ANALYSIS OF UNIVERSITY - INDUSTRY COLLABORATIONS IN DEFENSE INDUSTRY: THE CASE OF METU-ASELSAN R&D COLLABORATIONS

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ABSTRACT

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The main purpose of this study is to analyze university-industry collaborations in defense industry based on the case of METU – ASELSAN R&D collaborations. This qualitative study contributes to the literature, especially with the way it addresses the subject. This study, led by professionals with both academia and industry backgrounds, brings together the perspectives of both parties in university-industry collaboration in a single study.

ASELSAN is Turkey's largest defense contractor and leading R&D spender, while METU is among Turkey's top research universities. This study focuses on contract R&D projects and thesis studies conducted by ASELSAN engineers at METU in order to explore their perceptions, motivations, as well as the challenges they encounter and suggest solutions to the all parties participated to the collaboration, which are university, industry, and government.

In this regard, 41 online interviews were conducted with the participants of selected collaborative projects and technology transfer professionals from METU and

ASELSAN. The results indicate that both university and industry perceive each other as important contributors to their works. Interestingly, while industry thinks that research outputs coming from university are contribute to their products and systems, academicians have doubts about direct contribution of research outputs to final products. When it comes to problems arise during collaboration, both sides hold each other responsible. The most frequently mentioned barriers are differences between goals and expectations, conflicts at IPR sharing and bureaucratic burdens in collaboration process. In light of the findings, strategic partnership model is suggested, with a number of policy and strategy recommendations.

Keywords: R&D, Innovation, University-Industry Collaboration, Technology Transfer, IP Sharing

ÖZ

SAVUNMA SANAYİİNDE ÜNİVERSİTE - SANAYİ İŞ BİRLİKLERİNİN ANALİZİ: ODTÜ - ASELSAN AR-GE İŞ BİRLİKLERİ

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Bu çalışmanın temel amacı, savunma sanayiindeki üniversite- sanayi iş birliğini ODTÜ – ASELSAN Ar-Ge iş birlikleri örneğinden hareketle incelemektir. Bu nitel çalışma, özellikle konuyu ele alış biçimiyle literatüre katkı sağlamaktadır. Hem akademi hem de endüstri tecrübesine sahip danışmanlar tarafından yönetilen bu çalışma, üniversite-sanayi iş birliğinde hem üniversite, hem de sanayinin bakış açılarını tek bir çalışmada bir araya getirmektedir.

ASELSAN, Türkiye'nin en büyük savunma şirketi ve lider Ar-Ge yatırımcısı olup, ODTÜ ise saygın sanayi iş birlikleri geçmişiyle Türkiye'nin en iyi araştırma üniversitelerinden biridir. Bu çalışma, üniversite ve sanayinin birbirlerine yönelik yönelik algılarını, motivasyonlarını ve iş birliği sürecinde çıkan sorunları belirlemek ve iş birliği sürecinin katılımcıları olan üniversite, sanayi ve ilgili kamu kurumlarına bu sorunları adresleyen çözüm önerileri sunmak amacıyla, ASELSAN – ODTÜ ortaklığında yürütülen sözleşmeli Ar-Ge projeleri ve tez çalışmalarına odaklanmaktadır.

Bu kapsamda seçilen ortak projelerin katılımcıları ve ODTÜ ve ASELSAN'dan teknoloji transfer profesyonelleri ile 41 online görüşme yapılmıştır. Sonuçlar hem üniversitenin hem de sanayinin birbirlerini çalışmalarının önemli katkı sağlayanları olarak algıladığını göstermektedir. Dikkat çekici bir şekilde sanayi, üniversiteden gelen araştırma çıktılarının kendi ürünlerine ve sistemlerine katkı sağladığını düşünürken akademisyenler, araştırma çıktılarının nihai ürünlere doğrudan katkısı konusunda sanayi tarafı kadar pozitif düşünmüyor. Öte yandan, iş birliklerinde ortaya çıkan sorunlardan her iki taraf da birbirini sorumlu tutmaktadır. Hedef ve beklentiler arasındaki farklılıklar, fikri mülkiyet hakları paylaşımındaki çatışmalar ve iş birliği sürecindeki bürokratik yükler her iki tarafça da en sık dile getirilen engeller olarak tespit edilmiştir. Elde edilen bulgular ışığında stratejik ortaklık modelinin yanı sıra ilgili taraflara bir takım politika ve strateji önerilerinde bulunulmuştur.

Anahtar Kelimeler: Ar-Ge, İnovasyon, Üniversite-Sanayi İş birliği, Teknoloji Transferi, IP Paylaşımı, Bilgi Transferi

To my daughter

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LIST OF ABBREVIATIONS

R&D	Research & Development
NIS	National Innovation System
GDP	Gross Domestic Product
TRL	Technology Readiness Level
UIC	University-Industry Collaboration
METU	Middle East Technical University
SSB	Defense Industry Agency
TÜBİTAK	Scientific and Technological Research Council of Turkey
DARPA	Defense Advanced Research Projects Agency
YÖK	Higher Education Council
TTO	Technology Transfer Office
IPR	Intellectual Property Rights
BTYPK	Presidency's Policy Board for Science, Technology, Innovation

CHAPTER 1

INTRODUCTION

Countries will be better off when they exploit the outcomes of scientific research through high-technology manufacturing with high added-value. In order to achieve this, university and industry should co-work and co-create towards the common goal of contribution to society. Therefore, university-industry collaboration -UIC- has been an area, which is worth analyzing for the last couple of decades.

1.1. Aim of the Thesis

Outcomes of research conducted by universities and commercial interests of the industry have started to be more aligned with each other recently. For this reason, overcoming the barriers and improving the effectiveness of UIC are at utmost importance when its socioeconomic aspects are considered.

With this motivation, this study is designed to explore and analyze how participants of UIC from both sides perceive UIC, what they expect from each other, what barriers and challenges they face during collaboration, and how they can handle them.

It aims to shed light on the differences between the perceptions of university and industry about collaboration and their collaboration partners, identify the challenges they face and their expectations in UIC, and propose policies and recommendations, addressing to those challenges to firms, universities and related public authorities.

This study contributes to the existing body of literature on the analysis of UIC in defense industry and offers concrete steps for building and sustaining effective UICs.

Originality of the study: The available research on UIC encompasses a wide range of subjects, including collaboration models, enabling conditions, and limitations. However, to the best of my research, the ones that specifically about Turkey and defense industry is very rare. It is seen that all of the available studies are one sided, meaning that they handle the subject from either the view from university or industry. As far as it has been searched, there is no study analyzing UIC in Turkey's defense industry from the views of two sides.

For example, Temel & Glassman (2013) discusses the barriers that industry in Turkey experienced in university collaborations -from industry's point of view-, while Yalcintas & Kaya (2015) investigates the advantages and disadvantages of UIC from the perspective of academicians.

For the defense industry case, barriers to UIC are still under-researched with only a few studies on this topic. Therefore, this study extends the empirical scope on the drivers and barriers to UICs for Turkey's defense industry, based on a case study of collaborations between ASELSAN and METU, which are two important institutions with strong relations, which root back to the foundation of ASELSAN. Collaboration between ASELSAN and METU is a good reflection of UIC in defense industry, because of the size and variety of ways that they interact and transfer knowledge including contract R&D projects, joint TEYDEB projects, academic consultancy, etc.

Based on the data collected from UIC participants from ASELSAN and METU, this thesis aims to assist decision-makers in university and industry as well as policy-makers to develop a proper and more enabling ground on which universities and firms cooperate and support the development of each other, as well as the development of the country.

In this context, this study aims to provide insights into the research questions below:

Research Question-1:

What are the perceptions of collaborators about each other and what are the barriers and challenges in UIC in defense industry?

Research Question-2:

How can those barriers be overcome; which measures can be taken to improve the effectiveness of UIC in defense industry?

The remainder of the study is organized as follows. Chapter 1 provides an overview of the sector and the company, Chapter 2 explores UICs from past to present, Chapter 3 presents challenges in UICs available in the literature, Chapter 4 explains the methodology of the study, Chapter 5 reports the data collected and results of the analysis, and Chapter 6 suggests policy recommendations to the university, the firm, and the government.

1.2. Theoretical Background

Current literature on UIC as a basis for innovation and how it is critical for defense industry are reviewed in this part. The concepts of R&D, innovation, and UIC are strongly related to one another.

Continuous efforts on Research and Development (R&D) create knowledge capital which is one of the bases of countries' welfare and economic growth. When we consider a high degree of competitiveness in today's international markets, it is very important for countries to differentiate what and how they manufacture by using their knowledge capital.

At this point, innovation enters to the scene. In the simplest terms, innovation provides higher productivity, meaning that a same amount of input generates a higher amount of output and is a driving force for countries' value-added manufacturing capabilities.

A country's ability to develop new technologies and successfully commercialize them in both domestic and international markets move that country up in the global competitiveness league. Entrepreneurs and large enterprises of the industries with high technology and knowledge accumulation are considered as the engines of productivity and economic growth of the countries they operate. They have the

innovation capabilities required for manufacturing and exporting high-tech goods. They also enhance qualified and well-paid employment in their countries.

Technology-intensive manufacturing can only be achieved with the contribution of industrial R&D activities since R&D is the driver of different forms of innovation. Countries' National Innovation Systems (NIS), which are sets of institutions and relationships key to the innovation at country level, have gone through structural changes in recent years. One of the most important changes is that basic research is getting riskier and difficult to afford for firms. This increasing expense of acquiring new knowledge pushes industry players to pursue innovation strategies that rely more on collaborating with external R&D partners such as universities and research institutions. (Hall, Link, & Scott, 2001)

In this regard, it is important for firms to re-shape their innovation strategies and exploit external knowledge sources by forming sustainable collaborations with them. External collaborations are excellent strategies for increasing a company's ability to innovate by boosting their organizational learning capabilities.

As innovation factories of countries, universities play a significant role not only in national growth but also in industrial growth, since university research is one of the engines of industrial innovation and needs to be commercialized in order to reap the expected benefits for the society. Therefore, collaborating with universities is a leverage for innovation in terms of industry.

Stakeholders of University – Industry Collaboration (UIC) are mainly: 1) university researchers, who create innovation and new knowledge, 2) firms/entrepreneurs, who commercialize them, 3) university Technology Transfer Offices (TTOs), who facilitate technology transfer process, and 4) government, who funds the collaborative research projects. As shown in Figure 1, knowledge exchange is a two-way journey in UIC, which is mediated by TTO and regulated by government through legal and policy environment.

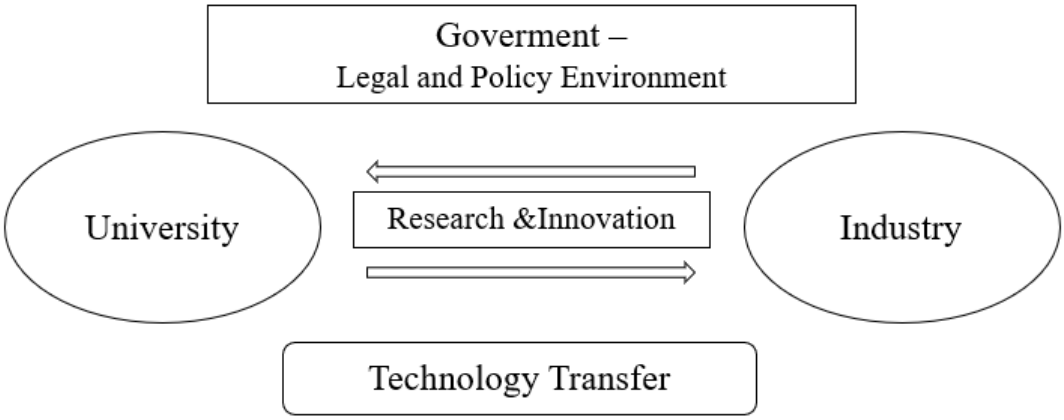

Figure 1. *Stakeholders in University-Industry Collaborations*

UIC is seen as an important source for knowledge acquisition to enhance the innovative capabilities of firms since collaboration provides a suitable framework for combining resources to produce new knowledge and enhance individual talents. Collaboration thus promotes not only a firm's innovation capacity, but also development of technical and soft skills necessary for effective and sustainable innovation.

According to Barnes et al., there is a growing global trend towards more collaboration between university and industry, which governments support as a way to boost competitiveness and GDP development. (Barnes, Pashby, & Gibbons, 2002)

There are several studies showing that collaborations with universities boost firms' innovation performance. For example, according to a study, R&D collaboration with universities has a favorable impact particularly on firms' process innovations. (Un & Asakawa, 2014) Another study conducted in Taiwan finds out that collaborations have had a positive impact on innovation performance of Taiwanian ICT companies. (Huang & Yu, 2011)

It can be advantageous for both parties engaged under the right circumstances. Especially in high-tech sectors, it is important for firms to develop strong and sustainable partnerships with academia for technological knowledge acquisition.

Therefore, UIC is strongly supported by governments, especially for R&D-intensive sectors -including defense- in order to capitalize on the innovative spirit of universities by directing their energy and ideas to the real problems of the industry. Their collaboration contributes to job and wealth creation, generate higher levels of growth and promote increased productivity.

Types of UIC can change from one country to another, as well as one sector to another. For example, Perkmann and Walsh (2009) identified four types of University–Industry projects; (1) knowledge generation, (2) idea testing, (3) technology development, (4) problem solving. (McKelvey, Zaring, & Ljungberg, 2015)

On the other hand, OECD identified more ways to collaborate and channels to transfer knowledge between universities and industry players such as collaborative research, contract research, academic consultancy, IP transactions, conferencing & networking, facility sharing, and continuing education, which will be examined in detail in the following chapters. (OECD, 2019)

Collaboration between universities and defense industry is considerably important when it comes to national and homeland security missions of a country. In defense area, dual-use -civilian and military use- technological development is crucial when increasing global competition is considered. UIC supports it by creating a knowledge intensive defense innovation model and reinforces the firms' competitive power by enabling them to have a world-class research and talent pipeline from universities. (Barbaroux, 2020)

1.3. Introduction to the Sector and the Company

In this part, global and Turkish defense industry, the importance of innovation and research collaborations in defense industry, as well as innovation efforts of METU and ASELSAN are briefly introduced before deeply analyzing the collaborations between two parties.

1.3.1. Dynamics of Defense Industry

Feeling safe and secure is a basic human need that should be met to sustain a healthy and balanced life. At this point, governments are supposed to ensure the safety of their citizens against internal and external threats and enemies. Therefore, building an indigenous defense-industrial base is crucial for bringing political influence on the international arena.

Defense has some specific characteristics, i.e. business models, competencies, and strategies, different than other commercial sectors. In defense, there is usually one dominant buyer, which is government and one supplier in each product group, meaning that almost no competition exists in domestic markets. However, defense firms are increasingly exposed to fierce competition in international markets.

Since defense is considered a public good, which serves to all citizens, it is not left entirely to the private sector. Therefore, state has a bigger role and controlling power in defense sector than it has in other sectors. Government directly interferes in business and R&D strategies of firms.

The policy, in which government manages the defense monopoly is called the policy of the Defense Industrial Base (DIB) and implemented by many countries. (Achmadi, 2019) For example, in the US, defense industry consists of 100,0000 companies, which provide materials and services to the US government under the contract of the Department of Defense. (What is the Defense Industrial Base?, 2022)

Defense industry is considered as a strategic sector in almost every country in the world, not just because of its contribution to the national security and economic development, but also its leading role for other industries in terms of new technology development and innovation. Defense R&D is the biggest component of public-funded R&D in majority of the developed economies and defense R&D expenditure is seen as a catalyzer for innovation in other industries, as well as the overall economic growth.

The evidence can be found in an analysis conducted across all OECD countries, which suggests that 10% increase in military R&D results in a 4% increase in private sector R&D. (OECD, 2000) Another evidence can be the fact that today's most critical civilian technologies such as the Internet, GPS, semiconductors, the microwave, and virtual reality are examples of dual-use technologies with military origins.

1.3.2. Global Defense Industry

Every year, considerable shares of state budgets are allocated to military expenditures by the governments in order to deal with ever-increasing political tensions and geopolitical threats. In 2021, U.S. spent 10% of its overall federal budget on military, which is a clear sign of how much it attaches importance to its national security. (SIPRI, 2022)

It is very important for countries to have technological independence. Especially when sovereignty of the nation is the subject, being technologically independent in military field becomes indispensable. According to the European Parliament's 1993 study on the countries' defense industries, European countries considers military industries as a prerequisite for their national sovereignty. (C4Defence, 2021)

Not surprisingly, global military spending continued its growth in 2021 for the seventh consecutive year and exceeded $2 trillion for first time in history. The spending of the U.S. (38%) and Republic of China (14%) accounted for more than the half of world total. Turkey took place among Top 20 military spenders on the same list. (SIPRI, 2022)

In order to meet both present and future military requirements, defense industry provides governments with military capabilities in all domains from marine to land, and from aerospace to cyber systems. Therefore, defense firms work closely with governments as their important strategic partners for significant military missions.

Due to the rapid advancement of technology and the size of the defense contracts, it won't be wrong to say that defense industry is complicated and hard to analyze. One

of the reasons that defense industry was chosen as the case subject of this thesis is its high-technology orientation, R&D intensity, and high potential for research collaborations, as well as its impact on innovation in other industries. The other reason is that I currently work in defense industry and have experience in university collaborations formed by the firm.

1.3.3. R&D and Innovation in Defense Industry

In defense industry, technological depth and complexity is much higher than other sectors, which enable it to work on cutting edge technologies and push the limits of those technologies. For these reasons, defense industry is one of the leading sectors among the ones that continuously seek innovative approaches and creative solutions. Therefore, R&D has made ground for defense as it is understood from increasing share of countries' defense budgets for R&D. For example, funding of US government for defense-related R&D grew by 24% from 2012 to 2021. Especially after 1940s, a new paradigm based on technology-oriented defense showed up and continued to be considered the best approach to have military superiority. (SIPRI, 2022)

Even if R&D is one of the best ways to gain a competitive edge, companies operating in competitive sectors tend to consider R&D as a risky way. However, one strong buyer can easily finance R&D investment and determine the innovation agenda in defense sector. (Dombrowski & Ross, 2008)

R&D investments in defense sector also nurtures technology-intensive civilian sectors including ICT, electronics, semi-conductors, and aviation through technical capabilities, and patents obtained. Utilization of defense R&D outputs in civilian sectors improve the economic development in a country, which indicates that defense R&D is a driving force for overall technological and economic development. (Dağ, 2020)

Defense firms has had strong ties with the universities in their regions through recruitment and research activities. In the US, the leading defense contractor

Lockheed Martin implements a comprehensive collaboration policy, which aims to reinforce its presence in university campuses. Besides building talent pipelines especially from STEM (Science, Technology, Engineering, Mathematics) faculties to the firm, it heavily invests in defense research carried out at universities that support students, professors and their research budgets. (Olivier, 2022)

1.3.4. Turkish Defense Industry

Turkey is ranked 18th in the List of Top Military Spenders, accounting for 0.7% global military spending and 2.1% of its GDP in 2021. (SIPRI, 2022) Defense is the locomotive of the technology foundation of the country with its technology depth and spill-over effects that is created for other industries.

In Turkey, history of defense industry dates back to 1920s. After the foundation of the Republic, several military equipment and ammunition factories were established in frame of initial industrialization efforts of the new government. Moreover, an aircraft factory was founded within the efforts of initiating a national aviation industry.

However, the milestone in establishment of Turkish defense industry is undoubtfully the embargo imposed by the US for certain weapons and military equipment during Cyprus Peace Operation. That incident enabled and accelerated the foundation of today's leading Turkish defense firms. It provided Turkey with an opportunity to build its national defense base, which brought it less reliance on imports and more autonomy in international field.

Turkish defense firms are mostly state-controlled and mainly operate in land-air-naval platforms, battery systems, electronic and software, ICT, and ammunition areas. Three of them take place among Top 100 defense companies of the world, according to the ranking of Defense News. (DefenseNews, 2022)

For the last twenty years, Turkey's defense industry has shifted from the one dependent largely on imports to a self-sufficient industry along with its advancing

R&D and technology base. Defense capabilities have recorded a steady growth with government's dedication on ending the country's dependence on imports, its policy prioritizing defense investments and strategic plans on defense modernization. As of 2022, Turkey has been meeting almost 80% of the needs of its Armed Forces through its domestic supplies.

The sector is an overall ecosystem that contains over 1.000 firms, various SMEs, research institutes, and universities. Currently, Defense Industry Agency (SSB) - previously Presidency of Defense Industries- is the sole procurement authority, which was founded in 1985 and re-named in 2017 and 2022. Since its establishment, SSB has made significant achievements. For example, between 2002 and 2019, the number of defense industry programs increased from 62 to 700, the number of companies operating in defense sector increased from 56 to 1500, total defense revenue increased from USD 1 billion to USD 10.8 billion, and export volume increased from USD 248 million to USD 3.1 billion. In addition, total budget of defense projects reached more than USD 70 billion, while it was only around USD 5 billion in 2002. (Bekdil, 2020)

The majority of countries do not combine civil innovation channels with defense R&D systems. In other words, there is a lack of collaboration between the defense industry, other industries, and universities. (Jara-Olmedo, Quisimalin, & Chavez, 2020) Nonetheless, this situation does not hold for Turkey. Turkish defense firms are active players in overall R&D ecosystem in terms of external R&D collaborations.

In terms of R&D, defense industry is a leading sector in Turkey thanks to the government's technology-oriented and R&D-based defense industry policies, which motivates firms to dominate Turkey's top R&D spenders list each year. Defense R&D expenditures increased by 34 times between 2002 and 2019 to nearly USD 1.7 billion, corresponding to 15% of total industry turnover. (Defence Turkey, 2021)

These numbers have been achieved thanks to SSB's R&D oriented technology development approach, which promotes co-working of defense companies with universities and research institutions. R&D Projects Roadmap for the national

defense industry is prepared by the R&D department of SSB according to the technology needs of the industry by considering dual use areas, export restrictions, capabilities, and TRLs. In line with this roadmap, it supports R&D activities conducted within the collaboration of industry-university- research institutions.

In addition to SSB, TÜBİTAK also executes the defense R&D projects through its Defense Industries Research and Development Institute – SAGE, founded in 1972 in order to meet the technology needs of the Turkish Armed Forces. Its vision is also to make Turkey gain a complete technology independence in defense industry. It executes R&D projects basically on munition systems, software development, and strategic subsystems. One of the laboratories of SAGE is located at METU campus in Ankara. (TÜBİTAK SAGE, 2021)

1.3.5. ASELSAN

Founded right after Cyprus Peace Operation in Ankara, ASELSAN is Turkey's largest defense firm, owned mostly by Turkish Armed Forces Foundation -TSKGV-. It develops advanced electronic technologies, products and systems not only in military but also in civilian scope including health, energy, transportation, and ICT sectors. Besides being a strategic provider of Turkish Armed Forces, it is also exporting its state-of-the-art products and systems to more than 80 countries across the world.

As one of the world's top 100 defense companies, it sees R&D as the catalyzer of its indigenous high-technology and allocates 7% of its annual turnover for financing R&D projects. In its nine R&D centers located in İstanbul and Ankara, nearly 6,000 R&D personnel work on technology development at all technology readiness levels (TRL) from basic research to commercialization.

As Turkey's leading R&D spending company, ASELSAN carries out its R&D activities according to its technology roadmap and investment plan, which is prepared annually for 5-year periods and includes all focus technologies-in progress. In this plan, university collaborations are also specified for each project being worked on.

1.3.6. University Collaborations at ASELSAN

Firms with specific characteristics may tend to collaborate universities more than others. In a study analyzing knowledge interactions in Australia, it is stated that possibility of participating in university collaborations mostly depend on a firm's size and its R&D capabilities, meaning that larger firms with higher R&D capabilities are likely to collaborate with universities more and in a better way. In addition, it was stated that the number of R&D employees was a crucial element determining a firm's ability to collaborate and work with universities effectively. (Tödtling, Lehner, & Kaufmann, 2009)

Since ASELSAN employs the highest number of R&D personnel, graduated from Turkey's most outstanding research universities and thus have high R&D capabilities, it can be said that its propensity to work with universities is high.

Believing in potential of open innovation, ASELSAN values to the research output and knowledge produced in universities and tries to utilize them in its products and systems. It nurtures its R&D ecosystem and is nurtured back by it via two-way knowledge transfer. Therefore, university collaboration is an integral part of ASELSAN's innovation strategy, which is also reflected in the vision of senior management. With this vision, ASELSAN has collaborated with over 60 universities so far and provided USD 170 million funding to those universities for collaborative R&D projects.

ASELSAN believes in the importance of fostering long-term research relationships with the universities instead of carrying out one-time projects with them. For this purpose, it located some of its research teams at university campuses and techno-parcs in Ankara and İstanbul since it believes having an R&D existence geographically near to top research universities reinforces their relationships.

Under R&D and Technology Management Units, there are "R&D Collaboration Teams" dedicated to find the best academic researchers for the specific technology areas of interest within the company. They enable internal R&D teams to reach the

best academic match for collaboration by organizing regular university visits and technology workshops, where they bring university and industry researchers working in the same technology area together.

ASELSAN collaborates with the universities in many ways. However, in this study, contract R&D projects and graduate thesis studies of ASELSAN employees were analyzed.

Collaborative projects are funded either by ASELSAN, a public institution -TÜBİTAK, SSB- or an international funding program -HORIZON- via collaborative proposal by the university and the company.

R&D projects funded by ASELSAN are required to have the approval of "Committee of Self-funded R&D Projects" to get the demanded budget. In that committee, projects are discussed and evaluated by executives from each business unit in terms of their technology and innovation level, project management metrics, and targeted outcomes. In particular, technology and innovation level of a project is evaluated by considering the aspects below:

- Contribution of the project to technology capabilities of ASELSAN
- Innovation level of the project in national and international level
- Effect of the project on reducing exports
- Subject of the project being among the prioritized technology areas of the country

University collaboration is encouraged in this process by having at least one university partner is being favored in the assessment of the projects. ASELSAN assigns only a part of its main projects to universities in the form of "collaborative projects". These can be literature review, technical analysis, testing, algorithm development, prototyping, etc.

Generally, technical engineers directly engage in researchers in academy in all stages of the project from the beginning. As shown in Figure 2, They first find the

academician to collaborate, then prepare and share a job description document, which identifies technical requirements and expectations from the academician in detail. After that, procurement teams ask academician to share his financial offer to complete the project. Lastly, collaboration agreement, which includes the project plan with deliverables and timeline is signed between the firm and the university.

During the project, engineers do not only give feedback on the outputs delivered by the academician, but they also make regular visits to the university during which they work together.

Project managers are mostly responsible for the compliance of the university project with the main project in terms of budget and timing and carry out formal application process if there will be an application for an external fund such as a TÜBİTAK grant.

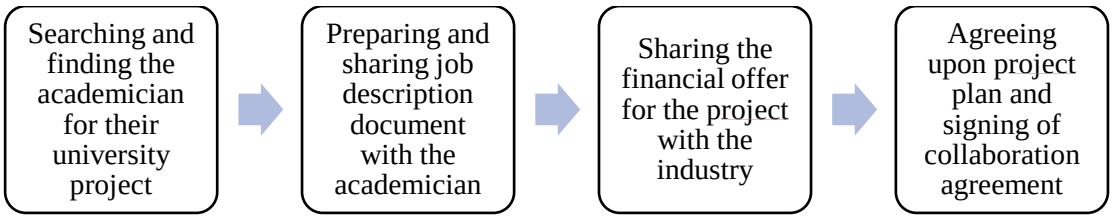

Figure 2. *Process of Starting a University Collaboration at ASELSAN*

1.3.6.1 ASELSAN Academy

When it comes to improve technical capabilities of its employees, ASELSAN encourages them to have MSc and PhD degrees in their own fields. With the aim of motivating the employees for having graduate degrees and improve their competences for the projects they work on, ASELSAN launched a special postgraduate training program “ASELSAN Academy” in 2017.

ASELSAN Academy is a unique model of 4th generation university that brings university and industry researchers together. It provides the necessary environment for developing new technology and know-how through the thesis studies of the employees.

The main objective of the program is to shape the courses that employees take and the thesis studies they conduct in accordance with the projects they work on at ASELSAN. Thesis topics are evaluated and approved by the ASELSAN Academy Council, in terms of whether they are coherent with the company's 5-year technology roadmap and investment plan. Advisors mentor and employees with PhD degree at ASELSAN co-mentor the thesis study.

In this model, ASELSAN has partnered with Turkey's four outstanding research universities in engineering fields through a protocol singed with Turkey's Higher Education Council – YÖK. The Council has authorized ASELSAN as the legal campus of the partner research universities, which is a constitutional right.

Employees can choose whichever university and department they want to study at. If they are found eligible by the university, they get their courses from the lecturers of these universities at company buildings. In this way, employees don't waste their time on the road to university campuses. In the end, ASELSAN Academy graduates take the same diploma with the students of partner universities.

Table 1. *Universities and Departments in ASELSAN Academy Program*

Universities	Departments
Gazi University	Computer Engineering
Gebze Technical University	Electrical/Electronics Engineering
Istanbul Technical University	Materials Engineering
Middle East Technical University	Mechanical Engineering

ASELSAN Academy contributes to technology development activities and know-how transfer between ASELSAN and universities, not only in favor of ASELSAN, but also in favor of universities. It has opened a new channel for connections in academic world, which enable employees to find the right academic partner to collaborate more easily on their specific technology areas. Academicians, on the other hand, from the partner universities benefit from ASELSAN's R&D and test infrastructures for their projects. They will have a chance to work on real industry projects and gain industrial experience.

There is a special funding program named “ASELSAN Seed Grant”, aiming to provide financial support up to USD 50,000 for the theses in frame of ASELSAN Academy. In this way, theses can be transformed to research projects, that carry the potential to result in an intellectual property or a critical innovation that contribute to existing products, systems, or technological maturity level of ongoing projects of the company. Decision of giving the grant is given by the ASELSAN Academy Scientific Assessment Board according to certain criteria.

So far, 313 employees have graduated MSc and PhD degrees from ASELSAN Academy with 28 patents, 8 utility models, 27 articles, and 134 proceedings papers. Currently, 595 employees continue their postgraduate studies in their business project subjects in the workplace, which is the requirement of the program. These conditions enabled effective UIC outputs, such that it received the grand prize among more than 400 applications from 60 countries in the "Outstanding Support Mechanisms" category within the scope of the "University-Industry Cooperation Conference" held by UIIN (University – Industry Innovation Network) in 2022.

1.3.7. METU and its Collaborations with Industry

Founded in 1956, METU is one of Turkey’s leading universities over 120 thousand graduates. Its mission during foundation was to train qualified workforce in the fields of natural and social sciences.

As a research university, METU has developed an expertise not only in basic research, but also in applied research with the industry projects it has involved. It has strong and close relations with the industry thanks to the collaborative projects and commercialization activities of its researchers. It can be said it has even closer relations with defense industry, when the share of its graduates from engineering faculties working in defense firms is considered. Additionally, it has a special focus on academic entrepreneurship, which is one of the best ways for commercialization of technological knowledge generated in universities.

METU Technoparc is Turkey's first technoparc with more than 10 thousand researchers and almost 500 tenant companies, majority of which were founded there. The technoparc firms, which have a total export volume of USD 1.7 billion mainly operate in energy, ICT, life sciences, and defense industries. They extensively collaborate with the university, with more than 48 departments and research institutions through 2800 UIC projects. (METU, 2023)

As another interaction channel with industry, METU Continuing Education Center (SEM) has been offering certificate programs in several areas including defense technologies since 2011, which contributes to their occupational development.

For these reasons, the university shows considerable attention and effort for industry collaborations through its Technology Transfer Office (TTO), which is a structure to improve UIC, as well as technology- based entrepreneurship. It catalyzes UIC and works as an intermediary institution between university and industry by finding a match from industry for the research conducted by the university researchers and vice versa. It also provides academicians with the necessary support for their technology transfer activities by executing the whole financial and administrative process from obtaining a patent till the transformation of the academic know-how into an economic value. METU TTO has made over 440 national and international patent application, 260 of which were certificated.

1.4. Concluding Remarks

In Chapter 1, aim of the thesis and its theoretical background are discussed. In addition, the sector, the firm, and the university, as well as their collaboration activities are briefly introduced.

Technological knowledge, generated in academia through scientific research is the crucial input of the industrial innovation that creates value for the overall society. Therefore, transfer of knowledge from university to industry should be facilitated through the formation of effective UICs.

Knowledge can be better transformed into value that improves the quality of people's lives, when university and industry combine their efforts that complement each other. Considering the importance of their collaboration, the factors that deter them from collaborating are critical to analyze.

Because of the value it creates for countries, defense industry is one of the top sectors that promote innovation and allocate considerable sources to the transfer of knowledge from universities. Considering the strong ties of defense firms with universities in their regions through various channels, UIC in defense industry is worth deeper analysis. In Turkey, defense industry is a leading sector in terms of R&D thanks to the government's technology-oriented and R&D-based defense industry policies. As a result, considerable number of UIC projects are conducted in defense industry. ASELSAN and METU are two institutions that have been conducting many joint R&D projects since the foundation of ASELSAN in 1975.

