara, Sabancı, Çankaya, Boğaziçi, Hacettepe, Eskişehir Osmangazi, Süleyman Demirel, Gaziantep, Bursa Uludağ, Niğde Ömer Halisdemir, Selçuk, Yeditepe, İstanbul, Kocaeli, Gebze Technical, Adana Alparslan Türkeş Science and Technology, Van Yüzüncü Yıl, Akdeniz, Mersin, Necmettin Erbakan, Anadolu, Osmaniye Korkut Ata, İhsan Doğramacı Bilkent, Düzce, Kütahya Dumlupınar, Bartın, Kırıkkale, Pamukkale, Zonguldak Bülent Ecevit, İzmir Katip Çelebi, Bursa Teknik, Sivas Cumhuriyet, Trakya, Ankara Yıldırım Beyazıt, İnönü, On Dokuz Mayıs, İskenderun Teknik, Aydın Adnan Menderes, Munzur, İstanbul Aydın, Bayburt, Hitit, Konya Teknik, Atılım, Bahçeşehir, Başkent, Siirt, İstinye, Gümüşhane, Batman, Dicle, Erzincan Binali Yıldırım, Kahramanmaraş Sütçü İmam, Karamanoğlu Mehmet Bey, Bingöl universities should increase their number of publications.

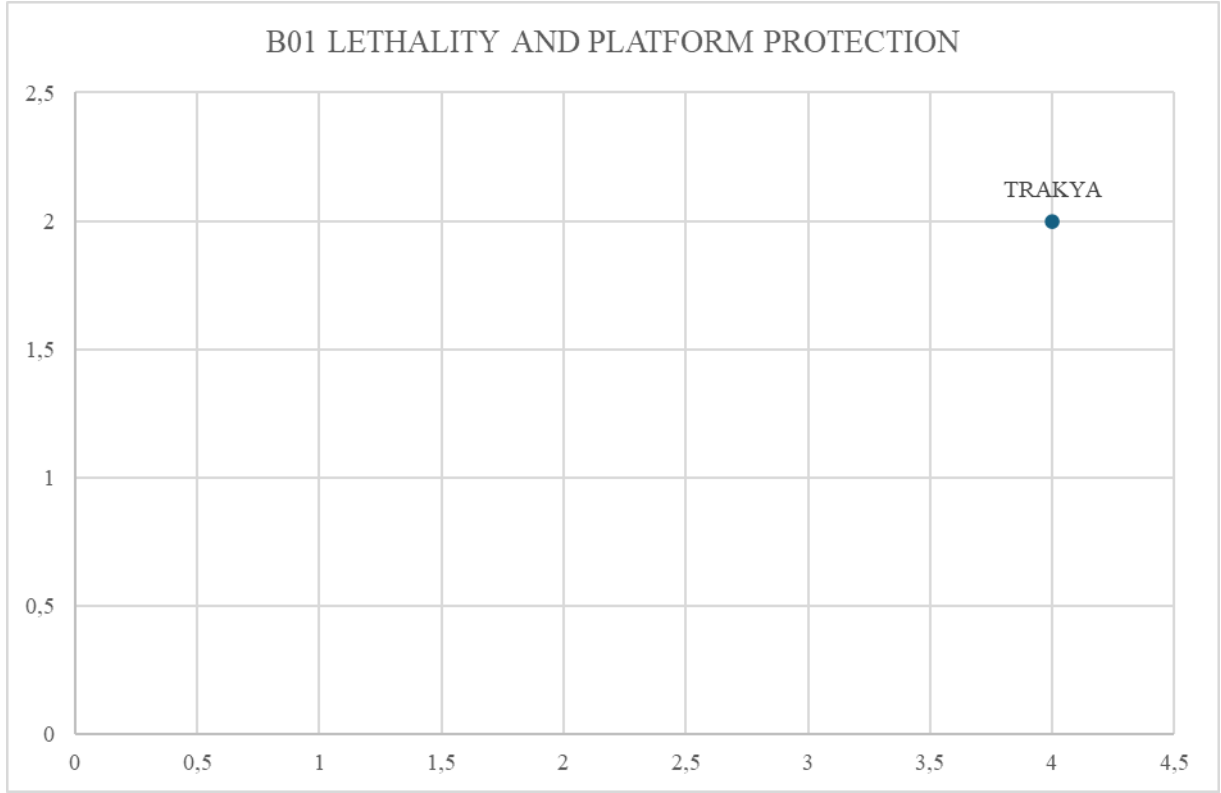


Figure 4.40. B1 Lethality and Platform Protection Area Competency Graphic

Since there are a total of 58 publications belonging to Koç, Erciyes, Yıldız Technical, Gazi, Dokuz Eylül, Ankara, Ege, TOBB Economy and Technology, İzmir Institute of Technology, Marmara, Çankaya, Hacettepe, İstanbul, Gebze Technical, Afyon Kocatepe, Akdeniz, Anadolu, Osmaniye Korkut Ata, Trakya, Atılım, Başkent universities among the nine sub-definitions in the field of B01 Lethality and platform protection, it is beneficial for all universities to increase the number of publications and fields for this breakdown.

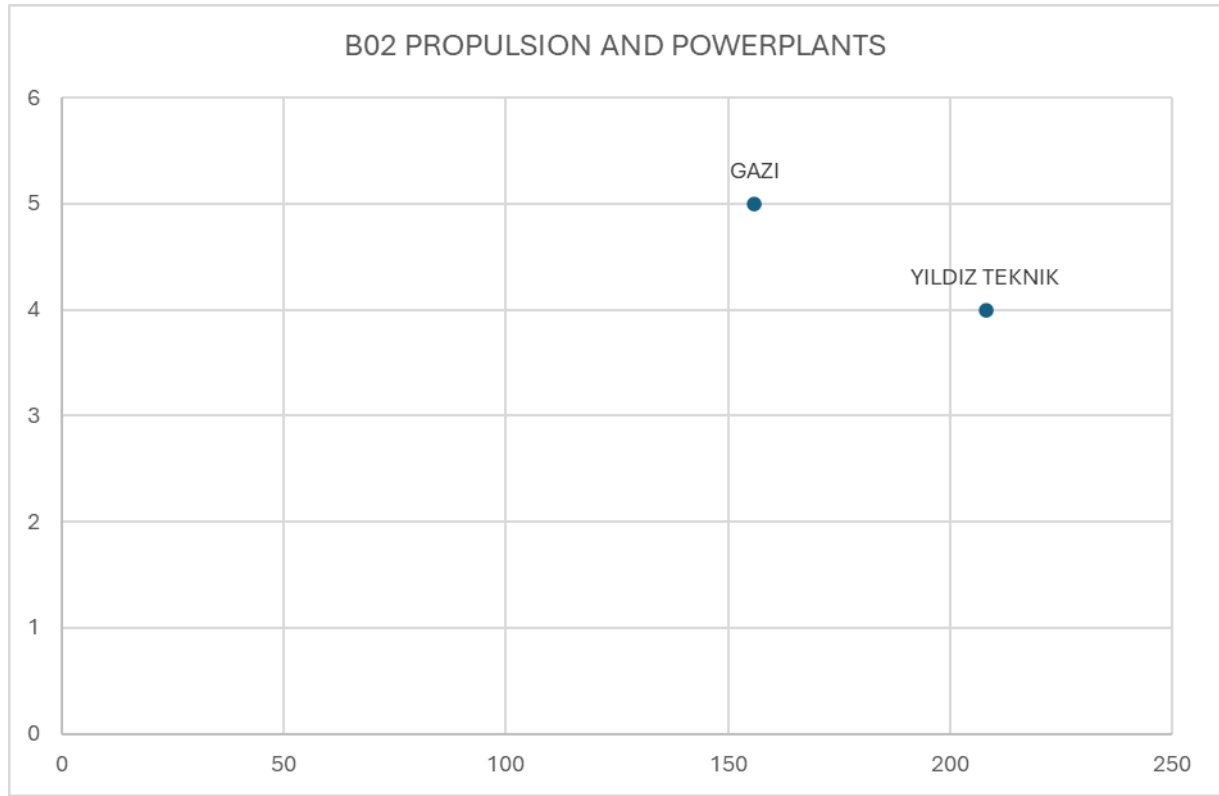


Figure 4.41. B2 Propulsion and Power Systems Area Qualification Graphic

Sakarya, Anadolu, Fırat, Karabük, Düzce, Kocaeli, Karadeniz Technical, Hacettepe, Süleyman Demirel, Erciyes, Eskişehir Technical, Isparta Applied Sciences, Sabancı, Gebze Technical, Atatürk, Ankara Yıldırım Beyazıt, Bursa Uludağ, İstanbul, Uşak, Koç, Eskişehir Osmangazi, Marmara, Özyeğin, Dokuz Eylül, Akdeniz, Necmettin Erbakan, İstanbul-Cerrahpaşa, Zonguldak Bülent Ecevit, Kastamonu, Erzincan Binali Yıldırım universities should increase their field and number of publications.

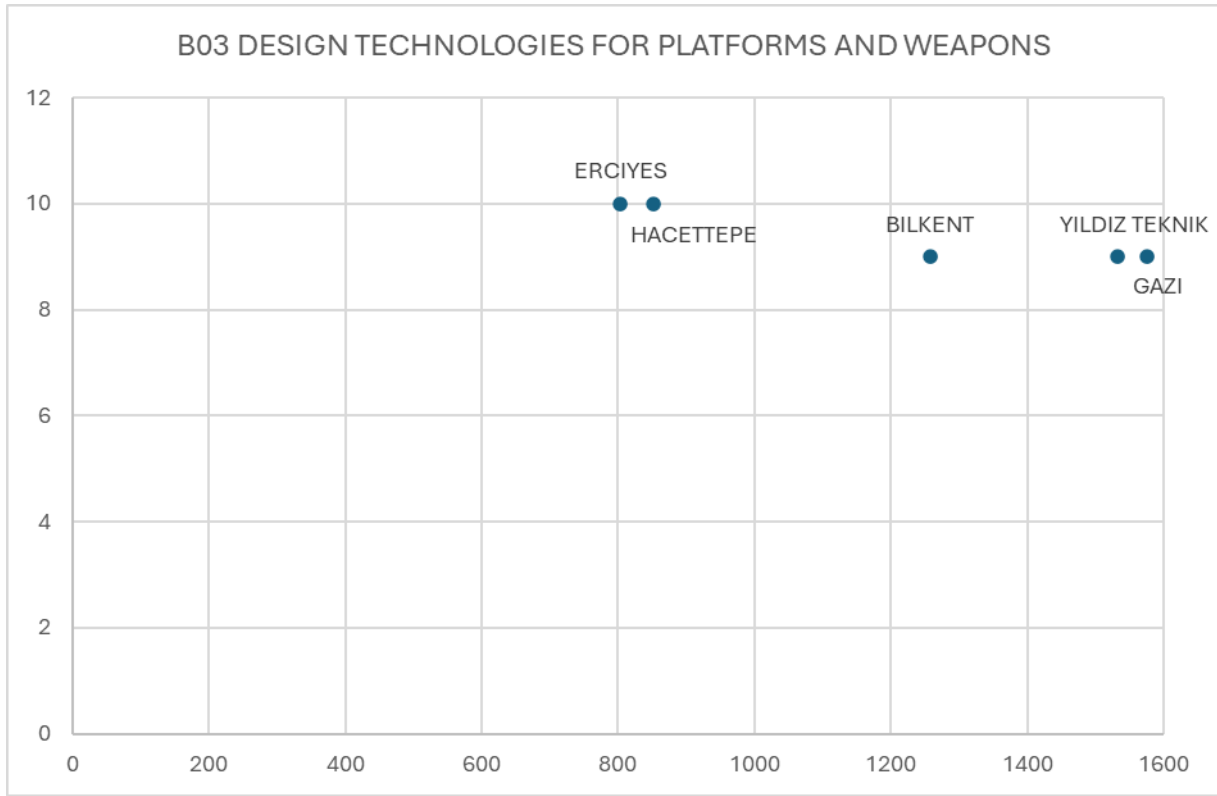


Figure 4.42. B3 Design Technologies for Platforms and Weapons Area Competency Graphic

B03 Design technologies for platforms and weapons field qualification Koç, Erciyes, Yıldız Technical, Gazi, Dokuz Eylül, Ankara, Ege, TOBB Economy and Technology, İzmir Institute of Technology, Marmara, Çankaya, Hacettepe, İstanbul, Gebze Technical, Afyon Kocatepe, Akdeniz, Anadolu, Osmaniye Korkut Ata, Trakya, Atılım, Başkent, Kocaeli, İstanbul-Cerrahpaşa, Fırat, Karadeniz Technical, Boğaziçi, Atatürk, Sabancı, Bursa Uludağ, Pamukkale, Özyeğin, Karabük, Eskişehir Osmangazi, Çukurova, Selçuk, Niğde Ömer Halisdemir, Gaziantep, İnönü, Süleyman Demirel, İskenderun Technical, Ondokuz Mayıs, Ankara Yıldırım Beyazıt, Bahçeşehir, Balıkesir, Düzce, Manisa Celal Bayar, Karamanoğlu Mehmetbey, Aksaray, Yeditepe, İzmir Katip Çelebi, Bursa Technical, Zonguldak Bülent Ecevit, Kahramanmaraş Sütçü İmam, Necmettin Erbakan, Hatay Mustafa Kemal, İstanbul Bilgi, Bolu Abant İzzet Baysal, Bitlis Eren universities should increase their number of publications.

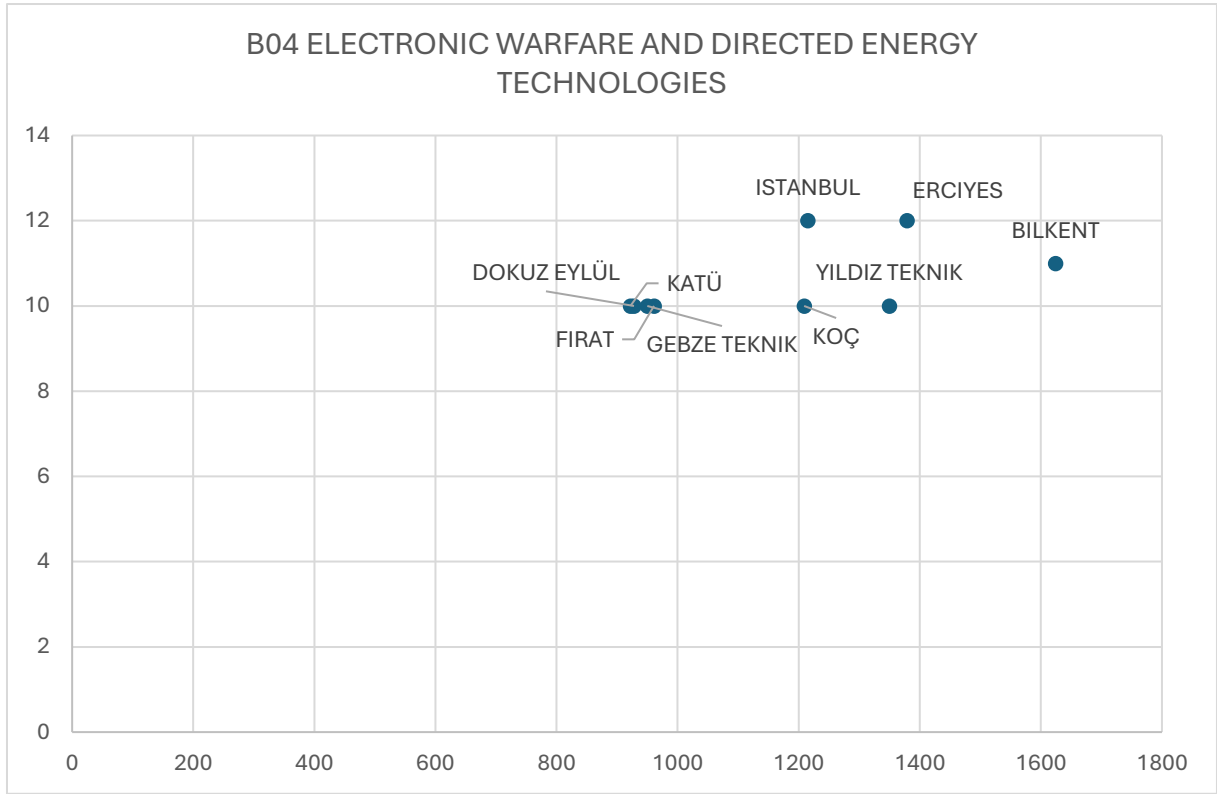


Figure 4.43. B4 Electronic Warfare and Directed Energy Technologies Area Competency Graphic

B04 Electronic warfare and directed energy technologies field qualification Kocaeli, İstanbul, Koç, Fırat, TOBB Economy and Technology, Karadeniz Technical, Boğaziçi, Marmara, Atatürk, Sabancı, Bursa Uludağ, Ege, Dokuz Eylül, Sakarya, Ankara, Pamukkale, İzmir Institute of Technology, Özyeğin, Karabük, Eskişehir Osmangazi, Çukurova, Selçuk, Akdeniz, Niğde Ömer Halisdemir, Gaziantep, Atılım, İnönü, Süleyman Demirel, İskenderun Technical, Ondokuz Mayıs, Gebze Technical, Ankara Yıldırım Beyazıt, Bahçeşehir, Trakya, Balıkesir, Düzce, Manisa Celâl Bayar, Karamanoğlu Mehmetbey, Aksaray, Yeditepe, İzmir Kâtip Çelebi, Bursa Technical, Zonguldak Bülent Ecevit, Başkent, İstanbul-Cerrahpaşa, Kahramanmaraş Sütçü İmam, Necmettin Erbakan, Hatay Mustafa Kemal, Afyon Kocatepe, İstanbul Bilgi, Anadolu, Bolu Abant İzzet Baysal, Bitlis Eren Universities should increase the number of publications.

