MEASURING THE PERFORMANCE OF TECHNOLOGY TRANSFER OFFICES (TTOs): THE CASE OF TURKEY

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ABSTRACT

MEASURING THE PERFORMANCE OF TECHOLOGY TRANSFER OFFICES (TTOs): THE CASE OF TURKEY

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Employing a qualitative approach the main objective of this thesis is to investigate the metrics which can be used in the measurement of the performance of Turkish TTOs. After the metrics that are used in the performance measurement in developed and developing countries are collected from the literature, 15 interviews are conducted to two sets of main stakeholders separately. The first set is composed of 10 TTO managers and the second is a focus group made of 5 experts. This qualitative design enables comparing and contrasting different views of different groups and also increases validity of the findings. The data obtained from the interviews are quantified and interpreted using a qualitative approach. As a result a metric set that consists of nearly half of the overall number of metrics that are used in the world is proposed and requirement of a context-specific assessment for a developing country is verified. The proposed metric set to be used in the measurement of TTO performance includes some of the metrics that are context-specific to Turkey and some that are common to the metrics of other countries. In addition, the importance and necessity of using qualitative metrics is investigated.

Keywords: Technology Transfer Office (TTO), Performance, Measurement

ÖZ

TEKNOLOJİ TRANSFER OFİSLERİNİN (TTO)
PERFORMANSLARININ ÖLÇÜLMESİ: TÜRKİYE ÖRNEĞİ

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Bu çalışmanın amacı, nitel bir yaklaşımla Türkiye'de bulunan Teknoloji Transfer Ofislerinin performansının ölçülmesinde kullanılabilecek metriklerin araştırılmasıdır. Gelişmiş ve gelişmekte olan ülkelerde kullanılan metrikler literatür aracılığıyla elde edildikten sonra, konuyla ilgili paydaşların oluşturduğu iki ayrı grup ile 15 adet mülakat gerçekleştirilmiştir. İlk olarak 10 adet TTO yöneticisi ile mülakatlar yapılmıştır. Sonrasında 5 adet uzmandan oluşan bir odak grup ile mülakatlar yapılmıştır. Bu niteliksel tasarım, iki grubun da değişik görüşlerinin kıyas edilebilmesine ve ayrıca bulguların doğruluk derecesinin yükselmesine olanak sağlamaktadır. Mülakatlar neticesinde elde edilen veriler niceliksel olarak gruplandırılmış ve niteliksel bir yaklaşımla yorumlanmıştır. Sonuç olarak, dünyada kullanılmakta olan metriklerin neredeyse yarısını teşkil eden bir metrik seti önerilmiş ve gelişmekte olan bir ülke için hususi bir değerlendirme yapılmasının gereği doğrulanmıştır. TTO performansının ölçülmesinde kullanılabilmesi için önerilen metrik seti, hem Türkiye'ye özgü bazı metriklerden hem de diğer ülkelerin metrik setlerinde bulunan bazı metriklerden oluşmaktadır. Buna ek olarak niteliksel metriklerin kullanılmasının önemi ve gerekliliği de ortaya çıkmıştır.

Anahtar Kelimeler: Teknoloji Transfer Ofisi (TTO), Performans, Ölçüm

To all my Masters who showed me there are still many things in this world that are worth fighting for

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ACCT	The Alliance for Commercialization of Canadian Technology
AUTM	Association of University Technology Managers
CRDF	U.S. Civilian Research and Development Foundation
EATTM	Eurasian Association of Technological Transfer Managers
EU	European Union
ICC	Intraclass Correlation
IP	Intellectual Property
IPR	Intellectual Property Rights
IRR	Inter-rater Reliability
KTO	Knowledge Transfer Office
KTT	Knowledge and Technology Transfer
MoSIT	The Ministry of Science, Industry and Technology
NIS	National Innovation System
OECD	Organization for Economic Co-operation and Development
PRO	Public Research Organization
ProTon	Pan-European Network of Knowledge Transfer Offices
TRIPS	Trade-Related Aspects of Intellectual Property Rights
TTO	Technology Transfer Office
TÜBİTAK	The Scientific and Technological Research Council of Turkey
SME	Small and Medium Enterprises
STI	Science Technology and Innovation
USTPO	United States Patent and Trademark Office
WTO	World Trade Organization

