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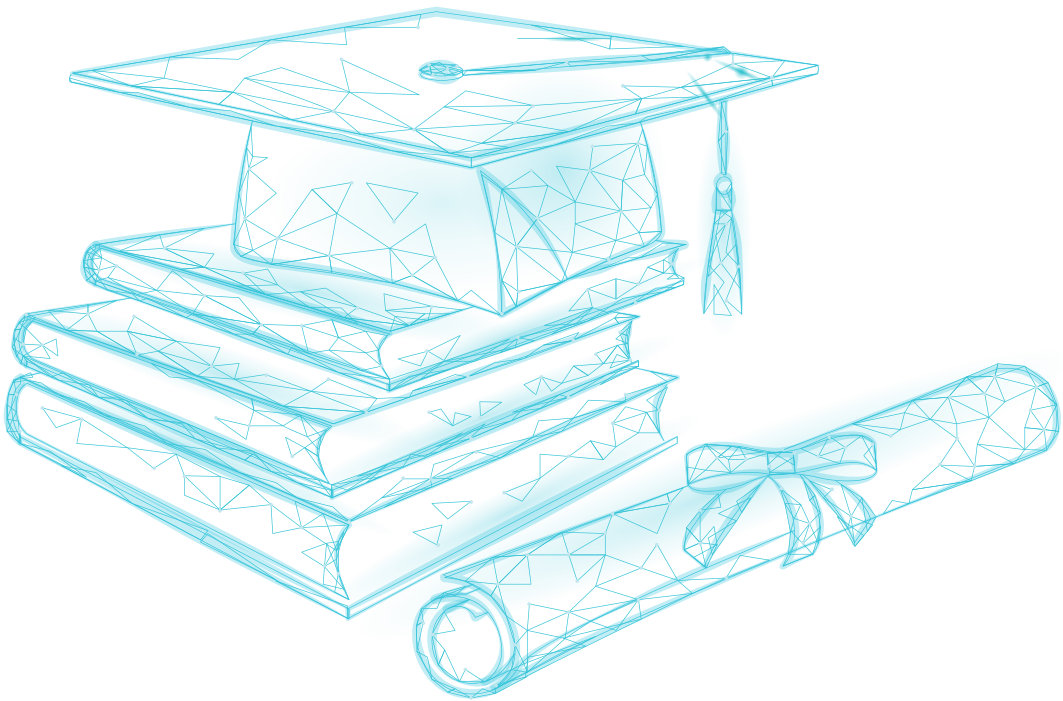
TEBD TURKEY-EU BUSINESS DIALOGUE

University-Industry Collaboration Framework



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CIVIL SOCIETY SECTOR

TOBB

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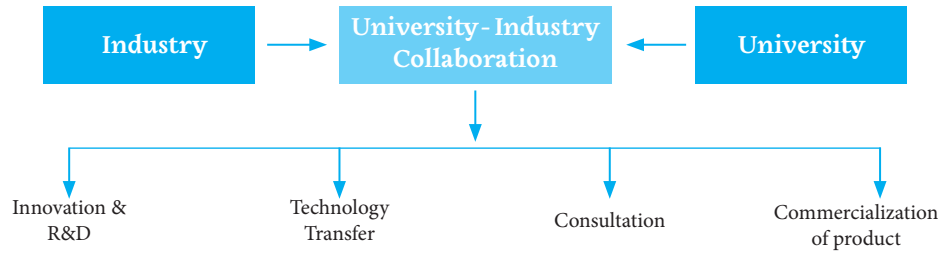
What is University - Industry Collaboration (UIC)?

UIC means the interaction aiming to encourage the information and technology-based transformation of the industry;

Briefly, it is any kind of interaction between the Higher Education System (HES) and industry.