University collaboration is an integral part of ASELSAN's innovation strategy, which is also reflected in the vision of senior management. It has internal R&D collaboration teams dedicated to find the best academic researchers for the specific technology areas of interest within the firm. It collaborates with the universities in several ways including contract R&D projects and graduate thesis studies of ASELSAN employees. Those collaborations are determined according to its five-year Strategic Plan and Technology Roadmap and Investment Plan.

METU, on the other hand, has strong ties with the industry, especially the large defense contractors in Ankara through academic consultancy, contract R&D projects, post-graduate studies, certificate programs, etc. In addition, considerable part of its graduates from engineering departments is employed in defense industry, especially in ASELSAN. Therefore, the topic of R&D collaborations formed between them is picked as the case study for this thesis.

In Chapter 2, available literature on UIC is reviewed.

CHAPTER 2

UNIVERSITY INDUSTRY COLLABORATION FROM PAST TO PRESENT

The history of collaborations between university and industry in research is as far back as the mid- to late 1800s in Europe and the First Industrial Revolution in the US. Throughout the time, those collaborations have undergone structural changes and evolved towards more formal research partnerships. (Hall, Link, & Scott, 2001)

Initial linkages between university and industry were mostly in the form of consulting relationship and 66% of them had been initiated by universities. (Melchiori, 1983) Formal collaborations were usually stemmed from informal contacts and during firm visits of university professors or vice versa.

2.1. Universities' Changing Missions

Universities' mission has changed dramatically throughout the history and transformed from being a sole training institution to the one that is a vital player in the transfer of knowledge. The rise of the information economy caused an expansion of the mission of the university.

Earliest universities in the history (University 1.0) had one and only mission, which was teaching. At the beginning of the 19th century, the University of Berlin started to combine teaching with research (University 2.0), which brought the second mission. Towards the end of the 19th century, universities adopted a third mission of contribution to society (University 3.0), which necessitates providing knowledge that could be used in practical aspects. (Zuti & Lukovics, 2014)

Third mission of the universities concerns the use of resources of the university for the benefit of all parts of the society. Universities fulfill this mission by transforming

scientific knowledge comes out as research output into marketable innovations (University 3.0). They realize it in several ways. For example, universities in the United States, in particular, increased their entrepreneurial efforts in a variety of ways such as patenting and licensing, constructing scientific parks, and investing in start-ups to fulfill this third mission of actively contributing to regional development. Therefore, University 3.0 is described as the entrepreneurial university by many scholars. (Compagnuccia & Spigarelli, 2020). It is important for university administrations to balance all these missions for achieving utmost benefit for the society. (Meissner, Erdil, & Chataway, 2018)

Universities started to take active role in the areas such as intellectual property, spin-offs, participation into policy making, and collaboration with industry (Frondizi & Fantauzzi, 2019). This has made universities' roles more diversified and made them contribute to regional development more than they did before. This was mostly enabled by the passage of certain federal laws and regulations, which will be covered in following chapters in detail.

These mission expansions of universities have made forming successful cooperation between universities and businesses indispensable. Therefore, the development of "industry–university cooperation" that began in the early 1980s can be explained by the phenomena of third mission of universities. (Zuti & Lukovics, 2014)

A number of billion-dollar companies were founded in the US thanks to the entrepreneurial environment provided by universities. As the most famous example, computer science graduate students at Stanford University created a web search algorithm and founded Google Inc in 1990s. When examples like Google is considered, how mission expansion of universities affects economic development can be better illustrated.

New approaches to universities such as University 4.0 and even University 5.0 are available. ASELSAN Academy can be shown as an example to University 4.0, which can be described as "the university inside the industry". University 5.0 is on the other hand, is described as global university, which has co-creation and online education at its heart. (Dewar, 2017)

2.2. The ‘Triple Helix’

Research should be related to societal issues, which necessitates policies that promote knowledge and technology transfer, as well as research funding mechanisms that are tied to these goals. This automatically makes government the third stakeholder of UIC and this triple interaction involving university, industry, and government is described as “Triple Helix -TH-” of innovation, which is described by Etzkowitz and Leydesdorff. (Etzkowitz & Leydesdorff, 1995)

Governments are fostering collaboration as a strategy of improving innovation and enhancing wealth creation in the era of fierce competition and rapid technological change. To better exploit the benefits of university research, governments have designed funding programs targeting UIC, which were proven to result in an increase in patenting activity. (Nugent, Chan, & Dulleck, 2021)

Networks of relationships among the primary actors: universities (science), businesses (business), and governments (governance), The Triple Helix concept, assumes that the generation and diffusion of socially structured knowledge is the driving force of economic progress in the post-industrial epoch. In this model, government considers university as an important actor for economic development and designs science and technology policies accordingly. (Tether & Tajar, 2008)

Interaction between university, industry, and government has changed through the evolution of innovation systems. In statist or state-centric model, which was implemented in Soviet times, government only guides and structures university and industry’s mutual relationships. On the contrary, laissez-faire model rejects government intervention to the collaboration and embarks on “leave alone” approach.

The current TH model centers on interactions between universities – industry – government, in which university takes the role of generating new knowledge, industry takes the role of production, and government takes the role of overseeing. It is a framework of a tripartite interface between hybrid organizations and open extension of four or more helixes, as shown in Figure 2. (Farinha, 2012)

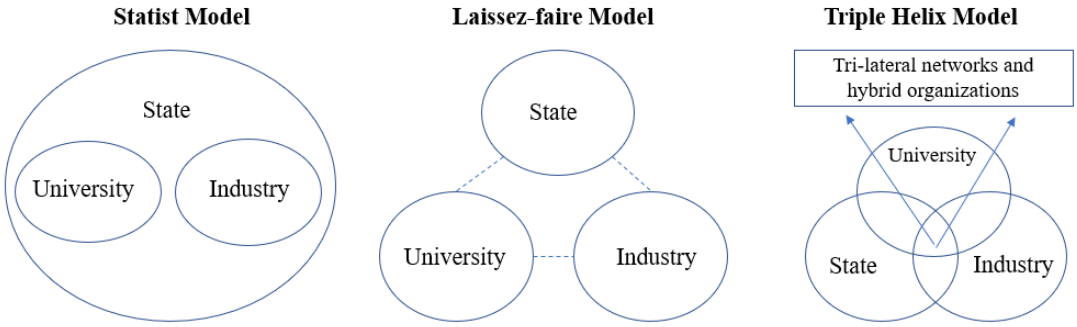

Figure 3 *Models of Triple Helix*

In this scheme, government's policy support for R&D can be seen as key for the introduction of new ideas, technologies, and products into the market. Governments should provide policy support for collaborative R&D through "to the purpose subsidies, tax incentives, research funds and by establishing research infrastructures such as science parks, innovation/technology centers, incubation centers and TTOs". (Farinha, 2012)

It is important to note that public R&D spending initiate more private R&D investments, which enhances firms' R&D capabilities and ultimately results in increased collaborative activities with universities.

Recently, TH model has evolved to quadruple helix and quintuple helix to better explain innovation ecosystems for sustainable competitiveness. In quadruple and quintuple helix model of innovation, media-oriented public and civil society and environment, which shape innovation policies of the governments are included to the framework. (Carayannis, Barth, & Campbell, 2012)

2.3. Ways of UIC

Universities increasingly engage in industry along with their changing missions towards the society, while industry follows the same pattern with the increasing need for new knowledge generation to stay competitive in the market. For these reasons, UIC has been showing a rising pattern not only in terms of quantity, but also in terms of quality worldwide.

It can be proven by the fact that the share of co-patent applications with industry in all patent applications of universities increased from 24% to 43% between 1992 and 2014. It means that universities co-work with industry for more efficient research, which result in an intellectual property. (OECD, 2019)

As the efficiency of collaboration has been increasing, the ways of collaboration have diversified as both sides need and know each other more. Literature defines three main forms of UIC; which are (1) educational collaboration, (2) academic entrepreneurship and (3) research related collaboration. These forms of UIC can be conducted through variety of ways and mechanisms. (Nsanzumuhire & Groot, 2020)

One of the most frequent mechanisms used in UIC is via collaborative R&D contract, which is an example of the formal methods that allow businesses and universities to engage in a win–win situation. This collaborative R&D studies could be in the form of long-term strategic co-development partnership, where two parties agree to share finance, expertise, or other resources in the pursuit of a common goal, or a one-time research sponsorship, where industry provides funding to the university for the solution of a technical problem or development of a new technology.

Even if it is more difficult, it will be better for both parties to build long-term sustainable relationships instead of ad-hoc collaborations because in ad-hoc approach, partnership is based on personal connections, meaning that it remains limited between individuals and completely depend on individual preferences. Therefore, when the project ends, the collaboration comes to an end too. Afterwards, industry will have to spend additional effort and time to find an academic partner for its future projects. Instead, forming a strategic partnership can help industry avoid long negotiations for every research project.

In strategic partnerships, collaborations are not established between individuals for one-shot projects but they are established permanently between organizations through strategic collaboration contracts. It allows businesses to choose the universities to partner in accordance with their strategic priorities and academic capabilities of the university to the sector of the company. (Frolund, Murray, & Riedel, 2017)

Besides collaborative R&D research, there are other ways of UIC, which are more informal and indirect ways such as "co-publications, conferencing, academic consultancy, infrastructure sharing" etc. OECD categorizes the methods of knowledge transfer from university to industry as formal and informal channels, as shown in Figure 3. It classifies "labor mobility, academic spin-offs research mobility, intellectual property, and collaborative research" under formal channels for knowledge transfer, as it classifies "research publications, conferencing, geographic proximity, facility sharing, and training" under informal knowledge transfer channels from university to industry. (OECD, 2019)

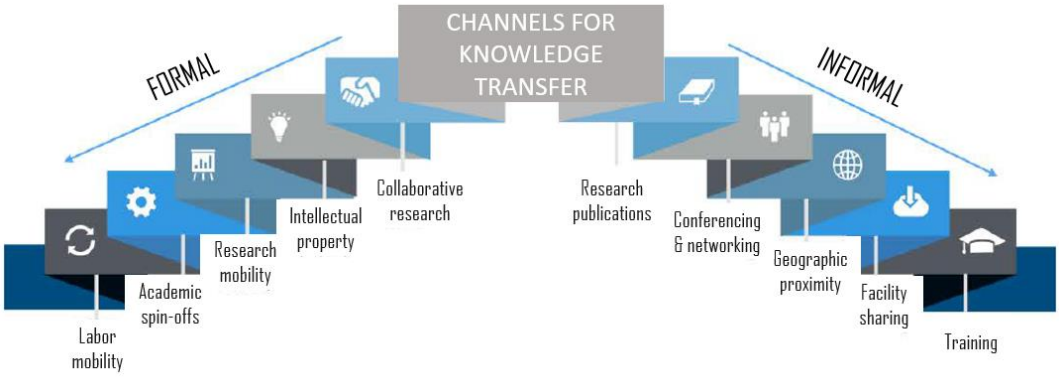

Figure 4 *Channels for Knowledge Transfer (OECD, 2019)*

The channels through which two parties interact may show difference from one sector to another, and from one firm to the other. In defense industry, collaboration choices of the firms are usually shaped by their mission-based operational needs. The most frequently used mechanisms of collaboration in defense industry are "research, resource-use, personnel exchange, and educational agreements". (Gupta, Sergi, Tran, Nek, & Howieson, 2017)

UIC projects can also be categorized according to their funding institution, which can be a firm, a public institution, or an intergovernmental funding institution. Projects in defense industry are mainly financed by governments via special funding programs available for application of universities and defense firms.

Post graduate studies of firms' employees can be shown as a mechanism of educational collaboration, which will be covered in this study in addition to contract

R&D projects. Even if our case study does not include academic entrepreneurship, it is a fundamental form of UIC that impacts and is impacted by educational collaboration and research-related collaboration.

2.4. Advantages of UIC

The research partnerships between universities and companies enable both entities to gain sustainable growth in their areas. Industry, in particular, begins to see the value of partnering with the universities as a source of future-oriented innovation and talent development.

Knowledge generated in universities is a fundamental source for businesses to gain competitive edge through innovation on their products and processes. This is because of several factors including “fierce competition in international markets, constantly-changing customer needs, and most importantly, increased cost and riskiness of internal R&D”.

While firms rely on university researchers mainly for innovation, universities gain prestige through increased external research funds. Just as businesses need innovative ideas to sustain their competitiveness, researchers need additional funding to carry-out their research. However, their contribution to one another is not restricted to these, yet they gain various advantages from collaborating with each other.

Through collaboration, industry will have access to “research from early-stage to applied stage, academic consultancy, innovative ideas, and well-trained workforce”, as university will have “additional funding, real industrial cases, advanced research infrastructure, and employment opportunities for its graduates”, as shown in Figure 4. (Al-Tabbaa, 2015) These prospective advantages can also be considered as motivations and incentives behind their partnerships.

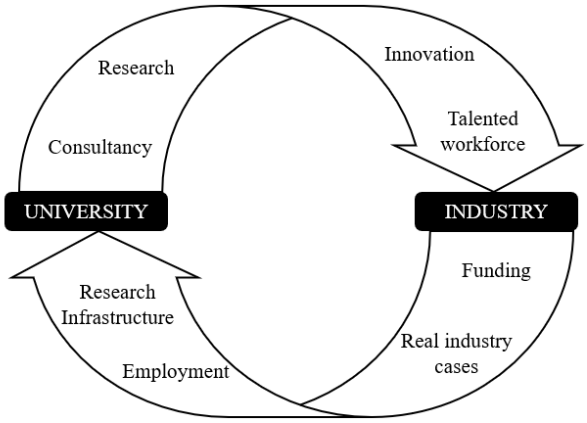

Figure 5 *Contributions of University and Industry to Each Other*

According to Lee, participants in university–industry partnerships appear to reap major benefits, some of which were anticipated and others which were not. Firms profit most from increasing access to fresh university research and discoveries, while universities benefit most from augmenting their own academic research by accessing financing for graduate students and lab equipment, as well as seeking insights into their own studies. (Lee, 2000)

It is important to keep in mind that university and industry are not the only ones that benefit but government also take advantage of their collaboration, because of the value created in favor of the society as a whole.

2.4.1. Advantages of UIC for Industry

Firms benefit from collaborating with the universities in a variety of ways, including access to new knowledge, lower costs of generating new knowledge and creating innovations, increased productivity, and reduced risks associated with R&D and innovation projects. By some scholars, those benefits are grouped under three headings as knowledge exploration, competence enhancement, and knowledge exploitation. (Thune , 2009)

A number of researches done so far proves that collaboration with third parties improves a company's ability to innovate. One of those studies shows that UIC has a significant positive effect on technological innovation, after the second year of collaboration. (Wirsich, Kock, Strumann, & Schultz, 2016)

Companies can improve their business performance by inventing new processes or technologies, de-risking research investments, and expanding their capabilities and experience. However, firms are reducing their expenditure on early-stage research as conducting basic research is getting riskier in terms of time and resource. Instead, they expect universities to fill that gap.

The evidence can be found in the declining number of scientific publications by firms alone. They rather tend to conduct basic research projects and make scientific publications in collaboration with their academic partners. (Krieger, Pellens, Blind, Gruber, & Schubert, 2021) Therefore, this is one of the most important motivations of industry to engage in collaborative work with universities.

Collaboration allows businesses to grow technologically at a lower cost and with a lower risk of failure. Collaboration also gives them access to a wider range of technical knowledge than they might get from internal development alone. (Barnes, Pashby, & Gibbons, 2002) Moreover, employees can learn new research techniques from university researchers, which further contributes to their capability development.

Universities are mostly seen as a talent factory by industry and collaboration enables firms to shape and contribute to training of their future-workforce. Therefore, it plays a critical role in supplying businesses with highly qualified employees and access to world-class specialists and academic talent to solve crucial problems.

In Turkey’s Eleventh Development Plan, this advantage of collaboration is extensively highlighted. In the plan, it is aimed that raising of qualified workforce with PhD degree will be enabled by UIC and their employment by private sector will be encouraged. Certain requirements for the share of R&D personnel with PhD degree will be set for the industry and they will be monitored. In addition, graduate programs at the universities will be adjusted to industry needs through close UIC and the universities doing that will be incentivized. (Presidency of Strategy and Budget , 2019)

Firms that see gains in their products and processes as a result of their innovation activities are more likely to continue doing so. Similarly, they are expected to have a good attitude toward collaborations and to work more with the third parties, mainly universities, in the future if positive results are achieved as a result of collaborations formed by firms for innovative initiatives. The results of a study show that both product-oriented and process-oriented impacts of innovation are positively influenced by external collaboration. (Fındık & Berna, 2015)

In order to take the full credit out of university collaborations, especially large enterprises with R&D focus have started to create specialized units for managing such relations, directly reports to senior management. Those units work for finding the right academic partner for the focus areas of the company and managing the collaboration process by acting as a bridge between university TTO and internal R&D teams.

2.4.2. Advantages of UIC for University

Even if UIC has been heavily criticized by some academicians who have concerns that academic values are disrupted by financial expectations, R&D collaborations formed with industrial players offer several advantages to the academic world including students and academicians.

First of all, industry collaboration is a crucial factor for progressing academic research and translating it into practical use through commercialization. Academia can benefit from industry collaboration in the forms of new sources of funds for research and students, new sources of equipment, machinery, laboratories, and instrumentation, exposure to real world research, income from intellectual property rights, and alternative funding source. (Melchiori, 1983)

It is an undeniable fact that industry is becoming more essential for universities as declining public R&D funds has obliged academicians to search for new sponsors for funding their research. Both students and academicians benefit from industry cooperation by accessing new sources of financing. Universities get more resources

to conduct their research and can expand their research areas simply by forming industry partnerships. Feedback and guidance given by industry professionals especially for the process of taking an invention or product from conception to market are key to success of a university research.

Moreover, the opportunity to solve difficult research topics with real-world applications and gain access to real data can be shown as possible rewards of industry collaboration for academicians since research output can be socially relevant only if it has a practical use. (UK Ministery of State for Universities and Science, 2015) In this way, universities will have the opportunity to align their curriculum with the requirements of the industry, respond better new technology trends and conduct their mission of "contribution to society".

Since the higher the R&D capabilities of industry, the more the university will take advantage of the collaboration; having an industry partner with relevant R&D capabilities is a great way to create application-driven research areas that can bring even more funding opportunities. It is important for academicians to be aware that research with a commercial focus can more easily access to external funding opportunities.

Abramo et al (2009) stated that individual university scholars' scientific output is influenced by public–private research partnerships. The findings suggest that university researchers who work with people in the business sector perform better in their research than counterparts who do not.

For students, university's partnership with industry provides them with career opportunities after graduation as it provides partnered business with the ability to find new talent to hire. Industry collaborations provide employment opportunities for university students, especially engineering students, who are involved in collaborative projects They may easily acquire access to post-graduate research positions in those firms. Therefore, it can be said that UIC is a good way to build a pipeline of graduates for defense research. This talent pipeline enables building

awareness of research needs and long-term relationships that lead to future collaborations.

The mentoring of the industry is also critical for student's training, skill development, and job placement. In addition, a university's strength in job placement of its graduates has a positive effect on its reputation in the public eye and is an attraction force for prospective students. Even if the collaboration does not deliver the expected outcome, training and experience that especially young researchers get during the project can be considered as a gain since they are potential employees of the industry.

In the case of defense sector, advantages for universities out of industry collaborations range from chance to work on cutting-edge issues of national importance and access to specialized research facilities and prospective funding sources, supported considerably by the government.

Firstly, collaborating with a defense firm motivates academicians by exposing them to exciting mission-specific problems and transforming their research outputs to operational applications in the battlefield. University researchers obtain specific topical area expertise by collaborating with defense industry and also opportunity to use this expertise in defense field in civilian disciplines. (Gupta, Sergi, Tran, Nek, & Howieson, 2017) Secondly, collaboration enables universities to access specialized research laboratories that they may not be able to afford or may not be permitted to develop.

2.4.3. Advantages of UIC for Government/Society

Since both sides gain from collaborating, this can be labeled as a symbiotic relationship. In addition, there is a third party who also gains out of it, which is the government. Since gain for government means gain for society, it can be extrapolated that "university-industry collaboration" benefits the whole community.

To be more precise, UIC positively impacts the long-term national economic competitiveness by creating a well-trained workforce which is capable of finding

solutions for most striking challenges that the society is confronting today. These partnerships also enable new technologies to come out in critical areas such as health, defense, manufacturing, agriculture by accelerating discoveries and their applications to societal problems. (Association of Public and Land-Grant Universities, 2020)

Recently, the world has better understood the importance of collaboration that industrial players form with the universities as it has been struggling against COVID-19. Governments have centered their exit strategy from COVID-19 around innovation and subsidizes collaborative projects aiming to develop a vaccine and cure against COVID-19.

According to the New York Times's vaccine tracker, as of August 2020, there were over 165 vaccines in the development stage, most of which were developed through university-industry collaborations. (Stockham, Covid response will reset university-industry links, 2021) The best example for vaccine development through UIC is undoubtfully the partnering of Oxford University with Astra Zeneca. In the frame of the partnership agreement signed on April 2020, the vaccine itself was developed at the University of Oxford, and AstraZeneca would be responsible for the development, manufacturing, and worldwide distribution of the vaccine. (AstraZeneca, 2020) This collaboration attracted considerable attention from all over the world and encouraged other collaborations to be formed.

It is understood from this example that, UIC is not only a tool for financial profit or economic development but it may also be a remedy for the most devastating crisis that societies face.

2.5. Policy Support for UIC

2.5.1. Policy Support for UIC Worldwide

University and industry are completely different structures with different missions, principles, and strategies. Therefore, effective government policies are needed in

order to bring them together and carry out joint R&D projects. This kind of approach can be shown as an example of a developmental state, which is characterized by strict state incentivization and regulation and implemented by East Asian governments. (Caldentey, 2008)

Policy support is also critical for full realization of beforementioned advantages of UIC. Government can interfere in UIC through directly by financing R&D projects, overseeing the universities and managing IPR legislation, and indirectly by providing research infrastructure, intermediary organizations, networking opportunities, and consultancy. (Qin & Mkhitaryan, 2018)

Initial government efforts towards establishing a linkage between university and industry have their origins in the US in 1970s. At those times, there were some barriers towards the utilization of new knowledge discovered in the universities for enhancing the global competitiveness of American firms, especially the ones operating in knowledge-intensive sectors.

In order to overcome those barriers and ensure effective knowledge transfer from universities to private companies, US government passed the Bayh-Dole Act in 1980. This legislation significantly increased the patenting and licensing activities of US universities. Many analysts have claimed that Bayh-Dole was a major accelerator for university-industry knowledge transfer based on the rise of academic patenting and licensing. (Siegel, Waldman, Atwater, & Link, 2003)

By enacting the Cooperative Research Act in 1984, US Congress made another move toward tying public universities and commercial businesses together. Alliances for technology transfer between universities and industry were made easier by this law. (Huang W. , 2011)

Universities began to set up Technology Transfer Offices (TTOs) in order to manage their relations with the industry based on patenting and licensing activities, which eventually accelerate the commercialization of new technologies. In this way, contribution of universities to economic growth ramped up through technological

innovation. (Mowery & Sampat, 2005) Role of TTOs in facilitating UIC will be discussed further in the following chapters.

Public research institutions had entered into the scene in the US with the passage of Stevenson-Wydler Technology Innovation Act in 1980. With this act, government laboratories started to be involved in collaborative R&D projects with university and industry. (Environmental Protection Agency, 2022)

To give an example from another country, Malaysian government introduced the Knowledge Transfer Partnership (KTP) program to enable the transfer of skills and research discoveries through collaborative projects between faculty members and their industry partners. (Salleh & Omar, 2013)

Since government funding support is crucial for accelerating the pace of research commercialization, governments provide targeted funding on UIC throughout their science institutions and agencies. For example, in the US, main providers of university funding are the National Institutes of Health (NIH) and the National Science Foundation (NSF), which stimulate UIC through different schemes and programs such as Industry-University Cooperative Research Centers (IUCRC) Program and the Grant Opportunities for Academic Liaison with Industry (GOALI) Proposals. (Martin-Vega, Seiford, & Senich, 2002)

In the UK, UK Research Institution (UKRI), which is a non-departmental public body sponsored by the Department for Business, Energy and Industrial Strategy, invests heavily in collaborative R&D projects in a cross disciplinary and cross sector manner to incentivize UIC and build an inclusive research and innovation ecosystem. (National Centre for Universities and Business, 2022)

2.5.2. Policy Support for UIC in Turkey

Turkish government encourages UIC through several policy tools implemented by different institutions. It was first mentioned in the first 5-year development plan of the government, which also proposed the foundation of TÜBİTAK. However, the

first concrete step was taken in 2001 via the issuance of Law No. 4691 on Technology Development Zones.

As the country's top authority to draw general policy framework for science and technology, Presidency's Policy Board for Science, Technology, Innovation - BTYPK-revealed a policy document on incentivizing UIC. Accordingly, encouraging UIC via public procurement, scholarship support to graduate students who select his thesis topic among the thesis pool formed by the industry, government support for commercialization of university-industry joint research result are only a few examples of measures taken as part of the government's policy framework. (Presidency's Policy Board for Science, Technology, Innovation - BTYPK, 2019)

Secondly, a Commission of UIC was established under the roof of YÖK (Turkish Council of Higher Education) in order to form policy suggestions to universities, firms, and decisionmaker public authorities for the improvement of UIC in Turkey. On that commission, there were representatives from academia, state, and different industrial sectors such as defense, telecommunications, energy, and consumer electronics. During the meetings of the commission, 51 policy recommendations, some of which also took place in the 11th Development Plan and Economy Reform Package of the Government were formed. Common goal of those recommendations is to support Turkey's technological development and competitive manufacturing through the development of the R&D and innovation ecosystem. (Turkey's Council of Higher Education, 2021)

UIC is financially supported through targeted funding programs of the Scientific and Technological Research Council of Turkey - TÜBİTAK-. It has specific grant programs aiming to commercialize the know-how generated in universities by transferring it to the industry. 1501-Industry R&D Project Support Program, 1503 – Project Markets Grant Program, 1505 - University and Industry Cooperation Grant Program, 1507-SME R&D Start-up Support Program, 1513 - Technology Transfer Offices Grant Program and 1602 – Patent Grant Program, 2244 – Industrial PhD Program are the examples of TÜBİTAK's grant programs, aiming to incentivize UIC in Turkey. These grants meet several expense items of the firms related to personnel,

equipment, software, machinery, scholarships, etc. and have a pre-condition of having a university partner. (TÜBİTAK Grants, 2017)

TÜBİTAK 1501 Industry R&D Project Support Program was designed to support industrial firms from all sizes for R&D projects aiming at developing a new product, improving an existing product, and increasing the efficiency of current manufacturing techniques. The grant covers personnel, travel, material, machinery, consultancy, and R&D service costs. The program was accepting applications of firms in all sizes until recently, but now it is open only for Small and Medium sized enterprises – SMEs-. (TÜBİTAK, 2023)

TÜBİTAK 1505 University and Industry Cooperation Grant Program aims to contribute to the commercialization of technical knowledge in universities and research institutes by transforming it into a product or process innovation in line with industry needs. In this respect, it directly nurtures UIC by supporting the projects with the objective of new product development, improvement of an existing product or process, and development of new manufacturing techniques. The projects to be granted are supposed to contain a research institute (public, private, or a university) and an industrial firm (SME or large enterprise). After a comprehensive evaluation process carried out by TÜBİTAK, selected projects are granted up to TRY 750,000. Between 2011 and 2019, 267 projects out of 715 applications were supported with a 37% success rate. (TTGV, 2020)

1507-SME R&D Start-up Support Program aims to support project-based research, technology development and innovation activities of Small and Medium-sized Enterprises (SMEs).

TÜBİTAK 1602 Grant Program provides support to universities, enterprises, and also individuals for their patent applications in national and international scopes. It is aimed to increase the number of patens by incentivizing researchers to make patent applications for their invention.

TÜBİTAK 2244 – Industrial PhD Fellowship Program to train qualified human resources with a doctorate degree needed in industry through UIC, to encourage the employment of researchers with PhD degrees in industry, and to develop university/research infrastructure-industry cooperation. Cooperation models are university-industry cooperation model, where university and a private sector organization come together and pre-competitive university-industry cooperation model, where university and at least two private sector organizations come together. (TÜBİTAK, 2023)

In order to encourage UIC, Ministry of Industry and Technology offers 75% of the project budget to graduate students who develop a new product or technology through Industry Theses Support Program (SAN-TEZ). Students apply to this program with a partner from industry, which will cover the remaining 25% of Project budget. Besides financial support, this program also provides graduates with employment opportunities for the future.

There are also non-governmental organizations, which operate to enhance the relations between university and industry in Turkey such as University-Industry Collaboration Centers Platform of Turkey -USİMP-.

Turkish defense contractors including ASELSAN frequently apply and is found eligible for TÜBİTAK 1501, 1503, 1505, 1602 programs, as well as SAN-TEZ program of the Ministry.

On the laws and regulations side, Turkey had passed many laws to promote UIC as a part of its science and technology policies. Even if UIC started to take place in Five-Year Development Plans for the first time in 1980s, the first serious policy action taken was the publishing of the Law on Technology Development Zones-TDZs (No. 4691) in 2001. It provides firms located at TDZs with tax incentives for R&D activities. Aim of this law was to facilitate the cooperation between universities, research institutions and private sector, especially the ones operating in high-tech manufacturing industries.

Following this, a number of laws and regulations - Law No. 5746 on Supporting Research and Development Activities, Law No. 6550 Support of Research Infrastructures, and Law No. 6769 Industrial Property Law (IP Code No 6769) aiming to support innovative firms, protect intellectual property and enhance university-industry cooperation were enacted. (OECD, 2021)

In Turkey, public research infrastructures are operated and supported by the Ministry of Industry and Technology under Law 6550 - The Research Infrastructures Law. Performance of those research centers is monitored regularly for the continuation of their funding and number of projects they conduct with industry is one of the key performance indicators. This is also a clear sign of how much importance is attributed to UIC by the government.

IP Code No 6769 regulates trademarks, geographical indications, designs and patent rights. It was prepared by the Turkish Patent and Trademark Office (the "Office") and repealed earlier decree laws relating to intellectual property (IP). The IP Code was approved by Parliament on December 22, 2016, and it went into effect on January 10, 2017, after being published in the Official Gazette. (Erciyas & Alkan, 2017).

Principles of commercialization of knowledge created during collaborative studies are mainly set by this Code, so that complexities disputes can be minimized between university and industry. In this way, it indirectly nurtures IUC by being a guidance for dispute resolution for the most frequently seen barrier to UIC, which will be covered later on.

In order to encourage academicians to conduct more R&D projects with industry, universities may adopt some formal policies such as setting a performance indicator, which measure that academician’s time allocated for industry projects. In Turkey, YÖK annually ranks research universities according to their performances in three main indicators, one of which is “interaction and partnership”. Under this, there exist sub-indicators directly focus on UIC including share of joint scientific publications with industry, share of joint patent filings with industry, amount of public funds for

UIC taken, etc. This can be a clear sign of how much UIC is given importance by policymakers in Turkey.

2.5.3. Policy Support for UIC in Defense Industry

During WW2, use of nuclear power for mass-destruction purposes has dramatically changed governments' science and technology policies in a way that they started to devote more resource for military R&D.

Since countries' self-sufficiency in military technology is considered a matter of national security and technological superiority is considered a key element in achieving defense effectiveness, governments allocate considerable shares of their budgets to military R&D. As the top military spender in the world, constant increase of the share of military R&D spending over total R&D spending of US government can be showed as a proof of increased importance devoted to R&D and innovation in defense industry. (SIPRI, 2022)

In addition, governments attribute considerable attention to defense-related R&D since investment in this field has been considered to affect innovation in the broader civilian economy. Development of civilian technologies such as the Internet, GPS, semiconductors, which had dramatic impacts in the last industrial revolution have their origins in military R&D.

Moreover, some critics argue that military R&D spending of a country is a catalyzer for that country's innovation and productivity of civilian industrial sector. In an analysis among OECD countries, it was shown that 10% rise in military R&D results in a 4% increase in private sector R&D. (Moretti, Steinwender, & Reenen , 2019)
Since faculties with strong ties with the industry are mostly from engineering disciplines, it is not surprising to observe that UIC is mostly formed between R&D-intensive firms and engineering faculties. The same situation is also applicable to defense industry.

Being among the top R&D-intensive sectors, defense industry is supposed to be one of the pioneers in terms of intensity of collaborative R&D too. Knowledge transfer from universities, particularly from engineering departments and departments related to defense technologies is essential for defense industry since fundamental research is devoted considerable importance by defense firms in order to improve their technological capabilities and introduce novel products and systems to maintain their competitiveness.

Defense industry is of particular importance in nations' overall science and technology policy since superiority in global area is parallel to the competitiveness in military and defense fields, which require sustainable science and technology (S&T) capability through its R&D efforts. High quality of defense R&D, which also contribute to technological advancement of other industrial sectors, can be achieved by the support and contribution of all players in the NIS. One of the most frequently used way of this is to take advantage of the research dynamism at the universities by forming effective collaborations with them.