CHAPTER 1

INTRODUCTION

University Technology Transfer, an attractive term, as a key concept for a nation's scientific and economic development, has become more of an issue in the world. When new knowledge and technology is generated in the university, its transformation to a commercialized product or service is critical to create added-value for public benefit and achieve socio-economic development. It is also one of the main drivers of knowledge-based economy. Technology Transfer Offices (TTO) are the main institutions that are established to perform the task of university technology transfer in the ecosystem. They are the main interface institutions, which provide university-industry collaboration, commercialization of intellectual properties (IP) that are obtained from research and finally the establishment of knowledge and technology-based new firms. For the past four decades, TTOs have spread out in both USA and Europe bringing out their own models, systems and concepts. Today most universities in the developed countries commercialize knowledge via TTOs. Developing countries also took this step and began to execute policies to establish TTOs or TTO kind of structures to perform the task of the university technology transfer. As a developing country, Turkey has a history of about 10-15 years regarding the establishment and operating of TTOs. With the implementation of 1513 Program, which is formed by the Scientific and Technological Research Council of Turkey (TÜBİTAK) to support the establishment and operations of TTOs in Turkish universities, today there are more than 75 TTOs in different regions of the country acting as public units of the universities or as private firms.

Since TTOs are one of the critical structures for the scientific and technological progress, their performance measurement becomes a significant factor for their success. In order to contribute for public benefit and socio-economic development by scouting and commercializing the IPs in university research or the brilliant business ideas from the individuals of the university ecosystem, TTOs should perform effectively in their various activities, should access and manage their resources

efficiently and should provide qualified services for their customers that are in the ecosystem. In this regard, the measurement of TTO performance becomes an important task. In this way the university managements, the authorities in other public institutions and TTOs themselves will be informed of the performance, the level of success and the deficiencies of the TTO which will invite further learning and enhancement.

The measurement of TTO performance is a complicated issue since there are many methods and instruments that are used by the performers. There are two major questions regarding to this issue: how it should be done? and, what metrics should be considered? In the literature both quantitative and qualitative methods are used in USA, European and Asian countries to measure the performance of TTOs. On the other hand, it is vital to take into account the conditions of the country that TTOs operate in. In developed countries Science, Technology and Innovation (STI) ecosystem is widely enhanced and sophisticated. Correspondingly the knowledge and technology diffusing / transferring structures and institutions are developed with effective tools and systems that measure their performance, evaluate their mechanisms and provide feedback to them. However, in developing countries establishing and operating technology-transferring structures are problematic because of weak STI systems, rather inexperienced technology transfer structures and legally unsettled technology transfer institutions. Measuring their performance and enhancing them are also more difficult in an environment of rapid change where institutions and systems are new. Therefore, observations and outcomes are very limited for designing reliable strategies to enhance the technology transfer systems and institutions. In this regard, using the ready performance measuring models and procedures of the developed countries may not be a good choice for the developing countries. Indeed, direct application of TTO performance measuring models used in the developed countries to the developing ones may not yield accurate results. Thus, the context-specific characteristics of developing countries should be considered to design and evaluate such systems. On the measurement of TTO performance, looking at the cases of several developed and developing countries, and examining their models is a key step.

In coordinating the Technology Transfer Offices Support Program, measuring the performance of Turkish TTOs and its qualification is a major research problem for TUBİTAK. The need for such a system is now even more urgent given the program's progress and the necessity of a mid-period evaluation. However, to design a model for the measurement of TTO performance, context-specific characteristics of Turkey that are dependent on its socio-economic conditions and the level of its scientific and technological infrastructure should be considered. Thus, the approach of the measurement and the metrics that should be used can be determined accurately when context-specific characteristics are taken in to consideration. Moreover, this would prevent making measurement errors, especially when selecting metrics. By taking all these issues into account, suggesting and generating a useful and systematic performance evaluation criteria that consists of a set of metrics is the main objective of this thesis. The thesis will try to answer the following questions. Which metrics should be used to measure the performance of Turkish TTOs? Are the metric sets of other countries suitable for Turkey? Which approaches should be used for this measurement process?