> ***Knowledge Transfer:*** *It is the process of reciprocal knowledge and technology transfer to perform the university or company operations within the collaboration.*
>
> ***Academic Engagement:*** *It is the collaboration process of scientists and researches for knowledge transfer with industrial companies.*
>
> ***Commercialization:*** *The process of patenting, licensing academic inventions and researches and/or resulting in academic entrepreneurship.*

University- Industry Collaboration has a long history as a tool for establishing the knowledge stock of organizations. UIC has been on the significant rise in many countries including USA, Japan, Singapore and European Union countries. This rise is resulted from the combination of pressures on the industry and universities. For the industry, the pressures include rapid technological change that is radically transforming the current competition environment for most companies, includes shorter product life cycles and intense global competition. For the universities, the pressures include growth in knowledge and increasing costs and difficulties of funding problems. In addition to being accepted as the engine of economic growth in universities and increasing social pressures to perform more comprehensive social services that they had in the past (in other words, education and knowledge generation). Such pressures on both sides have created an increasing stimulus for the development of UIC aiming to increase innovation and economic competitiveness in corporate levels through knowledge exchange between the academic and commercial fields (for example, countries and sectors). Besides, UIC is deemed as a promising tool generally in order to increase the organizational capacity in open innovations in the points where an organization uses external networks in innovation and knowledge development as a supplementary option for traditional internal R&D.



Key Role

UIC

University - Industry Collaboration plays a key role in providing economic development through commercialization of the knowledge not only in terms of reciprocal knowledge transfer. It has shown that approximately 10% of new products and technologies developed would not emerge without university and industry collaboration.

Historical Development Process of University-Industry Cooperation

The first application of university - industry collaboration was observed in England in early-17th century. Even though several university - industry collaborations were obseved in 18th century in the Europe and 19th century in USA, the second half of 20th century when 'research' and 'contribution to economic and social development' were included into "education", the primary mission of universities was the period when university-industry collaboration was one of the most effective actors of the national innovation systems.

A German pharmaceutical company, Bayer, started collaborative research with universities in the late 19th century. During World War I, the American National Research Council brought together universities to work in collaboration with industrial institutions in order to find solutions to the problems caused by the war.

Mutual collaboration established between MIT and Standard Oil Company before 1940 enabled the development of chemical engineering discipline and resulted in a registered patent for Standard Oil. Research Corporation was established after World War I in order to conduct and manage the patenting and licensing activities centrally.

The last quarter of 20th century witnessed a technological competition between Japan and USA. While Japan focused on collaboration with industrial research programs in particular sectors such as microelectronic in post-Cold War period, USA increased its collaboration investments for defense purposes in post-World War II period.

Bayh-Dole law entered into force in 1980 enabled licensing and patenting activities to increase, and universities like Stanford, Columbia, University of California to become the main licensor of technology and holder of intellectual property rights.

The beginning of 1980s are the years when Japan gained superiority against USA in the global competition with university-industry collaboration based R&D activities. As the result, USA made the university-industry collaboration the primary factor of federal technology policy for the development of national competition. Bayh-Dole law which saved the economy in USA became a role model for many countries in terms of intellectual rights.

Pressures Driving University-Industry Collaboration

Industry-Driven

- Fast technological transformation
- Shortening life cycles
- Global competition
- Finance and human resource need

University-Driven

- Increase in scientific knowledge
- Increasing research costs
- Difficulty in finding fund and financial support
- Difficulty in supplying resource
- Requirement of commercializing information

Social-Driven

- Perception that universities should be the source of economic development
- Instead of social-social results of researches, economic consequences are attached importance

Organizational Forms of the University - Industry Collaboration

Table: Organizational Forms of University - Industry Collaboration (Ankrah and Omar, 2015:391)

Personal Informal Relationships	- Academic spin-offs - Individual consultancy (paid for or free) - Information exchange forums - Collegial interchange, conference, and publications - Joint or individual lectures - Personal contact with university academic staff or industrial staff - Co-locational arrangement
Personal Formal Relationships	- Students' involvement in industrial projects - Scholarships, Studentships, Fellowships and postgraduate linkages - Joint supervision of PhDs and Masters theses - Exchange programmes (e.g. secondment) - Sabbaticals periods for professors - Hiring of graduate students - Employment of relevant scientists by industry - Use of university or industrial facility (e.g., lab, database, etc.)
Third Party	- Institutional consultancy (university companies including Faculty Consulting) - Liaison offices (in universities or industry) - General Assistance Units (including technology transfer organizations) - Government Agencies (including regional technology transfer networks) - Industrial associations (functioning as brokers) - Technological Brokerage Companies