In the US, The Defense Advanced Research Projects Agency (DARPA) of the Department of Defense supports the development of early-stage 'advanced' research at low TRLs for the use of the military. (Budden & Murray, 2019)

In addition, Department of Defense fosters collaboration between academia, industry, and government partners specifically on the fundamental research through to-the-target grants. Its main support programs are Laboratory University Collaboration Initiative -LUCI-, Multidisciplinary University Research Initiative -MURI-, and Defense University Research Instrumentation Program -DURIP-. (Department of Defense, 2022)

In Europe, The European Defense Agency (EDA), founded in 2004, supports EU member states in the development of joint defense capabilities through The European Defense Fund (EDF), which is the European Commission's funding program for defense R&D. This funding program of 8 billion Euros specifically targets

collaborative capability development projects and collaborative defense research for 2021 – 2027. (European Commission, 2020)

In Turkey, the Presidency of Defense Industries encourages defense firms' collaboration with universities through a special cooperation program called "The Researcher Training Program for Defense Industry (SAYP)". The program was launched in 2011 and expanded to cover 31 universities and 35 defense firms as of 2018. ASELSAN and METU are among them. The main objective of the program is to transfer knowledge between the defense industry and academia in a more systematic way, while considering the current technological needs of the defense industry. In frame of the program, subjects of the thesis are determined according to the R&D needs of defense firms and thesis are regarded as research projects. Students are employed by the firms that have signed the protocol and spend a part of their work hours at the university. In this way, defense industry, universities, and the government win all.

2.6. Role of Technology Transfer Offices in UIC

TTOs are intermediary structures between university and industry and actually one of the principal institutions in charge of forming effective and sustainable UICs. They are crucial parts of universities, responsible from commercialization of the scientific knowledge generated at universities by marketing it to the industry. In this way, they accelerate technology-based innovation and entrepreneurship activities in their universities and bring academic inventions to the market for the use of society. A competent TTO motivates and enables academicians in the university to commercialize their inventions, which boost knowledge transfer from university to industry. (Göktepe, 2010)

TTOs construct a portfolio of the research from their university to present firms mainly via project submissions from academicians, which makes research commercialization solely dependent on academicians' motivation to commercialize their research output. TTOs are responsible for carrying out intellectual property applications for university research output and licensing them to external partners.

TTOs also provide information and advice to the private sector on knowledge and technology transfer subjects. In this way, TTOs nurture UIC by benefitting the both sides. They facilitate UIC by finding external collaboration partners for university and keeping firms informed and updated about collaboration opportunities with their universities. They also undertake an important role in the process of signing collaboration and IP sharing agreements for the joint research activities of university and industry. Therefore, it can be said that they are in charge of establishing sustaining collaborations without any disruption.

All research universities should have a well-functioning TTO to make sure of the effective commercialization of scientific knowledge. The most widely used performance measure for the efficiency of TTOs worldwide can be listed as a 1) revenue generated, 2) licenses executed, 3) startups created, 4) invention disclosure forms (IDF) received, and 5) patents issued. (Nag, Gupta, & Turo, 2020)

A study conducted among manufacturing firms located in Istanbul proves the importance of university TTOs for well-functioning UICs. (Schaefer & Schaefer, 2022) Another empirical study conducted among Spanish public universities, it was reported that successful R&D contracts depend on university and TTO characteristics. (Mirabent, Garcia, & Soriano, 2015)

Government support for TTOs is also at great importance for facilitating the creation and commercialization of new technologies. In Turkey, TTOs are supported by the government via the 1513 - Technology Transfer Offices Grant Program of TÜBİTAK. With this program, TÜBİTAK provides grants to TTOs, which create collaboration between universities and private sector. In addition, in the Eleventh Development Plan, it is said that “the organizational structure of TTOs will be improved and supported in a performance-oriented manner”. (Presidency of Strategy and Budget , 2019)

Private companies may also have internal technology transfer teams, in charge of carrying out intellectual property processes for employee inventions, contacting with university TTO s for having a license of a university invention, and all the paperwork

of university collaborations including IPR and non-disclosure agreements between them.

Because of the important role that they have in UIC, technology transfer teams were also interviewed with, in frame of this thesis study.

2.7. Concluding Remarks

In Chapter 2, change in the mission of universities, models and channels of UIC, advantages of UIC in terms of each participant, policy support in global, national, and sectoral scales, and technology transfer mechanisms between university and industry are discussed.

Once they were only education institutions, role of universities changed in a way that they contribute to the society by developing solutions to societal problems through scientific research. Today's prominent technology giants are born through commercialization of the research outputs conducted by universities in the entrepreneurial environment created by universities.

Universities increasingly engage in industry along with their changing missions towards the society. They generally collaborate with educational, entrepreneurial, and research-related purposes. There are number of channels in which academic knowledge is transferred to industrial firms such as collaborative research, conferencing, training, facility sharing, etc. Among them, the most frequently used channel is research contracts, through which firms outsource their R&D for industrial innovation.

UIC can be described as a win-win game for all of its participants, as well as the whole society. Universities are fundamental partners for businesses with the knowledge they generate and new talents they provide at gaining competitive power. On the other hand, industry is the biggest financier of academic research and provider of employment for new graduates. Society benefits the most from UIC since it boosts economic development and enhance the quality of people's lives by creating

a well-trained workforce which is capable of finding solutions to the most striking challenges that society faces. Vaccines and medications developed against COVID-19 through UIC can be shown as the most recent example for the advantages that society gains from UIC.

For these reasons, governments all over the world support and promote UIC through different mechanisms since university and industry are completely different structures with different missions, principles, and strategies and need to be incentivized properly to work in harmony. Government can get on the stage in UIC through several roles such as funder, regulator, infrastructure provider, intermediator, consultant, etc. Initial government efforts for accelerating knowledge transfer from university to industry extent to 1980s in the US with Bayh-Dole Act. In Turkey, BTYPK, Ministry of Industry and Technology, and Turkish Council of Higher Education are main policymakers and implementers in UIC. Under the Ministry, TÜBİTAK funds collaborative research through some goal-oriented grant programs in order to boost commercialization of scientific knowledge.

In this process, university TTOs are indispensable players with their intermediary roles between university and businesses. They facilitate commercialization by matching R&D needs of the industry with the available intellectual property of the academicians. In this way, both parties are able to find the best partners to collaborate in joint R&D projects.

It is understood that universities carry a critical importance for a country's economic development and competitiveness not only through training the future workforce but also creating knowledge that industry gets and transforms to commercial products with advanced technology. Therefore, governments all over the world endeavor to facilitate and accelerate the transfer of knowledge from universities to industrial firms, especially in high-technology producing sectors including defense industry.

Despite all these facilitators, a great number of challenges and problems, which are about to be discussed in Chapter 3, are encountered by university and industry prior, during, and after collaboration.

CHAPTER 3

CHALLENGES IN UNIVERSITY INDUSTRY COLLABORATION

It can be an expectable situation that collaboration of different structures with totally different objectives, working cultures, expectations, and values will be challenging to both of sides. Various stumbling blocks in front of establishing and sustaining effective UICs can cause misunderstandings and suspicion on both sides.

In fact, both sides want to stay connected and accelerate the transformation of research output into commercial products that drive economic growth. However, because of some major organizational differences between them, many obstacles are faced prior to and during the collaborative process. They should be carefully identified before developing strategies and policies in company and country level to nurture UIC environment in order to be able to address them properly.

In this chapter, challenges in UIC available in the literature are reviewed and mainly grouped into four parts; finding the right partner, building and maintaining trust, organizational differences, and intellectual property sharing.

3.1. Barriers About Finding the Right Partner

Finding the right collaboration partner, which can be difficult for both parties is not only critical, but also determinant to the success of the collaboration. Since collaborations are mostly initiated by firms for their projects on a new technology development or solution of a technical problem, finding the right partner mostly constitutes a matter for industry.

Before moving to the literature, it is important to describe what we mean by “right” when we say “finding the right partner”. The right research partner for industry is

probably the one not only with adequate technical capabilities but also with the awareness of industry needs, practical applications, experience of working with the industry and ability to adjust changes in the research environment.

For firms, it may be really costly to find the appropriate university partner with these qualifications to collaborate on a specific research area. According to a study, main reasons behind firms' hesitation to collaborate with universities are lack of knowledge about the research capabilities of the universities. (Kleiner-Schaefer & Schaefer, 2022)

Some firms think that researchers at universities are not as skilled or knowledgeable as their employees in their internal R&D teams. Although this is a prejudgment, it is still constituting a serious barrier while they are searching for collaboration opportunities with universities and research centers. (Temel, 2013)

Even if firms complain more, finding the right collaboration partner is a challenge for universities too. According to a study conducted among academicians of one of the universities in Turkey, most of the academicians thinks that there is a lack of interest in UIC from both sides and it is really difficult to find an industrial partner, which show interest to their area of research. (Kaymaz & Eryiğit, 2011)

TTOs assist academicians on finding an industrial partner/funder for their research or want to license their invention. At such times, technology transfer professionals need to identify not only relevant firms, but the right contacts within those firms to interact.

In a survey conducted among technology transfer professionals about the biggest challenge they face during their role in UIC, 55% of respondents answered as "Finding the right industry partner", followed by "Limited time and resources" with 28%. When the same respondents were also asked about areas of improvement regarding UIC, 94% of them the same answer, which is "better communication around aims and expectations". (Wilkinson, 2021)

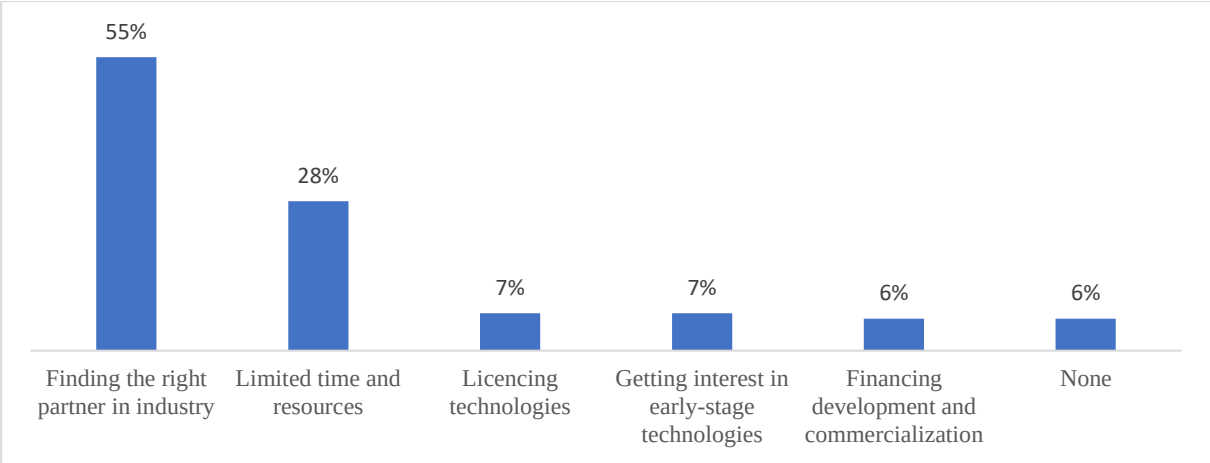

Figure 6 *Biggest Challenges that TTO Professionals Face*

In order to overcome this barrier, proper search strategies such as partner evaluation method with specific criteria can be implemented for the search of a matching partner. (Barnes, Pashby, & Gibbons, 2002)

3.2. Barriers Related to Trust

In bilateral relations, building trust is key to establish and sustain the connection. Interaction between institutions has just the same logic. Misunderstandings as a result of miscommunication might deteriorate trust and become detrimental to a collaboration. Therefore, it can be said that trust is the major issue in front of all research partnerships, no matter which sector or country they are formed. In order to overcome this, open and transparent communication are crucial for building trust and forming a successful collaboration.

A partnership cannot be sustained without making sure of the other party's trustworthiness and honesty. For this reason, lack of trust between firms and universities appears as one of the most frequent barriers in front of forming successful UICs. According to the results of a survey conducted among 200 companies in Turkey, building trust is reported as the major barrier preventing research collaborations between university and industry. (Temel, 2013)

Especially in research partnerships, industry's concerns regarding any breach of confidentiality by the university might deteriorate industry's trust to the it. It is

understandable when it is considered that firms allocate considerable budgets for university research projects and do not want to take the risk of any leakage of research output or facts that differentiate them from their competitors since these can cause serious commercial losses.

In order to overcome this barrier, firms often use non-disclosure agreements (NDAs), which are legally binding contracts that limit the use and disclosure of confidential information to keep breakthroughs out of the eyes of their competitors.

The signing of an NDA between two parties guarantees the protection of all sensitive information regarding the firm and the research carried out. NDAs also prevent the misuse of those information by university side through the means of legal sanctions. Besides the advantages it offers, signing of NDAs might disturb the university side because they think that it

- contradicts with the university's academic research mission,
- limits researchers' academic freedom,
- prevents a possible academic publication that might contribute to universal knowledge accumulation,
- overpromises the protection of research output,
- makes researchers open to legal sanctions. (Office of the Vice Chancellor for Research and Innovation, 2021)

Being so important in collaboration process, NDAs should be carefully prepared and personalized according to the needs of the parties involved. However, the actual problem about NDAs is who are and are not involved in the negotiation process, more than what is negotiated because agreements are sometimes brokered by university administrators, not by the researchers who will work under that agreement. This situation may cause unintended violations of the terms of the NDA and result in legal repercussions. (Lutchen, 2018)

On the other hand, building trust is a hard business that requires a long time and cannot only achieved by the force of written documents. Therefore, awareness and

familiarity of university and industry to each other can also become critical for building sustainable collaborations and can only be achieved by setting an open two-way communication.

Absence of adequate information about the collaboration partner and open communication do not only deteriorate collaborative efforts, but also make the idea of collaboration unappealing to both sides. Worse than that, perception of inadequately skilled collaboration partners increases the barrier to using UICs for innovation. Specifically, perception of inadequately skilled universities from the eyes of firms can lead to considerable collaboration barriers and prevent the emergence of successful UICs from the beginning. (Kleiner-Schaefer & Schaefer, 2022)

It is very important for firms to frankly state the requirements of the project, including the technical requirements and their expectations from the university in their collaborations. Unclearly defined requirements of the project by the industry can cause delayed or under-quality research output and failure of the project in the end. This situation will create dissatisfaction in both sides and discourage them for any future collaboration. Therefore, sustaining a clear communication channel is a big part of building and maintaining trust.

3.3. Differences Between University and Industry

It is difficult task to bring two structures with different objectives and cultures together and expect them working in harmony. In order for this to happen, there should be cognitive similarities and common goals, which will be adequate to motivate both sides and defined prior to the collaboration.

Successful UICs involve lower R&D costs, generate higher levels of innovative output (George et al., 2002) and have a greater capacity to commercialize intellectual property (Etzkowitz, 2003). However, not all UICs achieve their goals because university and industry are characterized by different missions, organizational structures and management systems, as shown in Table 2. (Villani , 2014)

Table 2. *Main Differences Between University and Industry*

		University	Industry
Cultural Differences	Objectives	Basic research for publications	Applied research for profit
	Motivation	Academic career	Competitive advantage
Institutional Differences	Reward System	Number of citations	Financial return
	Organization of Work	High level of freedom	Low level of freedom
Operational Differences	Language Used	Ambiguous and complex	Goal-oriented and concise
	Transparency Rules	Dissemination of research output	Protection of research output

For most of the time, expectations, requirements, and objectives of university and industry differ from each other considerably. Those differences are reflected in their motivation, work culture, profit-orientation, mission and objectives.

According to the results of a survey conducted in five research universities in the US, different stakeholders of UIC have different perspectives and preferences on the output of the joint project. In the same study, main obstacles to efficient UIC were defined as cultural differences, bureaucratic inflexibility, poorly designed reward systems, and ineffective management of university TTOs. (Siegel, Waldman, Atwater, & Link, 2003)

On the other hand, in a PhD dissertation written on the role of trust in university-industry research partnership performance, differences between university and industry that cause conflicts in collaboration are identified as differences in their objectives, cultures, locations, and processes. (Wilcox, 2016)

3.3.1. Differences in Objectives

Firstly, objectives and motivations of university and industry differ in almost all angles. While commercial businesses are largely motivated to acquire knowledge that can be exploited to gain a competitive advantage, universities are primarily driven to produce new knowledge and to educate. (Dasgupta & David, 1994) In the broadest sense, main objective of university is to produce academic publications, while that of industry is to make profit.

Therefore, academicians prefer to conduct basic research in their area of interest and contribute to the universal knowledge accumulation, which contribute to their academic career. Most of the time, obtaining a major research outcome is not enough for businesses. They need those outcomes to be transformed into practical usage in the forms of commercialized products and systems or material improvement in productivity. Therefore, industry seeks after tangible innovations resulting from applied research, which provides them with a competitive edge over their rivals.

The output of collaborative research can be in the form of a technical paper or a source code of a computer program, that needs to have a business application or an innovation in a commercial product or process. At this point, firms might be disappointed with the outcome since not every research output can be directly used in their products or systems and creates an impact on business performance.

According to a study conducted on MIT's 106 collaborative research projects with different industrial firms, it is reported that only 20% of the projects led to major business outcome as firms expect at the beginning such as a solution to a technical problem, a new intellectual property or an improvement on an existing process. (Pertuze, Calder, Greitzer, & Lucas, 2010)

3.3.2. Differences in Cultures

There are considerable differences between work cultures of academy and industry by their nature. Those differences can be in the forms of the organizational rigidities coming from the past, inability to give up from some established practices, degree of risk aversion, weight of bureaucracy, encouragement of creativity, etc. (Barbaroux, 2020)

A study conducted in Turkish aviation industry found that different institutional cultures together with resulting pressures for both sides are main barriers to effective UICs. (Peksatici & Ergun, 2019)

As the clearest difference, academic culture encourages openness; researchers are motivated to share and publish new findings. In contrast, corporate culture is more conventional; they need to monetize their innovations. (Elsevier, 2021)

Therefore, when it comes to transparency rules, academic environment promotes transparency, and researchers are motivated to share their findings and ideas in order to enrich the intellectual accumulation of the society that they live in. Corporate culture, on the other hand, requires a degree of confidentiality since they are profit-oriented structures and need to make money out of their inventions. Because of these differences, they face a number of challenges during their co-working.

Academic world has a long-term vision, in contrast to business world, which mostly focuses on short-term financial objectives. For this reason, firms might think that universities do not fully understand their business goals. In addition, academicians are not used to work in tight deadlines. As a result, firms become dissatisfied with the amount of time that the university responds or completes any required task since delayed responses may result in missed opportunities and revenues.

Being an education-driven and profit-driven entities, university and industry are in fact two worlds with different ways of working, mainly stemmed from the differences between their objectives and cultures. There are also clear differences between their internal processes.

Those differences become more apparent as the bureaucracy and hierarchical structure complicate along with the size of the company. Since SMEs mostly engage in smaller project base, the number of decision-makers is less, and internal processes are simpler than large enterprises, forming collaborations with them seems to be easier for universities. (Peças & Henriques, 2006) However, it is important to note that collaboration with SMEs has its own drawbacks such as R&D capability gaps with universities.

Back to our topic, initiating an R&D collaboration with an external party could require to complete a long approval process along with a considerable administrative burden to large enterprises with structured processes. Especially if the firm is to provide the entire funding for the collaborative project, the approval process might take even a longer time since this kind of decisions can be subject to the approval of senior management. As the process takes longer time than academicians are used to

in their universities, they can lose their motivation towards taking part in an industry research project. It ultimately decreases the success of collaboration.

3.3.3. Differences in Locations

Until now, how proximity/ distantness between cognitive and cultural factors affect UIC has been explained. Nonetheless, physical proximity also matters for an effective co-working of two different structures as it facilitates interactive learning. (Boschma, 2005)

Even if global pandemic has changed how people and organizations communicate and carry out their businesses substantially and they have gained the habit of setting online meetings rather than coming physically together, being geographically near still matters for bilateral relations of organizations.

Undoubtfully, being in the same place and making an eye contact enhances the efficiency of co-working since it eliminates potential misunderstandings that can arise in long-distance interactions such as teleconferences and online meetings. For this reason, it won't be surprising to see that firms prioritize the universities in their regions to collaborate with.

According to the results of a survey conducted among Norwegian firms, interactions at the regional scale dominate those at other geographic scales for UICs, such that 7 out of 10 interactions are formed between universities and firms located in the same region as shown in Figure 7. (Alpaydın & Fitjar, 2020)

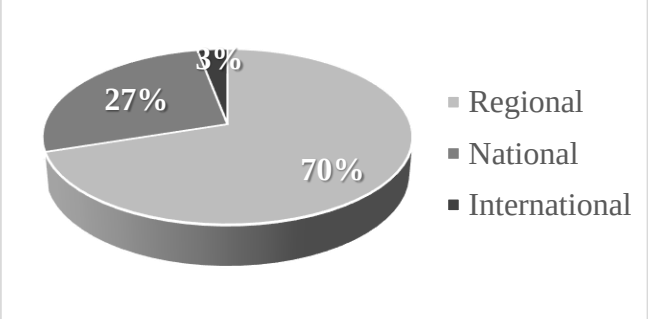

Figure 7 *Distribution of UIC at Geographical Scale*

Being geographically near facilitates collaboration not only because it enables a more effective work-setting. There are other advantages that it provides. Geographical proximity

- enables university and industry researchers to mutually use their research infrastructure more,
- prevents waste of time and resources for travel to make a face-to-face meeting,
- facilitates the transfer of physical documents and other stuff when there is a need.

In conclusion, it can be said that geographical proximity plays an important role in facilitating UICs. When it is looked from the other side, it can be said that differences in locations discourage firms to form a collaboration. Even if they do, it is very probable to face with some sort of delays and misunderstandings during the collaboration. (Iammarino, 2010)

Especially defense industry firms tend to collaborate with the universities geographically near to them more than others because of confidentiality concerns over the projects carried out with the universities. When transfer of a file is needed promptly in one of those projects, they prefer transferring it via physical data storage devices, instead of e-mailing it.

3.4. IP Sharing

During any R&D project, it is likely that an invention or intangible creation to occur. They need to be protected by law in order to reap the full benefit out of them. Inventors should be fully compensated for their creations to encourage further innovation activities. Therefore, effective management of IPR is essential for the success of UICs. Debates over 'who owns the outcome of research?' emerge sooner or later in almost all research partnerships.

Between businesses and universities, IPR concerns may serve as an impassable barrier, especially if the technology is difficult to commercialize. In a survey of

participants from 38 projects funded by US government between 1996—1999, it was concluded that 32% of the survey respondents stated that IP stands as a serious barrier in front of UICs. (Hall, Link, & Scott, 2001)

Firms usually claim the full control over IP if the invention is related to a product or process of the business. In some cases, inventors can be fully or partly compensated for their creations by the employer. It completely depends on firm's policy and approach to the issue. In any case, terms related to IP ownership are pre-defined in employee's work agreement.

However, when the intellectual creation emerges during a collaborative project, IP sharing may become problematic and cause debates between two parties since their objectives regarding intellectual property may differ beyond the ultimate goal of innovation. A common industry approach to ownership of IP rights is "we own what we pay for". Having financed the research project, industry usually claims exclusive ownership of any foreground IP, as well as protecting their background IP at the beginning of the collaboration.

However, they miss an important detail that even if the firm pays for that research, university completes it by using its existing infrastructures and researchers, meaning that there is a serious resource used from university side as well. (Glover & Keiller, 2013)

Universities, on the other hand, are usually reluctant to take part in a collaboration, in which the collaboration partner takes away their IP or force them to license their technology. Prior to partnership, both parties might face with paradox of openness, which refers to the dilemma of uncovering their background IP for the benefit of the current project and protecting the knowledge accumulation of their organization. (Gretsch, Tietze, & Kock, 2020)

Their purpose of using the joint IP also differ in a way that universities mostly want to use the IPRs for their future research, while firms want them for commercial use. Conventions and appreciations of each party over IP also differs such that firms

probably see IP as a source of income while universities see it as an opportunity to disseminate the results of their research. Moreover, academicians might even want to share or publish the research findings even before IP is legally protected.

In order to construct a successful collaboration base, they need to reach an agreement with each other regarding the allocation of IPRs of joint projects. The way that these agreements are made is affected by the legal environment of the country.

Each country's own legal framework on intellectual property determines the sets of rules regarding owning, exercising and protecting all kinds of IPRs. These laws and regulations are applied when a conflict over IP ownership arises among multilateral inventors. As mentioned in Policy Support part, IP Code No 6769, which has been in effect since 2017 defines the legal framework in IP ownership and sharing in Turkey. It is a fact that firms are more assertive on IP ownership because they are profit-driven entities and need to get return on their investment at the end of the day. They conduct R&D projects in order to earn money by using the resulting invention in their own products and maybe licensing it to the third parties.

On the other hand, universities' claim over IPR is totally understandable since license fee is an important source of revenue, which can be used to finance further research and universities can also get additional funding by patenting their inventions. Therefore, capability of a university TTO to license the scientific discoveries in the university is pretty crucial.

A study conducted by the Milken Institute found that for every million dollars spent on research, universities in the US receive higher licensing income than the equivalent amount for universities in Europe, which can indicate that the use of patents by universities in the US is more effective than Europe. (DeVol, Lee, & Ratnatunga, 2017)

Another important point to keep in mind is that a considerable part of patent filings of universities has been registered by industry, especially in the cases of UIC. On

those filings, university researchers only appear as the inventors, not as the patent applicants. (Yang, Hamdan-Livramento, Feuvre, Wunsch-Vincent, & Zhou, 2021)

Universities can commercialize the output of their research only by licensing to the industry or forming an academic spin-off company. For the IPRs in collaborative projects, patent licensing royalty rates need to be determined so that royalty payments to be made to the university.

In university-industry joint inventions, industry is the one that manufacture and sell the commercial product by using the related patent. Therefore, it is supposed to make royalty payment to the university for the use of the joint patent. Typically, royalties are agreed upon between university and industry as a percentage of revenue or profit obtained from the sale of the product, in which the joint patent was utilized.

A fair royalty rate can be identified by comparing previous similar agreements done by others, alignment with industry or internal practice or calculating from scratch. According to the previous industry experiences, methods of comparison with similar deals and industry alignment are not that reliable when one of the parties is not an industrial institution. (Salauze, A Simple Method for Calculating a "Fair" Royalty Rate, 2011)

There is a worldwide rule of thumb of 25% in IPR valuation as a fair royalty rate to charge in for IP assets, which suggests that licensee pays the licensor 25% of the sales income or profit. The reason why 3:4 rule is used is that the licensee takes the majority of the risk involved in developing the product and bringing it to market. However, it is only a rule of thumb and become a starting point to the actual calculation, which takes into account individual circumstances. (Royalty Range, 2021)

The method and amount of payment to be made for the related invention are determined by calculating the value of that invention within the overall value of the product or system sold. Different royalty calculation methods can be combined for the IP evaluation, as illustrated in Figure 8. (Heberden, 2018)

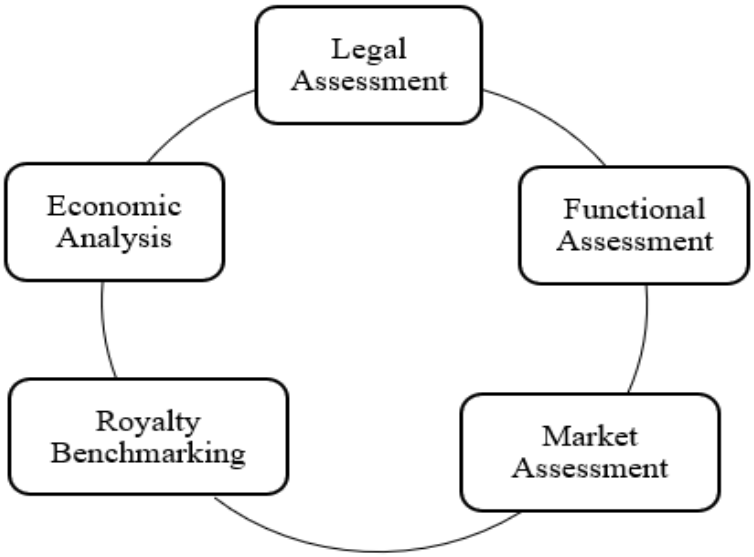

Figure 8 *IP Evaluation Process*

Besides this, several valuation suggestions, which are either qualitative or quantitative are available in the literature. Qualitative methods are preferable at the early stages of the related technology, when information is limited. As the technology develops, quantitative approaches including i) Income, ii) Market, iii) Cost approaches are applied more.

According to a study, the most preferred methods for IP valuation in Turkey are DCF method, the 25% rule and replacement cost method, which can change according to the purpose of valuation and availability of data. (Koc & Yildirim, 2018)

Even if royalty sharing over joint IP is subject to negotiations between university and industry, the real problem emerges when each party thinks that it has had more contribution to the project and claims more share on future revenue from prospective licensing.

According to a study, firms think that university TTOs overestimate the contribution that university researchers bring to the project and claim unrealistic returns on IP. On the other hand, academicians might think that it is not fair that firms claim full ownership over IPRs just because they finance the underlining research. (Hall, Link, & Scott, 2001)

As a general practice, each party has the right to license the joint IPR to the third parties. However, as another problematic area, defense firms might be more conservative about other firms' use of their invention in the cases when national security matters. Therefore, they require university to take a written permission when they consider licensing the joint patent to a third party.

In most of the contract-based UIC projects, sponsored research agreements include special terms related to the determination of background IP and ownership of foreground IP among university and industry. Therefore, once there is a consensus between two parties in the beginning, there won't be any problem during and after the project.

EU Commission recommends research collaborators to clarify all issues related to IPRs prior to the project. For the cases of contract research, it suggests the resulting IP to be owned by the private sector. However, it also warns that if industry partner finance and owns the foreground IP, then university should reserve the right to use that IP for non-profit purposes such as scientific publications. (Managing Collaboration between Research Institutions and Industry – IP Related Collaboration Contracts, 2011)

In general, collaboration partners give rights to each other to use the joint IPR. Countries might have different laws and regulations regarding the joint IPR ownership. For example, while EU laws require to take consent of the other party for commercializing the joint IPR, there is no legal requirement for it in the US. (Managing Collaboration between Research Institutions and Industry – IP Related Collaboration Contracts, 2011)

However, having a clear distinction from the beginning of the collaboration may not always be the case. In those situations, bilateral negotiations between legal departments of each institution can take months or even years. (Glover & Keiller, 2013) As a result, what matters the most at the end of the day is being able to reach a "win-win" deal for the favor of both sides.

3.5. Other Challenges

The other barriers in front of building effective UICs, which are indicated in the literature are summarized in Table 3 below. Their degree of effect over collaborations may show difference according to the type, dynamics, participants, and location of collaboration. Every UIC is not affected in the same way when there is underdeveloped government funding mechanisms or insufficient communication. Some collaborative research projects in specific industries might become more prone to the changes in policy environment compared to the ones in other sectors. For example, policy environment for UICs in a critical sector for national security like defense industry or in a critical sector for human health such as pharmaceutical industry matters a lot more than other sectors.

Table 3. *Top Barriers to Effective UICs*

Insufficient policy support	Science and technology policies of governments should prioritize and encourage UICs.
Poor communication	Poor communication may cause misunderstandings to occur more and deteriorate trust between parties.
Limited capabilities	Perception of under-skilled collaboration partners leads to prejudice and increases barriers for UICs.
Lack of adequate financing	Any research deprived of sufficient financing is convicted to fail because of the shortages it will cause in human resource, machinery, equipment, software, etc.
Unrealistic expectations	Unrealistic expectations of both parties regarding the outcome of cooperation can lead to disappointment and demotivation about the project. (Ćudić, Alešnik, & Hazemali, 2022)

3.6. Challenges in UICs in Defense Industry

While all these barriers underlined so far are valid for defense industry as well, there are some additional barriers coming from the specific nature of defense.

Firstly, defense industry is an area in which knowledge is mostly considered confidential and should be kept within the company. However, biggest motivation of university researchers for conducting an R&D project with industry is to share the research results with their community and contribute to universal knowledge

accumulation by making scientific publications. Therefore, this divergence between perspectives of transparency may cause discrepancies and needs to be taken seriously and dealt with properly for sustainability of collaboration.

Such concerns might cause delays in signing of R&D collaboration contracts between university and industry. The Federal Demonstration Partnership's 2012 Faculty Workload Survey found that the faculty, which perform research pertaining to national security face a heavier administrative burden than those who do not. The potential limitations and administrative burdens associated with defense research can limit the pool of universities and researchers who are able and willing to collaborate, and they can even lead universities to back out of collaborative partnerships. (Gupta, Sergi, Tran, Nek, & Howieson, 2017)

Secondly, development time for a specific military technology at the universities may sometimes come too long for a defense firm to sustain its competitiveness. For this reason, working in collaboration with universities may be subject to limitations regarding timing and deadline of the projects.