A major motivation for this thesis is the lack of studies that aims to measure TTO performance in developing countries. Since many of the developing countries adopts the metrics that are used by the developed countries, they may become unable to determine the metrics that are compatible to their technology transfer ecosystem and that reflects the true nature of their TTOs. Conducting a research for the Turkish case requires an extensive field exploration and a detailed study considering all the dynamics mentioned. For such a comprehensive investigation, a mixed-design methodology that mainly consists of two groups of qualitative interviews is followed. Within this context, 10 interviews were conducted with managers of the TTOs that are the first beneficiaries of the 1513 TTO program of TUBITAK. To complement the findings at the TTO level 5 additional interviews are held with the executive board of the program that consists of experts from various areas of technology development. This qualitative approach allowed the research to acquire detailed data that is context-specific for the case of Turkish TTOs and as well as the issues that hardly have been investigated before in Turkey and in any other developing countries. The data from

both rounds of interviews is quantified and analyzed with a number of statistics that are constructed to determine which metrics to choose. In the final stage, the findings are benchmarked and interpreted with the qualitative perspectives of the interviewees and the researcher. 75 out of 92 metrics are proposed by the interviewees with a high correlation in their decisions. In addition, 7 completely new metrics are suggested. As a result, 51 out of 92 metrics are proposed and 41 metrics are found unsuitable for various reasons and a unique metric set that can be used for the measurement of TTO performance in Turkey is acquired.

This thesis contributes to the measurement of technology transfer literature along three main dimensions. First, this is the first research that uses a comprehensive and also an integrative approach to study measurement criteria for the performance of technology transferring institutions in the developing countries. In this manner, the methodology and the context of the research is novel. Secondly, the data that is acquired from the qualitative interviews show important determinants of the performance of TTOs. Contrary to the few number of research that focuses solely on the measurement of technology transfer office performance, the findings of this thesis include not only the metrics that can be used, but also a considerable number of variables that are crucial for the success of TTOs. Lastly, to the best of our knowledge, this is the first study, which investigates the issue of the measurement of TTO performance in a developing country such as Turkey. In this regard, the research presents an introductory milestone in an unexplored field. Thus it also presents a framework that can be used in future research.

The thesis proceeds as follows: Chapter 2 presents a literature review on the measurement of TTO performance and some other concepts related to the university technology transfer. Chapter 3 briefly describes the current state of several developing countries in comparison to Turkey on the subject of technology transfer ecosystem and TTOs. Chapter 4 defines the framework of the methodology and the process followed to conduct and complete the research. Chapter 5 consists of a broad evaluation of the overall data and the analysis phase of the research. Finally, Chapter 6 briefly concludes the study with recommendations for policy and future research.

CHAPTER 2

REVIEW OF THE LITERATURE ON TECHNOLOGY TRANSFER OFFICES AND ITS MEASURMENT

A great number of research on measuring TTO performance are conducted in the last three decades since the Bayh-Dole Act and the topic is becoming more popular as the field grows. Before directly discussing TTOs and its performance measures, it is necessary to draw a brief and general framework of knowledge and technology transfer concept.

2.1 Brief History and Typology of Knowledge and Technology Transfer: Definitions, Types and Mechanisms

As a matter of fact, knowledge transfer exists since the very first days of humanity as a complex and non-linear process. As methods and techniques emerge from knowledge, they were processed and turned into technologies. In advanced economies, traditional economy has left its place to a knowledge-based economy which highlighted the significance of knowledge and technology diffusion more than ever. In this context, Knowledge and Technology Transfer (KTT) became a substantial symbol for this diffusion as well as a key concept for a nation's scientific and economic development. For the past three decades KTT concept, its activities and its institutions have spread out in both the USA and Europe pervasively bringing out their own models. With the growing influence of the concept the applications in its content started to be conducted systematically where some other existing organizations like research centers, universities and industrial companies started to give special emphasis on knowledge transfer.

Especially after the World War II, it became essential to form public support mechanisms to achieve technological superiority. In the USA, the Congress provided an annual budget limit of $15 million for the National Science Foundation to conduct research at universities in 1950. As government funding for research increased in academic institutions, so did the challenges of harnessing inventions derived from this

research. In 1968 the University of Wisconsin, for the first time, succeeded in obtaining an Institutional Patent Agreement. This development opened the gate that drove the academic institutions into the technology transfer concept. In 1980 Public Law 96-517, which is essentially known as the Bayh-Dole Act, was legislated and passed. The law executed a uniform federal patent policy, which allowed universities to retain the related rights of the inventions derived from the federally funded research (Bremer, 1989). Following the 90s after the Bayh-Dole act, the number of technology transfer organizations in USA and Europe started to increase significantly.