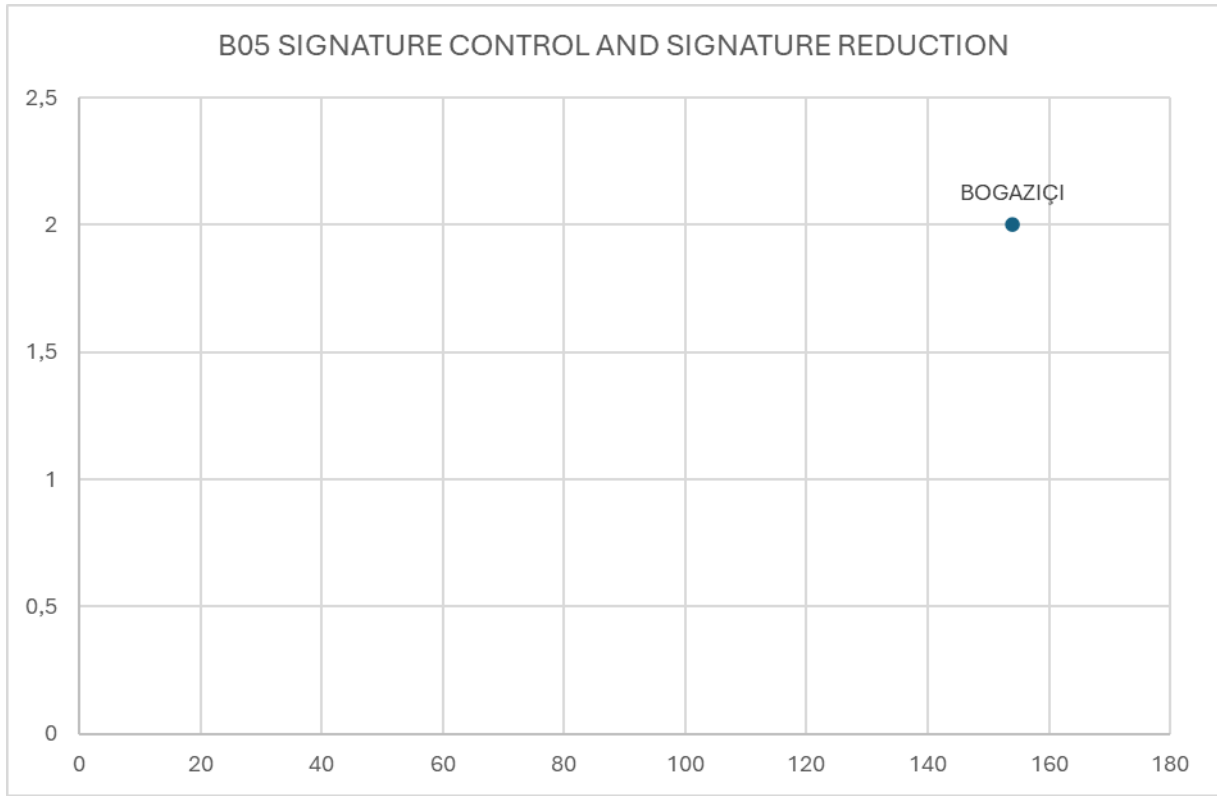


Figure 4.44. B5 Trace Control and Trace Reduction Area Proficiency Graphic

In the adequacy of B05 Signature control and signature reduction field, it would be beneficial for Çukurova, Adıyaman, Kafkas Universities to increase the number of fields and Bilkent, Hacettepe, Koç, Sabancı, Ankara, TOBB Universities to increase the number of publications.

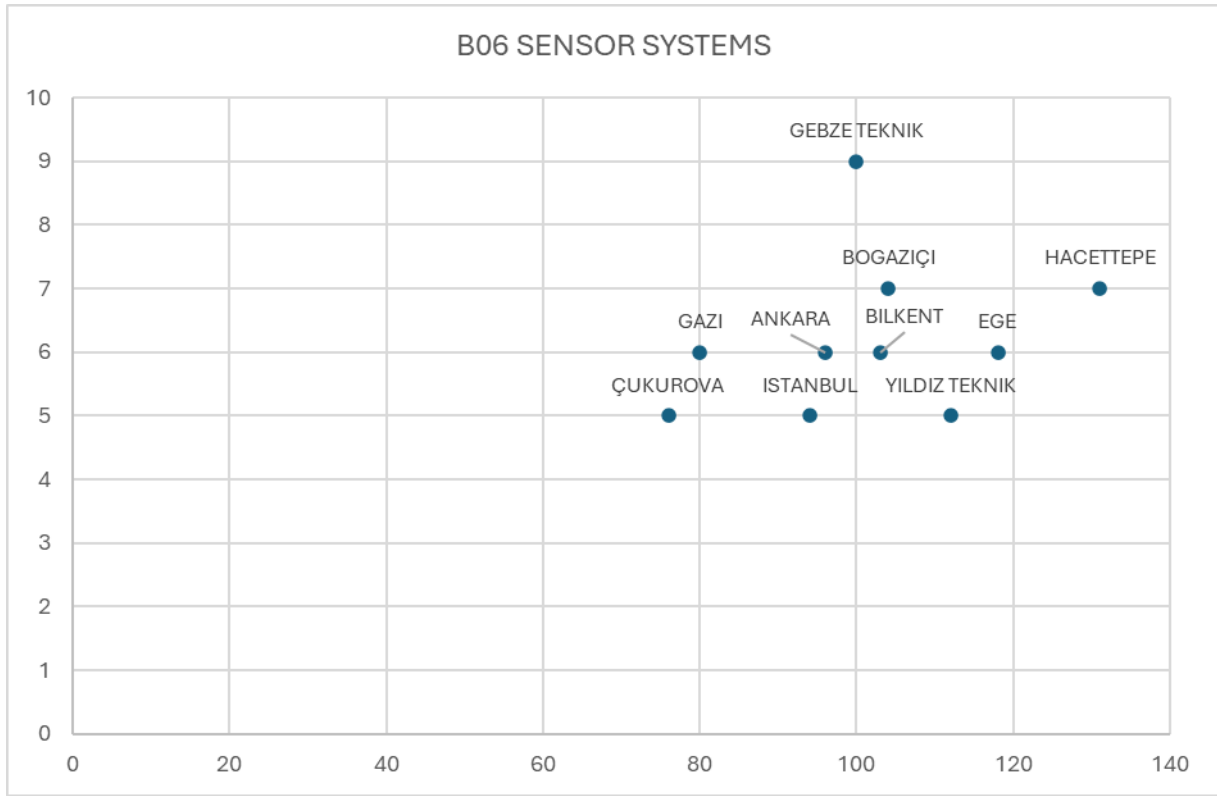


Figure 4.45. B6 Sensor Systems Area Competency Graphic

In B06 sensor systems field competence, Akdeniz and Dokuz Eylül Universities should increase the number of fields, and Marmara, Koç, Sabancı, Eskişehir Osmangazi Universities should increase the number of publications.

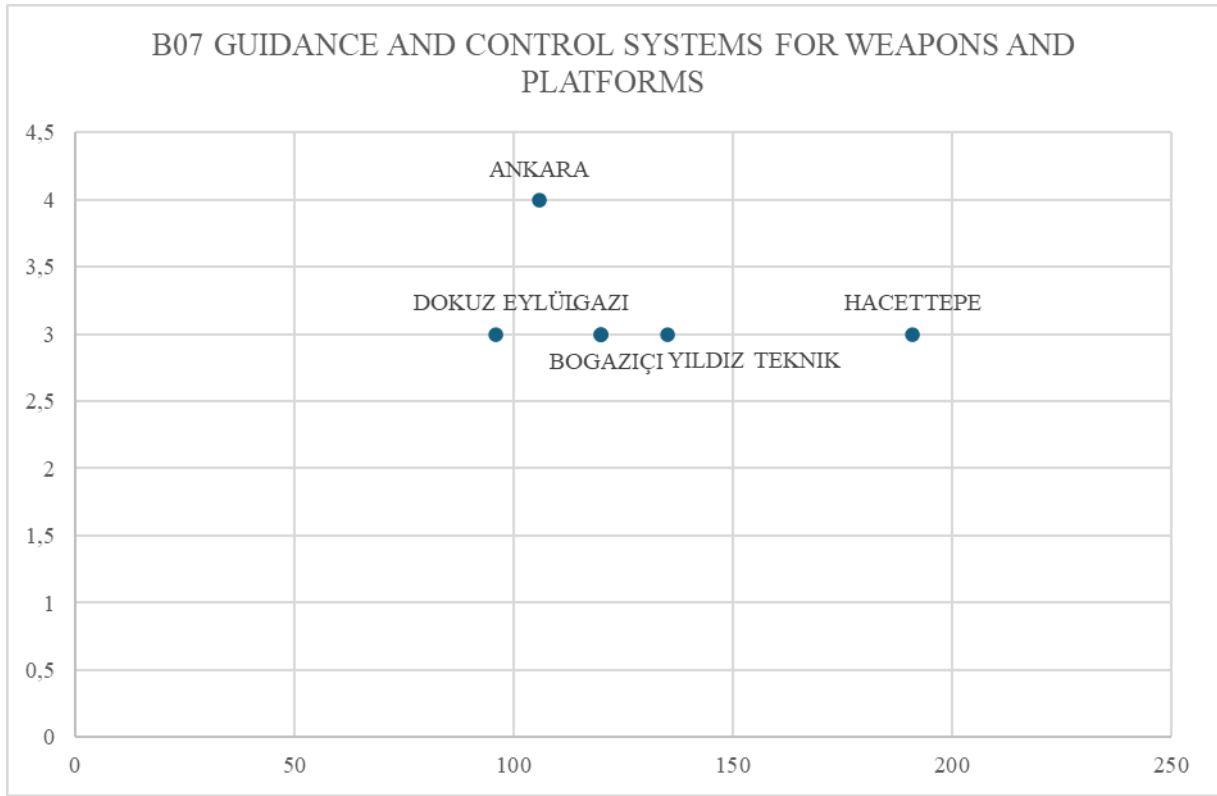


Figure 4.46. B7 Guidance and Control Systems for Weapons and Platforms Area Qualification Graphic

B07 guidance and control systems for weapons and platforms Marmara, Karadeniz Technical, Gebze Technical, Akdeniz, Atatürk, İhsan Doğramacı Bilkent, On dokuz Mayıs, İstanbul, Bahçeşehir, İzmir Katip Çelebi, İstanbul Medeniyet, Doğuş universities should increase their number of publications.

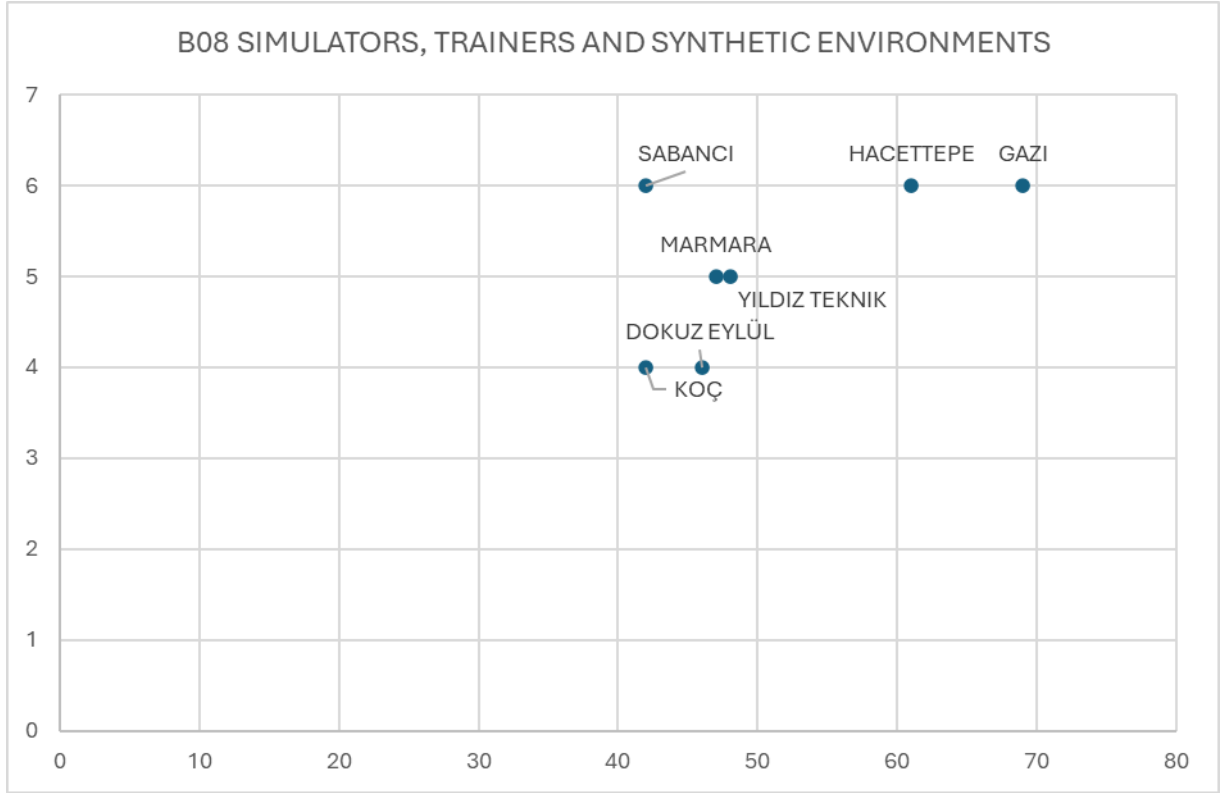


Figure 4.47. B8 Simulators, Trainers and Synthetic Environments Area Competency Graphic

Istanbul, Ege, Selçuk, Akdeniz, İstanbul-Cerrahpaşa, Bahçeşehir, Atatürk, Boğaziçi, Bursa Uludağ, Erciyes, Süleyman Demirel, Gebze Technical, İhsan Doğramacı Bilkent, Çukurova, Sakarya, Ondokuz Mayıs, Kocaeli, Bolu Abant İzzet Baysal, Karadeniz Technical, Karabük, Ege, Selçuk, Akdeniz, İstanbul-Cerrahpaşa, Bahçeşehir, Atatürk, Boğaziçi, Bursa Uludag, Erciyes, Süleyman Demirel, Gebze Technical, İhsan Doğramacı Bilkent, Çukurova, Sakarya, Ondokuz Mayıs, Kocaeli, Bolu Abant İzzet Baysal, Karadeniz Technical, Karabük universities should increase their number of publications in the field of B08 Simulators, trainers and synthetic environments.