Thirdly, universities usually conduct early-stage research between TRL 1-3, which results in creation of new knowledge, while defense industry mostly seeks for applied research between TRL 6 – 9, which is applicable to the current military systems. Therefore, collaboration should actually be realized in between, meaning TRL 4 – 6 and universities need to move away from their focus on pure research and approach to industry applications more. (El-Ferik & Al-Naser, 2021)

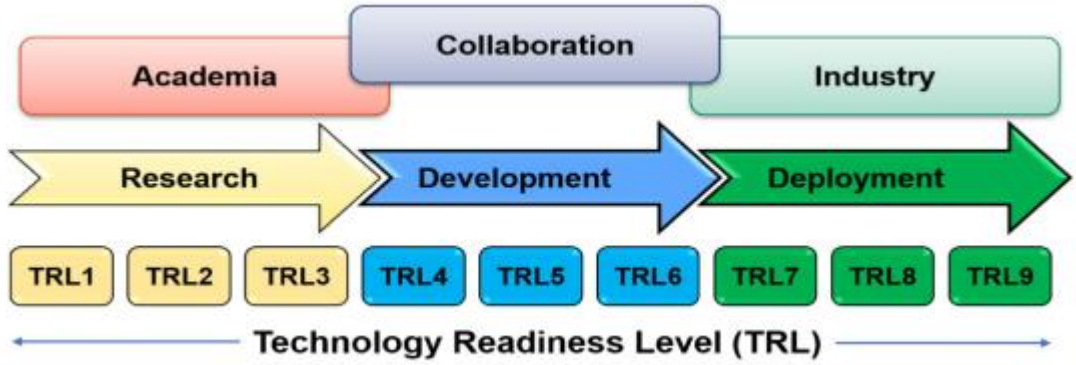

Figure 9. *Right Collaborator & Right Collaboration Time*

Lastly, open communication, which is key to the success of any collaboration may not always be possible in defense industry because of its confidentiality concerns. In the cases when strategy of the firm is not preferred to be shared with third parties including its research partners, outcomes of the research might not able to meet the firm's expectations. Findings of a study supports the phenomenon that the two-way communication should be definitely established to enable both parties to continue collaborations. (Shartinger, Rammer, Fischer, & Fröhlich)

3.7. Concluding Remarks

In Chapter 3, current literature on challenges and barriers in UIC is reviewed.

Even if both parties want to stay connected many obstacles are faced prior to and during the collaborative process because of some major organizational differences between them. They are mainly grouped into four parts; finding the right partner, building and maintaining trust, organizational differences, and intellectual property sharing.

Finding the best research partner is reported as one of the most frequently faced barriers in front of UIC. Especially firms find really costly to find the appropriate university partner with the required qualifications to collaborate on a specific research area. At this point, TTOs steps in and fill that gap between them by conducting commercialization activities. Academicians, on the other hand, are complainant from lack of adequate interest from industry for university research.

Maintaining open and transparent two-way communication are crucial for building trust and forming a successful collaboration. Its absence constitutes serious blockage in front of building a co-creation setting during collaborations. Having correct information about capabilities of the research partner and building expectations accordingly are also found as main prerequisites for building trust between two parties because uncovered expectations discourage them for further engagement with each other. Industry expectedly does not want to initiate a project with a university, if it has doubts about the completion of the project with success or about

confidentiality issues. Signing a non-disclosure agreement between two partners guarantees the protection of all sensitive information regarding the firm and the research carried out. They are frequently used by defense firms because of security concerns caused by potential information leakages.

There are serious differences that stand as a barrier in front of building and sustaining effective UICs. They can be grouped into three as cultural, operational, and institutional differences. Cultural differences include the ones between objectives and motivations. In the broadest sense, main objective of university is to produce academic publications, while that of industry is to make profit. Firms tend to be disappointed with the research outcome when they are not directly used in their products or systems and academicians can be disappointed when they are treated as sub-contractor companies by industry.

In the literature, geographical proximity is also found as an effective motivator and facilitator for both parties to interact with one another. A study conducted in Norway revealed that 7 out of 10 interactions are formed between universities and firms located in the same region. (Alpaydın & Fitjar, 2020)

When it comes to IPR sharing, it seems to be an impassable barrier, especially if the technology is difficult to commercialize. Industry is more assertive on IP ownership because they are profit-driven entities, while license fee is an important source of revenue for universities. In order to prevent disputes, research partners should clarify all conditions and rights over foreground IP. Industry thinks that academicians overestimate their contribution to the project, as academicians find industry's demand of having full ownership of the joint IPR.

There are other challenges such as insufficient policy support, unnecessary bureaucratic burden, lack of adequate financing, lack of capabilities in the literature. In defense sector, administrative burden might be heavier than other firms, development times for military technologies might be longer.

CHAPTER 4

METHODOLOGY

This section describes the methodology and organization of the study.

Case study has become more prevalent in UIC studies in recent years, helping to provide a better understanding about its multidimensional process. Therefore, this thesis study is based on a case study of R&D collaborations between ASELSAN and METU and aims to investigate challenges in university – defense industry collaborations and propose policy and strategy recommendations to the government and collaborators.

The human-centric nature of collaboration makes the use of qualitative data collection a necessary instrument to have meaningful insights since it is the best way to uncover valuable insight. Therefore, qualitative analysis method is chosen when the course of the study is considered.

In this qualitative research, interview method is used to collect qualitative data. Interviews were prepared based on the take-aways from the literature review.

4.1. Literature Review

A comprehensive literature research was conducted and data collected through the interviews was compared with the findings in the literature. The search for relevant papers, articles, proceedings and reviews was carried out using Google Scholar, Research Gate, Scopus, and other journal websites. Case studies from defense industry of variable countries and best-practices of UIC were reviewed. Literature was reviewed in three parts.

First part states the theoretical background and provides information about the sector and the company. In order to construct a solid base for the study, literature review is started with a brief description of defense sector, its current situation in global and national areas, R&D and innovation activities in the sector and continued with the introductory information about the company and the university as well as their UIC practices.

Second part provides an overall analysis on how notion of UIC emerged with the evolving mission of universities, what role governments play, which channels are available for collaboration, which policy tools are used to support UIC in the world, in Turkey, and in defense sector and what role TTOs play in facilitating the collaborations.

Third part sheds light on the challenges and barriers related to forming and sustaining effective UICs. Then, most frequently mentioned barriers were grouped into five parts to enable readers to have a better understanding of the subject.

4.2. Data Collection

In this study, data was collected through in-depth semi-structured interviews with UIC participants from ASELSAN and METU.

The rationale behind selecting interview method for the study is because it is an excellent way to gather detailed information on personal experience of the participants and reflect their insights on the topic. Data collection through interview allows researchers to adjust following questions according to the responses or formulate follow-up questions on the points emerge during the conversation. It also provides researchers with the opportunity to interrogate motivations behind the respondents' answers to the questions.

Before deciding on the method, disadvantages and advantages of the interview methods are searched in detail. As a result, semi-structured interview method was

decided since it includes a blend of closed- and open-ended questions, accompanied by follow-up why or how questions. (Newcomer, Hatry, & Wholey, 2015)

In addition, semi-structured interviews provide participants with enough freedom to express their views and experiences about the collaborations they involved in and encourages two-way communication. Multiple choice and yes/no questions were used to make sense out of the answers and reach meaningful results. Multiple choice and yes/no questions were mostly followed by open-ended questions in order to gather a deeper insight about participants' thoughts, have an understanding on the reasons behind their answers and learn their experiences they want to share about the subject. Therefore, type of information generated out of the interviews might differ between participants. Interviews lasted for about half an hour each.

In this qualitative research, individual experience of the participants to UIC from both sides is important for the data collected. The addition of them to the framework enhances its validity, and provides necessary insights for policy recommendations.

ASELSAN and METU have been collaborating since the establishment of ASELSAN in many different ways. As mentioned previously, contract-base collaborative R&D projects and thesis studies of employees, which have been supervised by METU academicians were focused in this study. In order to make correct and unbiased analysis of these collaboration channels, interface mechanisms dealing with commercialization of knowledge and technology transfer activities on university and industry sides were deeply analyzed as well.

23 interviews from industry side and 18 interviews from university side were conducted in frame of the research.

For this purpose, on industry side, one-on-one online meetings with project managers who involved in contracted university projects, employees who completed their graduate studies while working, and technology transfer teams at ASELSAN; on university side, one-on-one online meetings with academicians who involved in contracted industry projects, thesis advisors of ASELSAN employees, and

employees in university TTO were organized. The findings from the literature review and the results from this qualitative research collaboration were analyzed.

Interviewees profile at ASELSAN consists of

- R&D personnel, who took part at least one collaborative project with METU
- Employees, who completed his/her post-graduate study at METU while he/she was working at ASELSAN
- Employees, who work at technology transfer teams.

10 projects from contract R&D projects funded either by ASELSAN or a TÜBİTAK funding mechanism and 10 projects from graduate thesis studies of ASELSAN employees were included in the sample according to certain criteria. The contract projects are selected by looking whether they get TÜBİTAK grant and the ones that granted were selected. While projects were being determined, at least one project from each business unit conducted between 2017 and 2022 were selected, since it is easier to reach information about more recent projects than older ones. Our project sample is representative with its inclusiveness of all business units and all types of projects (contract projects, TEYDEB projects, self-financed projects, thesis projects) and covers almost more than 10% of the projects matching with our criteria.

Almost all interviewees were engineers with more than 10 years of R&D experience, especially on collaborative projects. Interviewees from technology transfer teams were also experienced in carrying out processes related to the signature of NDA, R&D project contracts, and managing IPR sharing issues with universities. The importance of the collaboration experience of the participants in this qualitative research proves the validity of the data gathered.

With the same logic, interviewees profile at METU consists of

- Academicians, who took part at least one collaborative project with ASELSAN
- Thesis advisors, who were part of a thesis study of an employee at ASELSAN
- Professionals, who work at METU TTO.

4.3. Design of the Interview Questions

Interview questions relating to the conceptual framework of the thesis were prepared by using the variables that make the research align with its objectives. The questions are designed for analyzing the participants' perception of the other party and their impression regarding the collaborations they took part. With this intention, open-ended questions were combined with close-ended questions, which enable a more precise and classifiable answers and enhance the possibility of generating a more comprehensive database for analysis.

Questions aiming to explore the reasons behind the conflicts that arise before and during the collaboration and their solution offers for them were also asked to the participants. Some follow-up questions, which were not planned but emerged during the interview were asked to the participants, which enabled a more insightful analysis. The questions were pilot-tested with a project manager from ASELSAN in order to make them more appealing and purposeful.

In the beginning of the interview, participants were informed about the topic and framework of the thesis. Interviews were started with demographic questions in order to have an insight on their age, gender, graduation degree, length of service, and title. In the rest of the interview, there were questions about general perception of university and industry about collaborating with each other, challenges they face in those collaborations, encouraging and discouraging factors for collaboration, and areas for improvement.

Semi-structured interviews, each lasted between half an hour and an hour, were conducted in participants' native language, Turkish, via Skype or Zoom. During the interviews, interview form was shared with the participants through screen sharing so that they can answer the questions more easily by seeing them. Their answers were not recorded but noted on the forms during the interview because of confidentiality concerns.

Questions to the participants of university and industry are slightly different from each other with the aim of gathering targeted answers. Questions also differ within

university and industry according to roles and backgrounds of the participants, as shown in Table 4.

Table 4. *Groups of Interviewees from University and Industry*

Interviewee Groups in Industry	
Group 1	R&D engineers, who engaged in METU in at least one contract-base project
Group 2	R&D engineers, who got their MS or PhD degrees at METU
Group 3	TTO professionals, who took active role in relations with METU
Interviewee Groups in University	
Group 1	Academicians, who worked in a contract-base project of ASELSAN
Group 2	Academicians, who carried out advisory of a MS or PhD thesis from ASELSAN
Group 3	TTO professionals, who took active role in relations with ASELSAN

As a result, six different interview forms were prepared for three different interviewee profiles in both university and industry, which can be seen in Appendix B.

4.3.1. Industry Side

On industry side, 23 employees at ASELSAN from different backgrounds and with different levels of experience were interviewed.

Firstly, R&D engineers from design, production, and project management departments, who engaged in METU in at least one contract-base project were interviewed. The questions are intended to identify the following points:

- Their experience regarding university interactions,
- The significance they attach to university collaborations,
- The availability of budget for university projects,
- The way and degree of difficulty of finding the right academic partner,
- Their assessment about how factors highlighted in the literature affect UIC,
- Their expectations from their academic partners and their success at meeting them,
- Their assessment on the performance of research teams at the university

- The most frequent challenges they encounter during university collaborations and how they overcome them
- Their assessment about how factors underlined in the literature constitute a problem in UIC
- Their thoughts about the policies of their company in terms of encouraging university collaborations
- Their opinion about the incentives provided by the government for UIC
- Their suggestions for improving the effectiveness of collaborative projects

Secondly, R&D engineers who carried out their post-graduate studies at METU while they were working at ASELSAN were interviewed. The questions are intended to identify;

- The contribution of their studies to their work
- Attitude and policies of the company at motivating employees to continue their academic career
- their communication with their advisors
- the problems they face with the university side during the sharing of the IP, which came out during the thesis study

Thirdly, engineers and lawyers working in the field of technology transfer were interviewed. The questions are intended to identify;

- The most frequent problems they encounter during IPR sharing in contract-base projects and thesis studies with the university
- The method they use to determine royalty shares of each party
- The effectiveness of the negotiations they with the university TTO
- Their opinions about the current legal framework related to IPR

4.3.2. University Side

On university side, 18 academicians at the Middle East Technical University, who took part in collaborative studies with ASELSAN were interviewed.

Firstly, academicians from different departments, who took part in at least one contract-base project of ASELSAN were interviewed on Zoom. The questions aim to shed light on almost the same points as the questions of industry, but this time from academic perspective. They are intended to identify;

- Their experience regarding interactions with industry,
- The significance they attach to UICs,
- Their assessment about how factors highlighted in the literature affect the success of UICs,
- Their expectations from their industry partners and their success at meeting them,
- Their assessment on their contribution to the products/systems of the industry
- The most frequent challenges they encounter during university collaborations and how they overcome them
- Their assessment about how factors underlined in the literature constitute a problem in UIC
- Their thoughts about the policies of their university in terms of encouraging academicians for industry projects
- Their opinion about the incentives provided by the government for UIC
- Their suggestions for improving the effectiveness of collaborative projects

Secondly, advisors of MS and PhD thesis studies of ASELSAN employees were interviewed to identify

- Their opinion about the selection of thesis topics according to the needs of industry
- Their assessment about the academic contribution of thesis
- their communication with their thesis students
- the problems they face with the industry side during the sharing of the IP, which came out during the thesis study

Thirdly, the specialists at industry collaborations unit and the director of the university TTO were interviewed to reflect their views on:

- The most frequent problems they encounter during IPR sharing in contract-base projects and thesis studies with industry

- Their expectations from their counterparts in industry
- The effectiveness of the negotiations they with the industry
- Their opinions about the current legal framework related to IPR

4.4. Data Analysis and Report

Answers to the interview questions were analyzed to validate what the literature says about university – defense industry collaborations and add more to which are available in the current literature.

Methods for qualitative data analysis are deeply searched in order to find and use the best fit for analyzing the findings of this research. There are mainly five data analysis methods used in qualitative research; which are content analysis, thematic analysis, narrative analysis, grounded theory analysis, and discourse analysis. Even though plenty of software packages are available, it is not a prerequisite for undertaking qualitative analysis. (Noble & Smith, 2014)

In this study, content analysis method was applied to the notes taken for the answers of open-ended questions in the interviews. Content analysis is a qualitative analysis method used to identify the presence and repetition of certain words and concepts in a written context gathered through any of qualitative data collection techniques including interviews. (Bengtsson, 2016) The rationale behind choosing this method is because some of the interview questions, especially the open-ended ones aim to learn participants' opinions and stories that made them have those opinions.

In order to analyze the qualitative data by using content analysis, I coded it into manageable code categories for analysis. Coding is a set of rules to analyze the content in a given text and examines the content in terms of frequency, direction, intensity, and space. Qualitative data gathered from open-ended questions was coded manually in order to identify the patterns, emotions, and point of views. The analysis can be realized as shown in Figure 9. (Content Analysis, 2023)

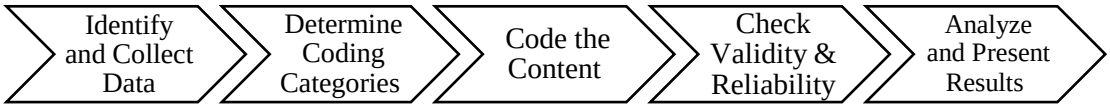

Figure 10 *Steps in Content Analysis Method*

In terms of reliability, 80% is an acceptable margin since coding errors cannot be completely eliminated but they can only be minimized when human nature of researchers is considered. (Content Analysis, 2023)

On the other hand, responses to the close-ended questions in the interviews were analyzed on Excel and results were illustrated in charts.

4.5. Concluding Remarks

Chapter 4 is about the methodology of the study. It also covers the steps followed during the study. Qualitative analysis is preferred because of the human-centric nature of collaboration. First of all, A comprehensive literature research was conducted. Data collected through semi-structured interviews with UIC participants from ASELSAN and METU. Interview questions include open-ended questions beside multiple choice and yes/no questions to get a deeper insight about respondents' experience on UIC. 23 interviews from industry side and 18 interviews from university side were conducted in frame of the research.

On industry side, 23 employees at ASELSAN from different backgrounds and with different levels of experience were interviewed. Interviewee profile at ASELSAN consists of R&D personnel, who took part at least one collaborative project with METU, employees, who completed his/her post-graduate study at METU while he/she was working at ASELSAN, employees, who work at technology transfer teams.

18 academicians at the Middle East Technical University, who took part in collaborative studies with ASELSAN were interviewed. Interviewee profile at METU consists of the academicians, who worked in a contract-base project of

ASELSAN, who carried out advisory of a MS or PhD thesis from ASELSAN, and employees at the university TTO.

The questions aim to understand their assessment on the performance of their research partners in collaborative projects, as well as the problems they face, areas of improvement they observe, and their expectations from their partners.

For the analysis of the qualitative data gathered, content analysis method is applied to the notes taken for the answers of open-ended questions in the interviews, which aim to investigate the challenges that UIC participants face and their expectations and suggestions for the solution of those problems and compare them with the literature.

CHAPTER 5

ANALYSIS OF FINDINGS AND DISCUSSION

Data collected through interviews from university and industry sides was firstly analyzed separately. Thereafter, the findings were combined in order to draw meaningful results.

5.1. Analysis of the Interviews with Industry

5.1.1. Demographic Analysis

Before proceeding to the interview, major demographic questions were asked to the participants in order to have a deeper understanding of their profile.

According to the results, descriptive characterization of the collaboration partners in industry are presented in Table 5. These figures reflect information about all of the 24 interviewees in industry side.

According to the results, majority of respondents were male (83%) and engineer (96%), which is an expected result when the characteristics of defense sector are considered. 74% of the respondents were between the ages of 30 and 40, which is parallel with their titles, 39% being lead engineers with 10-20 years of total experience. Our interviewees have high academic standings that, only 9% of them have Bachelor's degree. 61% of them have Master's degree and 30% of them have PhD degree.

Table 5 *Demographic Characteristics of Interviewees in Industry*

	Frequency	Percent
Age		
Below 30	2	9%
30-40	17	74%
40-50	2	9%
Above 50	2	9%
Gender		
Male	19	83%
Female	4	17%
Department of Graduation		
Engineering	22	96%
Basic Sciences	0	0%
Social Sciences	1	4%
Degree of Graduation		
Bachelor's Degree	2	9%
Master's Degree	14	61%
PhD Degree	7	30%
Other	0	0%
Duration of Total Employment		
Below 5	3	13%
5-10 years	3	13%
10-20 years	14	61%
Above 20	3	13%
Duration of Employment at ASELSAN		
Below 5	6	26%
5-10 years	5	22%
10-15 years	9	39%
Above 15	3	13%
Department of Work		
Design	11	48%
Project Management	4	17%
Production	1	4%
Other	7	30%
Title		
Assistant Specialist I-II / Engineer I-II	3	13%
Specialist I-II / Expert Engineer I-II	4	17%
Sr. Specialist / Sr. Expert Engineer	3	13%
Leader / Lead Engineer	9	39%
Sr. Leader / Sr. Lead Engineer	3	13%
Manager	1	4%
Director	0	0%

When it comes to department of work, distribution of the respondents is intentionally determined, since employees who take place in university collaborations mostly work at design and project management departments. Design engineers are the ones that directly and actively work with the university research teams on technical aspects of the projects. Project managers usually deal with planning and monitoring project activities and make sure that the project proceeds as planned. The option "other" includes the employees working in the field of technology transfer. They are working in engineering management teams of the business units, legal affairs directorate, and technology & innovation management directorate.

5.1.2. Qualitative Analysis

All interviews conducted in frame of the research aim to investigate how important is UIC for each party, their expectations from each other, barriers they face during UICs, and their suggestions to overcome those barriers. Findings of the interviews will be discussed in three parts, since the questions and findings of each group shown in Table 4 are different.

5.1.2.1. Analysis of Group 1

Industry – Group 1 consists of R&D engineers, who engage in METU in at least one contract-base project in technical or project management roles.

1. **UIC Involvement:** 80% of the respondents have taken place more than three collaborative activities with a university so far. The type of activity that they conduct with universities most are contract-based research, joint research, joint IP -patent or utility model-, and joint scientific publication respectively. In addition, 90% of respondents have involved in a university project, which was funded by TÜBİTAK.

2. **Perception of UIC:** Industry perceives transfer of knowledge from universities as an important part of their work. According to the results, half of the participants sees knowledge generated in universities as "important"

for industry, while the other half sees it as “very important”. 60% of the participants evaluate the contribution of university research output to their company projects considerably good and find them directly applicable to the algorithms and systems they develop in industry.

3. Respondents were asked to state that to what extent do the factors mentioned in the literature have an impact on success of collaborative research activities in their opinions. Responses were given on four-point likert scale as shown in Table 6.

Table 6. *Evaluations of the Industry on the Factors Impacting UIC*

Most effective factors on collaboration mentioned in the literature	**Never (%)**	**Sometimes (%)**	**Usually (%)**	**Always (%)**
Shared mission and objectives	-	10	80	10
Building trust	-	-	60	40
Setting clear objectives	-	10	40	50
Open communication	-	10	60	30
Perception of inadequately skilled collaboration partners	20	40	20	20
Time and resource limitations	-	20	50	30

According to the results, it can be concluded that the most effective factors on UIC in the literature except perception of inadequately skilled collaboration partners were seen as effective and determinant by our respondents as well.

4. Our findings validate which is found in the literature that, R&D collaborations between university and industry are mostly formed for the development of technologies between the maturity level TRL 3 – TRL 6. In addition, even if the number is lower, there are also UIC projects, which are basic research, corresponding to the technology maturity level between TRL 1 – TRL 3 and system test and qualification studies, corresponding to TRL 7 – TRL 9.

5. **Finding the Right Academic Partner:** It can be said that finding the right academic partner, which is reported as a serious barrier in front of building

effective UICs in the literature is also reported as a barrier in our case study. 70% of the participants stated that they had difficulties finding the academic partner to work with for their projects. They said that the main reason for that is because academicians focus on making academic publications in their fields instead of following the industry applications. As a result, they are mostly not capable of creating incremental innovations, which is demanded by the industry. It was also reported that finding the right academic partner for the projects started to get harder since experienced academicians retire and antecedents are not experienced as they were. In order to overcome this difficulty, a respondent suggested that;

Inside ASELSAN's network, it would be very useful to have an academic information portal, which includes a database about which academicians work in which areas and enables employees to share their experience and assessments regarding the performances of academicians, they have worked with in their university projects. In this way, we would have an idea about the academicians prior to projects. If a colleague from a different department had a problem with an academician that I plan to collaborate, I would know it beforehand and reconsider my decision accordingly.

Personal connections are reported as the most frequently used way of finding the academician to collaborate for their research projects. Those connections can be the ones, who previously took part in a project of other teams at ASELSAN, who were their lecturer from undergraduate times or who were thesis advisors of a colleague working in their project team.

A respondent remarked that;

Besides personal connections, workshops organized by R&D collaborations teams with the academicians studying on ASELSAN's focused technology areas are pretty useful for matching us with the right contacts in academia.

6. **Government Policy Support:** Respondents stated that their projects were funded via TÜBİTAK grant programs including 1501, 1505, 1003 and SAN-

TEZ. 80% of the respondents had at least one difficulty in the process of getting TÜBİTAK grant. The most frequently encountered problem is reported as delays in grant payments. Majority of the respondents stated that this situation caused delays in project timelines and disruptions in project deliveries. They said that if ASELSAN had not become the main financier of the projects, delays would have not been compensated.

Some respondents stated that application process is too long and too much information is required on project proposals, which discourages researchers from applying for a grant. As a matter of fact, one respondent underlined that;

For most of the time, the amount of funding is not worth to the time spent on filling the application forms to have it.

They also reported that some of the mediators assigned to the projects by TÜBİTAK do not work in harmony with the project partners in university and industry. Regarding the amount of the grant, none of them think that it is enough for covering the expenses related to projects.

Moreover, 70% of the respondents think that the amount of public research grants is not enough to motivate the parties to collaborate. In this regard, one of the respondents remarked that;

Supports will be more efficient if the number of grant programs is decreased and the amount of grant for each program is increased. Certain technology areas should be prioritized and supports should be focused in those areas.

Another respondent suggested that;

Special grant programs for basic research should be launched for the applications of large enterprises, since basic research paves the way for enhanced industrial innovation in high-tech sectors.

7. **Geographical Proximity:** All of the participants think that being geographically near to the university facilitates and enhances the effectiveness of the collaboration. 80% of the respondents think that ASELSAN takes advantage of the research potential in Ankara by forming close relationships with them. A respondent explained his answer with an example that;

   We have conducted two projects with the same academician, first one was through online meetings and the second one was through face-to-face meetings. We gained more effective results in the second project, in which we had a chance to discuss our ideas in person and demonstrate our calculations to each other on the white board.

   Other advantages of being geographically near to university partners were stated as the prevention of time losses caused by unnecessary mailing traffic.

   They also think that having close relations with the universities in Ankara is also a necessity for attracting the skilled workforce to the company.

8. **Expectations of the Industry:** Respondents were asked to rank their 3 most important expectations from universities regarding research collaborations. The most frequently mentioned expectation was related to the delivery of research output in accordance with the pre-determined deadlines in frame of project plans. Secondly, respondents stated that they expect research outcome coming from universities to be more appealing to the practical needs of industry, instead of only theoretical results without any applicability. Thirdly, they expect academicians to be real experts, who closely follow latest developments in their own fields. The other expectations were stated as research outcome to become cost-effective and financially feasible solutions and proper delivery and documentation of research outcome in right formats. 70% of the respondents thinks that university side meets their expectations.

9. **Evaluation of the Collaboration Partner:** 70% of the respondents evaluated the performance of university research teams at expected level, while 20%

thinks that it is above their expectations and 10% thinks that it is under their expectations in terms of technical know-how and competence. General assessment of industry regarding the performance of university research teams at meeting the requirements of the projects is shown in Figure 10.

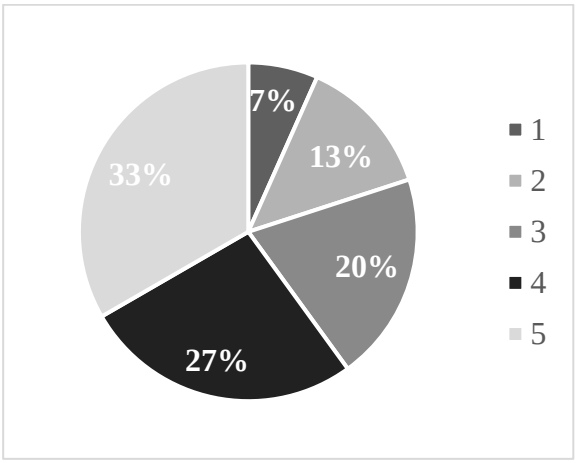

Figure 11. *Assessment of the Industry about the Performance of University*

When interviewees were asked whether the academicians worked for the project themselves or assigned the tasks to his assistants, they answered it as "both". They said that it was ok that the research assistants to involve in industry projects, but they definitely expect academicians to check the results before sending it to the industry side. They added that some academicians completely leave the projects to the assistants and this decreases the quality and reliability of the research outcomes. One respondent pointed out that,

Sometimes, outcomes might be delivered to us without academician's check. In these situations, close follow-up and proper feedback of the technical project teams in industry become critical. Otherwise, project can proceed with mistakes and result in unwanted delays.

10. **Communication**: When respondents were asked about their communication with their research partners in the university, all of them stated that they sustain a clear and healthy two-way communication with them until the project ends. One respondent stated that;

We have an idea about the working styles of many academicians and we pay attention to choose the ones that we can form an effective communication.

Majority (90%) of them also believe that they precisely and clearly share their expectations from the university through official documents such as project description documents, technical requirement documents, project plans, etc. On project plans, deadlines and all other requirements regarding the delivery of outcomes are clearly indicated. Therefore, they stated that there should not be any misunderstandings or delays regarding the project outcomes.

11. **Support of University Administration**: 60% of the respondents think that academicians have difficulties at allocating enough time for industry projects. Half of the respondents said that academicians are demotivated because of the fee cut applied by the university on the funds provided by the industry for the research projects, while the other half believes that academicians give their price offers by considering that those fee cuts. As a result, 50% of the respondents stated that they find university administration's approach to industry collaborations supportive, while 20% of the respondents find it unsupportive.

12. **Support of Industry:** 60% of the respondents think that vision of senior management and R&D policies of the company are supportive for university collaborations. While a respondent stated that;

    Our company is one of the leading companies in the country in terms of working with universities. It allocates considerable budgets for university projects and supports its employees to continue their graduate studies as they are working.

    However, another respondent complaint that;

    Even if the annual budget allocated for R&D projects is high and having at least one university partner is a requirement to get funding for the projects,

the conditions for getting approval are too hard to meet. Too much detail about the project is required in the first place, which discourage us to initiate a project. Therefore, I believe that approval process for self-funded R&D projects should be simplified. In addition, there is usually not enough time remained for university projects because of the workload.

50% of the respondents believe that their collaboration partners in academia find the payments made for the projects satisfactory. 50% of the respondents find research infrastructures of the company is adequate and equipped enough for using in university projects.

13. **Source of Problems:** Respondents were informed about the most underlined factors in the literature that cause a problem in UICs and asked to assess the frequency of each of them according their own experience. The results are shown in Table 7. Accordingly, some of the factors highlighted in the literature were also evaluated as potential sources for problem in their collaborations such as financial constraints, violation of deadlines, bureaucratic burdens, and sharing of IPR. On the other hand, other factors like communication failures, know-how gaps, cultural differences, unrealistic and unclear expectations were not perceived as major problem sources by our interviewees.

Table 7 *Potential Problem Sources in UICs*

Potential problem sources in UICs	**Never (%)**	**Sometimes (%)**	**Usually (%)**	**Always (%)**
Financial constraints	30	20	50	0
Communication failures	30	40	10	20
Violation of deadlines	10	40	30	20
Bureaucratic burdens	-	40	40	20
Know-how gaps	50	30	10	10
Cultural differences	50	50	-	-
Unrealistic financial expectations	40	40	20	-
IPR Sharing	20	20	30	30
Unclear expectations	20	60	20	-

When respondents were asked about which side was more responsible from the problems arising in UIC, 60% of them said that university side was more responsible, 30% of them said that university and industry were equally responsible. 50% of the respondents stated that those problems were solved out by the efforts of university and industry together.

14. **IPR Sharing:** Half of the respondents stated that they had been involved in a UIC project, which resulted in a joint invention and official patent applications were made for 50% of these projects. Majority of them reported that they did not have any trouble or problem with the university side regarding the sharing of income and expenses related to the IPR because they were explicitly stated in the agreement. At this point, a respondent stated that;

    In contract-based R&D projects, ASELSAN usually claims and gets the full control over any resulting IP. Some academicians reflect this to their price offers by giving up from IPR in the first place.

15. **Confidentiality**: When the respondents were asked if they have any problems regarding the signing of NDA, half of them answered it as yes and when they were asked whether they had any doubt regarding the violation of NDA terms by the university, 70% of them answered it as No. However, remaining 30% had serious challenges. For example, a respondent gave an example that;

    As far as we heard from his students, our project partner in the university used the outcomes of our joint research in his lecture notes, which is completely contradictory with the confidentiality terms in our NDA.

    Another respondent remarked that;

    I personally observed that the academician connected to the Internet through the project lap-top, which he is not allowed to do for the projects above a certain level of confidentiality.

    It can be inferred these statements that, academicians might not be aware of the terms of the NDA, most probably because they are not included in the negotiation process between university TTO and industry.

16. **Trust**: 70% of the respondents stated that they did not have any trust issue with their collaboration partners in the university but they added that academicians are very enthusiastic about disseminating the outcomes of the joint research through scientific publications, which is very normal since one of the mission of universities is contribute to universal knowledge accumulation. On these occasions, we just want them to ask for the approval of ASELSAN before making any publication.

17. **Other Difficulties:** When the respondents were asked about the main challenges and barriers, they face in university collaborations in addition to what they were asked during the interview, they gave these answers:
    - Know-how losses because of the changes in the academician's research team (brain drain)
    - Long-lasting processes within the company, especially the ones related to procurement (price offers are required to be on the R&D project proposals for approval process)
    - Too demanding and discouraging approval process for initiating self-financed R&D projects
    - Long-lasting project negotiation processes caused by the discussions especially on the terms of IPR sharing
    - Necessity of close follow-up and reminding the deadlines to the university side in order to get the research deliveries on time
    - Failure of university research teams on meeting the expectations of the industry side regarding the TRLs
    - Lack of adequate number of researchers for certain technology areas in defense
    - Too much work load of employees that leaves almost no time for conducting university projects or writing a project for TEYDEB grants
    - Lack of sense of responsibility in some academicians
    - Some academicians' inability to transform their theoretical knowledge into practical knowledge
    - Non-sensitivity of some academicians for confidentiality rules

- Problems related to documentation, delivery of research outcomes in the formats different than what is required by the industry
- Delays in project timelines, caused by academicians' lack of experience in industrial applications

5.1.2.2. Analysis of Group 2

In Group 2, employees who collaborate with METU academicians for their thesis studies were interviewed. The findings were listed below:

1. **Determination of the Thesis Topic:** When the respondents were asked how they determined their thesis topics, we got different answers. We saw that some of the thesis topics were proposed by the university, while some of them were proposed by the firm. In both cases, a consensus was reached in the end.