In his study Reisman (1989) made a classification and taxonomy of various technology transfer definitions. After combining many aspects he defines technology transfer as: "The conveyance or shift of the tools, techniques, procedures, and/or the legal titles thereto used to accomplish some desired human purpose" (Reisman, 1989: 1). These transfers can take place between countries and societies or within a more micro scale between scientific disciplines, industries and people. For a broader definition, Association of University Technology Managers (AUTM) defines technology transfer as:

> Technology transfer is the process of transferring scientific findings from one organization to another for the purpose of further development and commercialization. The process typically includes: (i) identifying new technologies; (ii) protecting technologies through patents and copyrights; (iii) forming development and commercialization strategies such as marketing and licensing to existing private sector companies or creating new start-up companies based on the technology.[1]

Technology transfer is claimed as a "Horizontal Technology Transfer" when there is a direct and constant transition between regions / places without any changes in its form like further research, development etc. satisfying necessary patent and license agreements. For instance, when a multinational corporation establishes a plant in a developing country, it brings out its own technology and starts to operate performing a horizontal transfer of its technology. However, if an intellectual property based specific knowledge or technology develop and mature until it become a solid product

[1] Association of University Technology Managers. What is technology transfer? Retrieved July 2014, from http:// www. autm.net/ What_Is_Tech_Transfer.htm

or a process, the transition becomes a “Vertical Technology Transfer” signifying the change in content in different stages of knowledge creation.

There are many different mechanisms of knowledge and technology transfer which are; interchanges of knowledge in personal levels by teaching, training, publications, conferences and programs, and in industrial levels as; consultancy, cooperative agreements, contracted research agreements, licenses and establishing spin-off and start-up companies. This research focuses on TTOs and their span of technology transfer activities, which are the most common technology transferring structures acting as a supplemental interface between the university and industry.

2.2 University Technology Transfer and TTO

A technology transfer activity cannot be done without knowledge accumulation from a university towards a technology transferring structure, since the knowledge is the input for technology transfer. Thus, universities and eventually scientists are the greatest source of this new knowledge and the main beneficiaries of the concept of university technology transfer. Although it is possible for firms to conduct in-house innovations and technology transfer within their boundaries, technology transfer organizations work with universities unless they are already part of universities. Firms and industries are generally the final stakeholder and recipient of the process.

In their research which is about the benefits of technology transfer and evolution of these benefits for the universities and the surrounding ecosystems, McDevitt (2014) claims that Bayh-Dole legislation in 1980 was the main cause to initiate effective university technology transfer. Thus, with this law universities gained the right to fully commercialize their patents and other intellectual properties. Decter, Bennett and Leseure (2007), conducted a survey on various issues which compares USA and UK universities regarding university technology transfer, mentioning that university technology transfer is actually a vertical type of transfer, which follows a path from research to development and to production until it meets the consumer as a final product.

Siegel, Waldman, Atwater and Link (2004) conducted qualitative research aimed to identify the key organizational issues for successful technology transfer in TTOs and defined three main stakeholders for technology transfer process which are: university scientists providing knowledge for new technologies, administrators of university and TTO, who manages the IPs and accommodate the connection between university and industry, and finally the firms and entrepreneurs responsible for commercialization of this new research-based technologies. As for being the second stakeholder, technology transfer organizations are the key facilitating structures between university and industry with their role of acting as a technology transfer interface. These organizations can bear different names such as technology transfer office (TTO), knowledge transfer office, technology licensing office etc. in various countries although they perform similar jobs.

Siegel et al. (2004) also defines the role of TTO as: to provide and facilitate the transfer of intellectual property obtained from the university research to industry via licensing activities. In their research on technology transfer performance focusing on institutional preferences of the foundation, TTOs condition and the environmental issues in the ecosystem, Diamant and Pugatch (2007) state the primary role of the TTO as; assisting the university and the scientists dealing with industry in the commercialization of knowledge and its formal activities like licensing agreements, contracts etc. As for a detailed list of TTO tasks, Young (2007) provides practical issues about creating a TTO and gives examples of TTO structures around the world, mentioning TTO operations as:

1. Assist faculty and researchers in identifying research results that have commercial value and document the discoveries through a disclosure process.
2. Evaluate commercial potential of disclosed innovations.
3. Determine whether or not to protect IP rights in the innovation; secure funding for filing patent, trademark, or copyright applications; and manage the protection process.
4. Conduct market research to identify potential industry partners, and then market the innovations.
5. Once one or more industry partners are identified for an innovation, negotiate legal contracts (license agreements) with these industry partners to transfer IP rights in the innovation in exchange for royalties or other consideration.
6. Maintain and manage administrative functions in support of the primary functions of IP protection and technology transfer.