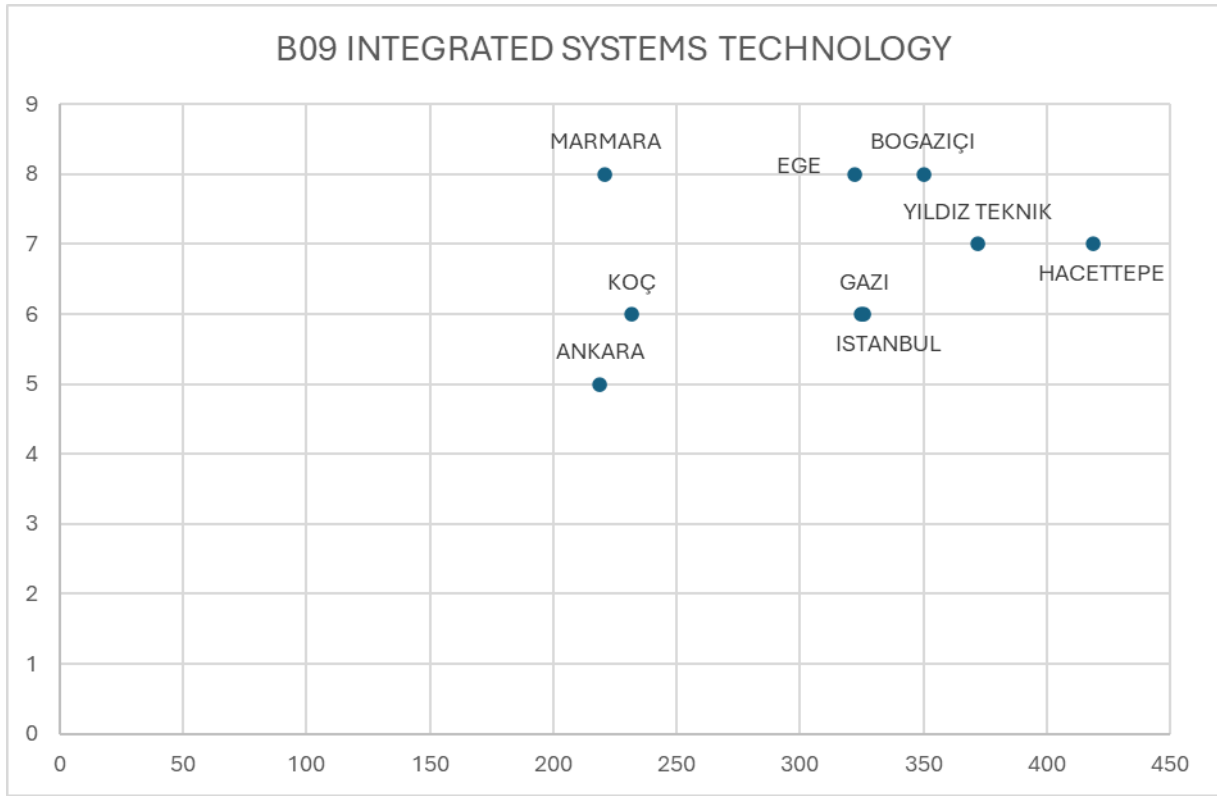


Figure 4.48. B9 Integrated System Technology Area Competency Graphic

Dokuz Eylül, Sabancı, Karadeniz Technical, Akdeniz, İhsan Doğramacı Bilkent, Çukurova, İstanbul-Cerrahpaşa, Selçuk, Fırat, Kocaeli, Eskişehir Osmangazi, Sakarya and Atatürk universities should increase their number of publications in B09 integrated systems technology field.

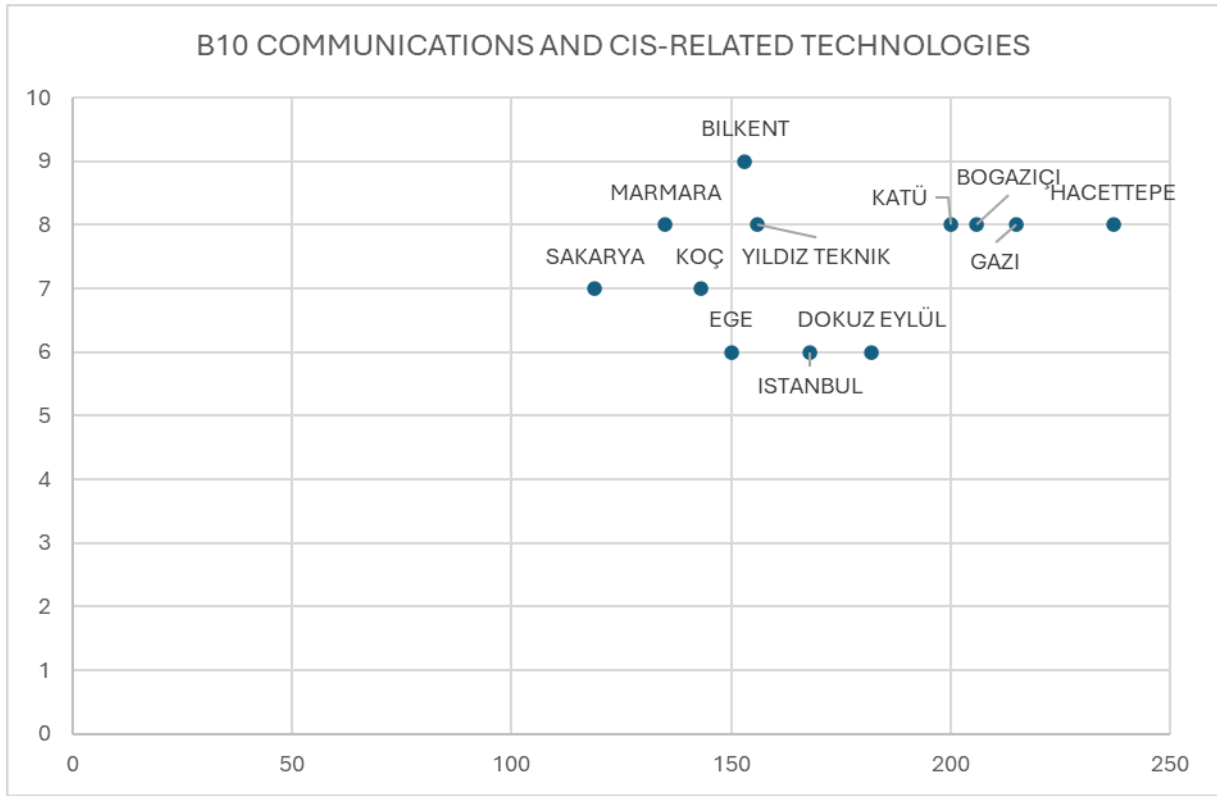


Figure 4.49. B10 Communication and Command and Information Systems and Related Technologies Area Qualification Graphic

In B10 communications and cis-related technologies field competency, Çukurova, Akdeniz, Fırat, İstanbul-Cerrahpaşa, Kocaeli, Kadir Has, Bahçeşehir, Galatasaray, Ankara, Manisa Celâl Bayar, Başkent, Sabancı, Eskişehir Osmangazi, Ondokuz Mayıs, Muğla Sıtkı Koçman, Sabancı universities would benefit from increasing their number of publications.

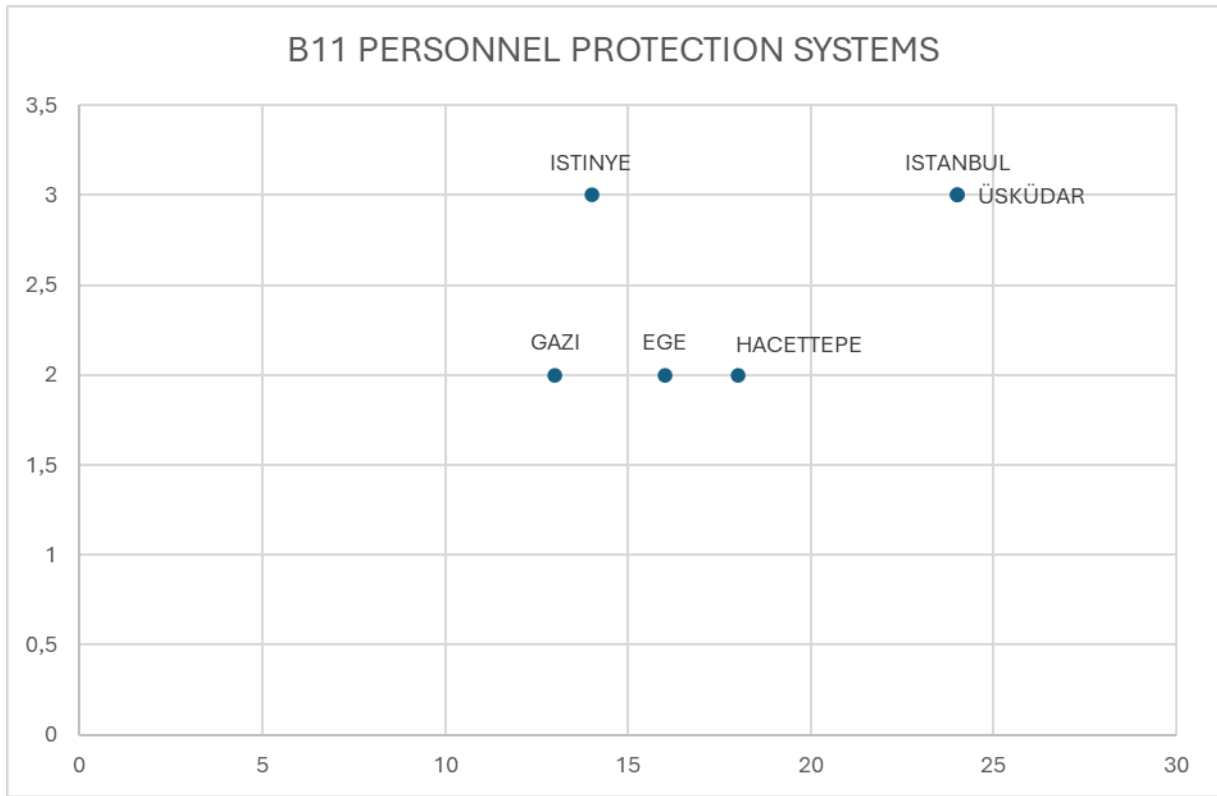


Figure 4.50. B11 Personnel Protection Systems Area Qualification Graphic

It is beneficial for Ankara, Eskişehir Osmangazi, Dokuz Eylül, Atatürk, Afyon Kocatepe, Koç Universities to increase the number of publications in B11 personnel protection systems field competence.

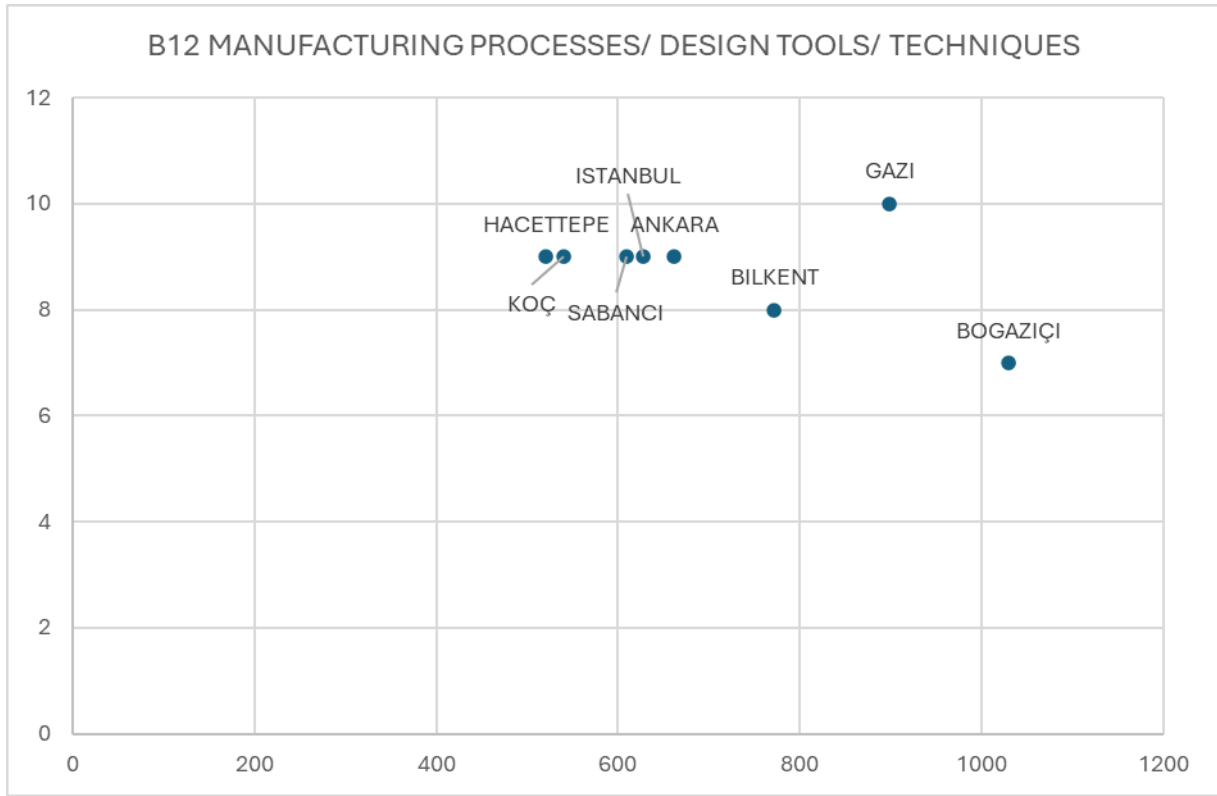


Figure 4.51. B12 Manufacturing Processes/Design Tools/Techniques Area Competency Graphic

Gaziantep, Erciyes, Bahçeşehir, Selçuk, Gebze Technical, Sakarya, Süleyman Demirel, Karadeniz Technical, İstanbul Aydın, Yıldız Technical, Marmara, Ege, Ege, Çukurova, Dokuz Eylül, Kocaeli, 19 Mayıs, Atatürk, Akdeniz, Fırat, İstanbul-Cerrahpaşa, Eskişehir Osmangazi, Atılım, Bursa Uludağ, Anadolu, TOBB Economy and Technology, İzmir Institute of Technology, Başkent, Yaşar, Özyeğin, Bartın universities should increase their number of publications in the field of B12 Manufacturing processes/ design tools/ techniques.

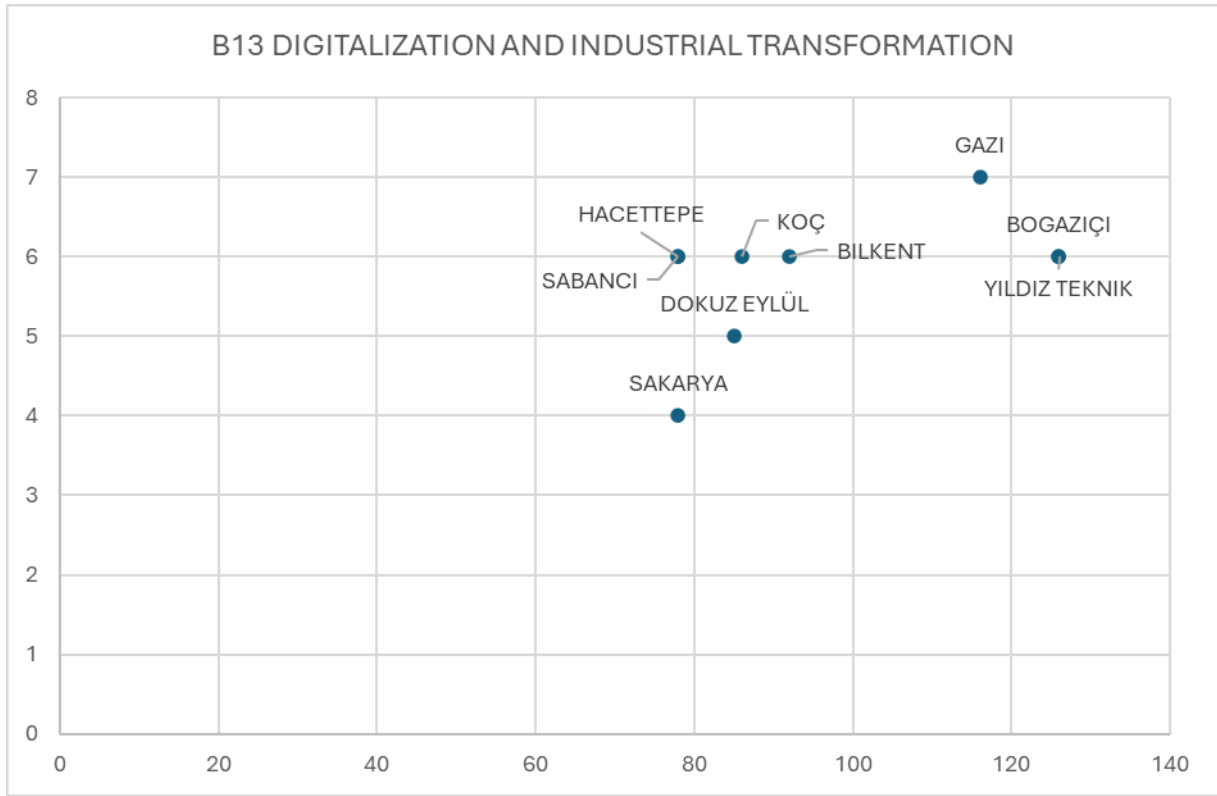


Figure 4.52. B13 Digitalization and Industrial Transformation Area Competency Graphic

In the adequacy of the B13 digitalization and industrial transformation field, Çankaya, Fırat universities should increase the number of fields, Bahçeşehir, Ege, Erciyes, Özyeğin, İnönü, Kadir Has, Kütahya Dumlupınar, İstinye, İstanbul Ticaret universities should increase the number of publications.