   A respondent said; "*There was a need for a new design in one of our ongoing product development projects and my manager asked me to study it in my master thesis. Since the subject was match with research areas of my supervisor, I chose that design as my thesis topic.*"

   Another one said; "*My supervisor proposed me a subject, which is one of his areas of interest. Then, I asked for my manager's approval and he accepted it.*"

   Even if university -the supervisor- and industry -the student and his managers- have eventually come to a consensus in some way, there were also interviewees reporting that they could not get approval of their managers for their thesis topics. For example, a respondent remarked that; "*I started my masters to study one of the topics from my area of interest but my manager of that time did not find the topic suitable for our ongoing activities. At the end of the day, I had to change it and study another area, which had potential to provide useful outcomes for the projects at the work."*

These cases belonged to the times before the foundation of ASELSAN Academy. Now, thesis topics of all employees are subject to the approval of the Executive Board of ASELSAN Academy, which evaluates the suitability of topics with the Technology Roadmap of the company.

However, it was understood that employees do not always choose the topic of their postgraduate thesis in accordance with their current tasks at work. The proof can be found in the following interview question. When the respondents were asked how they assess the contribution of their studies to their areas of work at ASELSAN, they gave 3.4 points on average out of 5. This is probably caused by the employees choosing the topics not related to their own jobs.

2. Once university and industry agree on the thesis topic, the employees are expected to carry out the responsibilities of their academic studies along with the professional commitments of their jobs. At this point, they have to abandon their leisure activities to be able to spare enough time for their academic studies. Almost all respondents stated that it was difficult to study for master or doctorate degree while working in a full-time job. For this reason, half of the respondents stated that they could not manage to finish their postgraduate education on time and had to request for an extension. However, there were also respondents emphasized that, the more someone's thesis topic is related to his work, the easier to make the time management, since they have the opportunity to make time for their thesis studies at work.

3. Graduate students evaluate the general interest and contribution of their supervisors for their thesis as 4.4 and their communication as 4.3 on average out of 5, meaning that once they were able to agree on the subject, they sustain an effective communication required for co-working on a joint study.

4. Majority of the respondents stated that they find the company policies supportive and motivating for employees to have a postgraduate degree in

their areas of work. When they were asked why they think so, they answered it as;

Our company gives permission to the employees, who have to attend classes in frame of their postgraduate studies. Employees are also given extra points in their performance evaluation when they graduate -6 points for Masters, 12 points for PhD- I think, they clearly reflect the supportive attitude of the company and top management.

5. According to the results, theses of the majority of the respondents resulted in a scientific publication such as article and conference paper and an invention such as patent and utility model. When it comes to sharing of IPRs regarding the joint invention of the employee and the supervisor, half of the respondents reported that they confronted a problem with the university. One of them explained the problem he had like this;

   In the beginning of the thesis, my supervisor asked me to sign an agreement in order to ensure that I am not going to claim any right on any foreground IP that comes out as a result of the thesis work. However, when we really had a joint-invention, legal unit of ASELSAN stepped in and made the agreement I signed before invalid. Afterwards, negotiations to sign a new agreement started but university TTO and company lawyers have not agreed on terms yet.

5.1.2.3. Analysis of Group 3

In Group 3, employees who work at the departments that carry out technology transfer operations in the firm were interviewed. They are working in engineering management teams of the business units, legal affairs directorate, and technology & innovation management directorate. The findings were listed below:

1. Respondents were asked about the most frequent problems they face in IP sharing with the university in contract-base projects and thesis projects respectively.

For contract projects, if the terms are pre-determined in the collaboration contract in the beginning, there will be no need to discuss IP sharing conditions. As a general practice, industry claims full control over resulting IP since they sponsor the project. Otherwise, the process works as follows: Firstly, technical teams fill the royalty forms, which is used to determine the royalty share of each party out of the commercialization of the joint invention. Afterwards, agreement model is determined and royalties are calculated by using the inputs in the forms by the technology transfer team of the firm. Finally, negotiations start based on the calculations.

Two possibilities exist on sharing commercialization rights between ASELSAN and university partners. Right to commercialize IPRs can fully belong to the industry or both sides jointly.

In those cases, different royalty rates are calculated, different agreements are signed and different procedures are followed as shown in Figure 9 below. In the same way, related costs for official registry are equally shared unless stated otherwise.

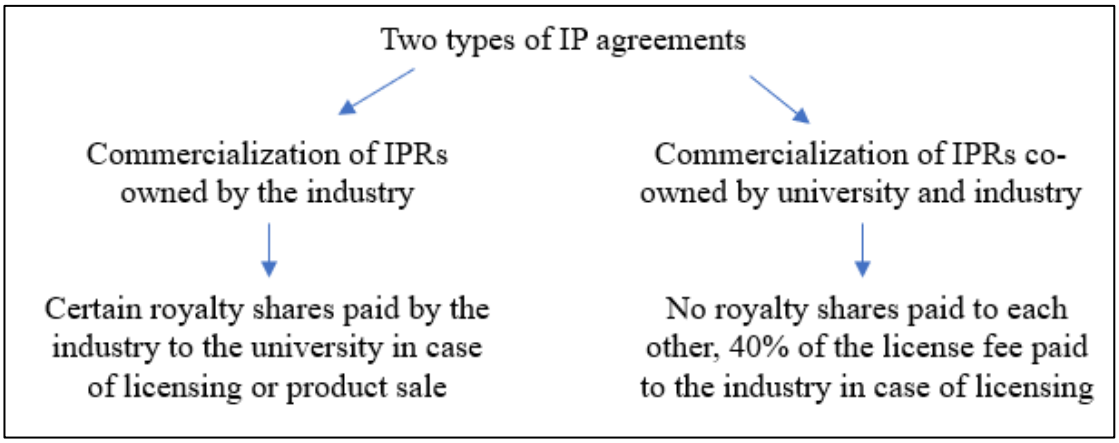

Figure 12. *Process for IP Agreements Between University and Industry*

Royalty Calculation: Royalty rates are calculated by Technology Transfer Unit by using the inputs provided by the related engineering unit, which is the owner of the invention. Inputs consist of the technical and commercial parameters about the invention. Each parameter, which is scored by the inventors, is weighted with a certain rate determined by the Technology Transfer Unit. As a result, royalty rates are calculated as a weighted average of those parameters, shown in Table 8.

Table 8. *Royalty Calculation Parameters at ASELSAN*

TECHNICAL	**Point**	**Weight**
Technology Readiness Level	0	
Commercialization Potential	0	
Innovation Level	0	
Competitiveness of the Technology	0	
Technical Scope of Protection	0	
COMMERCIAL	**Point**	**Weight**
Market Size	0	
Market Growth	0	
Market Feedback	0	
Number of Rivals	0	
Investment Needed for Development	0	
Investment Needed for Manufacturability	0	

2. They underlined that University TTO should be aware of the that things work differently in defense industry than other high-tech sectors. Use of one of the inventions by competitors is something completely intolerable in defense industry because of the security concerns.

3. There is generally no agreement signed on IP sharing prior to the inventions occurred during a thesis study. Bargaining over IPRs begins once the technology transfer teams in each party are informed about the occurrence of an invention. The process within the firm from occurrence of the invention until the official registry for IP protection is illustrated in Figure 13 according to the descriptions of the respondents.

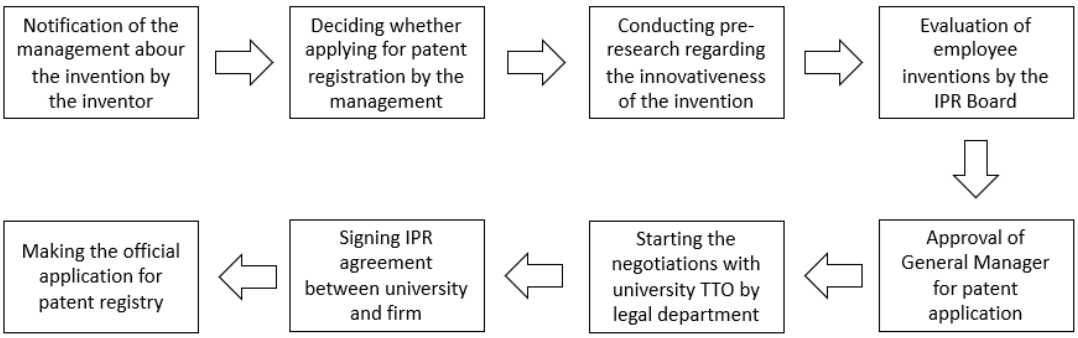

Figure 13. *The process of application for IP protection for joint applications*

However, respondents stated that;

Academicians may neglect informing their university TTO about the occurrence of the invention. Moreover, they might expect students to inform both sides, even if every inventor is responsible for informing its own TT team. Sometimes, when we contact with the university TTO, we see that they are not informed about the invention. This situation causes delays in patent filing process. When it comes to application, related expenses are shared as 50%-50% among university and industry.

In fact, the biggest problems arise during the bargaining process for IPR sharing. Specifically, terms of ownership and royalty shares as well as licensing are the most problematic topics that take a long time to reach a consensus. A respondent highlighted that;

Once the patent is registered, the university might want to license it to third parties, since licensing is a considerable source of income for universities. However, we do not want universities to license our joint patents on their own. As a result, it takes a long time to come to an agreement. We accept to pay royalties out of the sale of related products and systems but there has not been such a sale so far.

There is a general perception in industry's technology transfer units that expectations of the university are too much in terms of commercialization. However, a respondent admitted that ASELSAN's firm position about having the full control over the commercialization rights makes the negotiation process harder.

All respondents agreed that METU TTO is the most challenging but at the same time the most experienced and professional TTO that they interact with. Therefore, they see all these negotiations as opportunities for organizational learning.

Regarding the legal environment, majority of the respondents agree on the fact that laws and regulations regarding intellectual and industrial property protection in Turkey, namely Industrial Property Law: 6769, Turkish Commercial Code 6102, and

Employee Inventions Regulation are pretty clear and effective to ensure the fair protection of IPRs and stimulation of innovation activities and there is no legal gap in this field.

Respondents listed the areas of improvement as follows:

- Student and academician should inform the technology transfer units in their own organizations immediately when an innovation occurs during the project or the thesis study.
- A more practical method for calculating the share of an invention in the whole product or system should be developed and adopted.
- Awareness of both sides should be raised about commercialization of joint inventions.
- There should be a corporate strategy and roadmap about royalty calculation.
- Employee inventions can be ranked according to how much they contribute to the current operations of ASELSAN and their inventors can be rewarded accordingly.

5.2. Analysis of the Interviews with the University

5.2.1. Demographic Analysis

Similar demographic questions were asked to the respondents in university side in order to have an idea about their profile and make comparisons with the profile from industry participants.

According to the results, which are illustrated in Table 8, majority of respondents were male (95%) and engineer (89%), which is an expected result when the profile of METU academicians, who involve in collaborations with ASELSAN. 42% of the participants were above 60, indicating that our interviewee base mostly consists of academicians with over 30 years of experience. In parallel to this, majority of them (63%) have the academic title “Prof. Dr.”

Table 9. *Demographic Characteristics of Interviewees in University*

	Frequency	Percent
Age		
30-40	5	26%
40-50	2	11%
50-60	4	21%
Above 60	8	42%
Gender		
Male	18	95%
Female	1	5%
Department of Graduation		
Engineering	17	89%
Basic Sciences	1	5%
Social Sciences	1	5%
Academic Title		
Dr.	0	0%
Assistant Prof.	2	11%
Associate Prof.	3	16%
Prof.	12	63%
Other	2	11%
Department of Work		
ME	3	16%
EEE	9	47%
CE	3	16%
Other	4	21%

Currently, almost the half of the interviewees work at Department of Electrical and Electronics Engineering, followed by Mechanical and Computer Engineering. The remaining 21% work at TTO and research institutions under the umbrella of METU.

5.2.2. Qualitative Analysis

Three different interview forms were used for three groups of respondents, as it was in done in industry side. Some questions were same with the questions asked to the respondents in industry, with the aim of making a comparison between their views on the same subjects. The ultimate aim was finding answers to three research questions of the thesis.

5.2.2.1. Analysis of Group 1

University – Group 1 consists of the academicians, who have involved in at least one joint R&R projects with ASELSAN. The main findings compiled from the answers were listed below:

1. **Involvement in UIC:** 90% of the respondents have involved in more than three collaborative projects with industry so far. The type of activities that they involve in with an industry partner most are contract-based research, joint research, joint scientific publication, and joint IP -patent or utility model-respectively. In addition, 70% of respondents have involved in a TÜBİTAK project with an industry partner.

2. **Perception of UIC:** University perceives transfer of knowledge from university to industry as a crucial way of knowledge exploitation. According to the results, 70% of the respondents see knowledge generated in universities as "very important" for industry. However, when they are asked about the degree of contribution that university research makes to the projects conducted in industry, their assessments are not as positive as the industry's. Majority of the respondents think that university research cannot contribute to industry as it is supposed to do. One of them explained the underlining reasons as;

   "Our industry's demand for R&D is weak and there is also not enough research in universities to meet the needs of the industry. This is due to the fact that the industry in Turkey does not have such a demand. R&D-oriented growth vision is weak in our industry since its main focus is gaining a quick profit."

   Benefits of UIC for universities from the view of academicians were also questioned. Their answers are listed with their own words below:

   Providing case studies for academic research: "A real engineering should bring solution to a meaningful problem, which is provided by industry through contract research projects. A theoretical solution is developed first,

and then it is transformed to a practical solution with the feedback given by the industry. This two-way knowledge transfer benefits both sides."

Providing financial resources: "Industry funding supports academic research and motivates university researchers. It also contributes to the facilities of the faculties through the share cut by the university administration, which then increases the ability of university researchers to develop prototypes."

Providing employment opportunities: "In terms of our post-graduate student, UIC enables them to work on industry projects while they are carrying out their academic studies. Gaining a certain level of experience in a specific technology area through those projects provides them with various employment opportunities in industry."

"In terms of academicians, UIC enables them to see the areas of use in product development stages. Industry projects provides a solid reference for academicians, as well as inspiration and technical background for their future projects."

3. Academicians were asked to evaluate the factors mentioned in the literature in terms of their impact on the success of collaborative research activities. Responses were given on four-point likert scale as shown in Table 6.

Table 10. *Evaluations of the University on the Factors Impacting UIC*

Most effective factors on collaboration mentioned in the literature	**Never (%)**	**Sometimes (%)**	**Usually (%)**	**Always (%)**
Shared mission and objectives	-	10	30	60
Building trust	-	10	20	60
Setting clear objectives	-	-	60	40
Open communication	-	10	30	60
Perception of inadequately skilled collaboration partners	30	50	20	-
Time and resource limitations	-	10	10	80

According to the results, it can be concluded that the most effective factors on UIC in the literature except "perception of inadequately skilled collaboration partners" were seen as impactful on the success of UICs by our respondents. One of the respondents underlined the necessity of having a shared mission by saying; *"On order for a UIC to be successful; universities should be able to respond well to ever-changing needs of the industry, while industry should share the R&D vision of universities by adopting R&D-oriented growth strategies. ASELSAN is one of a few companies with this vision in Turkey."*

4. As previous studies in the literature suggested, the answers of the academicians show that the industry projects that they have involved so far were mostly between TRL 5 – TRL 6, followed by TRL 8 – TRL 9. They actually complaint on this situation by saying that *"Industry comes to us for the immediate needs related to their projects with very tight schedules. Instead, it would be much more effective, if collaborations were formed in earlier stages of technology development. In these occasions, collaboration may not result in outcomes as effective as expected by the industry."*

5. **Geographical Proximity:** Answers of the academicians to the question about the effect of geographical proximity on the success of UIC validates the existing literature. In our interviews, 80% of the respondents said that locating in the same city with the industry partner enhances the effectiveness of the collaboration by enabling academicians to work on industry's research and test infrastructures, motivating physical co-working, and facilitating transfer of critical documents.

   For example, an academician from Northern Cyprus Campus of the university said that they sometimes suffer from being far away from the firm facilities because they were devoid of necessary research infrastructures for conducting the projects.

6. **Support of University Administration**: Half of the respondents find the attitude of university administration toward industry collaborations

supportive, while the other half find it unsupportive. With the same logic, half of the academicians think that their academic burden is too much to allocate time for industry projects. Some of them said that they have administrative duties beside their academic responsibilities, which make time management even more difficult for them.

About the factors impacting their motivation for industry collaborations, cuts made by the university administration on research project fees for circulating capital of the university seriously demotivate academicians to start new industry projects. 60% of them indicated that they are demotivated by those cuts and added that at least the cut rate should be decreased.

Academicians think that opening new courses or adjusting the curriculums of the existing ones according to the evolving needs of the industry is also an indicator for the supportiveness of university administration. However, some respondents do not find the university policies regarding the course contents as flexible as they are supposed to be for facilitating UICs.

7. **Evaluation of the Collaboration Partner:** 50% of the academicians stated that their industry partners meet their expectations regarding the collaboration, while 40% stated that they could not.

   When they were asked whether they think that industry makes enough effort to transfer knowledge from universities, 80% of the respondents answered it as “No”. They think that industry should look at university collaborations more long-sightedly and invest more in long-term development projects for cutting-edge technologies.

   When they were asked to make self-evaluation of their performances in industry projects, 90% of them said they think the research outputs that they delivered to the industry satisfied them.

8. **Communication**: When academicians were asked about their communication with their research partners in the industry, 70% of them stated that they

sustain a clear and healthy two-way communication with them until the project ends. 90% of them think that industry clearly expressed its expectations from the university research team and underlining technical requirements in a complete manner before the projects start.

9. **Confidentiality**: When the respondents were asked if they have any problems regarding the signing of NDA, 90% of them answered it as "No". Only one academician perceives these agreements as an interference to their academic freedom.

10. **Source of Problems:** Respondents were informed about the most mentioned factors in the literature that create problems in UICs and asked to assess each of them according their own experience. The results are shown in Table 10.

    Academicians do not see the factors except financial constraints, bureaucratic burdens, and unclear expectations as source of problems in UIC, meaning that factors such as communication, deadlines, know-how and cultural differences, financial expectations, and IP Sharing do not constitute a remarkable problem in their industry projects.

Table 11. *Potential Problem Sources in UICs from University Perspective*

Potential problem sources in UICs	**Never (%)**	**Sometimes (%)**	**Usually (%)**	**Always (%)**
Financial constraints	-	10	60	30
Communication failures	10	70	20	-
Violation of deadlines	20	50	20	10
Bureaucratic burdens	-	20	50	30
Know-how gaps	40	60	-	-
Cultural differences	60	20	20	-
Unrealistic financial expectations	80	20	-	-
IP Sharing	50	10	30	10
Unclear expectations	10	30	60	-

The most challenging part in the whole collaboration process was shown as "bureaucratic burdens" by almost all participants. They complaint that;

"Signing process of the contracts takes too long because of the internal approval process of the firm. Even if R&D is not an ordinary service, university projects are subject to procedures applied for ordinary service procurement. Assurances are required but this is against the nature of R&D, which is a risky business. Sometimes, there may not be any tangible outcome at the end of the research, but the collaborative learning for both sides should be seen as a gain, which may enable more efficient outputs in the future. Therefore, universities should not be treated as sub-contractors"

A respondent also stated that;
"I involved in several industry projects when I was in US. Negotiations between university and industry for the research contract was lasting two months at most. Here, those negotiations take more than one year because of long-lasting approval processes. When the research contract is agreed upon, we even have difficulty to remember the research topic, which I believe extremely demotivates both parts for collaboration."

When the academicians were asked about which side was more responsible from the problems arising in UIC, 70% of them said that industry side was more responsible, 30% of them said that university and industry were equally responsible. 30% of the respondents stated that those problems were solved out by the efforts of university and industry together, while 50% said that the problems have not been resolved yet. A respondent added that;

"We have two groups of teams we were in contact in industry; one is engineering, one is administrative. Technical teams were more solution-oriented and has more constructive approach towards the solution of the problems. They acted as a bridge between administrative teams and us."

11. **Support of Industry:** Academicians were asked about their ideas regarding the supportiveness of industry through its payments made for contract base research projects. Half of them stated that they find the project fees sufficient, while the other half said they don't.

80% of the respondents claimed that industry does not accept the financial offer they deliver for the projects, and it always tries to bargain on the amount. One respondent highlighted that they had difficulties on obtaining the necessary equipment at the beginning of the project and said that this problem can be resolved if the industry makes a kind of down-payment prior to the project.

70% of the respondents find research infrastructures of the firm adequate and equipped well enough to work on for collaborative projects. They graded it as 4,2 out of 5.

12. **Government Policy Support:** 90% of the respondents think that UIC is not incentivized enough by the government in terms of policy and financial framework in Turkey.

    Respondents stated that their projects were funded via TÜBİTAK grant programs including 1501, 1505, 1001, 1003 and SAN-TEZ. 60% of the respondents remarked that they had at least one difficulty during the project, which were mainly the long time that application process and grant payments take. They added that, in order to get more effective returns on the grants provided, outcomes of the projects should be closely followed and objectively evaluated by competent evaluators. However, there is not such an evaluation mechanism regarding the performance of the projects.

    90% of the academicians think that the amounts of grants are too low to cover the project-related costs. They believe that grants should be given on a more focused basis by prioritizing strategic sectors for the country, in addition to increase their amount. Scholarships for PhD students should also be increased to the level where they can be competitive against the salaries paid by private sector.

13. **IPR Sharing:** 60% of the academicians involved in industry projects, which resulted in an invention. Patent registration applications were filed for all of those inventions. Majority of the respondents said that they did not encounter

any problem regarding IP sharing since it was clearly stated on the collaboration agreement that the firm is going to have the commercialization rights of a potential invention occurred during the project. They said that because the negotiations with the industry were carried out by the university TTO, they did not have much of an idea about the details of the agreement. However, they find industry's attitude of "I will get all IPR because I pay for the project" is wrong since they put their prior know-how and experience, as well as university's resources forward for the completion of the projects.

14. **Other Difficulties:** When the respondents were asked about the challenges and barriers, they face in industry collaborations other than the ones mentioned in the interview questions, they gave the following answers:
    - Lack of a strategic collaboration agreement between the university and the firm at the corporate level (collaborations are only formed at project levels for one time)
    - Delays in payments for the project deliveries (because they cause disruptions in salary payments of the researchers and procurement of equipment critical for the project)
    - Transfer of documents with confidentiality status
    - Discrepancies between work cultures
    - Conservativeness of the university administration about curriculums
    - Frequent changes and rotations in industry's technical teams (because it interrupts the process and causes attention losses towards the project in industry side)
    - Decision of discontinuance to some projects because of organizational changes inside the company
    - Difficulty of finding qualified researchers for the research teams because of industry's shortsighted approach to university research

18. **Expectations of the University:** Respondents were asked to state their expectations from the industry in research collaborations. The most frequently mentioned expectations stated by the academicians were listed below:

- Allocating more time for reviewing and giving effective and constructive feedback on the research output delivered by the university research team
- Instead of addressing immediate needs, aiming to collaborate for more future-oriented projects with the university
- Forming long-term technology groups of researchers from university and industry
- Removal of bureaucratic barriers; i.e. simplification of agreement process, reduction of paperwork regarding the procurement process
- Launching scholarship programs for our Master's and PhD students, working for defense projects or studying defense-related technologies in their theses
- Allocating a certain share out of research budgets to support university research facilities

5.2.2.2. Analysis of Group 2

In Group 2, interviews with the academicians, who were advisors to MS or PhD theses of ASELSAN employees.

1. **Determination of the Thesis Topic:** According to the answers, it is understood that industry prefers that employees pick their thesis topics in frame of their working area. Majority of the academicians find this point of view fair and reasonable, only if the matching between the working area and thesis topic occurs naturally, not by force. They remarked that:
   "ASELSAN rightfully wants employee theses to have a contribution to its ongoing projects. I believe that an engineering project without practical application area will remain incomplete."

   Opponents on the other hand challenged this by saying;
   "Industry projects are aimed at addressing its immediate needs. ASELSAN can do those projects by itself anyway. However, our agenda in academia is very different. We are working on cutting-edge technologies. Therefore, there

can be intersection points between the topics of academic studies and industry projects, but this should not be set as a condition for employees to carry out their post-graduate studies."

They think that employees should not be restricted to a certain technology area for post-graduate thesis. They should have the opportunity to develop their know-how and skills on any area of their curiosity and interest, as long as that area is within the operational scope of the company.

2. **Evaluation of Industry Theses:** When they were asked whether they find industry thesis successful in terms of scientificness and contribution to the literature, majority of them answered as "No". They argue that industry theses usually focus on solution of a problem, which generally have a low scientific value since they do not add something new to the literature. Even if practical problems of the industry can be topics of MSc theses, they cannot be studied in a PhD thesis. However, scientific value of a thesis also depends on the researcher and the advisor.

3. **Evaluation of the Student:** Majority of the academicians are satisfied with the effort and success of their students, as well as the opportunities and conveniences provided by the firm such as post-graduate leave given to the employees to attend the classes, if their thesis topic is deemed suitable. However, one respondent asserted that his student had great difficulty in allocating time for his thesis study because of his workload and working conditions.

4. **Importance of UIC for Industry:** Respondents think that degree of contribution of collaboration to the industry depends on the way the industry approach to the university. If they apply to the university for a completely pre-defined outcome in a limited timeframe, efficiency of that collaboration will be possibly weak. However, industry will benefit more when a long-term strategic collaboration is formed to develop a certain technology.

5. **Confidentiality**: During the interviews, even there is no question about it, some respondents mentioned the restrictions on scientific publications about military technologies. They rightfully expect to publish at least an article on the findings of the thesis that they were advisors of. However, since majority of the theses are confidential in defense sector, the maturity level of some technologies such as military radars and publications available in the literature about it differs pretty much from each other. This situation causes a slowdown in TRL improvement of that technology because of the limited literature and demotivates academicians to become advisors of those kind of thesis.

6. **IPR Sharing:** An invention might occur during some of the theses. In contrast to contract research projects, there is not any agreement that include terms describing IP sharing between university and industry beforehand. Therefore, IP sharing agreement is generally signed after the invention shows up. At this point, TTOs get involved in the process and negotiations are carried out between legal experts of two institutions. Academicians mostly stated that they do not involve in those negotiations. Some of them even do not have an idea about whether patent application is made or not.

5.2.2.3. Analysis of Group 3

In group 3, interviews with professionals from university TTO were conducted. They were asked questions, which were mainly about the role of TTOs in UIC, their specific role in the IPR sharing between university and industry based on the case of METU and ASELSAN, and their observations and expectations regarding the whole process.
The findings were listed below.

1. METU TTO was founded in 2002, as Turkey's first TTO. It has three units; (1) IPR and contracts, (2) Commercialization, and (3) UIC. UIC unit works as an interface working for matching the academicians who are experts in their fields with the right contacts in industry, and vice versa. They do not

only match the university research with the industry needs but they also find the most suitable model to make it. The existing models used by the TTO are business development, project-based, TÜBİTAK 2244 program, students' graduate studies, and collaboration activities with public.

2. The most important challenge of matching two sides is that research interests of the academicians do not always appeal to the practical needs of industry. Industry usually comes to us to find solutions for their immediate problems related to their products or production processes. Academicians on the other hand, want to work more on the research projects with scientific value. In order for this gap to be filled between capabilities and needs for research, firms should give more credit to basic research conducted in the university. Academicians are also supposed to follow the trends and latest industrial applications about the technology they work on.

3. When it comes to the role of TTOs in facilitating UICs, project managers in industry and researchers in university do not speak the same language for most the time and TTOs act as a translator between them. Before the formation of TTOs, collaborations could only be formed through the interaction of the employees and their university teachers.

4. The main problem they face in contract-base industry project is that industry treats university in the same way as it treats its sub-contractors about the way they try to build the collaboration agreement. For example, industry insists on putting penal clauses, they used to put on the agreement with their sub-contractors for the cases they do not deliver the product or service they are required on time. University TTO objects to it by saying that;

   "R&D is not a commercial product or service that can be sold through usual procurement agreements. R&D always carries an element of risk since it involves trying out completely new ideas. However, industry sees the academician as its contracted employee as it sees the university as its sub-contractor by adding those penal clauses on the agreement. Each time, we are losing time by requesting them to revise the agreement."

5. All practices related to IPRs have been carried out in accordance with the Law No. 6769 Industrial Property Law since 2017. We have a draft agreement with ASELSAN for sharing of IPR for the inventions, that occur during thesis studies of employees. However, we negotiate the articles related to commercialization each time specific to the inventions. IPRs jointly belong to METU and ASELSAN and related costs are shared as 50%-50%. When it comes to the terms of royalty sharing, the calculation is made by ASELSAN and TTO accepts that calculation. However, they explained the point at which they have disagreement like this;

   "We want to get a certain share of royalty out of the total revenue from the sale of the related product or system that the joint invention is utilized, but industry wants to give that royalty share out of net profit."

   When they were asked about the areas for improvement if they compare the effectiveness of TTOs in other countries, they stated that industry should be more liberal and open to innovation at sharing IP ownership and related revenue. They underlined the fact that TTOs earn much higher license incomes from the industry projects in the US and Europe but industry in Turkey is still so conventional and needs to change their points of view towards joint IPRs.

6. About government incentives, they stated that they had been supported through TÜBİTAK 1513 TTO Support Program for ten years. However, they added that;

   "After the program ends, TTOs are expected to gain their own income. We gain a certain amount of service fee out of 1702 Patent Based Technology Transfer Support Call, but we think that the number of TÜBİTAK calls for TTOs should be increased."

7. In conclusion, main expectations and requests of university TTO from the industry can be listed like:

- having the right to give exclusive license of joint patents to the third parties, otherwise covering 100% of the expenses related to patent registration
- not being treated like a sub-contractor in contract R&D projects
- being open to have a joint ownership and revenue sharing for the inventions resulted from contract-base projects
- being open to innovative methods in technology transfer such as forming spin-off companies by academicians

In addition, they indicated that patent applications of each business unit in ASELSAN are handled by that specific unit and this situation might sometimes cause discrepancies among different units. Therefore, the process will be more standardized and easier to follow for the university if all patent applications within the company is prosecuted by a single central unit.

5.3. Comparative Analysis of the Interviews

This thesis aims to make an analysis of the UICs in defense industry by seeking answers to these research questions listed below.

Research Question-1:
What are the perceptions of collaborators about each other and what are the barriers and challenges in UIC in defense industry?
Research Question-2:
How can those barriers be overcome; which measures can be taken to improve the effectiveness of UIC in defense industry?

The comparable results regarding the perception of each party about each other and UIC in general can be seen on Table 12. Accordingly, it can be said that university attaches more importance to UIC than industry, because industry does not find its outcomes satisfying enough and in line with their expectations. When the reasons of this perception were questioned, it was seen that financial support provided and effort made by the industry for collaborative projects was not found enough by the

university. Remaining factors such as effective communication and psychical research infrastructure are not seen as a source of problems by both parties.

Table 12. *Perceptions of University and Industry about UIC*

	View of Industry	***View of University***
Importance of knowledge generated at the universities for industry	Important	Very Important
Realized contribution of university research to the projects conducted in industry	Satisfying	Unsatisfying
Their perceptions regarding the maturity level of the collaborative project	TRL 3 - 6	TRL 5 - 8
Interest of the other party to the collaborative project	In line with their expectations	Under their expectations
Degree of effort made by the industry to transfer knowledge from the universities	Enough	Not enough
Communication throughout the project	Clear and two-way	Clear and two-way
Clear expression of expectations by the industry before the projects start	Agree	Agree
Financial support provided by the industry for the contract projects	Satisfying	Unsatisfying
Sufficiency of R&D facilities and infrastructure of the industry	Enabling	Enabling
Responsible party from the problems emerge during the collaboration	University	Industry

When the views of the university and the company towards the barriers and challenges of UIC identified in literature were questioned, it was seen that they perceive some of them as a barrier too, while they do not perceive some of them as a barrier in their collaborations. Their answers can be seen on Table 13. “Yes” means that barrier is also seen as a barrier by them, while “No” means the opposite.

Accordingly, both sides think that financial constraints, bureaucratic burdens, and IP Sharing are challenges for them in collaborations, while they agree that academic burden of academicians and cuts on project fees by the university are barriers to UIC in terms of academicians.

Table 13. *Perceptions of University and Industry About Barriers Identified in the Literature*

	View of Industry	***View of University***
Confidentiality requirements on defense projects	Yes	No
Academic and administrative burden of the university researchers	Yes	Yes
Loss of academicians' motivation because of the cut made by university on project fees	Yes	Yes
Financial constraints	Yes	Yes
Communication failures	No	No
Violation of deadlines	Yes	No
Bureaucratic burdens (amount of paperwork, process of approval)	Yes	Yes
Know-how gaps	No	No
Cultural differences	No	No
Unrealistic financial expectations of the university	No	No
IP Sharing	Yes	Yes
Unclear expectations	No	Yes

In the same way, validity of the critical factors that have an impact on the success of UICs indicated in the literature was also questioned. University and industry agree on the existence or non-existence of all factors questioned on the success of their collaboration, as shown in Table 14 below.