7. If the TTO decides not to pursue IP protection and commercialization of an innovation, implement a process to ensure that others have an opportunity to pursue protection and commercialization, if they chose to do so.(Young, 2007: 555-556)

2.3 Evaluating Technology Transfer Performance and Development of Metrics

Today, many new products are produced and presented to the society. The concept of innovation is the key factor for a product's usefulness and novelty. Globalization and increasing competitiveness in the world force nations to advance further and achieve a knowledge-based economy. Only the countries that has strong STI systems can achieve such accomplishments. Therefore, because innovation is the most fundamental concept in terms of value creation for development, measurement of it becomes a very important task. However measurement of innovation is a hard, complex and dubious task. This task becomes even more difficult for developing countries since they have weak STI systems, underdeveloped economies and immature science and technology ecosystem.

Being the process of transferring knowledge, skills, methods and technologies between a transferor and transferee, knowledge and technology transfer are fundamental sources of innovation. Thus, its expansion and measurement is of great importance. At this point, TTOs come forward as a primary actor that governs the knowledge and technology transfer process. TTO's development, efficiency and success are highly important for the university and industry ecosystem. Thus, the measurement and performance of a TTO are crucial for its progress and sustainability. There are many studies in the literature on the measurement of technology transfer within two broad categories: quantitative and qualitative approaches.

2.3.1 Quantitative Approaches

Gardner, Fong and Huang (2007) examined technology transfer metrics around the world aiming to compare the metrics, reveal regional differences, explore and further develop innovative metrics. For North American technology transfer associations using the data from AUTM and The Alliance for Commercialization of Canadian Technology (ACCT) surveys, they acquired the following metrics; Invention

disclosures, Patent applications, Licensing agreements, Licensing income, Startups formed, Value of sponsored research expenditures, patents issued, number of active licenses, total income from royalties, number of full time professionals of TTO and legal expenditures on protection of intellectual property. As for the European metrics, the ones that were advocated by the Pan-European Network of Knowledge Transfer Offices (ProTon) are; Annual KTO operational budget, Share of KTO budget by origin, Number of confidential disclosure agreements executed during the year to enable disclosure of Public Research Organization (PRO) know-how, Number of material transfer agreements executed for material originating from the PRO, Number of licenses/options executed within the year based only on know-how, Number of technical services executed and revenues deriving from these services, Number of public collaborative research project proposals submitted with KTO assistance, Spin-offs that have realized a capital increase during the year, Spin-offs that have ceased operation, Number of investments in PRO made within the year, Seed capital managed, invested within the year, Number of and revenue generated from companies and other entities that are clients/partners of the PRO in knowledge transfer activities serviced by its KTO. For the Asian metrics they state that they had failed to reveal any, however adding that Asian TTOs are also using similar metrics which outlined in the AUTM licensing surveys. Besides, according to the information that they gathered from the Asian organizations, unlike their counterparts in Europe and North America, Asian TTOs use a relatively narrow-scoped set of metrics (Gardner et al., 2007).

Holi, Wickramasinghe and Leeuwen (2008), developed a new set of metrics for the evaluation of UK universities' technology transfer activities also with a benchmark analysis of US and Canadian universities. Quantitative metrics that they defined were; networks (# of people met at events which led to other knowledge transfer activities), consultancy (# and value/income of contracts, % income relative to total research income, market share, # of client companies, length of client relationship), collaborative research (# and value/income of contracts, market share, % income relative to total research income, length of client relationship), contract research (# and value/income of contracts, market share, % income relative to total research income, length of client relationship), licensing (# of licenses, income generated from licenses,

# of products that arose from licenses), spin-outs / start-ups (# of spin-outs formed, revenues generated, external investment raised, market value at exit), teaching (graduation rate of students, rate at which students get hired), continuing professional development (income from courses, # of courses held, # people and companies that attend the courses).