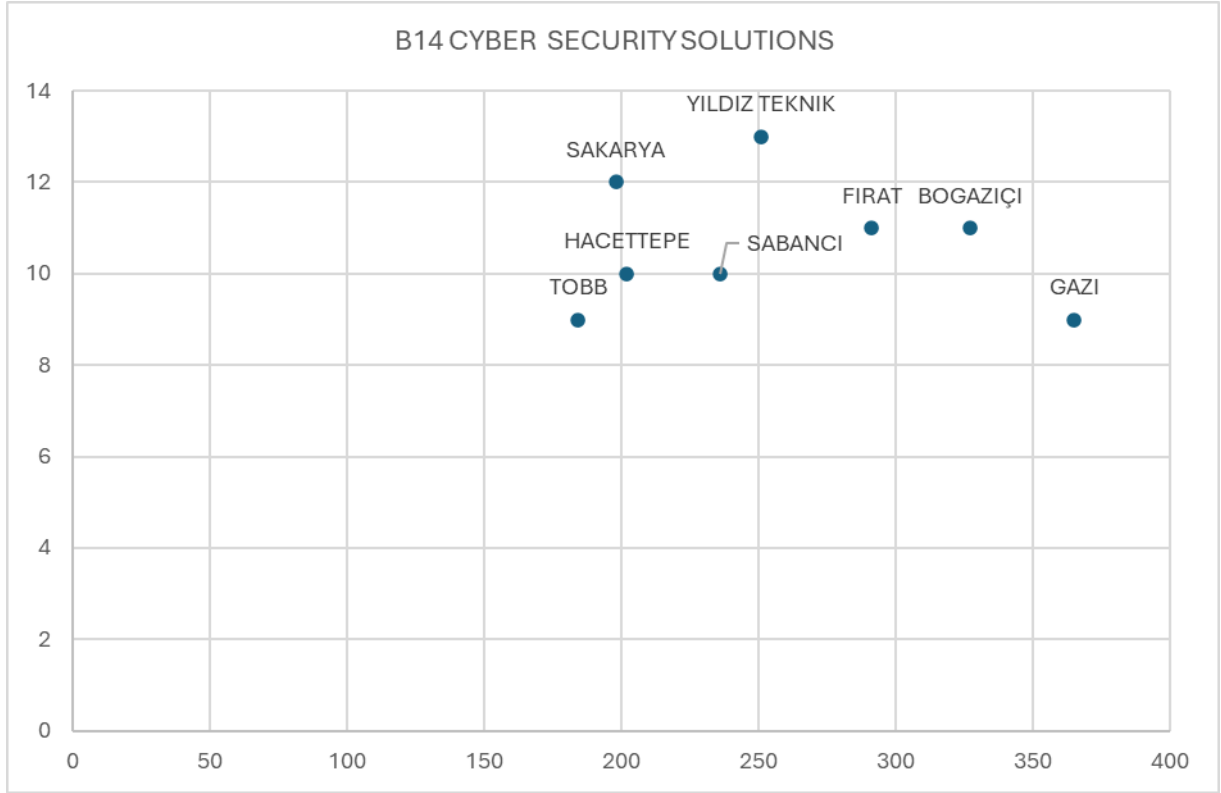


Figure 4.53. B14 Cyber Security Solutions Area Competency Graph

It is beneficial for İhsan Doğramacı Bilkent, Dokuz Eylül, Koç, Ege, Ankara, İstanbul, İstanbul Gelişim, Bahçeşehir, Atılım, Marmara, Kocaeli, Gebze Teknik, Yaşar, İstanbul Ticaret, Kadir Has, İstanbul Medipol, On dokuz Mayıs, Ankara Yıldırım Beyazıt, Anadolu, İstanbul Kültür, Trakya, Gaziantep, İzmir Institute of Technology, Haliç, Abdullah Gül University, Özyeğin, Erciyes universities to increase the number of publications in the field of B14 cyber security solutions.

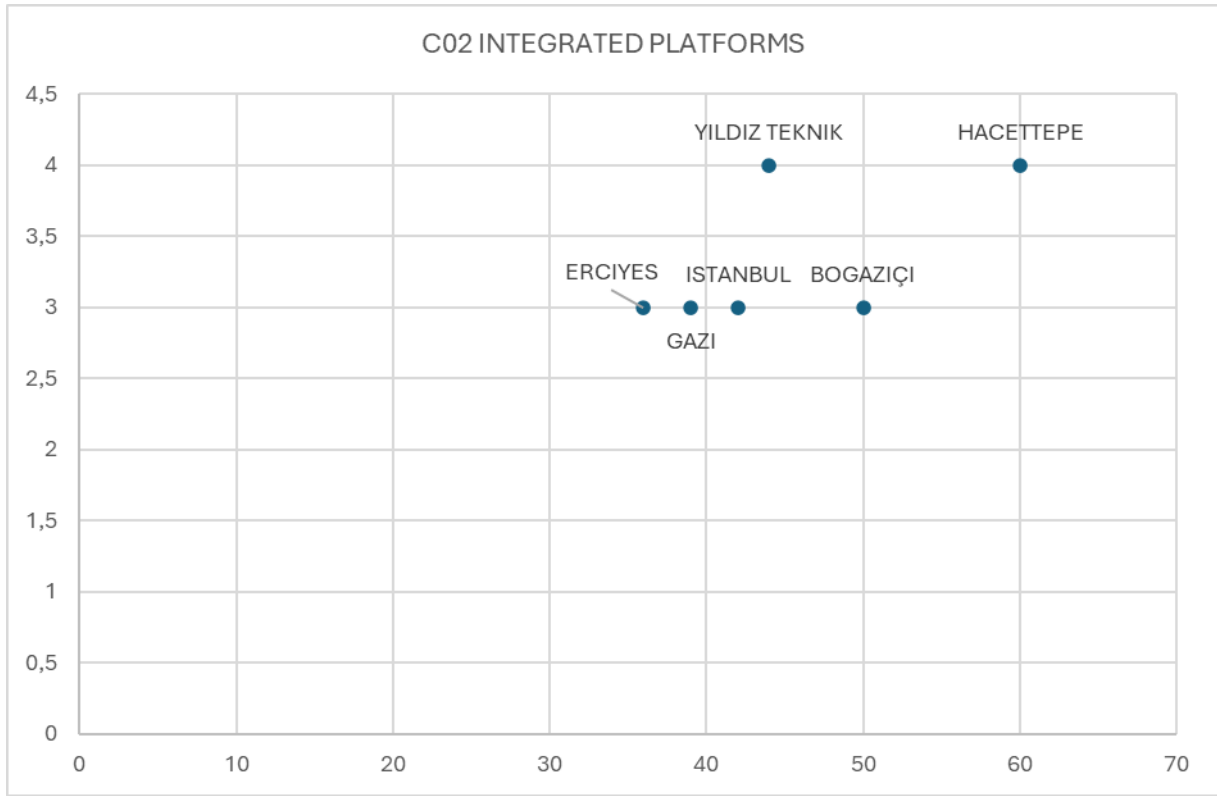


Figure 4.54. C2 Integrated Platforms Area Qualification Graphic

It would be beneficial for Zonguldak Bülent Ecevit, Gebze Technical, Ankara, İhsan Doğramacı Bilkent, Çukurova, Akdeniz, Sabancı, Dokuz Eylül, Kocaeli, Eskişehir Technical, Karadeniz Technical, Süleyman Demirel, Koç, TOBB Economics and Technology, Fırat, Anadolu Universities to increase their number of publications.

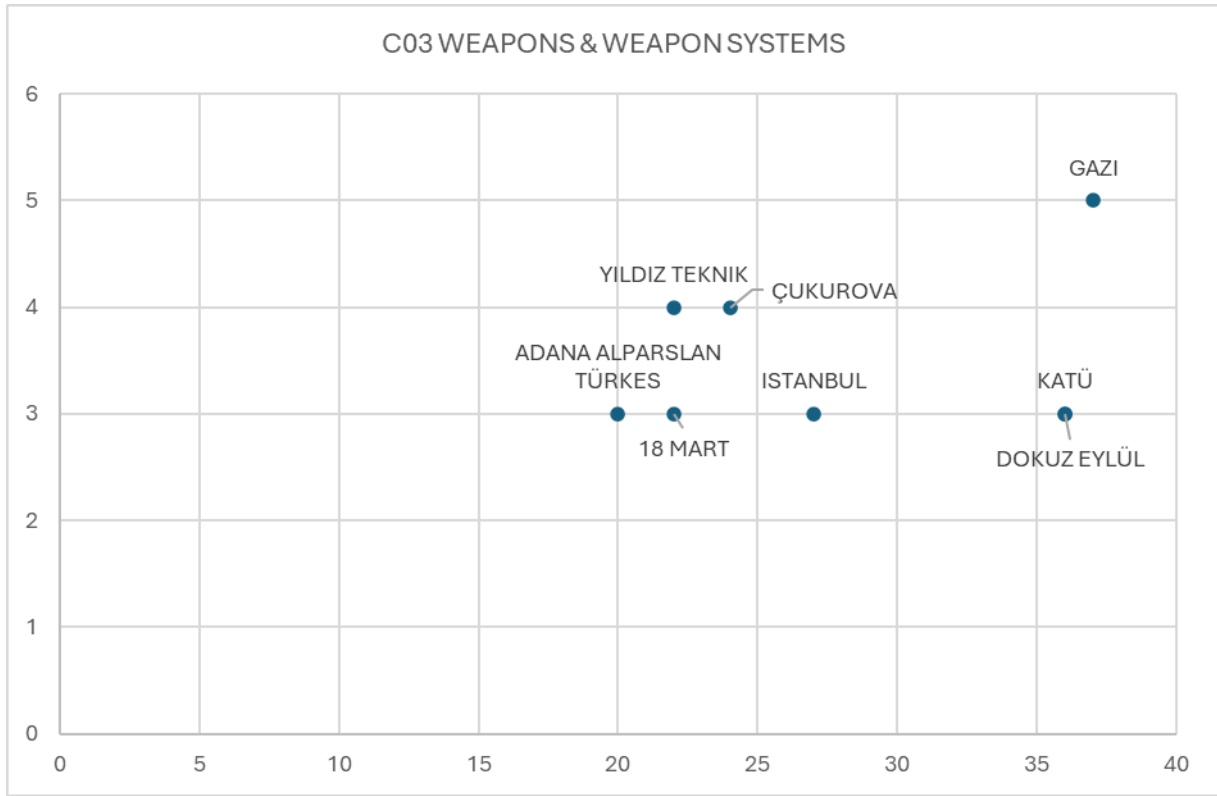


Figure 4.55. C3 Weapons and Weapon Systems Area Competency Graphic

In the field of C03 weapons & weapon systems, Boğaziçi, Zonguldak Bülent Ecevit, Sivas Cumhuriyet, Erciyes universities should increase the number of fields and Fırat, Ankara universities should increase the number of publications.

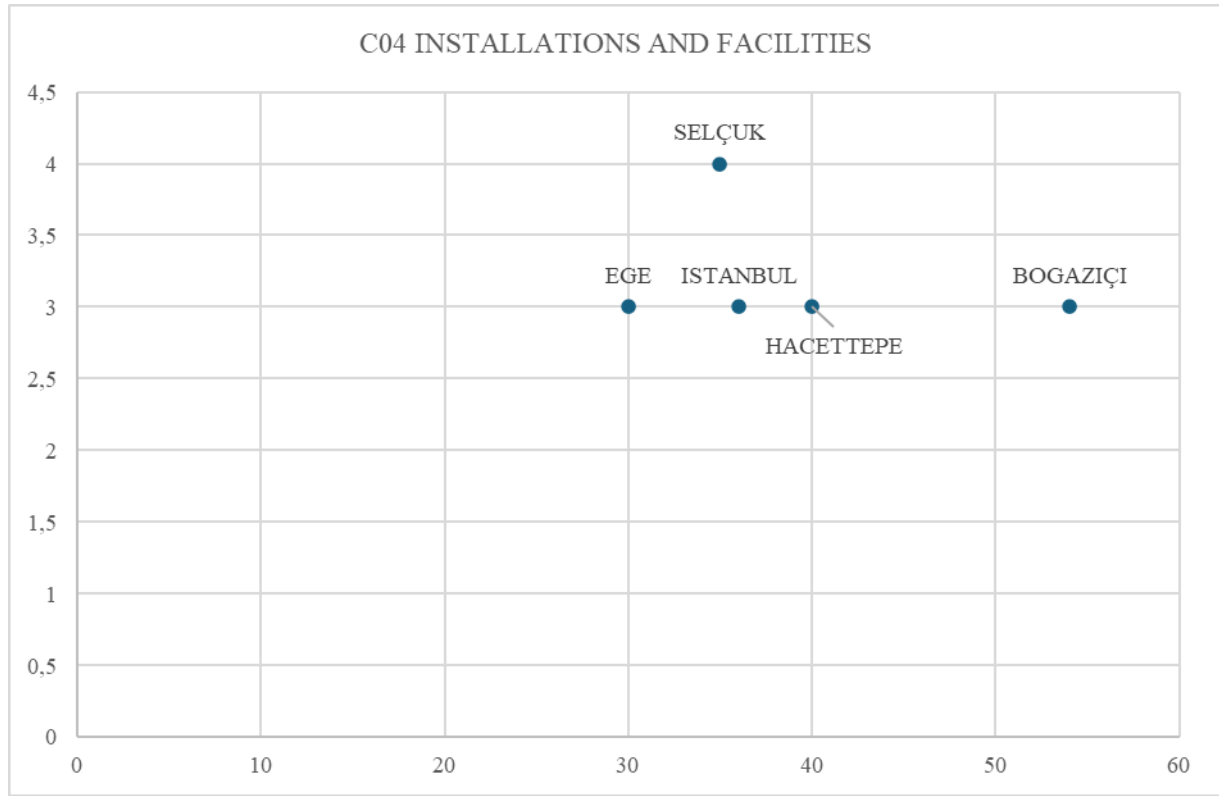


Figure 4.56. C4 Installation and Facilities Area Qualification Graphic

In C04 installations and facilities field adequacy, it would be beneficial for Çukurova University to increase the number of publications in Gazi, Kocaeli, Ankara, Çanakkale Eighteen Mart, Koç, Nineteen May, Anadolu, Erciyes, Sakarya, Akdeniz, İstanbul-Cerrahpaşa, Eskişehir Osmangazi, Gümüşhane, Marmara, Pamukkale, Eskişehir Technical, Gaziantep universities.