Table 14. *Perceptions of University and Industry About the Factors Impacting the Success of UIC*

	View of Industry	***View of University***
Having shared missions and objectives	Yes	Yes
Building trust on the other party	Yes	Yes
Setting clear and understandable objectives	Yes	Yes
Open communication	Yes	Yes
Perception of inadequately skilled collaboration partners	No	No
Time and resource limitations	Yes	Yes

5.4. Concluding Remarks

Reponses to the interviews are analyzed in Chapter 5. First, analysis of the interviews in industry is made, followed by the analysis of the interviews in university and comparative analysis of the results.

According to the answers to the common questions, university attaches more importance to UIC than industry, because industry does not find the outcomes of joint research satisfying enough, which validates the findings in the literature. Its main reason is showed as academicians' theoretical approach to industry solutions as suggested in a study conducted on MIT's collaborative research projects.

Again, in line with the literature, each party holds the other one responsible for the problems faced during collaboration. Source of problems, which are validated by our study, in the literature are financial restrictions, bureaucratic requirements, and IP sharing issues. The ones that are not validated by our respondents are communication failures, know-how gaps, cultural differences, and unrealistic financial expectations. When it comes to the factors impacting the success of collaborations; having shared missions and objectives, building trust on the other party, setting clear and understandable objectives, open communication, and time and resource limitations are highlighted in our study.

This chapter also discusses the answers of the interviewees about the examples form their own experience, which provides insight for the policy and strategy recommendation part in the next chapter.

Respondents from Industry side highlighted these points:
They think academicians focus on making more academic publications in their fields instead of following the industry applications and number of researchers for certain technology areas in defense is rare. The challenges they faced about academicians are delivery of research output not in accordance with the pre-determined deadlines, unappealing output to the practical needs of industry, cost-ineffective and financially unfeasible solutions to industrial problems, improper documentation of research

outcomes, and disagreement regarding IP sharing conditions. When it comes to IPR sharing, respondents from industry stated that: Terms on IPR are clearly stated on the agreements signed for contract project but there is generally no agreement signed on IP sharing prior to the inventions occurred during a thesis study. On those occasions, royalty rates are calculated by Technology Transfer Unit with technical and commercial parameters of the invention. The barriers they had from industry side are lack of enough time for university and thesis projects, too long internal approval process to initiate a firm-funded R&D project, and obligation of selecting thesis topics related to their working areas.

Respondents from University side highlighted these points:
They think industry in general, is lack of R&D-oriented growth vision and demand for university research but they find ASELSAN better than the rest of industry on this. However, they think industry's approach to universities should not be the same with their approach to their sub-contractors, since R&D always carries an element of risk and may not always result as determined prior to the project. Other challenges they had about industry side are their failure of delivering effective feedback on research outcomes, insufficient funding for conducting the requested research, frequent changes in project teams, short-term focus towards academic research, excessive administrative requirements, difficulty of document transfer because of conservative nature of defense industry, and disagreement regarding IP sharing conditions. The barriers they had from university side are lack of time because of their academic burden, difficulty of new course openings and adjustments of the existing ones according to the needs of the industry, and cuts imposed by university administration on project fees paid by the industry. METU TTO is seen as the most professional one among the others and plays a crucial role in facilitating the collaboration process by matching them when research interests of the academicians do not always appeal to the practical needs of industry, protecting the rights of university researchers on their inventions, making university and industry speak the same language while collaborating.

When it comes to government incentive for UIC, both university and industry find the size of research grants inadequate to cover the project expenses and the

application process too long to motivate applicants. Grant programs are found deprived of focus and scholarships of PhD students uncompetitive compared to the salaries paid by private sector.

CHAPTER 6

CONCLUSION AND POLICY RECOMMENDATIONS

6.1. Conclusion

As the importance of innovation ramps up for the competitive standings of the industrialized countries, creation of new knowledge starts to become more critical. Therefore, scientific and technological knowledge generated at universities should be transferred to industry for their transformation into high-value added products through commercialization.

Universities currently promote innovation in knowledge-based industries and boost economic development in their regions. Until this point, mission of the universities has evolved throughout the history. Initially, universities only had the mission of teaching. Afterwards, the second mission, which is research was added to their missions with the aim of discovering new knowledge. Nowadays, universities have the mission of contributing to society, which has imposed them certain social roles besides their economic roles.

The notions “entrepreneurial university, technology transfer, and university-industry collaboration” have brought by the third mission of universities. New mechanisms related to UIC such as TTOs, technoparcs, academic entrepreneurship, spin-offs have started to be used in order to facilitate dissemination of scientific knowledge outside of the university for the use of the society.

Since university and industry are very different structures with different objectives and working cultures, coming together and forming a collaboration are not easy. Therefore, government intervention through some incentive mechanisms becomes

essential for motivating related parties for establishing sustainable UICs. Those interactions between university, industry, and government are referred as the triple helix of innovation, which can take different forms.

Although some studies examining UIC in Turkey exist in the literature, the ones that analyze defense industry is very limited. In addition, their perspective to the subject is limited to one party, meaning that they analyze UIC and related barriers either from the eye of the university or the eye of the industry. Bringing the perspectives of the both sides together in a single study, this thesis adds a different methodology to the existing literature. Supervised by professionals with both academy and industry backgrounds, it provides a deeper understanding and an opportunity to make comparative analysis between the views of university and industry. In this way, defining and overcoming barriers and challenges might be easier since both sides will have a chance to look at existing problems in their collaborative projects from each other's perspectives and make objective judgements about their approach.

Knowledge-based and technology-intensive industries are the ones that require knowledge transfer most. Defense is one of them with its additional importance coming from its role in national security of a country. Besides this, defense R&D is also motivated for its catalyzing effect on industrial innovation in civilian sectors. Therefore, effective UIC that leads to successful defense R&D should be carefully analyzed and promoted accordingly.

Benefits that university and industry gains from collaboration differ in line with their short and long-term objectives. Industry benefits from collaboration by accessing technological knowledge, qualified workforce, and de-risking their R&D activities as academia takes the advantage of collaboration in the forms of research funding, employment and skill development opportunities for its graduates, real problems for their research, industry feedback, etc. UIC also provides society with several advantages such as well-trained workforce, high-tech competitive products, and solutions to the most challenging problems that society faces.

For this reason, governments adopt different policy tools from launching grant programs to preparing legal framework for IP sharing in order to promote UIC.

TÜBİTAK is the main responsible institution with its special grant programs supporting collaborative research activities. More targeted incentives are available for UICs in defense sector in Turkey with the government's vision of having a technologically independent defense industry.

Despite public policy support, there are numerous barriers to UIC that can change from country to country or even from one sector to another. Even if the barriers in front of the formation of successful UICs might differ between university and industry, there are common barriers such as finding the right collaboration partner, building and maintaining trust, organizational differences, and intellectual property sharing.

In this study, UIC in Turkey's defense industry is deeply analyzed through the case study of METU – ASELSAN collaborations -contract research projects and employee theses-. In frame of the research, questions aimed at defining the perspectives and evaluations of university and industry, barriers and problems they encounter during the collaborative projects, their expectations from each other, and areas for improvement were asked to the participants of collaboration and technology transfer professionals from university and industry. Our findings contribute to the concept of barriers in UIC as well as to the role of TTOs in UICs. It is understood from the answers of the interviewees that our case study validates most of the barriers identified in the literature.

In this regard, the most mentioned barriers to UICs by both sides are differences between goals and expectations, conflicts at IPR sharing and heavy bureaucratic burdens in collaboration process. As sharing common goals, gaining the collaboration partner's trust, defining clear and understandable objectives, expressing expectations properly, government support, and geographical proximity are proved to be critical factors to have for the success of UIC, time and resource limitations, finding the right collaboration partner, IPR issues, and confidentiality violations are seen as serious barriers to UICs by the firm.

UICs are mostly formed for the development of technologies between the maturity level TRL 3 – TRL 6, as suggested in the literature. Industry sees university research

as important for improving their innovative capabilities but most of the time, they have difficulties in finding a proper academic partner for their collaborative research project because research interests of the academicians do not always appeal to the needs of industry. Once they eventually find the partner mostly through their personal connections, it takes months, sometimes years to sign the collaboration agreement because of the long bureaucratic process required by the firm.

As another point, it is seen that frequency of conducting university projects and type of projects may differ from one business unit to another inside the firm. It is caused by the nature of the technology that related business unit works on. For example, technical teams working on command-and-control systems tend to work more with universities, while the ones working on radar technologies conduct less but longer projects with universities.

However, firms with high R&D capabilities like ASELSAN form more successful collaborations with universities compared to the firms without R&D focus. METU and ASELSAN take the advantage of locating near with each other in their collaborations, which also contributes to the innovation ecosystem in their region. Top expectations of industry from academicians are becoming experts in their areas, translating their theoretical knowledge to innovative practices, and complying with the project deadlines. On the other hand, top expectations of university from industry are coming to university for long-term projects instead of projects with strict deadlines, removal of bureaucratic barriers, and providing effective feedback on research deliveries.

In our case study, it is understood from the answers of the interviewees in industry that the difficulties they experience are mostly caused by the university side:

- Know-how losses because of the changes in the academician's research team (brain drain), and lack of adequate number of researchers in universities for certain technology areas in defense
- Lack of sense of responsibility in some academicians (failure of university research teams on meeting the expectations of the industry side regarding the TRLs, and necessity of close follow-up and reminding the deadlines to the university side in order to get the research deliveries on time)

- Some academicians' inability to transform their theoretical knowledge into practical knowledge
- Non-sensitivity of some academicians for confidentiality rules required by defense industry
- Problems related to documentation, delivery of research outcomes in the formats different than what is required by the industry and delays in project timelines, caused by academicians' lack of experience in industrial applications

However, some of the difficulties reported by the industry side are related to the internal processes of the firm:

- Long-lasting bureaucratic processes within the company, especially the ones related to procurement (price offers are required to be on the R&D project proposals for approval process) and too demanding and discouraging approval process for initiating self-financed R&D projects
- Too much work load of employees that leaves almost no time for conducting university projects or writing a project for TEYDEB grants
- Long-lasting project agreement processes caused by the discussions especially on the terms of IPR sharing

On university side, academicians expressed the main difficulties they faced as follows:

- Delays in payments of the industry for the project deliveries
- Industry's short-sighted focus requiring quick solutions from research projects
- Frequent changes and rotations in industry's technical teams and its negative effects on the projects

The government tries to incentivize UIC through the research grant programs of TÜBİTAK but they need to be improved in terms of scope and amount according to the respondents.

6.2. Overall Findings and Policy Recommendations

In the light of the above findings, policy recommendations to industry, university, and government are listed below.

6.2.1. Recommended Model

Respondents from the university side admitted that there is not enough supply of research appealing to the needs of the industry. However, they claimed that it is caused by the industry's weak demand for it.

Academic research is mostly demanded by the industry for meeting their ad-hoc design needs or finding a quick solution to a problem occurred in the manufacturing process. This situation prevents university to become familiar with the operations of the firm and come up with the expected innovations. In addition, it causes waste of time because of the paper-work that should be completed each time to start a project. It is understood from the answers of the industry respondents that those paper-work and related bureaucratic processes of the firm discourage employees to start collaborative projects with a university. It also frustrates academicians since a lot of information is requested during the process. They drew attention to the waste of time and inflexibility caused by the long approval process required for budget allocation to projects each time, which deteriorates the overall competitiveness of the company.

University collaborations should be coherent with the firm's five-year business plan and technology roadmap, so that research outcomes will be more appealing to the firm's innovation needs. In this regard, industry should adopt R&D-oriented growth strategies, which have university collaborations at the center and give more credit to basic research conducted at universities.

At this point, **strategic partnership model**, which is established at an institutional level for the development of a specific technology, not between individuals for a single project is suggested. In this model, a framework agreement about developing a certain technology, which is coherent with technology roadmap of the company will

be signed between institutions. Once the agreement is signed, single research projects on the relevant technology area can be conducted by referring to that agreement.

Under that agreement, different co-working practices such as formation of joint technical teams, establishment of research labs at university campus by the firm, and formation of scholarship and internship programs for research assistants can be made. To conduct the sub-projects in frame of the strategic partnership, a special-purpose budget can be allocated annually by the firm to support the research facilities of the partnered faculty and research teams. In this way, more efficient outcomes can be reached in a shorter time.

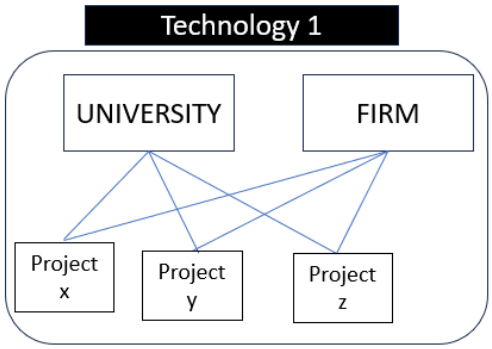

Figure 14 *Strategic Partnership Model*

It is important to keep in mind that collaboration between university and industry will result in more efficient outcomes and will be more sustainable if they develop a "co-creation" culture and form a strategic partnership, instead of forming a one-time, ad-hoc collaborations, as suggested by Frolund et all (2017).

Most of the time, researchers at ASELSAN and METU come together for single ad-hoc projects. There are only a few exceptions such as a long-term strategic partnership established in 2021 on a specific technology between one of the business units of ASELSAN and one of the research institutes of METU. The number of such partnerships on certain technology areas should be increased in line with the firm's five-year technology roadmap.

Long-term collaboration will be advantageous for both business and academia. While firms will have better access to cutting-edge research and scientific personnel,

universities will have access to stable funding and research partners. In addition, firms will not have to spend extra effort in finding a collaboration partner for its research and innovation needs and employees will not have to bear the same bureaucratic burden each time when they need to initiate a university project.

This will provide firm with an opportunity to become more innovative on the areas of strategic partnership and more responsive to the changes in competitive environment. On university side, continued financial support of the industry will enable academicians to work more effectively and closely with the industry partners.

6.2.2. Policy Recommendations

Policy and strategy recommendations to university, industry, and government are summarized in the table below, along with their aims and tools. Afterwards, they and their connections with the insights gathered from interviews are explained in detail.

Table 15. *Summary of Policy/Strategy Recommendations*

Policy/Strategy Aim	**Policy/Strategy Recommendation**	**Related Party**	**Policy/Strategy Tool**
More effective use of academic knowledge to address industry needs	Aligning the content of university research and education with industrial requirements	University	-adjustment of engineering curriculums according to industry needs -opening of elective courses aiming to increase students' technical capabilities -motivating structures like ASELSAN Academy
		Industry	-informing university about their R&D and business strategy -defining industrial problems as thesis topics to university -giving scholarship to the students picking those topics for their theses -initiation of long-term internship & talent programs for 4th grade & postgraduate students (such as ASELSAN A-Talent)
		Government	-forming a thesis pool at a regional level -enabling industry experts to give elective courses in engineering faculties

Table 15. (continued)

Increasing the efficiency of university - industry collaborations	Having the right match for collaboration Preventing duplicate investments to research labs	University	-keeping the national database for research infrastructures updated
		Industry	-building an intra-firm web portal for sharing experience about previous collaborations
		Government	-securing the up-to-dateness of the related database -making performance evaluations of the collaborative projects that supported through research grants -encouraging university research labs to be used by the industry -supporting entrepreneurship efforts of the industry including the launch of structures such as ASELSAN Entrepreneurship Center
Increasing the level of engagement between university and industry	Motivating academicians and employees towards collaborative projects Removing bureaucratic barriers in front of UIC Boosting regional/technological innovation systems	University	-decreasing the cut rates over grants of industry projects -taking industry projects into account for academic upgrades -decreasing administrative responsibilities of academicians who conduct industry projects
		Industry	-facilitating the internal process for project initiation by reducing paperwork -organizing workshops with universities on specific technology areas -opening research centers at university campuses or technoparcs
		Government	-providing financial support to TTOs on their performances -prioritizing the products of UIC projects in public procurement -organizing networking events for universities and firms -providing regional incentives to universities and firms in a certain geographical area

Table 15. (continued)

Increasing the effectiveness of granted projects	Motivating university and industry to make more applications to grant programs Improving the amount and the payment conditions of research grants	University	-desinging support programs like BAP (Scientific Research Projects) for industry projects
		Industry	-encouraging employees to write TEYDEB projects through reward mechanisms
		Government	-providing grants with more strategic focus in prioritized areas -decreasing the number of projects to be granted -creating a special grant program targeting large enterprises -simplifying the application process of research grants -increasing the scholarships of PhD students -monitoring the performances of the projects for future grant decisions

1. It was observed that university and industry hold each other responsible for the problems arise during collaboration. Industry respondents think that some of the academicians and research teams are not good enough at translating their theoretical knowledge into incremental innovation and practical solutions and following new technologies and trends that industry needs. Academicians, on the other hand, think that engineers in industry do not show the necessary interest to collaborative projects and provide effective feedback on the research outcome delivered by university researchers, which ultimately causes unwanted research results to come out at the end of the project. However, two-way communication is essential for the success of the collaboration and firms having an open communication with their research partners gain more out of the collaboration, as shown by a study. (Pertuze, Calder, Greitzer, & Lucas, 2010)

   Recommendation: Prior to the project start, firms should properly inform university about their R&D strategy as well as their overall business strategy, so that university researchers can meet their expectations from the collaboration. The efficient way of collaboration is to work between TRL 4 – 6 and experimental analysis and results will provide academicians with cited papers. The problem is that commercially sensitive information should not be

given in those papers, normalized graphics should be prepared. The differences between their goals and expectations can be tolerated as long as they are clearly expressed and respected by each other. In order to strengthen the practical side of the university education, a number of measures can be taken by university as well, including “the adjustment of engineering curriculums according to the evolving needs of the industry, opening of elective courses aiming to increase students’ technical capabilities on sector-specific technologies such as defense-related technologies, etc”. As it is stated in the Action Plan prepared by YÖK, trade chambers can make a contribution to the selection of the thesis topics of masters and PhD students at the universities in their regions, so that problems faced by industry in design and manufacturing process can be solved through those thesis studies. Firms can provide financial support to those students and their advisors to be used for the research they will conduct for the thesis, if the student chooses to study one of those topics. In this way, students and university will have a financial gain, while industry will have a solution to its technical problems. In addition to that, firms can open long-term internship programs for 3rd and 4th grade students, and experts from industry with PhD degrees can give applied courses to engineering students at the universities in their region, which enhance the responsiveness of university research and education to practical needs of the industry and the quality of collaboration by enabling two-way knowledge transfer. (Turkey's Council of Higher Education, 2021)

2. Majority of the respondents highlighted the importance and difficulty of finding the right academic partner for collaborative projects as revealed in a study, which indicates that firms hesitate to collaborate with universities because of their insufficient knowledge about the resources of research laboratories and capabilities of academicians. (Kleiner-Schaefer & Schaefer, 2022) For firms, this lack of information stands as a serious barrier in front of forming a collaboration with a university.

   Recommendation: In order for firms to find the right research institution to collaborate, a database consisting of information about research infrastructures in terms of human resources, machinery, equipment should be

constructed and kept updated by the related public institution for the use of all industrial firms. In this way, firms will be enabled to reach the right research partner as well as duplicate investment on research infrastructures will be prevented. (Turkey's Council of Higher Education, 2021) Furthermore, firms should organize technology workshops, at which they bring researchers on specific technology areas with the relevant contacts in the firm. Government should also schedule conferences and networking events for participants from university and industry with similar research interests to familiarize with each other, as suggested by Schaefer (2022). In addition, an intra-firm website like an academic information portal should be constructed for the use of employees, who are planning to start a university project. Research areas and assessment of other employees about academicians will be available on the portal. In this way, they do not have to spend extra time for searching for an academician for the topic of their projects or lose time with an academician, who was collaborated in a different project by a different department and did not do well.

3. According to the results, our respondents from both sides believe that UIC should be more effectively incentivized by the government.

   Recommendation: On university side, academicians should be provided with adequate opportunities to commercialize the outcomes of their research. As an effective way to research commercialization, academic entrepreneurship and academic patenting activity, which are conducted by university TTOs should be promoted as suggested in the Policy Document for Improving UIC. (Presidency's Policy Board for Science, Technology, Innovation - BTYPK, 2019). In order to foster these activities, TTOs should be provided with a sustainable financial support based on their performances. Besides this, all research universities should have an incubation center, where technology-based inventions are matched with institutional and angel investors. On industry side, university collaborations should be incentivized through prioritizing the products of those academic spin-offs in tenders for public procurement or making them procured without participating to a tender.

4. As suggested by Iammarino (2010), having a geographical proximity is proved to be a motivating factor for the establishment of new collaborations between university and industry, especially when knowledge intended to be transferred has a tacit nature. It is key to boosting the regional innovation ecosystem and its advantages rises more when the collaborative activity is related to the development of a defense technology, because of confidentiality restrictions.

   Recommendation: As stated in the Action Plan of YÖK, government can provide incentives to universities, industrial firms, and SMEs in a certain region to make them have an existence in the same technology development area or a technoparc based on their thematic areas. (Turkey's Council of Higher Education, 2021)Technoparcs can be formed at certain technology areas so that research conducted by the research institutions at those technoparcs can appeal more to the needs of industry operating in those areas. Firms can also open research centers at the technoparcs specialized on their sectors and thematic areas, so that university-industry research teams can work side by side in a more focused manner. It brings more efficient and focused work setting by eliminating the waste of time for knowledge transfer besides providing firms with additional tax incentives.

5. Academicians indicated that they encounter problems related to financial support given by the government for UIC projects. Funds provided by TÜBİTAK for projects start to remain insufficient to cover the related expenses of the projects. In addition, payments are made with delays. Both university and industry agreed that most of the machinery and equipment used for the projects are imported in USD, but government funds are in TRY. Because of the recent depreciation in the local currency, the amount of funds provided in frame of TÜBİTAK grant programs targeting UIC started to stay insufficient. They also stated that the time they spend on filling the application form does not worth to the grant itself. Grants have a lack of strategic focus in terms of technology areas and control mechanism regarding the results of the projects funded.

Recommendation: The amount of grant allocated for each project should be increased, while decreasing the number of grant programs. Grants should be provided by prioritizing strategic sectors and dual-use technologies with military and civilian applications. There should be a control mechanism enabling the results of the granted projects to be objectively evaluated so that failures can be punished and achievements can be rewarded in order to enhance the overall motivation of the project owners for getting more desirable outcomes. Application forms for grants should be shortened and simplified so that researchers do not demotivate by spending too much time for filling them. In addition, scholarships for PhD students provided by TÜBİTAK should also be increased to the level where they can be competitive against the salaries in private sector.

6.2.3. Strategy Recommendations for the Case Study

1. As a way of educational collaboration of university and industry, post-graduate studies of the employees are encouraged by the firm in our case study. Especially the permission given by the firm for attending the classes within working hours and using the research facilities of the company for thesis studies are strong motivators for employees who want to start their master or PhD studies like in ASELSAN Academy. However, they are provided with a condition of the thesis topic being relevant to the current working field of the employee. It was observed during the interviews that academicians and even employees find this condition discouraging and some of them see it as a barrier in front of UIC, which they believe should be removed.

   Recommendation: Research needs of the industry should be expressed properly to the university, so that the thesis topics of the employees can be determined based on those needs beforehand. Afterwards, duration of the thesis and project timelines should be matched in order for thesis outcomes to serve to company projects. Employees should not be restricted with their current projects at work while determining their research area but allowed to choose any topic for their thesis studies. They should be deemed worthy for

the post-graduate permission as long as their research areas are within the operational area of the company.

2. Another crucial point as a barrier to UICs is uncertainties related to IPR sharing. According to the responses of the university TTO, firms have a rigid attitude regarding the IP ownership resulting from collaborative projects. As the sole financiers of the contract R&D projects, firms usually see themselves as the natural owner of the resulting IP, which discourage academic partners from participating in a collaboration with the industry. However, in our case, since ASELSAN is a state-owned company, its IPRs also belong to the state (Presidency of Defense Industries - SSB). For this reason, it is actually the government, who is to make the decision on sharing related IPRs with universities. When it comes to royalty sharing, more conflicts might arise since determination of the exact value of a patent in a product or system that comprises many other patents is a very difficult job. In our case study, respondents indicated that royalty shares are calculated by the firm according to the value of the joint patent in the whole product and the university TTO accepts that calculation. However, there is a disagreement on whether the payment is to be paid over the net income or net profit resulting from the sale of the product/system that embodies the joint invention.

   Recommendation: First of all, collaboration agreement should include all the subjects regarding IP rights, authorities, responsibilities in order to eliminate the potential disputes between TTOs. On the agreement, background IP of both sides that can be used during the project should be identified and its owner should be compensated through a license or a royalty. When industry claims full control over resulting IP, university usually makes compensation for its renouncement from IPRs by increasing its price offer for the project. However, academicians will motivate more, if the firm recognizes the contribution of their background IP to the project and agrees to share the ownership of foreground IPRs with them. For the projects with joint IP ownership, industry should be open to discuss the requests of the university about licensing the related IP to third parties in the sectors that university and

firm agree on since universities' expectation of being rewarded for their contribution is very normal and it is a critical income source for the university TTO especially when the invention has strong commercial prospects. In our case, as the owner of all IPRs that belong to ASELSAN, SSB can share the ownership of the IPRs taken as a result of collaborative projects with the partner research university. On the other hand, universities should be aware that commercialization is not easy and all the costs until a product comes to the market are borne by the company. Therefore, royalty shares should be calculated and paid to the university out of the net profit, not income. More importantly, an effective collaboration with a high innovation potential should not be destroyed for having the rights of a single patent.

3. One of the most mentioned discouraging factors by the academicians is that firms' treatment to the university, as if they are their sub-contractors. They put university projects through the same process required by the procurement of a product or service. However, contracts for university projects should not be subject to the same terms as the other procurement contracts of the firm since R&D is a risky task by definition. It was clearly observed during the interviews that academicians are extremely disturbed and demotivated by this situation, which ultimately makes them hesitate to start a new collaborative project with the industry.

   Recommendation: Firms should have a separate contract format to be used for the research deals with universities. Some of the existing terms on the agreement about the sanctions to be imposed by the firm to the university in case of the failure to comply with the project requirements should be bent, in line with the level of riskiness of the relevant research project. In this way, discouragement caused by the pressure on the university research team will disappear, which will reflect on the outcomes in a positive way.

4. Respondents from industry expressed that it is getting harder to allocate time for TEYDEB projects, which they apply together with a university partner because of their workload. Therefore, they cannot make enough time for university collaborations.

Recommendation: In order to encourage employees to collaborate more with universities in their research projects, it can be added to their annual performance evaluation. For example, there can be a performance metric like "the number of collaborative projects completed with a university partner" for certain engineering teams such as design units.

5. Interviews indicate that academicians have difficulty in allocating enough time and energy for industry collaboration projects because of their academic burden, as well as some academicians' administrative responsibilities. Beside these, making scientific publications in prestigious journals scanned by reputable Science Indexes is the main concern of the academicians since it brings the highest point in the evaluation of academic promotion. In addition, cuts made by university administration at certain rates over the fees paid by the industry for contract R&D projects seriously discourage academicians to conduct industry projects.

   Recommendation: Number of industry projects completed successfully should be added to the evaluation criteria of academic promotion. Cut rates applied for the circulating capital of the university should be decreased, so that research team gets more of it and has motivation for more UIC collaboration.

6.3. Limitations of the Study

The outcomes of this study have certain limitations. First of all, applicability of the findings to other industries might be misleading because of different dynamics and nature of defense industry. Moreover, results might show meaningful changes for other defense companies as well.

Secondly, If the number of interviews had been increased, different insights would have been captured regarding the barriers to UICs. Engineers who work at design and project management departments in industry would have brought more diverse views regarding the challenges they face in their university collaborations into the table, if more of them with more diverse experience had been interviewed. It would

enhance the validity of the study and enable more relevant and effective solutions and policy recommendations to related parties.

6.4. Suggestions for Future Research

When the limitations mentioned are considered, it would be important to carry out additional research in other sectors and even other defense companies to compare the findings of this study and add to the body of knowledge on UIC obstacles in the defense industry. More comprehensive research can be conducted by collecting data from different areas of expertise and functions. In addition to these, further studies can be conducted on collaborations of industry with foundation universities, since some of their practices related to projects and academicians show considerable differences with state universities.

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APPENDICIES

A. APPROVAL OF METU HUMAN SUBJECTS ETHICS COMMITTEE

UYGULAMALI ETİK ARAŞTIRMA MERKEZİ
APPLIED ETHICS RESEARCH CENTER

ORTA DOĞU TEKNİK ÜNİVERSİTESİ
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27 OCAK 2023

Konu: Değerlendirme Sonucu

Gönderen: ODTÜ İnsan Araştırmaları Etik Kurulu (İAEK)

İlgi: İnsan Araştırmaları Etik Kurulu Başvurusu

Sayın Prof. Dr. Ahmet YOZGATLIGİL

Danışmanlığını yürüttüğünüz Necla Seyhan AKMAN'ın **"ÜNİVERSİTE-SAVUNMA SANAYİİ İŞBİRLİĞİNDE MOTİVE EDİCİ VE ENGELLEYİCİ FAKTÖRLERİN ANALİZİ: ODTÜ-ASELSAN AR-GE İŞ BİRLİKLERİ ÖRNEĞİ"** başlıklı araştırmanız İnsan Araştırmaları Etik Kurulu tarafından uygun görülerek **0058-ODTUİAEK-2023** protokol numarası ile onaylanmıştır.

Bilgilerinize saygılarımla sunarım.

Prof. Dr. Sibel KAZAK BERUMENT
Başkan

Prof.Dr. İ.Semih AKÇOMAK
Üye

Doç. Dr. Ali Emre Turgut
Üye

Dr. Öğretim Üyesi Şerife SEVİNÇ
Üye

Dr. Öğretim Üyesi Murat Perit ÇAKIR
Üye

Dr. Öğretim Üyesi Süreyya ÖZCAN KABASAKAL
Üye

Dr. Öğretim Üyesi Müge GÜNDÜZ
Üye

B. SEMI-STRUCTURED INTERVIEW QUESTIONS (ENGLISH)

RESEARCH VOLUNTEER PARTICIPATION FORM

This research was conducted by Necla Seyhan Akman, a graduate student of the Department of Science and Technology Policy Studies, Middle East Technical University, under the supervision of Prof. Dr. Ahmet Yozgatlıgil and co-supervision of Prof. Dr. Mehmet Çelik. This form has been prepared to inform you about the research conditions.

What is the purpose of the study?

The aim of the research is to identify challenges faced in University- Defense Industry Collaboration, expectations of the parties from each other, motivators, and demotivators and propose policy suggestions addressing them.

How do we ask you to help us?

If you agree to participate in the research, you are expected to participate in a sample group of 20 to 30 people. During the interviews, which are expected be half an hour long, you will be asked a series of multiple choice and open-ended questions and you will be asked why you gave a specific answer to these questions. During the interview, your answers will be noted.

How will we use the information we collect from you?

Your participation in the research must be entirely voluntary. In the study, no identity or institution identifying information is requested from you. Your answers will be kept completely confidential and evaluated only by researchers. The information obtained from the participants will be evaluated collectively and used in scientific publications.

What you need to know about your participation:

The interview does not contain questions or practices that may cause personal discomfort. However, if you feel bothered for any reason, you can leave the interview anytime you want.

If you would like more information about the research:

At the end of the interview, your questions about the study will be answered. Thank you in advance for your participation in this interview. For more information about

the research, please contact thesis supervisor Prof. Dr. Ahmet Yozgatlıgil (E-mail: ahmety@metu.edu.tr) or graduate student Necla Seyhan Akman (E-mail: necla.akman@metu.edu.tr).

INTERVIEW QUESTIONS TO INDUSTRY SIDE (ASELSAN)

DEMOGRAPHIC INFORMATION

1- Please indicate your age

( ) Below 30 ( ) 30 – 40
( ) 40 – 50 ( ) 50 +

2- Please indicate your gender

( ) Female
( ) Male

3- Department of Graduation

( ) Engineering
( ) Basic Sciences
( ) Social Sciences

4- Please indicate your education level

( ) Graduate Degree ( ) Master's Degree
( ) Doctorate Degree ( ) Other

5- How long have you been in working life?

( ) Less than 5 years ( ) 5 – 10 years
( ) 10 – 20 years ( ) More than 20 years

6- How many years have you been working in your current company?

( ) Less than 5 years ( ) 5 – 10 years
( ) 10 – 15 years ( ) More than 15 years

7- Please indicate your department of work

( ) Design ( ) Program/Project
( ) Production ( ) Other

8- Title (If you mark non-managerial)

( ) Assistant Specialist I-II / Engineer I-II

( ) Specialist I-II / Expert Engineer I-II
( ) Sr. Specialist / Sr. Expert Engineer
( ) Leader / Lead Engineer
( ) Sr. Leader / Sr. Lead Engineer
( ) Manager
( ) Director

QUESTIONS TO PARTICIPANTS TO UNIVERSITY PROJECTS

Do you see the transfer of knowledge from universities as an important part of your work?

( ) unimportant
( ) slightly important
( ) important
( ) very important

How do you evaluate the contribution of university research output to your projects?
( ) Very weak
( ) Poor
( ) Average
( ) Good
( ) Very good

Do you think that your company can sufficiently benefit from the research potential at the universities located in Ankara?
( ) Yes
( ) No

If you say no to the previous question, why do you think it cannot? What can be done to benefit more from the research potential at the universities located in Ankara?