Formal Targeted Agreements	- Contract research (including technical services contract) - Patenting and Licensing Agreements (licensing of intellectual property rights) - Cooperative research projects - Equity holding in companies by universities or faculty members - Exchange of research materials or Joint curriculum development: - Joint research programmes (including Joint venture research project with a university as a research partner or Joint venture research project with a university as a subcontractor) - Training Programmes for employees
Formal Non-Targeted Agreements	- Broad agreements for U-I collaborations - Endowed Chairs and Advisory Boards - Funding of university posts - Industrially sponsored R&D in university departments - Research grant, gifts, endowment, trusts donations (financial or equipment), general or directed to specific departments or academics
Focused Structures	- Association contracts - Innovation/incubation centers - Research, science and technology parks - University—Industry Consortia - University—Industry research cooperative research centers - Subsidiary ownerships - Mergers

Transfer Channels in University-Industry Collaboration

- Scientific publications
- Reports of universities for industry
- Patent texts
- Informal communication channels
- Employment of people graduated from university or with academic career in the industry
- Common research projects
- Contractual researches
- Financially supporting doctorate students and their projects

- Common use of facilities such as laboratories and equipment by both universities and companies
- Employees working simultaneously in universities and industry
- University spin-offs
- License, patent and know-how patents
- Consultation
- University technology transfer offices
- University centers

Barriers to the University - Industry Collaboration

Even though the advantages and potential of UIC collaborations are well defined, many barriers and challenges that might lead to failure are confronted.

Cultural Barrier	• Different missions and objectives • Conflicting interests regarding the confidentiality and Intellectual Property Rights • Different languages and assumptions
Corporate Barrier	• Different Nature of Work • Considering the nature of the R&D "product" in a different way • Structural and responsibility change in the Company
Operational Barrier	• Lack of information regarding the partner and processes • Lack of coordination and project management • Not accepting partner - generated results

The most important obstacles before academicians

- ➔ Bureaucracy within and outside of the university
- ➔ Fund deficiency for university for UIC
- ➔ External resource deficiency for UIC

The most important obstacles before universities

- ➔ External resource deficiency for UIC
- ➔ Financial resource deficiency of industry
- ➔ Awareness deficiency in university activities in the business world

Indirect output (for society)

Direct output (for actors)

University - Industry Collaboration

Affective factors

Situational factors | Obstacles | Drivers

Support mechanism

Key stakeholders

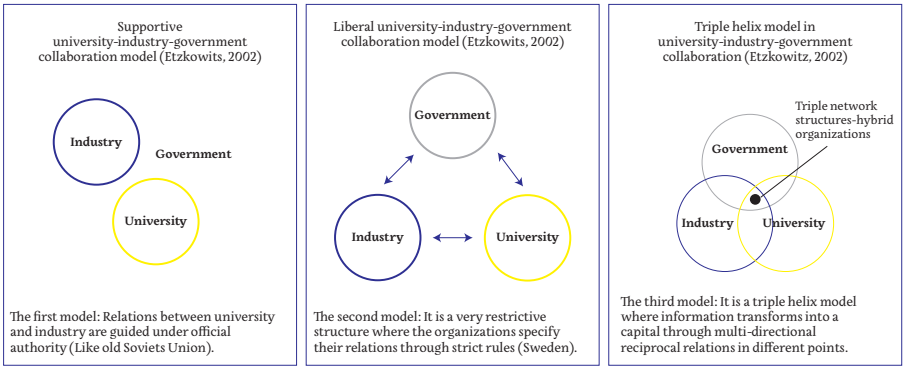
Action: Bureaucracy and funding issues should be resolved in order to remove the obstacles before UIC.

www.ub-cooperation.eu

Institutionalization Approaches of the University - Industry Collaboration Models

University-industry collaboration is one of the most critical elements of national innovation system since it has a determinative role in industry's transforming findings obtained as the result of scientific and technological studies into marketable product or service, new or developed manufacturing method or new social service method; in other words, in gaining competency in innovation and having a say in the world market (Goker, 2002). When the government is added into the collaboration structure, the three main elements of the national innovation system are created. Etzkowitz (2002) defines the relations of university-industry-government collaboration in three models.