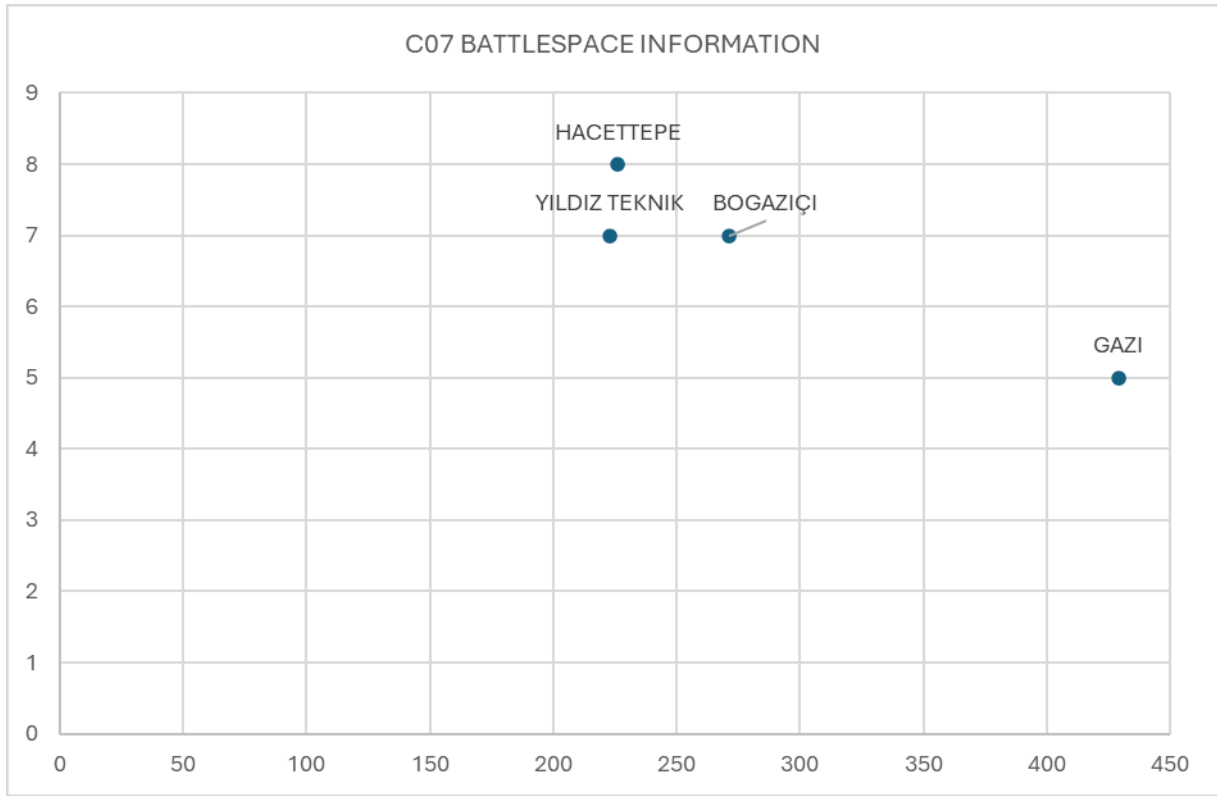


Figure 4.57. C7 Battlefield Information Area Proficiency Graph

It would be beneficial for Ege, Istanbul, Karadeniz Technical, Ankara, Sabancı, Marmara, Izmir Institute of Technology, Mersin, TOBB Economics and Technology, National Defense Universities to increase the number of areas in C07 battlespace information area sufficiency.

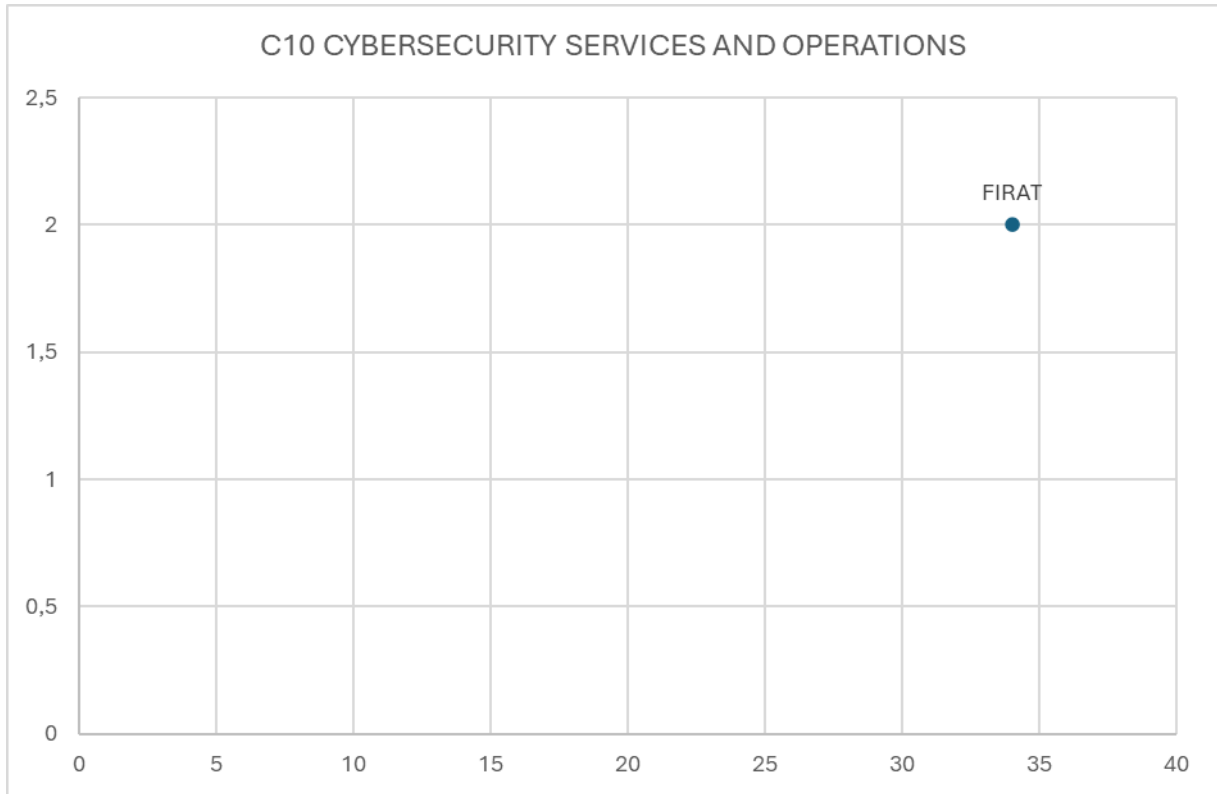


Figure 4.58. C10 Cyber Security Services and Operations Area Competency Graph

It is beneficial for Gazi, İstanbul-Cerrahpaşa, Çankırı Karatekin, Abdullah Gül, Sakarya universities to increase the number of publications in the field of C10 cybersecurity services and operations.

4.4. Ranking of Universities according to Adequacy

When the graphs above are analyzed according to the areas in which universities are competent, the following table emerges.

Table 4.3. Table of Qualification Areas of Universities

Adequate Space Table of Universities			
Row	University Name	Number of Adequate Spaces	Areas of Competence
1	Gas University	21	A1 Structural and smart materials and structural mechanics
			A3 electronic material technologies
			A4 photonic/optical materials and device technologies
			A5 electronic, electrical and electromechanical device technologies
			A6 energetic materials and plasma technologies
			A7 chemical biological and medical supplies

Adequate Space Table of Universities			
Row	University Name	Number of Adequate Spaces	Areas of Competence
			A8 Information Technologies and Mathematics Techniques
			B2 propulsion and power systems
			B3 design technologies for platforms and weapons
			B6 sensor systems
			B7 guidance and control systems for weapons and platforms
			B8 simulators, trainers and synthetic environments
			B9 integrated system technology
			B10 technologies related to communications and command and information systems (CIS)
			B11 personnel protection systems
			B12 manufacturing processes/design tools/techniques
			B13 digitalization and industrial transformation
			B14 cyber security solutions
			C2 integrated platforms
			C3 weapons and weapon systems
			C7 battlefield information
2	Yildiz Technical University	18	A1 Structural and smart materials and structural mechanics
			A5 electronic, electrical and electromechanical device technologies
			A9 information and signal processing technologies
			A11 technologies related to environmental conditions affecting operations
			A12 mechanical, thermal and fluid-related technology and devices
			B2 propulsion and power systems
			B3 design technologies for platforms and weapons
			B4 electronic warfare and directed energy technologies
			B6 sensor systems
			B7 guidance and control systems for weapons and platforms
			B8 simulators, trainers and synthetic environments
			B9 integrated system technology
			B10 technologies related to communications and command and information systems (CIS)
			B13 digitalization and industrial transformation
			B14 cyber security solutions
			C2 integrated platforms
			C3 weapons and weapon systems
			C7 battlefield information

Adequate Space Table of Universities			
Row	University Name	Number of Adequate Spaces	Areas of Competence
3	Hacettepe University	15	A7 chemical biological and medical supplies
			A9 information and signal processing technologies
			B3 design technologies for platforms and weapons
			B6 sensor systems
			B7 guidance and control systems for weapons and platforms
			B8 simulators, trainers and synthetic environments
			B9 integrated system technology
			B10 technologies related to communications and command and information systems (CIS)
			B11 personnel protection systems
			B12 manufacturing processes/design tools/techniques
			B13 digitalization and industrial transformation
			B14 cyber security solutions
			C2 integrated platforms
			C4 installations and facilities
			C7 battlefield information
4	Istanbul University	14	A3 electronic material technologies
			A6 energetic materials and plasma technologies
			A7 chemical biological and medical supplies
			A9 information and signal processing technologies
			A11 technologies related to environmental conditions affecting operations
			B4 electronic warfare and directed energy technologies
			B6 sensor systems
			B9 integrated system technology
			B10 technologies related to communications and command and information systems (CIS)
			B11 personnel protection systems
			B12 manufacturing processes/design tools/techniques
			C2 integrated platforms
5	Bosphorus University	13	C3 weapons and weapon systems
			C4 installations and facilities
			A8 Information Technologies and Mathematics Techniques
			A9 information and signal processing technologies
			B5 track control and track reduction
			B6 sensor systems
			B7 guidance and control systems for weapons and platforms
			B9 integrated system technology

Adequate Space Table of Universities			
Row	University Name	Number of Adequate Spaces	Areas of Competence
			B10 technologies related to communications and command and information systems (CIS)
			B12 manufacturing processes/design tools/techniques
			B13 digitalization and industrial transformation
			B14 cyber security solutions
			C2 integrated platforms
			C4 installations and facilities
			C7 battlefield information
6	Ihsan Doğramacı Bilkent University	10	A3 electronic material technologies
			A4 photonic/optical materials and device technologies
			A9 information and signal processing technologies
			A11 technologies related to environmental conditions affecting operations
			B3 design technologies for platforms and weapons
			B4 electronic warfare and directed energy technologies
			B6 sensor systems
			B10 technologies related to communications and command and information systems (CIS)
			B12 manufacturing processes/design tools/techniques
7	Ankara University	9	B13 digitalization and industrial transformation
			A3 electronic material technologies
			A6 energetic materials and plasma technologies
			A7 chemical biological and medical supplies
			A8 Information Technologies and Mathematics Techniques
			A9 information and signal processing technologies
			B6 sensor systems
			B7 guidance and control systems for weapons and platforms
			B9 integrated system technology
8	Dokuz Eylül University	6	B12 manufacturing processes/design tools/techniques
			B4 electronic warfare and directed energy technologies
			B7 guidance and control systems for weapons and platforms
			B8 simulators, trainers and synthetic environments
			B10 technologies related to communications and command and information systems (CIS)
			B13 digitalization and industrial transformation

Adequate Space Table of Universities			
Row	University Name	Number of Adequate Spaces	Areas of Competence
			C3 weapons and weapon systems
9	Aegean University	6	A7 chemical biological and medical supplies
			B6 sensor systems
			B9 integrated system technology
			B10 technologies related to communications and command and information systems (CIS)
			B11 personnel protection systems
			C4 installations and facilities
10	Koç University	6	B4 electronic warfare and directed energy technologies
			B8 simulators, trainers and synthetic environments
			B9 integrated system technology
			B10 technologies related to communications and command and information systems (CIS)
			B12 manufacturing processes/design tools/techniques
			B13 digitalization and industrial transformation
11	Euphrates University	5	A8 Information Technologies and Mathematics Techniques
			A12 mechanical, thermal and fluid-related technology and devices
			B4 electronic warfare and directed energy technologies
			B14 cyber security solutions
			C10 cyber security services and operations
12	Marmara University	5	A1 Structural and smart materials and structural mechanics
			A6 energetic materials and plasma technologies
			B8 simulators, trainers and synthetic environments
			B9 integrated system technology
			B10 technologies related to communications and command and information systems (CIS)
13	Sakarya University	5	A3 electronic material technologies
			A6 energetic materials and plasma technologies
			B10 technologies related to communications and command and information systems (CIS)
			B13 digitalization and industrial transformation
			B14 cyber security solutions
14	Gebze Technical University	4	A3 electronic material technologies
			A11 technologies related to environmental conditions affecting operations
			B4 electronic warfare and directed energy technologies
			B6 sensor systems

Adequate Space Table of Universities			
Row	University Name	Number of Adequate Spaces	Areas of Competence
15	Karadeniz Technical University	4	A9 information and signal processing technologies
			B4 electronic warfare and directed energy technologies
			B10 technologies related to communications and command and information systems (CIS)
			C3 weapons and weapon systems
16	Sabancı University	4	B8 simulators, trainers and synthetic environments
			B12 manufacturing processes/design tools/techniques
			B13 digitalization and industrial transformation
			B14 cyber security solutions
17	Cukurova University	3	A6 energetic materials and plasma technologies
			B6 sensor systems
			C3 weapons and weapon systems
18	Erciyes University	3	B3 design technologies for platforms and weapons
			B4 electronic warfare and directed energy technologies
			C2 integrated platforms
19	Ataturk University	2	A1 Structural and smart materials and structural mechanics
			A3 electronic material technologies
20	Izmir institute of high technology	1	A8 Information Technologies and Mathematics Techniques
21	Adana Alparslan Türkeş University of Science and Technology	1	C3 weapons and weapon systems
22	Çanakkale 18 March University	1	C3 weapons and weapon systems
23	Istinye University	1	B11 personnel protection systems
24	Manisa celâl bayar university	1	A12 mechanical, thermal and fluid-related technology and devices
25	Selcuk University	1	C4 installations and facilities
26	TOBB University of	1	B14 cyber security solutions

Adequate Space Table of Universities			
Row	University Name	Number of Adequate Spaces	Areas of Competence
	Economics and Technology		
27	Trakya University	1	B1 lethality and platform protection
28	Üsküdar University	1	B11 personnel protection systems

When the data above are analyzed, it is seen that 28 universities are competent in 162 categories in total. Istanbul, Boğaziçi, İhsan Doğramacı Bilkent, Ankara, Dokuz Eylül, Ege, Koç, Fırat, Marmara, Sakarya universities are competent in the defense industry, while Izmir Institute of Technology, Adana Alparslan Türkeş Science and Technology, Çanakkale 18 Mart, İstinye, Manisa Celâl Bayar, Selçuk, TOBB Economy and Technology, Trakya, Üsküdar universities are competent in only one area.

5. CONCLUSION

In the taxonomy 2.0 prepared by the Presidency of Defense Industry of the Republic of Türkiye, 314 definitions of 30 second level breakdowns belonging to the three main breakdowns to be used in the defense industry were identified. 314 definition titles were selected as keywords. Data were obtained by searching the number of publications issued by universities in the Republic of Türkiye with keywords in Web of Science.

For the competence of universities, there are publications and projects to be looked at, as mentioned in the third section. This study examined the publications side. When the results obtained were placed as described in the methodology, it was determined that 17 universities produced publications in 85 sub-fields in total. In these results, it was seen that the publications of ITU and METU are generally dominant and these two universities constitute 13.81% of the total publications with a total of 36,879 publications. When the data of these two universities were excluded, it was determined that 28 universities published in 162 5 sufficient sub-fields in the second breakdown. Under these conditions, when 121 universities increase the number of publications and fields within the scope of the taxonomy, our competence in 706 sub-fractions will increase.

This study has revealed the general tendencies of universities and in which areas they are competent for UIC.

With this study, it has become possible to determine which technologies will be used for a defense industry platform planned to be produced with guided projects to be carried out by the Presidency of Defense Industry, and which universities will be included in the study. Guided projects are special projects. Their subject and conditions are under the leadership and direction of the relevant department. In a guided project, the Presidency of the Defense Industry selects the university or universities and companies. According to the Istanbul Development Agency, universities are expected to contribute to the projects in terms of knowledge generation, technical infrastructure, training, R&D and innovation, etc. One of the benefits of the guided project is to improve university-industry cooperation. (ISTKA, 2024)

One of the issues to be considered for the organized industrial zones to be established in the defense industry should be the competence of the universities in the region in this field. Türkiye's 3rd Defense Industry Organized Industrial Zone was established in Sungurlu, Çorum (Çorum Hakimiyet, 2024). Hitit University in Çorum has a total of 837 publications in 52

definitions from 314 sub-definitions according to the taxonomy. Hitit University needs to increase its knowledge.