Do you think that you can allocate enough budget for university research collaborations?
( ) Yes
( ) No

If you say no to the previous question, why do you think you cannot?

How do you find the right academic partner for your project?
( ) Academic catalogs (*please specify*)
( ) Personal relationships
( ) Other (*please specify*)

In your opinion, what is the difficulty level of finding the right academic partner for your project?

( ) Very difficult
( ) Difficult
( ) Average
( ) Easy
( ) Very easy

What can be done to avoid this difficulty?

Approximately how many projects with a university partner have you involved so far?

( ) Less than 3
( ) 3 - 5
( ) More than 5

Which joint-activity have you involved with a university so far?

( ) Contracted Research
( ) Joint Research
( ) Joint Patent Application
( ) Co-authored Research Publication
( ) Other

At which level do you work with the universities most?

( ) Between TRL 1 – 2
( ) Between TRL 3 – 4
( ) Between TRL 5 - 6
( ) Between TRL 7 - 8

To what extent does the research output come from universities is applicable to your projects? *(1=min, 5=max)*

( ) 1
( ) 2
( ) 3
( ) 4
( ) 5

Do you believe that you clearly defined and expressed technical requirements and expectations of the project to the researchers beforehand?

( ) Yes
( ) No

In your opinion, to what extent do these factors have an impact on success of collaborative research activities with universities?

	No Impact	Little Impact	Considerable Impact	Huge Impact
Shared goals				
Building trust				
Clear objectives				
Open communication				
Perceived know-how gaps between parties				
Time and resource limitations				

As an industry partner, what are your main expectations from your academic partners?

1.
2.
3.

Do you believe that your research partners in academia meet your expectations?

( ) Yes
( ) No

Do you think that geographical proximity to the universities have an impact on the effectiveness on UIC?

( ) Yes
( ) No

Can you support your answer with an example?

How do you grade the performance of your research partners in academia at meeting the requirements of the joint research projects? ***(1=min, 5=max)***

( ) 1
( ) 2
( ) 3
( ) 4
( ) 5

In your opinion, does the academician in the contract works himself for your project or he assigns it to his research assistants? How do you comment on this?

How do you evaluate the performance of researchers in your projects?

( ) More than expected
( ) Expected
( ) Less than expected

How was your communication with your contacts in the university during the projects?

( ) Open and healthy
( ) Average
( ) Poor

What are the main challenges that you have faced during your university research projects?

What do you think about which part is more responsible from the problems arise during projects?

( ) Mostly university
( ) Mostly industry
( ) Equally responsible

Have those problems successfully solved? By whose efforts mostly?

( ) Mostly university
( ) Mostly industry
( ) Equally responsible

In your opinion, to what extent do the factors below are potential problem sources for UIC?

	Never	Sometimes	Usually	Always
Financial constraints				
Communication failures				
Violation of deadlines				
Bureaucratic burdens				
Know-how gaps				
Cultural differences				
Unrealistic financial expectations				
IP Sharing				
Non-clearly defined expectations				

Have you ever experienced a situation that a university project ends up with an invention?

( ) Yes
( ) No

If yes, did you file a joint patent application for your joint invention?

( ) Yes
( ) No

Have you ever encountered a problem/dispute with the university side regarding the arising economic benefits / costs of the patenting? Can you explain it?

( ) Yes
( ) No

To what extent does the ASELSAN technology transfer professionals take part in the solution of any of these problems? ***(1=min, 5=max)***

( ) 1
( ) 2
( ) 3
( ) 4
( ) 5

How would you grade your company's research infrastructure in terms of enabling successful projects with universities? ***(1=min, 5=max)***

( ) 1
( ) 2
( ) 3
( ) 4
( ) 5

Have you ever faced with a problem about Non-disclosure agreement process with the university TTO? What was it?

( ) Yes
( ) No

Have you ever had any suspect that confidentiality rules on the NDA are violated by university side? What happened afterwards?

( ) Yes
( ) No

Do you think that you have had trust issues to your research partners in the university side? Why do you think you had such an impression?

( ) Yes
( ) No

Do you think that you have a decent and open communication with your research partners in the university? What was key for establishing such a relationship?

( ) Yes
( ) No

Do you believe that R&D policies of your company encourage collaborative work with universities? Can you give an example for that?

( ) Yes
( ) No

Which practices/policies in your company encourage you for working with universities?

Which practices/bureaucratic processes in your company discourage you from working with universities?

What would you change in collaboration process, if you can?

Do you think that academicians can allocate enough time for industry projects, besides their academic burden?

( ) Yes
( ) No

Do you think that academicians find amount of research grants provided by ASELSAN to universities satisfying?

( ) Yes
( ) No

Do you think that academicians are demotivated because of the fee cut out of their research grants by university administration?

( ) Yes
( ) No

What can be done in order to avoid that situation?

Do you find attitude of university administration to industry collaboration supportive?

( ) Yes
( ) No

What role did university TTO play before, during, and after the project? How would you evaluate its general performance?

Do you think that government provides enough incentives for UIC?

( ) Yes
( ) No

In your opinion, how important is each function of government for university-industry collaboration?

	Unimportant	Slightly Important	Important	Very Important
Funding for R&D projects				
Rule-setting for state universities				
Formation of IP laws				
Providing infrastructure				
Enhancing networking				

Have you ever carried out a project funded by a TÜBİTAK TEYDEB Grant Program? Which program that was?

( ) Yes
( ) No

Have you ever encountered a problem regarding the Grant program? What was it about?

( ) the application process
( ) working with the researchers in harmony
( ) meeting project requirement
( ) financial issues

Do you think that the Grant was financially enough to cover the expenses related to the project?

( ) Yes
( ) No

What would be your recommendations to public authorities for encouraging UIC?

QUESTIONS TO GRADUATE-LEVEL STUDENTS AND GRADUATES

How did you decide on your thesis topic?

How would you assess your communication with your thesis advisor? *(1=min, 5=max)*

( ) 1
( ) 2
( ) 3
( ) 4
( ) 5

Have you ever faced with a difficulty on working and studying at the same time? How could you handle it?

( ) Yes
( ) No

Could you manage to finish your graduate study on time?

( ) Yes
( ) No

In your opinion, to what extent does your thesis contribute to your work at ASELSAN? *(1=min, 5=max)*

( ) 1
( ) 2
( ) 3
( ) 4
( ) 5

How would you evaluate your advisor's attention and contribution to your thesis? ***(1=min, 5=max)***

( ) 1
( ) 2
( ) 3
( ) 4
( ) 5

Do you believe that your company is supportive about employees' graduate studies?

( ) Yes
( ) No

Did your thesis end up with an invention?

( ) Yes
( ) No

If yes, what was it?

( ) Patent application
( ) Utility model application
( ) Design application
( ) Scientific publication
( ) Other

Did an IP revenue sharing agreement signed between your company and your university?

( ) Yes
( ) No

Do you know whether your advisor will get any royalty income out of the co-invention?

( ) Yes
( ) No

How would you evaluate the contribution of Technology Transfer and legal team in your company to the process? ***(1=min, 5=max)***

( ) 1
( ) 2
( ) 3
( ) 4
( ) 5

QUESTIONS TO TECHNOLOGY TRANSFER & LEGAL TEAM

What is the most frequent problem that you encounter regarding IP sharing in contracted projects with universities?

What is the most frequent problem that you encounter regarding IP sharing in employees' graduate studies?

Do you have any idea on which problems do other defense firms encounter in IP sharing with universities? Are the problems similar with yours?
( ) Yes
( ) No

Who do you usually contact and compromise with for finding a common ground during IP sharing negotiations?
( ) University TTO
( ) Academicians

How would you describe the attitude of the university TTO during those negotiations?

Do you think that the challenges you have encountered are caused by legal gaps in IP law? Could these problems be prevented if there were more clear/definitive law enforcements?
( ) Yes
( ) No

What would your recommendations to the university TTO, the academicians involved in collaboration with ASELSAN, and to your colleagues in ASELSAN to improve the process?

INTERVIEW QUESTIONS TO UNIVERSITY SIDE (METU)

Not: Please consider ASELSAN as "industry".

ACADEMICIANS WHO TAKE PART IN CONTRACTED PROJECTS OF ASELSAN

Approximately how many projects with an industry partner have you involved so far?
( ) Less than 3
( ) 3 - 5
( ) More than 5

Which joint-activity have you involved with industry so far?
( ) Contracted Research
( ) Joint Research
( ) Joint Patent Application
( ) Co-authored Research Publication
( ) Other

In your opinion, how important is the knowledge generated in universities for industry projects?
( ) unimportant

( ) slightly important
( ) important
( ) very important

How do you evaluate the contribution of university research output to industry projects?
( ) Very weak
( ) Poor
( ) Average
( ) Good
( ) Very good

At which level do you work with the industry most?
( ) Between TRL 1 – 2
( ) Between TRL 3 – 4
( ) Between TRL 5 - 6
( ) Between TRL 7 - 8

What were the main challenges you faced during industry projects?

Have those problems successfully solved? By whose efforts mostly?
( ) Mostly university
( ) Mostly industry
( ) Equal

What do you think about which part is more responsible from the problems arise during projects?
( ) Mostly university
( ) Mostly industry
( ) Equally responsible

In your opinion, to what extent do the factors below are potential problem sources?

	Never	Sometimes	Usually	Always
Financial constraints				
Communication failures				
Violation of deadlines				
Bureaucratic burdens				
Know-how gaps				
Cultural differences				
Unrealistic financial expectations				
IP Sharing				
Non-clearly defined expectations				

In your opinion, to what extent does the research output is applicable to products/systems of the company? *(1=min, 5=max)*

( ) 1
( ) 2
( ) 3
( ) 4
( ) 5

In your opinion, were the research grants provided by the company economically satisfying?

( ) Yes
( ) No

How was your communication with your contacts in the industry during the projects?

( ) Open and healthy communication
( ) Average
( ) No communication at all

Do you believe that technical requirements and expectations of the project are clearly expressed by the company beforehand?

( ) Yes
( ) No

Have you ever felt academically restricted or had any concern about your academic freedom while working with the industry?

( ) Yes
( ) No

In your opinion, to what extent do these factors have an impact on success of collaborative research activities?

	Never	Sometimes	Usually	Always
Shared goals				
Building trust				
Clear objectives				
Open communication				
Perceived know-how gaps between parties				
Time and resource limitations				

As an industry partner, what are your main expectations from your industry partners?

1.
2.
3.

Do you believe that your research output meets the expectations of industry?

( ) Yes
( ) No

How do you grade the performance of your research team at meeting the requirements of the industry projects? ***(1=min, 5=max)***

( ) 1
( ) 2
( ) 3
( ) 4
( ) 5

To what extent did the industry meet your expectations from the collaboration?
( ) More than expected
( ) Expected
( ) Less than expected

Do you think that industry makes enough effort to transfer knowledge from universities?
( ) Yes
( ) No

Do you think that geographical proximity to the universities have an impact on the effectiveness on collaboration?
( ) Yes
( ) No

Can you support your answer with an example?

Did you carry out projects with other defense companies as well?
( ) Yes
( ) No

How was your experience with them, compared to ASELSAN? Why?
( ) Better
( ) Same
( ) Worse

Have you ever experienced a situation that an industry project ends up with an invention?
( ) Yes
( ) No

If yes, did you file a joint IP application for your joint invention?
( ) Yes
( ) No

Have you ever encountered a problem/dispute with the industry side regarding the arising economic benefits / costs of the patenting? Can you explain it?
( ) Yes
( ) No

To what extent does the university TTO take part in the solution of any of these problems? *(1=min, 5=max)*

( ) 1
( ) 2
( ) 3
( ) 4
( ) 5

How would you grade the company's research infrastructure in terms of enabling successful collaborative projects with universities? ***(1=min, 5=max)***
( ) 1
( ) 2
( ) 3
( ) 4
( ) 5

Have you ever faced with a problem about Non-disclosure agreement process? What was it?
( ) Yes
( ) No

Do you find the attitude of university administration to industry collaboration supportive?
( ) Yes
( ) No

In your opinion, what are the areas for improvement regarding university and company policies in order to boost the effectiveness of UIC?

Do you think that you can allocate enough time for industry projects, besides your academic burden?
( ) Yes
( ) No

Do you think that you are demotivated because of the fee cut by university administration out of industry research grants?
( ) Yes
( ) No

What can be done in order to avoid that situation?

Have you ever discontinued to an industry project? If yes, what was the reason for that?
( ) Yes
( ) No

How did university TTO support you before, during, and after the project? How would you evaluate its general performance?

Do you think that government provides enough incentives to industry to collaborate with universities?

( ) Yes
( ) No

Have you ever carried out a project funded any TÜBİTAK TEYDEB Grant Program? Which program that was?
( ) Yes
( ) No

If yes, have you ever encountered a problem regarding the Grant program? What was it about?
( ) the application process
( ) working with the researchers in harmony
( ) meeting project requirement
( ) financial issues

Do you think that the Grant was financially enough to cover the expenses related to the project?
( ) Yes
( ) No

What would be your recommendations to public authorities for encouraging UIC?

ASELSAN EMPLOYEES' THESIS ADVISORS

In your opinion, for working students, what are the advantages of carrying out their thesis studies in their working areas?

Have you ever involved in an industry thesis study that results in an invention?
( ) Yes
( ) No

Did you already have an IP Sharing agreement prior to the invention, or did you make the agreement after the invention comes out?

Did you face with any challenges during IP negotiations with the industry side or your university TTO? If yes, what were they?
( ) Yes
( ) No

How was your thesis student's attitude, and the company's standing during the agreement process?

Do you think that you got a fair royalty share out of your co-invention in the end? Why?
( ) Yes

( ) No

Did the overall study satisfying for you in terms of the success of your student, opportunities provided by the company? How so?
( ) Yes
( ) No

UNIVERSITY TTO (METU TTO)

What is the most frequent problem that you have encountered regarding IP sharing in contracted projects of the company (ASELSAN)?

What is the most frequent problem that you encounter regarding IP sharing in graduate studies of working students?

Who do you usually negotiate and compromise with for finding a common ground in the company?
( ) TTM
( ) Legal Affairs
( ) Students / Project Managers

How would you define attitude of the company during those negotiations? How does it differentiate from the attitude of other defense firms?

Do you think that there are legal gaps or a need for more clear/definitive law enforcements in order to prevent the challenges you have encountered?
( ) Yes
( ) No

Do you have difficulties for finding an industry partner for commercialization of research output in your university?
( ) Yes
( ) No

Do you have any expectation from the industry side at this subject?

What would your expectations from ASELSAN TTO, the academicians involved in collaboration with ASELSAN, and to R&D partners in ASELSAN on improving this whole process?

C. SEMI-STRUCTURED INTERVIEW QUESTIONS (TURKISH)

ARAŞTIRMAYA GÖNÜLLÜ KATILIM FORMU

Bu araştırma, ODTÜ Bilim ve Teknoloji Politikası Çalışmaları Bölümü Yüksek Lisans öğrencisi Necla Seyhan Akman tarafından Prof. Dr. Ahmet Yozgatlıgil ve Prof. Dr. Mehmet Çelik danışmanlığındaki yüksek lisans tezi kapsamında yürütülmektedir. Bu form sizi araştırma koşulları hakkında bilgilendirmek için hazırlanmıştır.

Çalışmanın Amacı Nedir?

Savunma sektöründeki Üniversite - Sanayi İşbirliklerinde karşılaşılan zorlukları, aksayan yönleri, tarafların birbirinden beklentilerini ve tarafları motive ve demotive eden unsurları tespit ederek bunları adresleyen çözüm önerileri sunmaktır.

Bize Nasıl Yardımcı Olmanızı İsteyeceğiz?

Araştırmaya katılmayı kabul ederseniz, sizden 20 ila 30 kişiden oluşan bir örneklem grubuna katılmanız beklenmektedir. Yaklaşık olarak yarım saat sürmesi beklenen mülakatlarda sizlere bir dizi çoktan seçmeli ve açık uçlu soru yöneltilecek ve bu sorulara neden belirli bir cevap verdiğiniz sorulacaktır. Mülakat sırasında cevaplarınız not edilecektir.

Sizden Topladığımız Bilgileri Nasıl Kullanacağız?

Araştırmaya katılımınız tamamen gönüllülük temelinde olmalıdır. Çalışmada sizden kimlik belirleyici hiçbir bilgi istenmemektedir. Cevaplarınız tamamıyla gizli tutulacak ve sadece araştırmacılar tarafından değerlendirilecektir. Katılımcılardan elde edilecek bilgiler toplu halde değerlendirilecek ve bilimsel yayımlarda kullanılacaktır.

Katılımınızla ilgili bilmeniz gerekenler:

Mülakat, genel olarak kişisel rahatsızlık verecek sorular veya uygulamalar içermemektedir. Ancak, katılım sırasında kendinizi rahatsız hissederseniz istediğinizde çıkmakta serbestsiniz.

Araştırmayla ilgili daha fazla bilgi almak isterseniz:

Mülakat sonunda, bu çalışmayla ilgili sorularınız cevaplanacaktır. Bu çalışmaya katıldığınız için şimdiden teşekkür ederiz. Çalışma hakkında daha fazla bilgi almak için ODTÜ Makine Mühendisliği öğretim üyelerinden Prof. Dr. Ahmet Yozgatlıgil (E-posta: ahmety@metu.edu.tr) ya da yüksek lisans öğrencisi Necla Seyhan Akman (E-posta: necla.akman@metu.edu.tr) ile iletişim kurabilirsiniz.

SANAYİ TARAFININ (ASELSAN) MÜLAKAT SORULARI

DEMOGRAFİK BİLGİ

1- Yaşınız

( ) 30 altı ( ) 30 – 40
( ) 40 – 50 ( ) 50 +

2- Cinsiyetiniz

( ) Kadın
( ) Erkek

3- Mezun olduğunuz bölüm

( ) Mühendislik
( ) Temel bilimler
( ) Sosyal bilimler

4- Mezuniyet dereceniz

( ) Lisans ( ) Yüksek Lisans
( ) Doktora ( ) Diğer

5- Kaç yıldır çalışma hayatındasınız?

( ) 5 yıldan az ( ) 5 – 10 yıl
( ) 10 – 20 yıl ( ) 20 yıldan fazla

6- ASELSAN'da kaç yıldır çalışıyorsunuz?

( ) 5 yıldan az ( ) 5 – 10 yıl
( ) 10 – 15 yıl ( ) 15 yıldan fazla

7- Hangi departmanda çalışıyorsunuz?

( ) Tasarım ( ) Program/Proje
( ) Üretim ( ) Diğer

8- Unvanınız (Yönetim dışını seçtiyseniz)

( ) Uzman yardımcısı I-II / Mühendis I-II
( ) Uzman I-II / Uzman Mühendis I-II
( ) Kıdemli Uzman / Kıdemli Uzman Mühendis
( ) Lider / Lider Mühendis
( ) Kıdemli Lider / Kıdemli Lider Mühendis
( ) Müdür
( ) Direktör

ÜNİVERSİTEYLE PROJE YÜRÜTMÜŞ ÇALIŞANLARA SORULACAK SORULAR

Not: Lütfen soruları cevaplandırırken Üniversite olarak sadece ODTÜ'yü göz önünde bulundurunuz.

Üniversiteden sanayiye olan bilgi ve know-how transferinin işleriniz için önem derecesini nasıl değerlendiriyorsunuz?

( ) önemsiz
( ) bir miktar önemli
( ) önemli
( ) çok önemli

Üniversite araştırmalarının çıktılarının projelerinize olan katkısını nasıl değerlendirirsiniz?
( ) Çok zayıf
( ) Zayıf
( ) Ortalama
( ) İyi
( ) Çok iyi

Şirketinizin Ankara'da bulunan üniversitelerdeki araştırma potansiyelinden yeteri kadar faydalandığını düşünüyor musunuz?
( ) Evet
( ) Hayır

Cevabınız hayır ise, sebebini açıklar mısınız? Sizce şirketiniz Ankara'daki üniversitelerin araştırma potansiyelinden nasıl daha fazla faydalanabilir?

Üniversite araştırma projeleri için yeteri kadar bütçe ayırabiliyor musunuz?
( ) Evet
( ) Hayır

Cevabınız hayır ise, sebebini açıklar mısınız?

Projeniz için doğru akademik partneri nasıl buluyorsunuz?
( ) Akademik kataloglar (*lütfen belirtiniz*)
( ) Kişisel bağlantılar
( ) Diğer (*lütfen belirtiniz*)

Sizce üzerinde çalıştığınız proje için akademide doğru kontağı bulmanın zorluk derecesi nedir?
( ) Çok zor
( ) Zor
( ) Ortalama
( ) Kolay
( ) Çok kolay

Bu zorluğu aşmak için neler yapılabilir?

Bugüne kadar kaç üniversite projesinde yer aldınız?
( ) 3'ten az
( ) 3 - 5
( ) 5'ten fazla

Bugüne kadar bir üniversite ile hangi ortak aktivitelerde bulundunuz?
( ) Sözleşmeli Araştırma
( ) Ortak Araştırma
( ) Ortak Patent
( ) Ortak Bilimsel Yayın
( ) Diğer

Üniversitelerle en çok hangi teknoloji hazırlık seviyelerinde çalışıyorsunuz?
( ) THS 1 – 2 arasında
( ) THS 3 – 4 arasında
( ) THS 5 – 6 arasında
( ) THS 7 – 8 arasında

Üniversiteden gelen araştırma çıktılarının projelerinizde kullanılabilirliğini puanlayınız. *(1=min, 5=max)*
( ) 1
( ) 2
( ) 3
( ) 4
( ) 5

Proje başlangıcından önce projeyle ilgili teknik gereksinimleri ve beklentilerinizi karşı taraf ile eksiksiz bir şekilde paylaştığınızı düşünüyor musunuz?
( ) Evet
( ) Hayır

Sizce aşağıdaki faktörlerin her biri üniversite iş birliği projelerinizin başarısını ne derece etkiliyor?

	Hiç etkilemiyor	Az etkiliyor	Ciddi manada etkiliyor	Çok fazla etkiliyor
Ortak misyon ve hedefler				
Karşılıklı güven tahsisi				
Hedeflerin açık ve net olması				
Açık iletişim				
Karşı tarafın proje için yetersiz olduğu algısı				
Zaman ve kaynak kısıtları				

Sanayi tarafı olarak, üniversite sanayi iş birliğinde akademik ortağınızdan beklentileriniz nelerdir?

1.
2.
3.

Akademideki araştırma ortaklarınızın, beklentilerinizi karşılamada yeterli olduğunu düşünüyor musunuz?

( ) Evet
( ) Hayır

Üniversite ile lokasyon olarak yakın olmanın ya da aynı kampüste bulunmanın, iş birliğinin etkinliğine bir etkisi olduğunu düşünüyor musunuz?

( ) Evet
( ) Hayır

Cevabınızı bir örnekle açıklar mısınız?

Akademideki araştırma ekiplerinin proje gereksinimlerini karşılamadaki performansını nasıl değerlendirirsiniz? *(1=min, 5=max)*

( ) 1
( ) 2
( ) 3
( ) 4
( ) 5

Sizce sözleşmeyi yaptığınız hoca projeniz için bizzat kendisi mi çalışıyor yoksa asistanlarından birini mi görevlendiriyor? Bu durumu nasıl değerlendiriyorsunuz?

Aynı projede yer aldığınız akademik ekiplerin projeye katkısını Teknik bilgi, uzmanlık ve know-how açısından nasıl değerlendirirsiniz?

( ) Beklenenin üzerinde
( ) Beklenen seviyede
( ) Beklenenin altında

Proje süresince üniversitedeki kontaklarınızla olan iletişimiz nasıldı?
( ) Açık ve sağlıklı
( ) Ortalama
( ) Zayıf

Üniversite projelerinde karşılaştığınız temel zorluklar nelerdir?

Projede çıkan sorunlardan hangi taraf daha sorumluydu?
( ) Çoğunlukla Üniversite
( ) Çoğunlukla Endüstri
( ) Eşit derecede sorumlu

Bu sorunlar başarılı bir şekilde çözüldü mü? Çoğunlukla hangi tarafın çabalarıyla?
( ) Çoğunlukla Üniversite
( ) Çoğunlukla Sanayi
( ) Eşit derecede

Sizce üniversite projelerinde aşağıdaki faktörlerin her biri ne derece sorun teşkil ediyor?

	Hiçbir zaman	Bazen	Genellikle	Her zaman
Finansal Kısıtlar				
İletişim Sorunları				
Bitiş tarihlerine uyulmaması				
Bürokratik Süreçler				
Know-how farkları				
Kültürel farklılıklar				
Gerçekdışı finansal beklentiler				
Fikri hak paylaşımı				
Net olarak ifade edilmeyen beklentiler				

Hiç sonunda buluş çıkan bir üniversite projesinde yer aldınız mı?
( ) Evet
( ) Hayır

Evetse, buluş için ortak patent başvurusunda bulundunuz mu?
( ) Evet
( ) Hayır

Patent başvurusu için ödenecek giderler/ elde edilecek gelirler özelinde bir anlaşmazlık yaşadınız mı? Açıklayabilir misiniz?
( ) Evet
( ) Hayır

Şirketinizdeki Teknoloji transfer ekibi bu sorunların çözümünde ne derece yer aldı? ***(1=min, 5=max)***

( ) 1
( ) 2
( ) 3
( ) 4
( ) 5

Şirketinizin araştırma alt yapılarını üniversite iş birliği projeleri açısından ne derece yeterli buluyorsunuz? ***(1=min, 5=max)***

( ) 1
( ) 2
( ) 3
( ) 4
( ) 5

Üniversite TTO'suyla NDA anlaşması veya başka bir konuda sorun yaşadığınız oldu mu? Olduysa neydi?

( ) Evet
( ) Hayır

Projeye dair gizlilik kurallarının üniversite tarafından ihlal edildiği şüphesi hiç yaşadınız mı? Sonrasında ne oldu?

( ) Evet
( ) Hayır

Üniversite tarafındaki proje ortaklarınızla ilgili herhangi bir konuda güven sorunu yaşadığınız oldu mu? Bu şekilde düşünmenize sebep olan neydi?

( ) Evet
( ) Hayır

Üniversitedeki proje ortaklarınızla açık ve çift yönlü iletişim tahsis edilebilmiş miydi? Sizce bu şekilde bir ilişki kurabilmenin anahtarı nedir?

( ) Evet
( ) Hayır

Şirketinizin Ar-Ge süreçlerinin üniversite iş birliklerini motive edici nitelikte olduğunu düşünüyor musunuz?

( ) Evet
( ) Hayır

Şirketinizin hangi politikalarının üniversite işbirliğine teşvik edici nitelikte olduğunu düşünüyorsunuz?

Şirketinizdeki hangi bürokratik süreçlerin, üniversite iş birliklerini sekteye uğrattığını düşünüyorsunuz?

Değiştirebilecek olsaydınız, işbirliği sürecinde neleri değiştirmek isterdiniz?

Akademisyenlerin, ders yüklerinin yanında sanayi projeleri için yeterli zaman ayırabildiğini düşünüyor musunuz?
( ) Evet
( ) Hayır

ASELSAN tarafından verilen araştırma desteğini, akademisyenlerin yeterli bulduğunu düşünüyor musunuz?
( ) Evet
( ) Hayır

Akademisyenlerin, sanayi projelerinden gelen gelirden üniversite döner sermayesi için kesinti yapılmasından dolayı demotive olduğunu düşünüyor musunuz?
( ) Evet
( ) Hayır

Sizce bu durum nasıl çözülebilir?

Üniversite yönetiminin sanayi işbirliğine olan yaklaşımını destekleyici buluyor musunuz?
( ) Evet
( ) Hayır

Üniversite TTO'su projelerinizin başlangıcında, proje süresince ve tamamlandıktan sonra nasıl bir rol oynadı? Genel katkısını ve performansını nasıl değerlendirirsiniz?

Kamunun Üniversite sanayi iş birliğine yeterli teşvik sağladığını düşünüyor musunuz?
( ) Evet
( ) Hayır

Hiç TÜBİTAK TEYDEB desteği alan bir projede yer aldınız mı? Hangi destek programıydı?
( ) Evet
( ) Hayır

Aldıysanız bu süreçte herhangi bir sorunla karşılaştınız mı? Sorun neyle ilgiliydi?
( ) başvuru süreci
( ) tarafların uyum içinde çalışması
( ) proje gereksinimlerinin zamanında karşılanması
( ) finansal sorunlar

Sağlanan desteğin projenin tamamlanabilmesi için yeterli olduğunu düşünüyor musunuz?
( ) Evet
( ) Hayır

Üniversite Sanayi İşbirliğinin geliştirilmesi için kamu tarafına verebileceğiniz öneriler ne olurdu?

LİSANSÜSTÜ ÖĞRENCİLERİNE VE MEZUNLARA SORULACAK SORULAR

Tez konunuza nasıl karar verdiniz?

Tez danışmanınızla olan iletişimizi nasıl değerlendirirsiniz? *(1=min, 5=max)*
( ) 1
( ) 2
( ) 3
( ) 4
( ) 5

Aynı anda hem çalışıp hem de yüksek lisans yapma konusunda zorluk çektiniz mi? Bu durumu nasıl yönettiniz?
( ) Evet
( ) Hayır

Lisansüstü eğitiminizi zamanında tamamlayabildiniz mi?
( ) Evet
( ) Hayır

Sizce teziniz ASELSAN'da çalışmakta olduğunuz alana ne derece katkı sağlamakta? *(1=min, 5=max)*
( ) 1
( ) 2
( ) 3
( ) 4
( ) 5

Tez danışmanınızın tezinize olan ilgi ve katkısını nasıl değerlendirirsiniz? *(1=min, 5=max)*
( ) 1
( ) 2
( ) 3
( ) 4
( ) 5

Şirketinizi çalışanları lisansüstü eğitimlerine devam etmeleri konusunda destekleyici buluyor musunuz?
( ) Evet
( ) Hayır

Teziniz bir buluşa dönüştü mü?
( ) Evet
( ) Hayır

Evet ise, ne idi?
( ) Patent başvurusu
( ) Faydalı model başvurusu
( ) Tasarım başvurusu
( ) Bilimsel yayın
( ) Diğer

Şirketiniz ve üniversiteniz arasında buluşunuzla ilgili bir Fikri Hak Sözleşmesi imzalanmış mıydı?
( ) Evet
( ) Hayır

Tez danışmanınızın ortak buluşunuz üzerinden herhangi bir royalti geliri elde edip etmeyeceğini biliyor musunuz?
( ) Evet
( ) Hayır

Şirketinizdeki Teknoloji Transfer Müdürlüğü ve Ar-Ge Sözleşmeler Müdürlüğü'nün bu sürece olan katkısını nasıl değerlendirirsiniz?
( ) 1
( ) 2
( ) 3
( ) 4
( ) 5

TEKNOLOJİ TRANSFER VE AR-GE SÖZLEŞMELER MÜDÜRLÜĞÜNE SORULAR

Üniversitelere verilen sözleşmeli projeler kapsamında ortaya çıkan buluşlarla ilgili en sık karşılaştığınız sorunlar nelerdir?

Çalışanların lisansüstü tezlerinde ortaya çıkan buluşlarla ilgili en sık karşılaştığınız sorunlar nelerdir?

Diğer savunma şirketlerinin üniversitelerle fikri hak paylaşımıyla ilgili ne gibi sorunlar yaşadığına dair bir fikriniz var mı? Sizin karşılaştığınız problemlere benziyor mu?

Bu tarz sorunları aşmak için genelde hangi taraf ile görüşüp ortak payda buluyorsunuz?
( ) Üniversite TTO'su
( ) Akademisyenler

Üniversite TTO'sunun bu süreçler sırasındaki tavrını ve çözüm odaklılığını nasıl tarif edersiniz?

Karşılaştığınız sorunların herhangi bir hukuki boşluktan kaynaklı olduğunu düşünüyor musunuz? Daha açıklayıcı ve net kanunlar ile bu sorunların önüne geçilebilir miydi?

( ) Evet
( ) Hayır

Sürecin iyileştirilmesi için üniversite TTO'suna, ASELSAN ile proje yürüten akademisyenlere ve ASELSAN'daki lisansüstü öğrencileri ve proje yöneticilerine önerileriniz ne olurdu?

ÜNİVERSİTE TARAFINA (ODTÜ) SORULAR

Not: Lütfen soruları cevaplandırırken Sanayi olarak sadece ASELSAN'ı göz önünde bulundurunuz.

ASELSAN'IN SÖZLEŞMELİ PROJELERİNDE YER ALAN AKADEMİSYENLER

Bugüne kadar yer aldığınız sanayi projesi sayısını belirtiniz.
( ) 3'ten az
( ) 3 – 5 arası
( ) 5'ten fazla

Bugüne kadar sanayi ile hangi işbirliği faaliyetlerinde yer aldınız?
( ) Sözleşmeli Araştırma
( ) Ortak Araştırma
( ) Ortak Patent
( ) Ortak Bilimsel Yayın
( ) Diğer

Sizce üniversitelerde üretilen bilimsel bilginin sanayi projeleri için önem derecesi nedir?
( ) önemsiz
( ) bir miktar önemli
( ) önemli
( ) çok önemli

Üniversitelerde yürütülen araştırma çıktılarının sanayi projelerine olan katkısını nasıl değerlendirirsiniz?
( ) Çok zayıf
( ) Zayıf
( ) Ortalama
( ) İyi
( ) Çok iyi

Yer aldığınız sanayi projeleri genellikle hangi THS aralığındaydı?
( ) THS 1 – 2 arasında
( ) THS 3 – 4 arasında
( ) THS 5 – 6 arasında
( ) THS 7 – 8 arasında

Sanayi projelerinde karşılaştığınız temel zorluklar nelerdi?