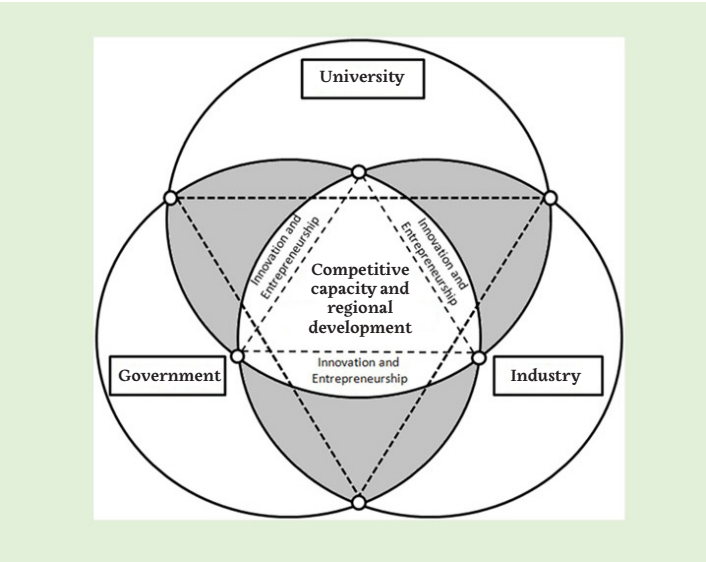
The triple helix is a helix innovation model in which the information process is transformed into capital through multi-directional mutual relations at different points. The first phase of the model consists of internal changes such as improvement of economic development by bilateral relations and universities between the firms through strategic collaborations in each three branch. The second phase is to create an impact of a helix on another. The three and last phase is the birth of triple networks and creative organizations from the three branches of the helix through new opinions and forms for the advanced technological development. In the triple helix, university-industry-government relations are defined as organizational fields that are attached to each other and in a constant interaction where one organization can replace the other. The university takes an educational role for firm founders, industry and universities through incubators while the government has a role providing risk capital with minor-scaled innovation researches and other programs (Etzkowitz, 2002).



Triangulation of the Triple Helix Model

This model represents the organizational relations towards the innovation between the public, private sector and academic arena through triple helix structure, and plans such relations in different levels of the structure and then tries to explain the use of information as capital. It has developed many applications in compliance with this model practically.

It has focused on innovation and enterprise as critical factors in university-industry collaboration; the main aim is to create employment upon the regional competitiveness and development thanks to the capacities of encouraging new investments; and accordingly to direct the economies to meet new competitiveness standards.

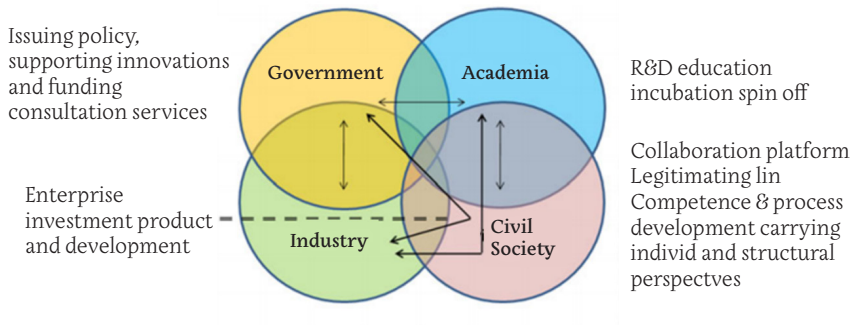


Farinha ve Ferreira, 2013

The Quadruple Helix Innovation System understanding emphasizes that sustainable development, knowledge economy, knowledge society and knowledge democracy should develop all together. Quadruple Helix promotes the perspectives of knowledge society and knowledge democracy to support, encourage and further advance the knowledge production (research) and knowledge application (innovation).

For developing economy, competition and long-term sustainable growth, quadruple helix model which is based on stakeholder theory is a model for co-creation with stakeholders using the innovation developed for other stakeholders in the society. In quadruple helix model, stakeholders and users of the innovation especially included are not passive; instead, active and participatory in the innovation developed within the scope of collaboration. It directs its collaboration focuses as in awareness of social needs and problems. Both the participation of users in the process activates the feedback mechanism and enables the developed innovation as an open innovation. In quadruple helix model, the collaboration of the parties is supported with the process

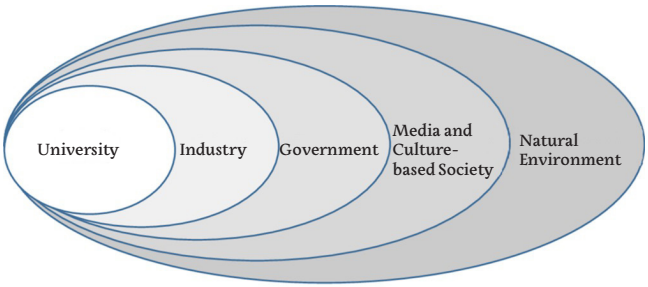
of co-creation. For the success of this model, the stakeholders should fully comprehend their priorities and skills and then establish a harmonized co-creation relations.