5.1. Recommendations to Universities

- a. Increasing the Number and Quality of Publications: Universities should increase the number of research and publications according to the topics in the defense industry taxonomy. This is important for universities to demonstrate their competence and take part in projects.
- b. Improving R&D and Innovation Activities: Universities should invest more in R&D and innovation activities and increase their competencies in these areas. This is an important factor that will contribute to defense industry projects.
- c. Strengthening University-Industry Cooperation: Universities should seize opportunities to put their knowledge and technologies into practice by cooperating with industry. This contributes to the development of both the university and the industry.
- d. Participation in Special Projects: Universities should take an active role in guided projects carried out by the Presidency of Defense Industry. These projects are an important platform for universities to showcase their competencies and contribute to the defense industry.
- e. Strengthening Education and Technical Infrastructure: Universities should strengthen their education programs and technical infrastructure in areas related to the defence industry. This will enable students to work in sector companies upon graduation and academics to become more competent in these fields.
- f. Developing Regional Competencies: Universities, especially in the regions where defense industry organized zones are located, should increase their competencies in these fields and contribute to regional development.

5.2. Recommendations for Companies

- a. Strengthening Collaboration with Universities: Companies should collaborate with universities to support R&D and innovation efforts. Joint projects and research both enable academic knowledge to be translated into practical applications and strengthen the technological infrastructure of companies.
- b. Increasing R&D Investments: In order to be competitive in the defense industry, more emphasis should be placed on R&D investments. Developing new technologies and improving existing ones strengthens the position of companies in the sector.
- c. Technical Training and Expertise Development: Continuous training programs should be organized to increase the technical knowledge and competencies of employees. Especially

in cooperation with universities, trainings can be provided to accelerate the adaptation of employees to new technologies.

d. Taking Part in Joint Projects: Companies should take an active role in guided projects carried out by the Presidency of Defense Industry. These projects provide companies with access to new technologies and increase knowledge sharing through cooperation with universities.

e. Utilization of National and International Funds and Incentives: Funds and incentives offered at national and international level in the field of defense industry should be utilized. These resources offer important opportunities to finance projects and support R&D activities.

f. Technology Transfer and Licensing: New technologies should be integrated into the company through technology transfer and licensing from universities. This process helps companies to quickly adapt to innovative technologies.

g. Contributing to Regional Development: Companies should contribute to regional development by operating in defence industry organized zones. This both supports the development of the local economy and enables companies to expand their regional networks.

5.3.Recommendations to the Presidency of Defense Industry

a. Encouraging University-Industry Collaboration: Incentive mechanisms should be created to increase cooperation between universities and industry. Joint research projects, internship programs and collaboration platforms can accelerate this process.

b. R&D and Innovation Support Programs: Special funding and incentive programs should be established to support R&D and innovation activities in the defence industry. This encourages the development of new technologies and the improvement of existing technologies.

c. Strategic Planning for Guided Projects: While determining the topics and objectives of guided projects, a strategic planning should be made. The stakeholders of these projects should be universities, individuals and companies with competencies.

d. Education and Human Resource Development: Training programs and scholarships should be provided to train qualified human resources in the defence industry. Sector-specific training modules and certificate programs can be developed in cooperation with universities.

e. National and International Cooperation: National and international cooperation should be increased. Joint projects and technology transfer agreements with foreign countries can contribute to the development of the defense industry.

f. Technology Transfer and Commercialization: The process of transferring and commercializing technologies from universities and research institutions to industry should be supported. This ensures that innovative technologies become available quickly.

5.4.Recommendations to the Council of Higher Education (YÖK)

a. Developing Education Programs in the Defense Industry: Undergraduate, graduate and doctoral programs designed specifically for the defense industry should be established. These programs should provide students with the technical knowledge and competencies needed in the sector.

b. Supporting University-Industry Collaboration: Projects and programs should be developed to encourage cooperation between universities and defence industry companies. Joint research projects, internship programs and cooperation platforms can strengthen this cooperation.

c. Research and Development (R&D) Support Programs: Special funding and incentive programs should be established to support academic research in the defence industry. These programs help to implement innovative projects and increase the R&D capacity of universities.

d. Academic Publication and Patent Incentives: Incentive mechanisms should be created to increase the number of academic publications and patents related to the defense industry. Awards and support for publication and patenting activities can increase academic productivity.

e. Strengthening Technology Transfer Offices (TTO): It is necessary to support the transfer and commercialization of defence industry projects to industry by increasing the capacity of Technology Transfer Offices (TTO) at universities.

f. Establishing Defense Industry Themed Research Centers: Research centres and institutes specializing in the defence industry should be established. These centers can increase the contribution of universities to the defence industry by conducting sector-specific research.

g. Regional Development and University Contribution: Universities located in defence industry organized zones should be encouraged to contribute to the development of these regions. In this context, universities should be included in regional projects.

h. Improving Education and Research Infrastructure: Education and research infrastructure for the defense industry should be strengthened. Laboratories, research facilities and technical equipment should be modernized to provide better opportunities for students and researchers.

i. International Cooperation and Exchange Programs: Cooperation with international universities and defense industry organizations should be developed. International information

sharing should be ensured by organizing student and academician exchange programs, joint projects and conferences.

This thesis assessed the competence of universities through publication output. In future projects, there is a need for studies to measure the competence of universities through publications, citations to publications and projects over a certain period of time. The competence of universities and the competence of individuals should be analyzed and a technological competencies data for SSTT 2.0 should be created by analyzing the competence of individuals through publications, projects and experience areas.



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BACKGROUND

PERSONAL INFORMATION

Name Surname : Harun ERGEN

Place of Birth - Date :

EDUCATION STATUS

Undergraduate Education : 2001, Army War College Systems Engineering

Graduate Studies :

Foreign Languages : English

Scientific Activities :

WORK EXPERIENCE

Internships :

Projects :

Working Organizations : Turkish Armed Forces (2001-Today)

Date: July 01, 2024

Annex 1 Taxonomy Definitions and Product Family

Sequence No.	Code	Title	Total Number of Publications	Land Vehicles	Marine Vehicles	Air Vehicles	Missiles and Ammunition	Barreled Systems	Communication Support Systems	Informatics and Software	Radars and Sensors	Electronic Warfare Systems	Simulator and Training Systems	Propulsion, Propulsion and Power Systems	Generators and Batteries	Security and Sensitive Services	Logistics Support Systems	Defense Industry Other Subsystems
1	A	A-BASIC TECHNOLOGIES																
2	A1	STRUCTURAL AND SMART MATERIALS AND STRUCTURAL MECHANICS																
3	A1.1	Metal and Metal Matrix Composite Technology	2035	X	X	X			X					X	X	X	X	X
4	A1.2	Ceramics, Ceramic Matrix Composite and Glass Technologies	685	X	X	X	X		X		X	X	X			X		X
5	A1.3	Polymers and Polymer Matrix Composite Technologies	20298	X	X	X			X					X	X	X	X	X
6	A1.4	Processing of Structural Materials - Joining Technologies	9193	X	X	X			X					X	X	X	X	X
7	A1.5	Processing of Structural Materials - Surface Protection Technologies	26	X	X	X	X	X	X		X	X	X	X	X	X	X	X
8	A1.6	Nondestructive Testing and Life Extension of Structural Materials	140	X	X	X	X	X	X		X	X	X	X	X	X	X	X
9	A1.7	Corrosion and Abrasion Control Technology	1014	X	X	X	X	X	X		X	X	X	X	X	X	X	X
10	A1.8	Structural Mechanics	3732	X	X	X	X	X	X		X	X	X	X	X	X	X	X

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11	A1.9	Structural Materials - Forming	1404	X	X	X	X	X	X		X	X	X	X	X	X	X	X
12	A1.10	Structural Materials - Chip Removal	4849	X	X	X	X	X	X		X	X	X	X	X	X	X	X
13	A1.11	Smart / Functional Materials for Structural Use	113	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
14	A1.12	Nanomaterial Technologies	72	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
15	A1.13	Structural Materials - Additive Manufacturing	1014	X	X	X	X	X	X		X	X	X	X	X	X	X	X
16	A1.14	Polymer and Polymer Matrix Ablative Composite Technologies	2	X	X	X	X	X	X		X	X	X	X	X	X	X	X
17	A1.15	Production Processes of Ablative Composite Materials - Production and Application Technology	4	X	X	X	X	X	X		X	X	X	X	X	X	X	X
18	A1.16	Structural Metamaterials	34	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
19	A2	MATERIALS ASSOCIATED WITH TRACE																
20	A2.1	Acoustic and Vibration Damping Materials	2		X		X				X							
21	A2.2	Infrared Trace Control Materials	35	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
22	A2.3	Radar Absorbing Materials and Coatings	9	X	X	X	X	X	X	X	X	X		X	X	X	X	X

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23	A2.4	Radar Absorbing Structural Materials	11	X	X													
24	A3	ELECTRONIC MATERIAL TECHNOLOGIES																
25	A3.1	Silicone Based Materials	640	X	X	X											X	
26	A3.2	III-V Compounds	74								X	X						
27	A3.3	Other Semiconductor Materials	62								X	X			X			
28	A3.4	Insulating and Dielectric Materials	54								X	X			X			
29	A3.5	Carbon Based Materials	2541	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
30	A3.6	Superconducting Materials	0	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
31	A3.7	Magnetic Materials	6089	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
32	A4	PHOTONIC/OPTICAL MATERIALS AND DEVICE TECHNOLOGIES																
33	A4.1	Optical Components and Devices	1142	X	X	X	X	X	X	X	X	X	X			X		
34	A4.2	Infrared/Visible/Infrared Detector Materials and Devices	25	X	X	X	X	X	X	X	X	X	X			X		
35	A4.3	Nonlinear Optical Materials and Devices	1	X	X	X	X		X	X	X	X	X			X		

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36	A4.4	Instrumentation Materials and Devices	2481	X	X	X	X	X	X	X	X	X	X					
37	A4.5	Lasers and Laser Components	686	X	X	X	X	X	X	X	X	X	X					
38	A4.6	Laser External Light Sources	111	X	X	X	X	X	X	X	X	X	X					
39	A4.7	Photonic/Optical Materials	299	X	X	X	X	X	X	X	X	X	X					
40	A5	ELECTRONICS, ELECTRICAL AND ELECTROMECHANICAL DEVICE TECHNOLOGIES																
41	A5.1	Device Concepts and Manufacturing	33	X	X	X			X	X	X	X	X			X		
42	A5.2	Device Packaging	235	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
43	A5.3	Device Integration and Reliability	35	X	X	X			X	X	X	X	X			X		
44	A5.4	Electric Batteries and Capacitors	85	X	X	X	X		X	X	X	X	X		X	X		
45	A5.5	Electrical Fuel Cells	700	X	X	X	X		X	X	X	X	X	X	X	X		
46	A5.6	Solar Panels	749												X			
47	A5.7	RF Power Amplifiers and Devices	132						X		X							
48	A5.8	Acoustic Power Amplifiers and Devices	6		X	X												
49	A5.9	Other Electrical Power Supplies and Equipment	2069						X	X								

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50	A5.10	Electric Motors	1710	X	X	X	X				X			X				
51	A5.11	Inertial/Gravitational Devices	7					X			X							
52	A5.12	Devices and Electromechanical Structures	163	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
53	A5.13	RF/Microwave Component Technologies	416								X	X						
54	A5.14	RF/Microwave Device Technologies	85								X	X						
55	A5.15	Antenna Technologies	483	X	X	X	X		X		X	X				X	X	
56	A5.16	Electronic Component Technologies	3064	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
57	A5.17	Connection, Cable and Cabling Technologies	773	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
58	A5.18	Acoustic Device Technologies	34								X	X						
59	A6	ENERGETIC MATERIALS AND PLASMA TECHNOLOGIES																
60	A6.1	Propulsion Fuels	84			X	X							X				
61	A6.2	Conventional Fuels	774	X	X	X	X							X				
62	A6.3	Explosives	826	X			X											
63	A6.4	PiroTechnical Systems	12				X											

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64	A6.5	Plasma Techniques	1447				X											
65	A6.6	Explosive Detection Techniques	170								X							
66	A7	CHEMICAL, BIOLOGICAL AND MEDICAL MATERIALS																
67	A7.1	Defense Against Chemical Agents, Precursors and Related Materials	60						X								X	X
68	A7.2	Defense Against Biological Agents, Precursors and Related Materials	48						X								X	
69	A7.3	Defense Against Mid-Spectrum Agents	185						X								X	
70	A7.4	Chemical and Biological Detection Techniques	299						X								X	
71	A7.5	Research on Non-Chemical/Non-Biological Applications	1						X								X	
72	A7.6	Medical Products and Supplies	8395														X	
73	A8	INFORMATION TECHNOLOGIES AND MATHEMATICAL TECHNIQUES																

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74	A8.1	Software Engineering	10317	X	X	X	X	X	X	X	X	X	X		X	X		
75	A8.2	Protocol Technology	925	X	X	X			X	X		X						
76	A8.3	Off the Shelf (RAHAT/COTS) Software Evaluation	105							X								
77	A8.4	Architectures	7863							X								
78	A8.5	High Integrity and Safety Critical Systems	8							X								
79	A8.6	Secure Computing Techniques	708													X		
80	A8.7	Encryption / Crypto Technologies	25													X		
81	A8.8	Mathematical Model Development	1008							X								
82	A8.9	OA Tools and Techniques	33							X						X		X
83	A8.11	Software Verification, Validation and Accreditation Techniques	19							X								
84	A8.12	High Performance Computing	4558						X	X						X		
85	A9	INFORMATION AND SIGNAL PROCESSING TECHNOLOGIES																
86	A9.1	Data & Information Management Technology	3761								X							

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87	A9.2	Digital Signal Processing Technology	1134		X		X			X								
88	A9.3	Optical Signal Processing Technology	354							X	X	X						
89	A9.4	Image/Pattern Processing Technology	1024	X	X	X		X										
90	A9.5	Speech and Natural Language Processing Technology	59						X									
91	A9.6	Optimization and Decision Support Technology	586						X									
92	A9.8	Information and Data Fusion Technology	295			X			X	X	X							
93	A9.11	Other Information Processing Technology	2872				X	X		X								
94	A10.1	HUMAN SCIENCES	0															
95	A10.1	Human Knowledge Process Model	1193															
96	A10.2	Military Human Resources	36															
97	A10.3	Teams, Organizations and Cultures	59															

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98	A10.4	Human Survival, Protection and Stress Effects	19															
99	A10.5	Personal and Team Training	99															
100	A10.6	Human Factors Integration	146															
101	A10.7	Joint Training	101															
102	A10.8	Improving Human Performance	74															
103	A10.12	Surgical Methods and Medical Procedures	1654															
104	A10.13	Physics of Human Health	1924															
105	A10.14	Human Performance Imaging Methods	83															
106	A10.15	Human Factors in Production	138															
107	A11	TECHNOLOGIES RELATED TO ENVIRONMENTAL CONDITIONS AFFECTING OPERATIONS																
108	A11.1	Oceanography	196		X													
109	A11.2	Land Science	252	X		X	X	X										
110	A11.3	Meteorology	494		X	X	X										X	
111	A11.4	Upper Atmosphere and Space Environment	2			X												

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112	A11.5	Acoustic Propagation in Air and Water	227		X	X												
113	A11.6	Electromagnetic Propagation of Air and Water	702		X	X												
114	A12	MECHANICAL, THERMAL AND FLUIDIC TECHNOLOGIES AND DEVICES																
115	A12.1	Mechanical/Hydraulic/Pneumatic Technologies and Devices	10	X	X	X												
116	A12.2	Lubrication Technology	186	X	X	X												
117	A12.3	Thermal and Thermodynamic Technologies and Devices	1269	X	X	X	X	X										
118	A12.4	Fluid Mechanics - Phenomenological and Experimental	4537			X	X	X										
119	A12.5	Fluid Dynamics Techniques	2296			X	X	X										
120	B	B-SYSTEMS RELATED TECHNOLOGIES																
121	B1	LETHALITY AND PLATFORM PROTECTION																

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122	B1.1	Warheads	23	X			X											
123	B1.2	Drillers	6	X			X											
124	B1.4	War Damage Reduction Techniques	12	X	X	X												
125	B1.5	Explosive Material Disposal	2			X	X											
126	B1.6	Mine Detection and Clearance	2															
127	B1.7	Armor Systems	41															
128	B1.8	Defense Assistance Package Systems	4															
129	B1.9	Other Platform Protection Measures	38															
130	B2	PROPULSION AND POWER SYSTEMS																
131	B2.1	Gas Turbines	782			X								X				
132	B2.2	Reciprocating and Rotary Internal Combustion Engines	0	X	X	X								X				
133	B2.3	Rocket and Ramjet Engines	1											X				
134	B2.4	Weapons and Launch Tubes	12											X				
135	B2.5	Electrical Thrust - Rotational and Linear	104	X	X	X	X							X				