Projede çıkan sorunlardan hangi taraf daha sorumluydu?

( ) Çoğunlukla Üniversite
( ) Çoğunlukla Endüstri
( ) Eşit derecede sorumlu

Bu sorunlar başarılı bir şekilde çözüldü mü? Çoğunlukla hangi tarafın çabalarıyla?
( ) Çoğunlukla Üniversite
( ) Çoğunlukla Sanayi
( ) Eşit derecede

Sizce üniversite projelerinde aşağıdaki faktörlerin her biri ne derece sorun teşkil ediyor?

	Hiçbir zaman	Bazen	Genellikle	Her zaman
Finansal Kısıtlar				
İletişim Sorunları				
Bitiş tarihlerine uyulmaması				
Bürokratik Süreçler				
Know-how farkları				
Kültürel farklılıklar				
Gerçekdışı finansal beklentiler				
Fikri hak paylaşımı				
Net olarak ifade edilmeyen beklentiler				

Üniversite araştırma çıktılarının sanayi projelerinde direk kullanılabilirliğini nasıl değerlendirirsiniz? *(1=min, 5=max)*
( ) 1
( ) 2
( ) 3
( ) 4
( ) 5

Sanayi tarafından sözleşmeli projeler için sağlanan ödeneği yeterli buluyor musunuz?
( ) Evet
( ) Hayır

Proje süresi boyunca sanayideki proje kontaklarınızla olan iletişiminiz sizin açınızdan nasıldı?
( ) Açık ve sağlıklı
( ) Ortalama
( ) İletişimimiz yoktu

Sanayi tarafının proje başlangıcından önce projeyle ilgili teknik gereksinimleri ve beklentilerini sizle eksiksiz bir şekilde paylaştığını düşünüyor musunuz?

( ) Evet
( ) Hayır

Sanayi ile birlikte yürüttüğünüz çalışmalarda akademik özgürlüğünüzün kısıtlandığına dair bir endişe yaşadınız mı?
( ) Evet
( ) Hayır

Sizde aşağıdaki faktörlerin her biri sanayi iş birliği projelerinizin başarısını ne derece etkiliyor?

	Hiçbir zaman	Bazen	Genellikle	Her zaman
Ortak misyon ve hedefler				
Karşılıklı güven tahsisi				
Hedeflerin açık ve net olması				
Açık iletişim				
Karşı tarafın proje için yetersiz olduğu algısı				
Zaman ve kaynak kısıtları				

Üniversite tarafı olarak, üniversite sanayi iş birliğinde sanayi ortağınızdan beklentileriniz nelerdir?
1.
2.
3.

Proje sonundaki araştırma çıktılarınızın sanayinin beklentilerini karşıladığını düşünüyor musunuz?
( ) Evet
( ) Hayır

Araştırma çıktılarınızın sanayi projelerinin gereksinimlerini ne derece karşıladığını düşünüyorsunuz? ***(1=min, 5=max)***
( ) 1
( ) 2
( ) 3
( ) 4
( ) 5

Sanayi, sizin ortak çalışmadan beklentilerinizi ne derece karşıladı?
( ) Beklenenin üzerinde
( ) Beklenen seviyede
( ) Beklenenin altında

Sanayinin, üniversiteden bilgi transferi konusunda yeterince çaba harcadığını düşünüyor musunuz?
( ) Evet
( ) Hayır

Sanayi kuruluşu ile lokasyon olarak yakın olmanın, kurulan işbirliğinin etkinliği üzerinde etkisi olduğunu düşünüyor musunuz?
( ) Evet
( ) Hayır

Cevabınızı bir örnek ile destekleyebilir misiniz?

Diğer savunma şirketleriyle de ortak araştırma projelerinde yer aldınız mı?
( ) Evet
( ) Hayır

Onlarla olan deneyiminiz, ASELSAN ile kıyaslandığında nasıldı? Neden?
( ) Daha iyi
( ) Benzer
( ) Daha kötü

Sanayi projeleriniz arasından buluşa dönüşen bir projeniz oldu mu?
( ) Evet
( ) Hayır

Olduysa bu ortak buluşunuz için herhangi bir ortak fikri hak başvurusu yapıldı mı?
( ) Evet
( ) Hayır

Sanayi tarafıyla ilgili fikri hak başvurusundan doğacak giderlerin ve gelirlerin paylaşımı konusunda sorun yaşadınız mı? Ne olduğunu anlatabilir misiniz?
( ) Evet
( ) Hayır

Üniversite TTO'nuz bu yaşanan sorunlarının çözümünde ne derece aktif rol aldı? ***(1=min, 5=max)***
( ) 1
( ) 2
( ) 3
( ) 4
( ) 5

Şirketin araştırma altyapısı, üniversitelerle ortak araştırma yürütülebilmesine ne derece imkân sağlıyordu/uygundu? ***(1=min, 5=max)***
( ) 1
( ) 2
( ) 3
( ) 4
( ) 5

TTO ile NDA anlaşması süreciyle veya başka bir konuyla ilgili sorun yaşadığınız oldu mu? Olduysa neydi?

( ) Evet
( ) Hayır

Üniversite yönetiminizin, sanayi iş birliklerine yönelik tutumunu destekleyici buluyor musunuz?
( ) Evet
( ) Hayır

Üniversite sanayi iş birliğinin etkinliğinin artması için üniversite ve şirket politikalarında değişmesi gerektiğini düşündüğünüz hususlar nelerdir?

Ders yükünüzün yanında sanayi projeleri için yeterli zaman ayırabildiğinizi düşünüyor musunuz?
( ) Evet
( ) Hayır

Sanayi projelerinden gelen ödenek üzerinden üniversite döner sermayesi için kesinti yapılıyor olması sizi demotive ediyor mu?
( ) Evet
( ) Hayır

Bu durumun düzeltilmesi için sizce neler yapılabilir?

Bugüne kadar bir sanayi projesini yarıda bıraktığınız oldu mu? Oldu ise sebebi neydi?
( ) Evet
( ) Hayır

Sanayi ile yürüttüğünüz proje öncesi, sırası ve sonrasında üniversite TTO'nuzdan nasıl bir destek gördünüz? Genel performansını ve yaklaşımını nasıl değerlendirirsiniz?

Kamunun üniversite sanayi iş birliği için yeteri kadar teşvik sağladığını düşünüyor musunuz?
( ) Evet
( ) Hayır

Hiç TÜBİTAK TEYDEB tarafından destek alan bir projede yer aldınız mı? Hangi destek programıydı?
( ) Evet
( ) Hayır

Aldıysanız bu süreçte herhangi bir sorunla karşılaştınız mı? Sorun neyle ilgiliydi?
( ) başvuru süreci
( ) tarafların uyum içinde çalışması
( ) proje gereksinimlerinin zamanında karşılanması
( ) finansal sorunlar

Sağlanan desteğin projenin tamamlanabilmesi için yeterli olduğunu düşünüyor musunuz?
( ) Evet
( ) Hayır

Üniversite Sanayi İşbirliğinin geliştirilmesi için kamu tarafına verebileceğiniz öneriler ne olurdu?

ASELSAN ÇALIŞANLARININ TEZ DANIŞMANLARINA SORULAR

Sizce sanayide çalışan lisans üstü öğrencilerinin, çalışmakta olduğu konular üzerine tez yapmasının ne gibi avantajları bulunmaktadır?

Hiç buluşa dönüşen bir teze danışmanlık yaptınız mı?
( ) Evet
( ) Hayır

Buluş öncesinde karşı tarafla imzalanmış olan fikri hak paylaşımı sözleşmeniz var mıydı, yoksa sözleşmeyi buluş ortaya çıktıktan sonra mı yaptınız?

Fikri hak paylaşımı görüşmelerinde sanayi tarafıyla veya kendi TTO'nuz ile herhangi bir anlaşmazlık yaşadınız mı? Açıklayabilir misiniz?
( ) Evet
( ) Hayır

Anlaşma sürecinde tez öğrencinizin ve şirketin genel tutumunu nasıl değerlendirirsiniz?

Anlaşma neticesinde ortak buluşunuzdan adil bir pay almaya hak kazandığınızı düşünüyor musunuz? Neden?
( ) Evet
( ) Hayır

Tez çalışmanızı genel olarak değerlendirecek olursanız, öğrencinizin başarısı ve şirketin sağladığı olanakları sizin için yeterli miydi? Açıklar mısınız?
( ) Evet
( ) Hayır

ÜNİVERSİTE TTO'SUNA SORULAR

ASELSAN ile yürütülen sözleşmeli projeler kapsamında ortaya çıkan buluşlarla ilgili en sık karşılaştığınız sorunlar nelerdir?

ASELSAN çalışanlarının lisansüstü tezlerinde ortaya çıkan buluşlarla ilgili en sık karşılaştığınız sorunlar nelerdir?

Bu sorunların çözümü için genelde hangi taraflarla görüşüyorsunuz?
( ) TTM

( ) Ar-Ge Sözleşmeler Müdürlüğü
( ) Öğrencinin / Projecinin kendisi

Şirketin bu görüşmeler sırasındaki genel tutumunu nasıl değerlendiriyorsunuz? Sizce bu konuda diğer savunma şirketlerine benzeyen ve ayrışan noktaları neler?

Karşılaştığınız sorunların herhangi bir hukuki boşluktan kaynaklı olduğunu düşünüyor musunuz? Daha açıklayıcı ve net kanunlar ile bu sorunların önüne geçilebilir miydi?
( ) Evet
( ) Hayır

Üniversitenizdeki araştırma çıktılarının ticarileştirilmesi için uygun sanayi ortağını bulma konusunda zorluklar yaşıyor musunuz?
( ) Evet
( ) Hayır

Bu noktada sanayi tarafından beklentileriniz var mı?

Tüm bu süreçlerin iyileştirilmesi için ASELSAN TTO'sundan, ASELSAN ile proje yürüten akademisyenlerden ve ASELSAN'daki lisansüstü öğrencileri ve proje yöneticilerinden beklentileriniz ne olurdu?

D. TURKISH SUMMARY / TÜRKÇE ÖZET

Sanayileşmiş ülkelerin rekabet gücü açısından inovasyon ile birlikte yeni bilimsel bilgi de kritik hale gelmeye başlamıştır. Bu nedenle üniversitelerde üretilen bilimsel ve teknolojik bilgilerin sanayiye aktarılarak ticarileştirilmesi ve katma değeri yüksek ürünlere dönüştürülmesi önem arz etmektedir.

Üniversiteler özellikle bilgiye dayalı sektörlerde bölgelerindeki ekonomik kalkınmayı canlandırmaktadır. Bu noktaya gelinceye kadar üniversitelerin önceden sadece eğitim ve araştırma olan misyonlarına topluma katkı sağlama misyonu da eklenerek, üniversitelere ekonomik rollerinin yanı sıra sosyal roller de yüklemiştir.
Bu roller ile birlikte "girişimci üniversite, teknoloji transferi ve üniversite-sanayi iş birliği" gibi kavramlar literatüre girmeye başlamıştır. Üniversitelerde üretilen bilimsel bilginin toplumun yararına kullanımını kolaylaştırmak amacıyla TTO'lar, teknoparklar, akademik girişimcilik, spin-off'lar gibi Üniversite – Sanayi İş birliği (ÜSİ) ile ilgili yeni mekanizmalar kullanılmaya başlanmıştır.

Üniversite ve sanayi, farklı amaçlara ve çalışma kültürlerine sahip çok farklı yapılar olduğundan, bir araya gelme ve iş birliği kurma konusunda motive edilmesi için bazı teşvik mekanizmaları yoluyla devlet müdahalesine ihtiyaç duymaktadır. Üniversite, sanayi ve kamu arasındaki bu etkileşimler, farklı biçimlerde olabilen "inovasyonun üçlü sarmalı" olarak tanımlanmaktadır.

Literatürde Türkiye'de ÜSİ'yi inceleyen bazı çalışmalar mevcut olsa da konuya bakış açıları tek tarafla sınırlıdır, yani konuyu ya üniversite gözüyle ya da sanayi gözüyle analiz etmektedirler. Dolayısıyla her iki tarafın bakış açılarını tek bir çalışmada bir araya getiren ve hem akademi hem de sanayi tecrübeleri bulunan danışmanlar tarafından yönetilen bu tez, mevcut literatüre farklı bir metodoloji ekleyerek, üniversite ve sanayinin görüşleri arasında daha derin bir karşılaştırma yapma fırsatı sunmaktadır. Bu şekilde, engelleri ve zorlukları tanımlama daha anlamlı olabilir

çünkü her iki taraf da ortak projelerinde mevcut sorunlara birbirlerinin perspektifinden bakma ve yaklaşımları hakkında objektif yargılarda bulunma şansına sahip olacaktır.
Bu bağlamda çalışma kapsamında yanıt aranan araştırma soruları:

Araştırma Sorusu-1:
Savunma sanayiinde Üniversite – Sanayi İş birliğinde tarafların birbirlerine ve iş birliğine bakış açıları ile iş birliğinde karşılaştıkları sorunlar ve engeller nelerdir?
Araştırma Sorusu-2:
Bu engeller nasıl aşılabilir, savunma sanayiinde Üniversite – Sanayi iş birliğinin etkinliğinin iyileştirilmesi için hangi tedbirler alınmalıdır?

Bilgiye dayalı ve teknoloji yoğun endüstriler, bilgi aktarımına en çok ihtiyaç duyan endüstrilerdir. Savunma sanayii, bir ülkenin ulusal güvenliğindeki rolünden kaynaklanan ilave önemiyle bunlardan biridir. Bunun yanı sıra, savunma Ar-Ge'si sivil sektörlerdeki endüstriyel inovasyon üzerindeki katalizör etkisi nedeniyle devletler tarafından ekstra teşvik edilmektedir. Bu nedenle, başarılı savunma sanayiinde rekabetçiliği ve başarıyı beraberinde getiren üniversite iş birlikleri dikkatli bir şekilde analiz edilmeli ve buna göre teşvik edilmelidir.

Üniversite-sanayi iş birliğinden elde edilecek faydalar, kısa ve uzun vadeli hedefler doğrultusunda farklılık göstermektedir. Akademi tarafı iş birliğinden "mezunları için araştırma finansmanı, istihdam ve beceri geliştirme fırsatları, araştırmaları için gerçek sorunlar, endüstri geri bildirimi" gibi kazanımlar elde ederken, sanayi tarafı ise bilimsel ve teknolojik bilginin yanı sıra nitelikli işgücüne erişerek ve Ar-Ge faaliyetlerini riskten arındırarak iş birliğinden yararlanır. ÜSİ, toplumun geneline de "iyi eğitimli iş gücü, yüksek teknolojili rekabetçi ürünler ve toplumun karşılaştığı en zorlu sorunlara çözümler" gibi çeşitli avantajlar sağlar.

Bu nedenle kamu, ÜSİ'yi teşvik etmek amacıyla hibe programlarının başlatılmasından, fikri mülkiyet paylaşımına yönelik yasal çerçevenin hazırlanmasına kadar farklı politika araçları geliştirir ve uygular. Ülkemizde TÜBİTAK, işbirlikçi araştırma faaliyetlerini destekleyen özel hibe programları ile

ÜSİ bağlamında ana sorumlu kurumdur. Hükümetin teknolojik açıdan bağımsız bir savunma sanayisine sahip olma vizyonu ile Türkiye'de savunma sektöründeki ÜSİ'ler için daha hedefe yönelik çeşitli teşvikler mevcuttur.

Kamu desteğine rağmen, ÜSİ'nin önünde ülkeden ülkeye ve hatta bir sektörden diğerine değişebilen çok sayıda engel bulunmaktadır. Başarılı iş birliklerinin oluşumunun önündeki engeller üniversite ve sektörler arasında farklılık gösterse de literatürde en fazla değinilen engeller "doğru iş birliği ortağını bulmak, güven oluşturmak ve sürdürmek, organizasyonel farklılıklar ve fikri mülkiyet paylaşımı" gibi birtakım ortak engellerdir.

Bu nitel çalışmada Türkiye savunma sanayisinde ÜSİ, ODTÜ – ASELSAN iş birlikleri -sözleşmeli araştırma projeleri ve çalışan tezleri- örnek olay incelemesi üzerinden derinlemesine analiz edilmektedir. Çalışma kapsamında gerekli veriler yarı yapılandırılmış mülakat tekniğiyle toplanmış olup, daha önce ortak sözleşmeli ve yüksek lisans tezi projelerinde birlikte çalışmış olan firma çalışanlarına, akademisyenlerine ve iş birliği süreçlerine her iki kurumdan da dahil olmuş olan TTO çalışanlarına 30-40 dakika kadar süren çevrimiçi görüşmelerde sorular yöneltilmiştir. Sonuçlar kodlama yöntemiyle analiz edilmiştir.

Katılımcılara üniversite ve sanayinin birbirlerine ve iş birliğine karşı bakış açılarını, ortak projelerde karşılaştıkları engelleri ve sorunları, birbirlerinden beklentilerini ve iyileştirme alanlarını belirlemeye yönelik sorular sorulmuş olup, bulgular iş birliği önündeki engeller literatürüne ve aynı zamanda TTO'ların ÜSİ'deki rolüne katkıda bulunmaktadır. Görüşülen kişilerin cevaplarından, örnek olay çalışmamızın literatürde belirlenen engellerin çoğunu doğruladığı anlaşılmaktadır.

Bu bağlamda her iki tarafın da ÜSİ önündeki en çok dile getirdiği engeller; "hedef ve beklentiler arasındaki farklılıklar, fikri mülkiyet haklarının paylaşımındaki çatışmalar ve iş birliği sürecindeki ağır bürokratik yüklerdir". Ortak hedeflerin benimsenmesi, iş birliği ortağının güveninin kazanılması, açık ve anlaşılır hedeflerin tanımlanması, beklentilerin doğru ifade edilmesi, devlet desteği ve coğrafi yakınlığın verimli ve

sürdürülebilir iş birliklerinin kurulması için sahip olunması gereken kritik faktörler olduğu kanıtlanmıştır.

İş birlikleri literatürde de ifade edildiği üzere çoğunlukla THS 3 – THS 6 olgunluk seviyesi arasındaki teknolojilerin geliştirilmesine yönelik kurulmaktadır. Sanayi, üniversite araştırmalarını yenilikçi yeteneklerini geliştirmek için önemli görmesine karşın, çoğu zaman ortak araştırma projeleri için uygun bir akademik ortak bulmakta zorluk çekmektedir. Bunun sebebi ise akademisyenlerin araştırma ilgi alanlarının her zaman endüstrinin ihtiyaçlarına hitap etmemesi olarak görmektedir.

Bir diğer yakınılan husus ise üniversiteden iş birliği ortağını çoğunlukla kişisel bağlantıları aracılığıyla bulduktan sonra, şirket içi uzun bürokratik süreç nedeniyle iş birliği anlaşması imzalanmasının genellikle aylar, hatta bazen yıllar alacak kadar uzamasıdır. Öte yandan firma içerisinde farklı iş kollarının üniversitelerle uyum içerisinde ortak proje yürütme miktarları ve proje özelliklerinin farklılık gösterdiği görülmüştür. Bu da ilgili iş kollarının çalışmakta olduğu teknolojilerin iş birliğine imkan verip vermeme niteliğinden kaynaklanmaktadır. Örneğin komuta kontrol sistemleri geliştirme konularında çalışmakta olan ekipler üniversitelerle daha sık çalışabilirken, radar konularında çalışan ekipler üniversitelerle nispeten daha az sayıda ancak daha uzun soluklu projeler yürütmektedir.

Ancak ASELSAN gibi Ar-Ge kabiliyeti yüksek firmalar, yıllardır süregelen Ar-Ge kültürü ve iş birliğine imkân veren organizasyonel yapılanmalarından ötürü Ar-Ge odağı olmayan firmalara göre üniversitelerle daha başarılı iş birlikleri kurabilmektedir. ODTÜ ve ASELSAN, iş birliklerinde birbirlerine lokasyon olarak da yakın olmanın avantajını kullanarak bölgelerindeki inovasyon ekosistemini de beslemektedir. Sanayinin akademisyenlerden en büyük beklentisi “alanlarında uzman olmaları, teorik bilgilerini yenilikçi uygulamalara dönüştürmeleri ve proje terminlerine uymaları” olarak ifade edilirken; üniversitelerin sanayiden en büyük beklentileri ise “son teslim tarihlerinin katı olduğu projeler yerine, üniversiteye uzun vadeli projeler için gelmeleri, iş birliği önündeki bürokratik süreçlerin sadeleştirilmesi ve araştırma sonuçları üzerinde etkin geri bildirim sağlanması olarak ifade edilmiştir.

Örnek çalışmamızda sanayide görüşülen kişilerin verdikleri yanıtlardan, yaşadıkları zorlukların çoğunlukla üniversite tarafından kaynaklandığı anlaşılmakta olup, şu şekilde ifade edilmektedir:

- Akademisyenlerin araştırma ekibindeki değişiklikler (beyin göçü) ve üniversitelerde savunma alanında belirli teknoloji alanlarına yönelik yeterli sayıda araştırmacının bulunmamasından kaynaklanan teknik bilgi eksiklikleri
- Bazı akademisyenlerde yeterli düzeyde sorumluluk duygusu olmaması (üniversite araştırma ekiplerinin sanayi tarafının THS'lere ilişkin beklentilerini karşılama konusunda başarısız olması ve araştırma teslimlerinin zamanında alınabilmesi için üniversite tarafına yakın takip ve son teslim tarihlerinin sık sık hatırlatılması gerekliliği)
- Bazı akademisyenlerin teorik bilgilerini pratik bilgiye dönüştürmede yetersiz kalışı
- Bazı akademisyenlerin savunma sanayinin gerektirdiği gizlilik kurallarına hassasiyet göstermemesi
- Akademisyenlerin endüstriyel uygulamalardaki deneyim eksikliğinden kaynaklanan dokümantasyon sorunları, araştırma sonuçlarının sektörün gerektirdiği formatlardan farklı formatlarda sunulması ve proje zamanlamalarında gecikmeler

Bunun yanında sanayi tarafından bildirilen zorluklardan bazıları ise firmanın kendi iç süreçleriyle ilgilidir:

- Şirket içinde uzun süren bürokratik süreçler, özellikle satın alma ile ilgili süreçler (onay süreci için Ar-Ge proje tekliflerinde fiyat tekliflerinin olması gerekliliği üniversite tarafını zorlamaktadır) ve Özkaynaklı Ar-Ge projelerini başlatmak için zorlu ve uzun onay süreci
- Çalışanların çok fazla iş yükünün olması, üniversite projelerini yürütmek veya TEYDEB projesi yazmak için neredeyse hiç zaman kalmaması
- Özellikle fikri mülkiyet hakları paylaşımı şartlarına ilişkin tartışmaların yol açtığı uzun süren sözleşme süreçleri

Üniversite tarafında ise akademisyenler karşılaştıkları başlıca zorlukları şu şekilde dile getirmektedir:

- Proje teslimatları için sanayi tarafının yapmakla yükümlü olduğu ödemelerde yaşanan gecikmeler
- Sanayinin uzun soluklu teknoloji geliştirme projelerinden ziyade hızlı kar getiren ve kısa termin süreli proje talepleri
- Sektörün teknik ekiplerinde sık sık değişiklikler ve rotasyonlar yaşanması sonucu proje planlarında yaşanan aksamalar

Kamu, ÜSİ'yi TÜBİTAK'ın araştırma hibe programları aracılığıyla teşvik etmeye çalışmakta ancak katılımcılara göre bunların kapsam ve miktar açısından iyileştirilmesi gerekmektedir.

Akademik araştırmalar çoğunlukla sanayi tarafından anlık tasarım ihtiyaçlarını karşılamak veya üretim sürecinde ortaya çıkan bir soruna hızlı bir çözüm bulmak için talep edilmektedir. Bu durum üniversitenin, firmanın işleyişini tanımasını ve beklenen yenilikleri ortaya çıkarmasını engellemektedir. Ayrıca bir projeye başlamak için her seferinde tamamlanması gereken evrak işleri nedeniyle zaman kayıpları yaşanmaktadır. Sanayideki katılımcıların cevaplarından, firmadaki bürokratik süreçlerin, çalışanları üniversite ile ortak projeler başlatma konusunda demotive ettiği anlaşılmaktadır. Projelere bütçe tahsisi için her seferinde gereken onay sürecinin uzun sürmesi nedeniyle çeviklik sağlanamamasının şirketin genel rekabet gücünü bozduğuna dikkat çekilmektedir.

Üniversite iş birliklerinin firmanın beş yıllık strateji planı ve teknoloji yol haritasıyla uyumlu olması gerektiği, böylece araştırma sonuçlarının firmanın inovasyon ihtiyaçlarına daha fazla hitap edeceği aktarılmaktadır. Bu bağlamda sanayinin, üniversite iş birliklerini merkeze alan, üniversitelerde yürütülen temel araştırmalara daha fazla önem veren, Ar-Ge odaklı büyüme stratejileri benimsemesi gerekmektedir.

Bu noktada tek bir proje için bireyler arasında değil, belirli bir teknolojinin geliştirilmesi için **"kurumsal düzeyde kurulan stratejik ortaklık modeli"** önerilmektedir. Bu modelde kurumlar arasında şirketin teknoloji yol haritasına uygun olan belirli bir teknolojinin geliştirilmesine yönelik çerçeve sözleşme imzalanacak,

anlaşma imzalandıktan sonra, o anlaşmaya atıfta bulunularak her seferinde yeni bir sözleşme imzalanmasına gerek duyulmaksızın ilgili teknoloji alanına ilişkin tekil araştırma projeleri yürütülebilecektir.

Anlaşma kapsamında ortak teknik ekiplerin oluşturulması, firmanın üniversite kampüsünde araştırma laboratuvarları kurması, araştırma görevlilerine yönelik burs ve staj programları oluşturulması gibi farklı ortak çalışma uygulamaları yapılabilecektir. Stratejik ortaklık çerçevesinde alt projelerin yürütülmesi için, iş birliği kurulan fakülte ve araştırma ekiplerinin araştırma tesislerinin desteklenmesi amacıyla firma tarafından yıllık olarak özel amaçlı bir bütçe tahsis edilerek, bu sayede daha kısa sürede daha verimli sonuçlara ulaşılabilir.

Üniversite-sanayi iş birliklerinin tek seferlik, geçici bir ortaklık yerine "birlikte yaratma" kültürü ile stratejik ortaklık kurularak yapılması halinde daha verimli sonuçlar doğuracağı ve daha sürdürülebilir olacağı unutulmamalıdır.

Uzun vadeli iş birliği hem iş dünyası hem de akademi açısından avantajlı olacaktır. Firmalar en son teknolojiye sahip araştırmalara ve bilimsel personele daha kolay erişime sahip olurken, üniversiteler de istikrarlı finansman ve iş birliği ortağına sahip olacaktır. Ayrıca firmalar, araştırma ve inovasyon ihtiyaçları için iş birliği ortağı bulma konusunda ekstra çaba harcamak zorunda kalmayacak ve çalışanlar, üniversite projesi başlatmaları gerektiğinde her seferinde aynı bürokratik yükü taşımak zorunda kalmayacaktır.

Bu, firmalara stratejik ortaklık alanlarında daha yenilikçi olma ve rekabet ortamındaki değişikliklere daha duyarlı olma fırsatı sağlayacaktır. Üniversite tarafında ise sanayinin finansal desteğinin devam etmesi, akademisyenlerin sanayi ortaklarıyla daha etkin ve daha yakın çalışmasına olanak tanıyacaktır.

ASELSAN sektör başkanlıklarından biri ile ODTÜ'nün araştırma enstitülerinden biri arasında 2021 yılında belirli bir teknolojiye ilişkin kurulan uzun vadeli stratejik ortaklık gibi birkaç istisna haricinde, ASELSAN ve ODTÜ'deki araştırmacılar çoğu zaman tek seferlik projeler için bir araya gelmektedir. Firmanın 5 yıllık teknoloji yol

haritası doğrultusunda belirli teknoloji alanlarında bu tür ortaklıkların sayısının artırılması önerilmektedir.

Çalışma kapsamında stratejik ortaklık modelinin yanı sıra üniversite, sanayi ve kamu paydaşlarına birtakım politika ve strateji önerileri sunulmuştur:

Politikanın/Stratejinin Amacı	**Politika/Strateji Önerisi**	**İlgili Taraf**	**Politika/Strateji Aracı**
Sanayi ihtiyaçlarını karşılamak üzere akademik bilginin daha etkin kullanımı	Üniversitelerdeki eğitim ve araştırma konu ve içeriklerinin sanayinin ihtiyaçlarıyla uyumlu hale getirilmesi	Üniversite	-Mühendislik müfredatlarının endüstri ihtiyaçlarına göre ayarlanması -Öğrencilerin teknik yeteneklerini artırmaya yönelik seçmeli derslerin açılması -ASELSAN Akademi benzeri yapıların teşvik edilmesi
		Sanayi	-Üniversitenin Ar-Ge ve iş stratejileri hakkında bilgilendirilmesi -Endüstriyel sorunların üniversiteye tez konusu olarak tanımlanması -Tezleri için bu konuları seçen öğrencilere burs verilmesi -3. ve 4. sınıf öğrencilerine yönelik uzun süreli staj programlarının başlatılması (ASELSAN yetenek gibi)
		Kamu	-Bölgesel düzeyde tez havuzunun oluşturulması -Endüstri uzmanlarının mühendislik fakültelerinde seçmeli ders vermesinin önünün açılması -Üniversite araştırma laboratuvarlarının sanayi

			tarafından kullanılmasının teşvik edilmesi
Üniversite-Sanayi İş birliklerinin etkinliğinin artırılması	Doğru iş birliği ortaklarının eşleşmesi Araştırma altyapılarına mükerrer yatırımların önüne geçilmesi	Üniversite	-Ulusal araştırma altyapıları portalindeki bilgilerin eksiksiz ve güncel tutulması
		Sanayi	-Şirket içi ağda bir web portali açılarak daha önce işbirliği kurulan hocalarla ilgili şirket çalışanları arasında görüş alışverisine olanak sağlanması
		Kamu	-İlgili veritabanının araştırma merkezleri ve üniversiteler tarafından güncel tutulması -TÜBİTAK desteği alan projelerin proje kapanışında performans değerlendirmesine tabi tutulması Üniversite araştırma altyapılarının sanayi tarafından kullnımının teşvik edilmesi
Üniversite ile sanayi arasındaki etkileşim miktarının artırılması	Akademisyenlerin ve sanayide çalışan mühendislerin iş birliği projeleri gerçekleştirmeye motive edilmesi Üniversite – Sanayi İş birliği önündeki bürokratik engellerin kaldırılması	Üniversite	-Proje için sanayi tarafından ödenen miktar üzerinden üniversite yönetimi tarafından yapılan kesinti oranının azaltılması -Akademik yükselme kriterleri arasına sanayi ile yapılan projelerin de eklenmesi -Sanayi ile proje yapan akademisyenlerin idari sorumluluklarının azaltılması

	Bölgesel/teknoloji bazlı inovasyon sistemlerinin teşvik edilmesi	Sanayi	-Proje başlangıcı için şirket içindeki bürokratik süreçlerin sadeleştirilmesi -Üniversitelerle odak teknoloji alanlarına özel çalıştaylar düzenlenmesi -Üniversite kampüslerinde veya teknoparklarında araştırma merkezi açılması
		Kamu	-TTO'ların performans bazlı desteklenmesi -Kamu satın alımlarında üniversite – sanayi iş birliği projelerine öncelik verilmesi -Üniversite ve firmaların bir araya getiren teknoloji etkinlikleri düzenlenmesi -Belirli bir coğrafi bölgede aynı teknoloji alanında çalışan üniversite ve firmalara bölgesel bazlı teşvikler sağlanması
Araştırma desteği alan projelerin etkinliğinin artırılması	Üniversite ve sanayinin hibe programlarına daha fazla başvuru yapmasının teşvik edilmesi Araştırma desteklerinin miktar ve ödeme koşullarının iyileştirilmesi	Üniversite	-Sanayi projeleri için de BAP (Bilimsel Araştırma Projeleri) benzeri destek programları oluşturulması
		Sanayi	-Sanayide çalışan personelin birtakım ödüllendirme mekanizmalarıyla daha çok TEYDEB projesi yazmaya teşvik edilmesi

		Kamu	-Araştırma hibelerinin öncelikli teknoloji alanlarındaki projelere daha odaklı bir şekilde sağlanması -Proje başına ödenen destek miktarlarının artırılarak proje başlangıcında avans ödemesinin yapılması -Büyük ölçekli işletmelere özel araştırma desteği programlarının oluşturulması -Hibe programlarının başvuru sürçlerinin sadeleştirilmesi ve kolaylaştırılması -Doktora öğrencilerinin burs miktarlarının sanayi ile rekabet edebilecek düzeye çıkarılması -Hibe desteği sağlanan projelerin performans değerlendirmesine tabi tutularak bir sonraki başvuruda göz önünde bulundurulması

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