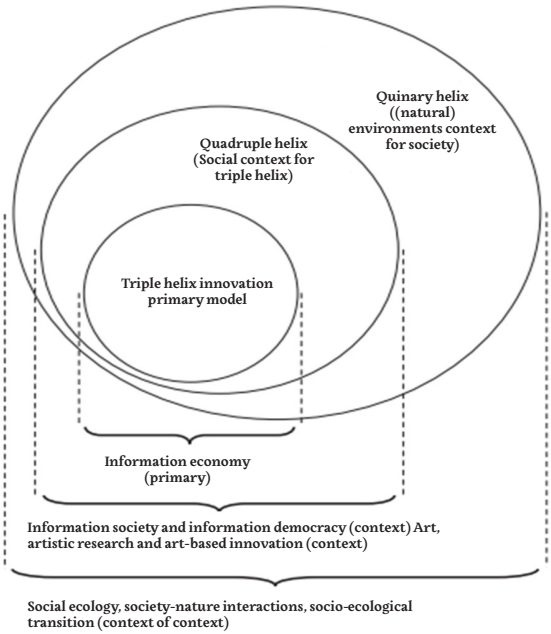
Lindberg, M., Lindgren, M., & Packendorff, J., 2014

The Quinary Helix refers to the socio-ecologic transition of the society, economy and democracy, and therefore, Quinary Helix Innovation System is ecologically sensitive. The quinary helix bases its understanding of knowledge production (research) and knowledge application (innovation) on social ecology.

Environmental matters (like global warming), causes concern and represents the survival matters for the humanity. However, quinary helix defines the environmentally and ecologically concerning matters as possible driving factors for future knowledge production and innovation in potential opportunities as well. Consequently, it defines the opportunities for knowledge economy as well; quinary helix supports the creation of win-win situation between ecology, information and innovativeness here and creates a synergy between the society and democracy (Carayannis ve Campbell, 2019).



Subsystems of Quinary Helix Model (Etzkowitz ve Leydesdorff, 2000; Carayannis ve Campbell, 2012)



Toplum, Ekonomi, Demokrasi ve Sosyal Ekoloji ile İlgili Dörtlü ve Beşli Sarmal Yenilik Sistemleri (Carayannis ve Campbell, 2019:46)

1 Open innovation

2 Model 2 approach in scientific knowledge production

3 Co-creation approach in university-industry collaboration

4 Collaboration networks

5 Quadruple helix model

New Approaches

University - Industry Collaboration: Role of the Government

University-industry-government strategical collaborations provide an organization structure where different skills, competencies, traditions, expectations and intellectual capital are integrated. Functions of the government are to operate the personal research laboratory, fund the universities, provide the science and knowledge infrastructure, provide support and guarantee for public research projects. It provides the legal and regulatory structure on the standardization and security of private technologies, research ethics and intellectual property for the production and use of knowledge. The government encourages business sector to make enterprises in suitable levels in the development, use and training of the technology. Configuration of the transformation system for reciprocal learning is one of the main functions of the government.

Briefly, the government connects the university and local industries to provide a sustainable communication and information change between the government, university and industry; feeds, raise and adjust the industry-science collaboration for the regulative collaboration of higher education institutions. It promotes the public-private sector collaboration to support innovation. Therefore, it establishes a organizational structure in line with the demands and priorities all actors. It provides financial conveniences for scientific and technological investments of private sector like tax exemption, support, etc. It puts forward more flexible working principles. What is more important that it informs the society about the university-industry-government collaboration (Koç and Mente: 2007).

We can summarize the role of the government as follows:

- R&D funds, incentives and tax reductions
- Innovation support credits
- Performance-centered premium and incentive system for the researchers
- Incentive criteria recommended by OECD to measure the university performance: R&D funds transferred from the private sector, consultation revenues, revenues earned from patent licenses, spin-off and start-up activities
- Intellectual Property Rights Adjustment and Technology Transfer Offices
- Science Parks, Spin-offs and Incubation centers
- Educational and development activities for the industry

Proposed Actions to Encourage Universities for Collaboration

Maintaining Environmental Balance: Legal regulators should create a balanced financial and legal environment which is free from volatility and uncertainty in order to establish long-term strategic partnerships.