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136	B2.6	Transmission and Powertrain Systems	3	X	X	X								X	X			
137	B2.8	Ion Propulsion Systems	5			X	X							X				
138	B2.9	Nuclear Propulsion Systems	27											X				
139	B2.10	Propellers and Rotors	4											X				
140	B2.11	Propulsion Systems Used in Water	1											X				
141	B2.12	Wheels and Tracks	189	X														
142	B2.13	Hybrid Power Systems	1357											X				
143	B3	DESIGN TECHNOLOGIES FOR PLATFORMS AND WEAPONS																
144	B3.1	Aerodynamic Design	336			X	X											
145	B3.2	Hydrodynamic Design	334		X		X	X										
146	B3.3	Structural Design	5583						X									
147	B3.4	Mechanical Design	12122	X	X	X												
148	B3.5	Low Visibility Designs	56	X	X	X	X	X										
149	B3.6	Ballistic Design	81				X	X										
150	B3.7	Thermal/Cryogenic Design	105				X	X										
151	B3.8	Electrical/Electronic Design	10846	X	X	X	X	X										
152	B3.9	Optical Design	2936	X	X	X	X	X			X					X		

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153	B3.10	Acoustic Design	576	X	X	X												
154	B3.11	Environmental Protection Design	2888	X	X	X												
155	B3.12	Mechatronics Design	82	X	X	X	X	X	X	X	X	X	X	X				
156	B4	ELECTRONIC WARFARE AND DIRECTED ENERGY TECHNOLOGIES																
157	B4.1	Directed Energy Technologies - RF	2				X		X		X	X						
158	B4.2	Directed Energy Technologies - Lasers	14				X				X							
159	B4.3	Directed Energy Technologies - Other	54								X	X						
160	B4.4	Electronic Countermeasure - Non-Communication	1577	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
161	B4.5	Electronic Countermeasures - Electro Optics	418				X	X										
162	B4.6	Electronic Countermeasure - Acoustic	3252		X													
163	B4.7	Electronic Countermeasure - Electric and Magnetic Field	3332			X												

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164	B4.8	Electronic Support Measures - Communication	19783						X									
165	B4.9	Electronic Support Measures - Non-Communication	1577			X		X										
166	B4.10	Electronic Protective Measures - RF	2261				X		X		X	X						
167	B4.11	Electronic Protective Measures - Electro Optics	418	X	X	X												
168	B4.12	Electronic Protective Measures - Acoustic	3252		X													
169	B4.13	Electronic Protective Measures- Electrical and Magnetic Field	3332														X	
170	B4.14	Electronic Support Measures - Electro-Optics	418	X	X	X	X											
171	B4.15	Electronic Countermeasure - Communication	0						X									
172	B5	TRACE CONTROL AND TRACE REDUCTION																
173	B5.1	Radar Traces	31								X							
174	B5.2	Laser Scars	49				X				X							
175	B5.4	Infrared Traces	524				X				X							

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176	B5.5	Visible/Infrared Traces	3								X							
177	B5.6	Acoustic Traces	21								X							
178	B5.7	Electrical and Electrochemical Traces	11	X	X	X	X				X							
179	B5.8	Magnetic Traces	79								X							
180	B6	SENSING SYSTEMS																
181	B6.1	RF Sensors/Active	231								X							
182	B6.2	RF Sensors/Passive	16								X							
183	B6.5	Infrared (IR) Sensors - Active, Laser Sources	35								X							
184	B6.6	Infrared (IR) Sensors - Passive, Laser Sources	3								X							
185	B6.7	Visible / Ultraviolet Band Sensors	5								X							
186	B6.8	Acoustic Sensors - Active	17								X							
187	B6.9	Acoustic Sensors - Passive	12								X							
188	B6.10	They Detected Non-Acoustic - Underwater	23								X							
189	B6.11	Electrical and Electrochemical Sensors	326								X							
190	B6.12	Magnetic Sensors	670								X							

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191	B6.13	Chemical Biological Sensors	40								X							
192	B6.14	Explosive Detection Sensors	97								X							
193	B6.15	Micro Sensor Systems for Active Control of Structures	18								X							
194	B6.16	Motion Sensor Systems	423								X							
195	B6.17	Environmental Monitoring Systems	1033								X							
196	B7	GUIDANCE AND CONTROL SYSTEMS FOR WEAPONS AND PLATFORMS																
197	B7.1	Navigation Systems	947	X	X	X	X											
198	B7.2	Weapon Guidance and Control Systems	5	X	X	X	X											
199	B7.3	Platform Guidance and Control Systems Technologies Platform	85	X	X	X	X											
200	B7.5	Image Systems Technologies	2334	X	X	X	X			X								
201	B7.6	Load and Weapon/ammunition Separation/Unloading Systems	5	X	X	X	X											
202	B8	SIMULATORS, TRAINERS AND SYNTHETIC ENVIRONMENTS																

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203	B8.1	Skill Training Systems	270	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
204	B8.2	Tactical / Crew Training Systems	5	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
205	B8.3	Command and Staff Training Systems	13	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
206	B8.5	Virtual Reality	755	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
207	B8.6	Synthetic Environments - Synthetic Force Generation	217	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
208	B8.7	Synthetic Environments - Creating Natural Environments	295	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
209	B8.8	Synthetic Environments - Management Systems	177	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
210	B9	INTEGRATED SYSTEM TECHNOLOGY																
211	B9.1	Systems Engineering and Integrated Systems Design	2306															
212	B9.2	Interoperability Standards	72															
213	B9.3	Radiation Resistance	36															
214	B9.4	Robotic and Automated Systems in Operational Systems	75															
215	B9.5	Reliability and Maintainability of Systems	40															

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216	B9.6	Health Monitoring Systems	822															
217	B9.7	Safety Systems	2902															
218	B9.8	System Repair Technologies	47															
219	B9.9	Electromagnetic Interference/Compatibility	47															
220	B9.10	Data Collection Systems for Product in Service	141															
221	B9.11	Integrated System Test and Evaluation	1165															
222	B9.12	Intermediate Layer Systems	37															
223	B10	COMMUNICATION AND COMMAND AND INFORMATION SYSTEMS (CIS) RELATED TECHNOLOGIES																
224	B10.1	Communication Systems - Sub-Microwave Frequencies	57						X									
225	B10.2	Communication Systems - Micro and Millimeter Wave	5						X									
226	B10.3	Communication Systems - Infrared/Visible/Infrared	4						X									

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227	B10.4	Communication Systems - Acoustics	127						X									
228	B10.6	Communication and KBS (Command and Information Systems) Security Systems	2						X									
229	B10.7	Command and Information Systems (KBS) Integration	191						X									
230	B10.9	Non-Collaborative Goal Recognition	70						X									
231	B10.11	Geographic Information Systems-CBS	1614						X									
232	B10.12	Optimization, Planning and Decision Support Systems	173						X									
233	B10.13	Infrastructures Supporting Information Management and Distribution	335						X									
234	B10.14	Network Management Systems	2195						X									
235	B10.15	Air Traffic Control Systems	60						X									
236	B10.16	Internet of Things	1151						X									
237	B11	PERSONNEL PROTECTION SYSTEMS																

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238	B11.1	Physical Protection Systems - Threat	10	X	X	X											X	
239	B11.2	Physical Protection Systems - Environment	51	X	X	X											X	
240	B11.3	Chemical, Biological and Nuclear (CBN) Protection Systems-Physical	40	X	X	X											X	
241	B11.4	Chemical, Biological and Nuclear (CBN) Countermeasures - Medical	293	X	X	X											X	
242	B12	MANUFACTURING PROCESSES/DESIGN TOOLS/TECHNIQUES																
243	B12.1	Designed for Enhanced Reliability and Maintainability	5															X
244	B12.2	Cost Engineering	11144															X
245	B12.3	Concurrent Engineering and Reduced Design Cycle	519															X
246	B12.4	Advanced Prototyping	161															X
247	B12.5	Techniques and Systems for Production Manufacturing	584															X

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248	B12.6	Project Management and Tracking	934															X
249	B12.7	Manufacturing Process Simulation	675															X
250	B12.8	Lean Production	103															X
251	B12.9	Process Control Technology	2249															X
252	B12.10	Environmentally Friendly Factory Processes	15															X
253	B12.11	Knowledge-Based Engineering	537															X
254	B12.12	Advanced Manufacturing Technologies	362															X
255	B13	DIGITALIZATION AND INDUSTRIAL TRANSFORMATION																
256	B13.1	Service Cloud Platform, Security and Privacy	88							X								
257	B13.2	Big Data Analytics	302							X								
258	B13.3	Modeling and Simulation Solutions	2617							X								
259	B13.4	Industrial Internet of Things Platform	216							X								

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260	B13.5	M2X Software and Hardware	1							X								
261	B13.6	Innovative Sensors	141							X								
262	B13.7	Robot, Automation, Equipment, Software and Management Systems	10							X								
263	B13.8	Additive Manufacturing Equipment, Software	58							X								
264	B13.9	Smart Factory Systems	38							X								
265	B13.10	Cyber Physical Systems	97							X								
266	B14	CYBER SECURITY SOLUTIONS																
267	B14.1	Network Security	1458						X	X		X				X		
268	B14.2	Endpoint Security	12						X	X		X				X		
269	B14.3	Identity and Access Management	65						X	X		X				X		
270	B14.4	Messaging and Communication Security	124						X	X		X				X		
271	B14.5	Data Security	2552						X	X		X				X		
272	B14.6	Cloud Computing Security	219						X	X		X				X		
273	B14.7	Application Security	1556						X	X		X				X		
274	B14.8	Internet Security	778						X	X		X				X		
275	B14.9	Mobile Device Security	172						X	X		X				X		

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276	B14.10	Industrial Control Systems Safety	60						X	X		X				X		
277	B14.11	Internet of Things Security	363						X	X		X				X		
278	B14.12	Operating System and Carrier Security	40						X	X		X				X		
279	B14.13	Autonomous and Intelligent Platform Security	98						X	X		X				X		
280	B14.14	Hardware Security	254						X	X		X				X		
281	B14.15	Embedded Software Security	4						X	X		X				X		
282	C	SYSTEMS AND PRODUCTS																
283	C1	DEFENSE ANALYSIS																
284	C1.1	Policy, Force Development and Balance of Investment Studies	28															
285	C1.2	Joint Operations Effectiveness and Investment Assessment	27															
286	C1.3	Platform and System Concept Studies	112															
287	C1.4	Requirements Definition Studies	163															
288	C1.5	Scenario Production	590															
289	C1.6	Tactical Development and Support for Operations and Training	11															

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290	C1.7	Other Events and Performance Studies	547															
291	C1.8	Military Doctrine Analysis	5															
292	C1.9	Wargame and Combat Simulation	2							X			X					
293	C2	INTEGRATED PLATFORMS																
294	C2.2	Submarine Platforms	8		X													
295	C2.3	Tanks and Combat Land Vehicles	2	X	X													
296	C2.4	Logistics, Support and Surveillance Land Vehicles	8	X	X												X	
297	C2.5	Combat Aircraft	27			X												
298	C2.6	Logistics, Support and Surveillance Aircraft	25			X												
299	C2.7	Helicopters	280			X												
300	C2.8	Unmanned Land, Sea and Air Vehicles	1	X	X	X												
301	C2.9	Light Airborne Vehicles	18		X													
302	C2.10	Communication Satellites	258		X													
303	C2.11	Observation and Positioning Satellite	1		X													
304	C2.12	Other Satellites	638		X													
305	C2.13	Spacecraft Launch Systems	19		X													

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306	C2.14	Surface Warfare Platforms	49		X													
307	C2.15	Surface Logistics and Support Platforms	10		X													
308	C2.16	Search and Rescue (SAR) Platforms	32		X													
309	C3	WEAPONS AND WEAPON SYSTEMS																
310	C3.3	Landmines	220				X											
311	C3.5	Missile Systems - Against Air Targets	140				X											
312	C3.6	Missile Systems - Against Surface Targets	6				X											
313	C3.7	Platform Integrated Weapon Systems	11				X											
314	C3.8	Handheld Weapon Systems	15				X											
315	C3.9	Directed Energy Weapons	97				X											
316	C3.10	Non-Lethal Weapons	2				X											
317	C3.12	Sea Mines	375				X											
318	C3.13	Missile Systems - Against Land Targets	9				X											

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319	C3.14	Torpedoes - Against Surface Targets	19				X											
320	C3.15	Torpedoes vs Submarines	13				X											
321	C3.16	Weapon Systems - Electromagnetic Launch	14				X											
322	C4	INSTALLATIONS AND FACILITIES																
323	C4.1	Ground Stations	491															
324	C4.2	Fortification / Defense	280															
325	C4.3	Battlefield Engineering	43															
326	C4.4	Test and Evaluation Facilities	163															
327	C4.5	Location Decontamination	24															
328	C5	EQUIPPED STAFF																
329	C5.1	Equipped People	38														X	
330	C5.2	Recruitment, Selection and Allocation	14															
331	C5.3	Education, Training	13966															
332	C5.4	Health and Peace	1458															
333	C6	VARIOUS DEFENSE FUNCTIONS AND POLITICAL SUPPORT																

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334	C6.2	International Security	2637															
335	C6.5	Non-Proliferation of Weapon Technologies	76															
336	C6.6	Hazard Assessment	10															
337	C6.8	Logistics	10212															
338	C6.9	Protection Against Stealth Technology	1															
339	C7	BATTLEFIELD INFORMATION	0															
340	C7.1	Information Infrastructure	789															
341	C7.2	Information Warfare	76															
342	C7.3	Command and Control Systems	221															
343	C7.4	Digitization of the Battlefield	4															
344	C7.5	ISTAR (Intelligence, Surveillance, Target Acquisition and Reconnaissance)	0															
345	C7.6	Military Intelligence	25															
346	C7.7	Command and Control Mission Planning	2															
347	C7.8	Command and Control Flight Training Planning	7															

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348	C7.9	Command and Control Operation Planning	9															
349	C7.10	Command and Control Intelligence Management	4															
350	C7.11	Command and Control Meteorological Data Management	0															
351	C7.12	Command and Control Oceanography Data Management	0															
352	C7.13	Command and Control Information Management	8															
353	C7.14	Command and Control Common Image Management	7															
354	C7.15	Command and Control GIS	1															
355	C7.16	Command and Control Message Infrastructure	1															
356	C7.17	Command and Control Authorization Infrastructure	1															
357	C7.18	Platform Command and Control Software	10															
358	C7.19	Tactical Data Link Management Systems	16															

Annex 1 Taxonomy Definitions and Product Family

Sequence No.	Code	Title	Total Number of Publications	Land Vehicles	Marine Vehicles	Air Vehicles	Missiles and Ammunition	Barreled Systems	Communication Communication Support Systems	Informatics and Software	Radars and Sensors	Electronic Warfare Systems	Simulator and Training Systems	Propulsion, Propulsion and Power Systems	Generators and Batteries	Security and Sensitive Services	Logistics Support Systems	Defense Industry Other Subsystems
359	C7.20	Platform Condition Monitoring Systems	120															
360	C7.21	Ship Data Distribution Systems	49															
361	C7.22	Submarine Information Distribution Systems	6															
362	C7.23	Sniper Detection Systems	8															
363	C7.24	Torpedo Fire Control Systems	0															
364	C7.25	Time Distribution Systems	2290															
365	C7.26	Remote Imaging Units	111															
366	C7.27	Converters (RS422, RS232, Ethernet, Synchro, 1553, ARINC etc.)	2335															
367	C7.28	Rugged Tablet Computers	15															
368	C7.29	Situational Awareness in Space	6															
369	C8	WORK PROCESSES	0															
370	C8.1	Requirements Definition	183															
371	C8.2	Concept and Product Definition	194															
372	C8.3	Product Supportability	0															
373	C8.4	Lifelong Recovery	11															
374	C8.5	Simulation of Business Processes	2															

Annex 1 Taxonomy Definitions and Product Family

Sequence No.	Code	Title	Total Number of Publications	Land Vehicles	Marine Vehicles	Air Vehicles	Missiles and Ammunition	Barreled Systems	Communication Communication Support Systems	Informatics and Software	Radars and Sensors	Electronic Warfare Systems	Simulator and Training Systems	Propulsion, Propulsion and Power Systems	Generators and Batteries	Security and Sensitive Services	Logistics Support Systems	Defense Industry Other Subsystems
375	C8.6	Benchmarking and Best Practice Research	47															
376	C8.7	Lean Business Models	11															
377	C8.8	Research and Technology Management	2489															
378	C8.9	Design in the Extended Enterprise	34															
379	C8.10	Procurement and Contracting Processes	20															
380	C10	CYBER SECURITY SERVICES AND OPERATIONS	0															
381	C10.1	Cyber Security Analytics	2															
382	C10.2	Cyber Intelligence	117															
383	C10.3	Cyber Security Operations	16															
384	C10.4	Cyber Security Incident Management	6															
385	C10.5	Cyber Technical/Forensic Informatics	74															
386	C10.6	Cyber Security Risk and Compliance Management	20															

Annex 1 Taxonomy Definitions and Product Family

Sequence No.	Code	Title	Total Number of Publications	Land Vehicles	Marine Vehicles	Air Vehicles	Missiles and Ammunition	Barreled Systems	Communication Communication Support Systems	Informatics and Software	Radars and Sensors	Electronic Warfare Systems	Simulator and Training Systems	Propulsion, Propulsion and Power Systems	Generators and Batteries	Security and Sensitive Services	Logistics Support Systems	Defense Industry Other Subsystems
387	C10.7	Cyber Security Consulting and Training	14															

Annex 2 Publication Number/Percentage/Ranking of Universities									
Sequence Nu	University Name	Number of Publications	Percentage Rate	SSYT	THE	RUR	CWUR	Webometrics	URAP
1	Abdullah Gul University	719	0,27%	80	76	35		105	50
2	Acıbadem Mehmet Ali Aydınlar University	15	0,01%	179	36			83	25
3	Adana Alparslan Türkeş University of Science and Technology	676	0,26%	85				129	75
4	Adiyaman University	742	0,28%	79			25	70	95
5	Afyon Kocatepe University	1169	0,44%	54				58	70
6	Afyonkarahisar University of Health Sciences	6	0,00%	180		28		134	159
7	Agri Ibrahim Chechen University	70	0,03%	153				110	131
8	Akdeniz University	2508	0,95%	32	12		21	18	24
9	Aksaray University	944	0,36%	63	37			87	77
10	Alanya Alaaddin Keykubat University	73	0,03%	152				190	137
11	Alanya Hamdullah Emin Pasa University	2	0,00%	196				204	185
12	Altinbas University	342	0,13%	113	77			147	114
13	Amasya University	325	0,12%	117				135	134
14	Anadolu University	2621	0,99%	28	19		45	14	44
15	Anka University of Technology	0	0,00%	203					
16	Ankara Science University	2	0,00%	197	78				
17	Ankara Hacı Bayram Veli University	54	0,02%	155				140	162
18	Ankara Medipol University	5	0,00%	184				171	

Annex 2 Publication Number/Percentage/Ranking of Universities									
Sequence Nu	University Name	Number of Publications	Percentage Rate	SSYT	THE	RUR	CWUR	Webometrics	URAP
19	Ankara Social Sciences University	0	0,00%	198				155	
20	Ankara University	6275	2,38%	9	38	5	4	4	4
21	Ankara Yıldırım Beyazıt University	959	0,36%	62	39	33		75	37
22	Antalya Akev University	0	0,00%	205				207	188
23	Antalya Science University	223	0,08%	127				158	122
24	Ardahan University	90	0,03%	148				163	125
25	Artvin Coruh University	130	0,05%	143				125	117
26	Ataturk University	3577	1,35%	24	20	21	19	8	15
27	Atilim University	2155	0,82%	35	21	27		57	69
28	Eurasia University	18	0,01%	174				186	179
29	Aydin Adnan Menderes University	896	0,34%	65				53	59
30	Bahcesehir University	2386	0,90%	33	9		38	24	64
31	Balıkesir University	1243	0,47%	50				66	94
32	Bandırma Seventeen September University	172	0,07%	137	79			151	156
33	Bartın University	823	0,31%	70	13			59	76
34	Baskent University	1479	0,56%	47	40		46	46	53
35	Batman University	373	0,14%	108				114	146
36	Bayburt University	286	0,11%	123	80			127	111
37	Beykent University	213	0,08%	129	81	37		82	167
38	Beykoz University	4	0,00%	187				167	187
39	Bezm-i Alem Foundation University	320	0,12%	118	22			100	27

Annex 2 Publication Number/Percentage/Ranking of Universities									
Sequence Nu	University Name	Number of Publications	Percentage Rate	SSYT	THE	RUR	CWUR	Webometrics	URAP
40	Bilecik Şeyh Edebali University	501	0,19%	95	41			130	101
41	Bingöl University	456	0,17%	100				63	66
42	Biruni University	187	0,07%	134	82			90	83
43	Bitlis Eren University	403	0,15%	104				132	140
44	Bosphorus University	6917	2,62%	5	6	6	5	161	16
45	Bolu Abant İzzet Baysal University	1164	0,44%	53	42			47	46
46	Burdur Mehmet Akif Ersoy University	490	0,19%	97				80	93
47	Bursa Technical University	815	0,31%	71	44	29		97	73
48	Bursa Uludag University	2568	0,97%	29	45	43	26	20	27
49	Çağ University	12	0,00%	177	83			126	158
50	Canakkale Eighteen Mart University	1711	0,65%	41				42	61
51	Cankaya University	1674	0,63%	43	7	30	48	23	32
52	Çankırı Karatekin University	317	0,12%	119	46			101	96
53	Cukurova University	4690	1,78%	14	23		10	60	19
54	Demiroglu Science University	35	0,01%	163	96			141	133
55	Tigris University	906	0,34%	66	47			77	92
56	Dogus University	670	0,25%	86		42		121	164
57	Dokuz Eylul University	5057	1,92%	13	24	18	14	12	17
58	Duzce University	1512	0,57%	46	25			107	56
59	Ege University	4569	1,73%	17	26	13	7	10	9
60	Erciyes University	4676	1,77%	15	27	22	17	17	14

Annex 2 Publication Number/Percentage/Ranking of Universities									
Sequence Nu	University Name	Number of Publications	Percentage Rate	SSYT	THE	RUR	CWUR	Webometrics	URAP
61	Erzincan Binalı Yıldırım University	616	0,23%	89	49		32	123	90
62	Erzurum Technical University	401	0,15%	105				122	82
63	Eskisehir Osmangazi University	2557	0,97%	30	50	23	42	35	29
64	Eskisehir Technical University	685	0,26%	84	84			148	47
65	Fatih Sultan Mehmet Foundation University	141	0,05%	140				149	171
66	Fenerbahçe University	2	0,00%	195		14		176	180
67	Euphrates University	5773	2,19%	10	14	34	34	15	18
68	Galatasaray University	386	0,15%	106				104	119
69	University of Gas	9849	3,73%	3	28	11	9	9	8
70	Gaziantep Islamic University of Science and Technology	36	0,01%	164				195	
71	Gaziantep University	2646	1,00%	26	51		16	26	41
72	Gebze Technical University	4068	1,54%	20	29	16	49	27	11
73	Giresun University	612	0,23%	91				65	104
74	Gumushane University	386	0,15%	107				111	130
75	Hacettepe University	6485	2,46%	8	8	9	1	1	2
76	Hakkari University	152	0,06%	141				177	165
77	Golden Horn University	101	0,04%	146	85			144	174
78	Harran University	771	0,29%	78				39	55
79	Hasan Kalyoncu University	100	0,04%	147				89	78
80	Hatay Mustafa Kemal University	644	0,24%	88				88	91
81	Hitit University	785	0,30%	77	52			91	80

Annex 2 Publication Number/Percentage/Ranking of Universities									
Sequence Nu	University Name	Number of Publications	Percentage Rate	SSYT	THE	RUR	CWUR	Webometrics	URAP
82	Ibni Haldun University Işık University	6	0,00%	182				152	123
83	Iğdır University	108	0,04%	145				103	108
84	İhsan Doğramacı Bilkent University	6866	2,60%	6	5	10	12	7	10
85	Inonu University	2073	0,79%	38	53			45	31
86	Isik University	597	0,23%	92				116	143
87	Iskenderun Technical University	855	0,32%	68				131	86
88	Isparta University of Applied Sciences	238	0,09%	126				192	85
89	Istanbul 29 May University	0	0,00%	201				172	186
90	Istanbul Arel University	96	0,04%	149	87			139	127
91	Istanbul Atlas University	4	0,00%	188				146	
92	Istanbul Aydın University	1730	0,66%	40	54	31	31	36	129
93	Istanbul Bilgi University	1098	0,42%	57	30		23	19	113
94	Istanbul Esenyurt University	16	0,01%	172				175	183
95	Istanbul Galata University	7	0,00%	185					
96	Istanbul Gedik University	70	0,03%	154				143	132
97	Istanbul Gelisim University	381	0,14%	109	88	48		54	
98	Istanbul Kent University	0	0,00%	191				182	178
99	Istanbul Kultur University	309	0,12%	120	89			106	147
100	Istanbul Medeniyet University	691	0,26%	83	31	25	50	55	38
101	Istanbul Medipol University	1110	0,42%	56	55	36		48	40
102	Istanbul Okan University	250	0,09%	125	90	32		108	128
103	Istanbul Rumeli University	4	0,00%	189				184	181

Annex 2 Publication Number/Percentage/Ranking of Universities									
Sequence Nu	University Name	Number of Publications	Percentage Rate	SSYT	THE	RUR	CWUR	Webometrics	URAP
104	Istanbul Sabahattin Zaim University	47	0,02%	159				112	115
105	Istanbul Health and Technology University	3	0,00%	190					
106	Istanbul Technical University	22405	8,49%	1	4	2	6	3	5
107	Istanbul Commerce University	350	0,13%	115				99	124
108	Istanbul Topkapi University	0	0,00%	192				180	184
109	Istanbul University	6807	2,58%	7	15	7	3	6	6
110	Istanbul University-Cerrahpasa	2546	0,96%	31	16		15	33	10
111	Istanbul New Century University	23	0,01%	169				165	172
112	Istinye University	426	0,16%	102		8		145	57
113	Izmir Bakircay University	40	0,02%	160				201	150
114	Izmir Democracy University	53	0,02%	157				142	163
115	Izmir University of Economics	788	0,30%	73	56			81	98
116	Izmir Katip Çelebi University	1113	0,42%	55				85	34
117	Izmir Tınaztepe University	0	0,00%	199				189	
118	Izmir Institute of Technology	3622	1,37%	23	32	17	20	31	20
119	Kadir Has University	853	0,32%	67	91			78	65
120	Kafkas University	712	0,27%	82			29	62	110
121	Kahramanmaraş İstiklal University	26	0,01%	167				196	
122	Kahramanmaraş Sütçü İmam University	801	0,30%	74				73	68
123	Cappadocia University	27	0,01%	166				162	175
124	Karabuk University	2109	0,80%	36	33			37	60
125	Karadeniz Technical University	5118	1,94%	12	57	38	28	21	21

Annex 2 Publication Number/Percentage/Ranking of Universities									
Sequence Nu	University Name	Number of Publications	Percentage Rate	SSYT	THE	RUR	CWUR	Webometrics	URAP
126	Karamanoğlu Mehmet Bey University	795	0,30%	75				64	72
127	Kastamonu University	497	0,19%	96	58			74	81
128	Kayseri University	36	0,01%	161				181	143
129	Kilis 7 December University	186	0,07%	136				160	161
130	Kirikkale University	1043	0,39%	59	59			32	79
131	Kirklareli University	298	0,11%	122				113	153
132	Kırşehir Ahı Evran University	464	0,18%	99	60	44		93	100
133	Kocaeli University of Health and Technology	4	0,00%	194	92			202	
134	Kocaeli University	3990	1,51%	21	61	41	40	30	33
135	Koç University	5433	2,06%	11	1	1	11	5	1
136	Konya Food and Agriculture University	59	0,02%	156				178	106
137	Konya Technical University	582	0,22%	93				159	62
138	KTO Karatay University	360	0,14%	112				124	139
139	Kutahya Dumlupinar University	998	0,38%	61	48			86	121
140	Kutahya University of Health Sciences	24	0,01%	168	93			138	141
141	Lokman Hekim University	4	0,00%	186				168	154
142	Malatya Turgut Özal University	147	0,06%	139				166	126
143	Maltepe University	255	0,10%	124				136	145
144	Manisa Celâl Bayar University	1811	0,69%	39	62		44	128	51
145	Mardin Artuklu University	48	0,02%	158				150	173
146	Marmara University	4624	1,75%	16	63	19	8	13	12

Annex 2 Publication Number/Percentage/Ranking of Universities									
Sequence Nu	University Name	Number of Publications	Percentage Rate	SSYT	THE	RUR	CWUR	Webometrics	URAP
147	MEF University	99	0,04%	150				34	152
148	Mersin University	1698	0,64%	42			18	34	43
149	Mimar Sinan Fine Arts University	150	0,06%	142			43	94	149
150	National Defense University	192	0,07%	130				157	
151	Mudanya University	0	0,00%	208					
152	Muğla Sıtkı Koçman University	1027	0,39%	60				51	58
153	Munzur University	376	0,14%	110				197	103
154	Mus Alparslan University	228	0,09%	128				118	135
155	Necmettin Erbakan University	928	0,35%	64	17		39	43	42
156	Nevşehir Hacı Bektaş Veli University	668	0,25%	87				98	109
157	Nigde Ömer Halisdemir University	1242	0,47%	52	64	46		76	67
158	Nisantasi University	469	0,18%	98		45		102	155
159	Nuh Naci Yazgan University	18	0,01%	170				179	176
160	Nineteen May University	2099	0,79%	37	65		35	22	26
161	Ordu University	186	0,07%	135	66			96	87
162	Middle East Technical University	14407	5,46%	2	2	3	2	2	3
163	Osmaniye Korkut Ata University	372	0,14%	111				115	107
164	Ostim Technical University	18	0,01%	175				174	
165	Ozyegin University	1673	0,63%	44	10		30	29	63
166	Pamukkale University	2236	0,85%	34	67		47	38	48
167	Piri Reis University	203	0,08%	132				109	138
168	Recep Tayyip Erdoğan University	859	0,33%	69	68			67	52
169	Sabancı University	4317	1,63%	19	3	4	36	11	7

Annex 2 Publication Number/Percentage/Ranking of Universities									
Sequence Nu	University Name	Number of Publications	Percentage Rate	SSYT	THE	RUR	CWUR	Webometrics	URAP
170	University of Health Sciences	796	0,30%	76	86		33	49	28
171	Sakarya Applied Sciences	447	0,17%	101		49		153	118
172	Sakarya University	4475	1,69%	18	34	20	41	16	30
173	Samsun University	19	0,01%	171	94			164	
174	Sanko University	15	0,01%	176				183	170
175	Selcuk University	3697	1,40%	22	35		22	71	22
176	Siirt University	347	0,13%	116				92	97
177	Sinop University	358	0,14%	114				84	112
178	Sirnak University	32	0,01%	162				117	160
179	Sivas University of Science and Technology	30	0,01%	165				191	
180	Sivas Cumhuriyet University	1542	0,58%	45	69			25	54
181	Süleyman Demirel University	2919	1,11%	25	70	40	37	28	36
182	Tarsus University	116	0,04%	144	95			173	105
183	Ted University	201	0,08%	131				120	120
184	Tekirdag Namik Kemal University	811	0,31%	72				72	71
185	TOBB University of Economics and Technology	2628	1,00%	27	18	24	27	40	49
186	Tokat Gaziosmanpasa University	614	0,23%	90	71		24	56	84
187	Toros University	15	0,01%	173				170	177
188	Trabzon University	7	0,00%	183				169	166
189	Trakya University	1291	0,49%	49				50	74
190	Turkish Aeronautical Association University	176	0,07%	138				194	148
191	Turkish-German University	90	0,03%	151				156	144

Annex 2 Publication Number/Percentage/Ranking of Universities									
Sequence Nu	University Name	Number of Publications	Percentage Rate	SSYT	THE	RUR	CWUR	Webometrics	URAP
192	International Islamic University of Turkiye, Science and Technology	0	0,00%	209					
193	Turkish-Japanese University of Science and Technology	0	0,00%	202				209	
194	Horizon University	14	0,01%	178				137	151
195	Usak University	309	0,12%	121	72			95	102
196	Uskudar University	206	0,08%	133				79	136
197	Van Yüzüncü Yıl University	1094	0,41%	58	73			41	39
198	Yalova University	515	0,20%	94				119	116
199	Yasar University	722	0,27%	81	97			61	99
200	Yeditepe University	1245	0,47%	51	74	26		44	45
201	Yildiz Technical University	9535	3,61%	4	11	12	13	52	13
202	Yozgat Bozok University	426	0,16%	103	43			69	89
203	High Specialization University	7	0,00%	181				203	157
204	Zonguldak Bülent Ecevit University	1432	0,54%	48	75	47		68	88