To provide the universities with the autonomy by which they can conduct the scientific researches and establish partnership: The best actor to decide on the strategy of a university its own management staff and academic personnel. It is not possible for universities which cannot act free to establish right and successful partnerships.

To award active and collaborative universities: Strong collaborations should be supported and promoted through correct legal regulations and governmental programs.

To support universities to fight for success: Universities are in search of establishing partnership with the best stakeholders all the time, therefore, the researches of successful universities should be supported that collaborations leading to higher employment rate can be established.

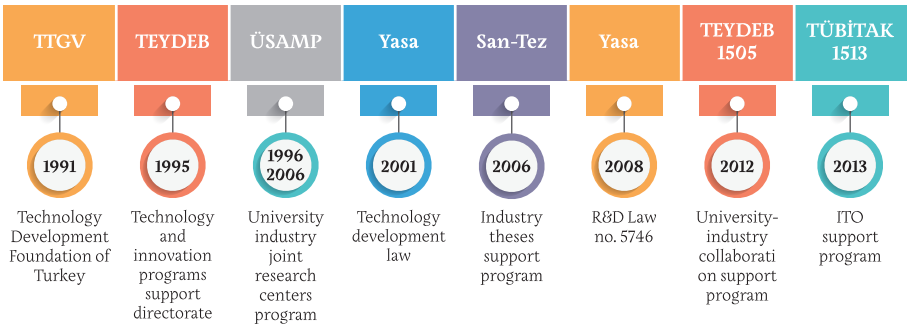
Proposed Actions to Encourage Industry for Collaboration

- To conduct a research that the industry cannot be successful on its own.
- To develop long-term but flexible research collaborations in line with the industry's goals.
- To develop a shared vision and commons strategy.
- To enable to contact with right people and authorize the right people.
- To allow the opinions to cross-grow, create and strengthen communication channels.
- To focus on the quality of the research instead of focusing on the intellectual property rights.
- To be open for the interaction of different disciplines and provide interdisciplinary solutions for the industry.

University - Industry Collaboration (UIC) Structure in Turkey

Provides support to innovative university-industry collaboration to improve the competitiveness of SMEs in many emerging countries such as Turkey. However, an effective structure of university-industry collaboration could not be established and / or has not measure up in Turkey. One of the most important reasons for this situation is that universities and industry have different goals and expectations and they do not match. In addition, funding this collaboration is one of the priority issues. Industry generally does not provide financial resources in Turkey. In fact, the situation is the same in the World and UI collaborations are generally a state-funded system. However, looking at the applications around the world, it is clearly seen that this cooperation with high funding creates very important innovation ecosystems and makes extraordinary contributions to the economy.

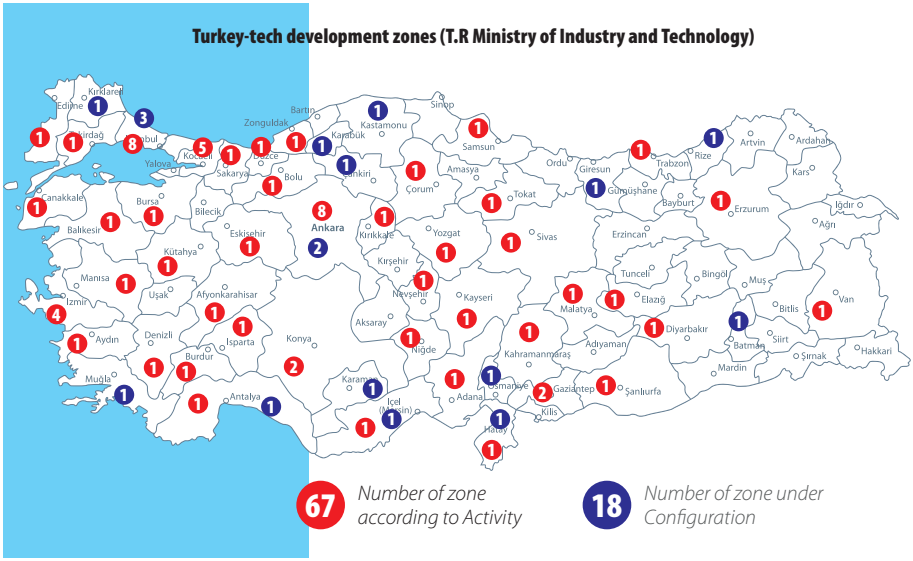
Turkey, after liberalization of the economy in the 1980s put emphasis on to the university-industry collaboration to stand in the face of international competition. In the 1990s, Turkey established institutions such as KOSGEB, TEYDEB and TTGV in order to create and increase the innovation ecosystem. As can be seen in the following figure, after 1996, the state continued to implement various programs to support industrialists, especially SMEs, in the field of innovation.



Ministry of Industry and Technology, in Technology Development Zones established by Law No. 4691 published in 2001; It is aimed to generate technological knowledge, commercialization of the generated knowledge, increase product quality and standard in products and production methods, and develop innovations that will increase productivity and reduce production costs. It is purposed to ensure the adaptation of small and medium-sized enterprises to new and advanced technologies. It is targeted to increase the competitiveness of the industry by providing job opportunities for researchers and accelerating the entry of foreign capital to the country that will make advanced technology investments.

Also on the official website of the Ministry; within the scope of this Law, which has been put into practice since 2001, which will enable them to develop new products and production methods for technological production by bringing them together with researchers and universities; as of December 2019; Total 85 Technology Development Zones (10 in Ankara, 11 in Istanbul, 5 in Kocaeli, 4 in Izmir, 2 in Konya, 2 in Gaziantep, 2 in

Antalya, 2 in Mersin, Hatay 2 and Kayseri, Trabzon, Adana, Erzurum, Isparta, Eskişehir-(Bilecik), Bursa, Denizli, Edirne, Elazig, Sivas, Diyarbakır, Tokat, Sakarya, Bolu, Kütahya, Samsun, Malatya, Urfa, Düzce, Çanakkale, Kahramanmaraş Tekirdağ, Van, Çorum, Manisa, Niğde, Burdur, Yozgat, Kırıkkale, Balıkesir, Karaman, Muğla, Afyonkarahisar-(Uşak), Aydın, Batman, Osmaniye, Zonguldak, Karabük, Nevşehir, Çankırı, Kastamonu, Kırklareli, Giresun and Rize stating that 1 each) was established; It has been reported that 67 of the 85 Technology Development Zones are continuing their activities, and 18 of them are not yet operational due to the ongoing infrastructure works.



When we analyze the Technology Development Zones in Turkey, the number of companies reached 5.506 (1,159 companies are academics partnership), 34 244 projects have been completed and 9673 project continues.

TECHNOLOGY DEVELOPMENT ZONES	
Total Firm Number:	**5.506**
Number of foreign companies or those with foreign partners (Existing)	310
Number of firms with academician partners	1.159
Total personnel number	56.689
R&D	46.108
R&D Design	760
Support	3.565
Out of Scope	6.256
Project Number (Ongoing)	9.673
Project Number (Completed)	34.244
Total Sales (TRY)	84,8 billion
Total Export (USD)	4,4 billion

Although the number of patents acquired within the context of intellectual and industrial property rights has enhanced, but it seems that it is not enough.

TECHNOLOGY DEVELOPMENT REGIONS	
INTELLECTUAL AND INDUSTRIAL PROPERTY	**NUMBER**
Number of patent registrations (national / international)	1.122
Number of Patent Application (Ongoing)	2.558
Number of Beneficial Model Registration	409
Number of Beneficial Model Application (Ongoing)	210
Number of Industrial Design Registration	122
Number of Industrial Design Application (Ongoing)	98
Software Copyright (Purchased)	288

Yıldız Technical University leads the 2018 performance index results of Technology Development Zones. It is considered that creating competition between technology development zones is very important for the innovation ecosystem. Therefore, this competition must be supported and motivated by additional support mechanisms.

TECHNOLOGY DEVELOPMENT ZONES 2018 PERFORMANCE INDEX RESULTS OVERALL RANKING	
Item No.	**TECHNOLOGY DEVELOPMENT ZONES (TGB) NAME**
1	Yıldız Technical University - Technology Development Zone
2	METU Teknokent Technology Development Zone
3	ITU Arı Teknokent Technology Development Zone
4	Ankara Technology Development Zone
5	Mersin Technology Development Zone
6	İstanbul Technology Development Zone
7	Erciyes University - Technology Development Zone
8	Batı Akdeniz Teknokent Technology Development Zone
9	Izmir Technology Development Zone
10	Tubitak-Marmara Research Center Teknopark Technology Development Zone

Resources

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