In 2012 in the AUTM's annual licensing survey; new commercial products created, research expenditures, invention disclosures, patent applications, patents granted, licenses, licensing income and start-up companies formed were mentioned as quantitative metrics (AUTM, 2012). In 2013 European Commission had published Knowledge Transfer Study 2010-2012 Final Report and used: number of invention disclosures, number of priority patent applications, number of technically unique patent grants, the number of start-ups, the number of licenses or option agreements with companies, the amount of license income earned as the "key indicators" and the number of R&D agreements between the affiliated institutions and companies, number of USPTO patent grants, the number of successful start-ups as "supplementary indicators".

Arundel, et. al. (2013) presented the results of their research that consists of three linked studies which are a survey on 498 European research organizations, a survey on 322 research organizations and a total of 100 interviews with universities and other PROs about measuring knowledge transfer activities. In their final report; R&D agreements, invention disclosures, patent applications, patent grants, USPTO patent grants, start-ups established, successful start-ups, licenses executed and licensing income metrics were used. Schroer, Farrington, Messimer and Thornton (1995) looked from a different perspective by defining quantitative input measures for technology transfer activities. The input measures were; telephone calls, company visits, newsletters, seminars and workshops, trade shows, requests for assistance, database searches, referrals, fact sheets, publicity articles, organizations providing assistance and agreements. The output measures were; job created or saved, increase in revenues, decrease in operating costs, solutions to requests, new products, process improvements, new partnerships, company startups and royalties. Siegel, Waldman and Link (2003) used invention disclosures, patents, licenses, royalties, sponsored

research agreements, start-up companies, students, informal transfer of know-how, product development and economic development as metrics in their research based on 55 interviews with technology transfer stakeholders about the relative productivity of university technology transfer offices.

On measuring the performance of university technology transfer via data envelopment analysis Kim, Anderson and Daim (2008) used research expenditure, license income, number of licenses and options executed, number of start-up formed, number of patents filed and number of patents issued. In a similar technology transfer performance measuring model Huang, Ken, Wang, Wu and Shiu (2011) used research expenditures, invention disclosures, patents issued, licensing income, published articles and school size as quantitative metrics.

2.3.2 Qualitative Approaches

Literature mentions several factors that are difficult to quantify and that affect the technology transfer process of TTOs. This section focuses on such factors, ranging from university policy to human resources, that most of the time demand a qualitative approach. These factors are quite essential indicators since they are able to monitor many different aspects, which are directly related to the performance of TTOs that quantitative metrics are not able to address. Although these factors do not have accurate measures and require qualitative approach, they cannot be put out of scope of the research because some of them are accepted critically essential for the performance and success of TTOs and they are used as metrics for the measurement of TTO performance. The factors mentioned in the literature that are used for the measurement of TTO performance are: (1) University's Policy, Support and Integration, Organizational Structure of TTO, (2) Human Capital and Quality, (3) Financial Resource Accessibility, (4) Management and Sustainability and finally (5) Quality and Efficiency of the Partnerships with Stakeholders.

University's Policy, Support and Integration - As it is mentioned before TTOs are interconnected with their hosting universities and they frequently work with the universities' faculties, members and even students. Since university administration is the authority and the main executive, its vision, policy, decisions and attitudes

regarding the TTO are critical. Eventually, the university's TT / TTO related policies, the political, financial, physical and operational support that it provides to TTO and procurement of TTO's integration with the university ecosystem are important determinants of the performance and success of the TTO. In their research about how universities and their economic, political and social influence affect the system of innovation, Bercovitz and Feldman (2006) claim that the university policy and structure mediates the technology transfer outcomes critically. The influence of university greatly affects the cost of technology transfer in both positive and negative ways. Effects include the process of technology transfer activities, their management and even the results of these activities. Caldera and Debande (2010) examined Spanish universities and their TTOs on how the university policies affect the technology transfer activities. According to them, it is essential for a university to clearly state its strategy, set of guidelines and applications for its technology transfer management, including: regulation of the laws for the scientists that are affected by conflict of interest, the procedures of invention disclosure process, and royalty sharing policies and rules and regulations about establishment of spin-offs by academicians. Universities should set up these procedures and regulations within a harmony with its other missions and responsibilities such as teaching and research. Heher (2007) in his study that benchmarked US, UK, Canadian and Australian university TTOs, argued the necessity of a university's promotion for an entrepreneurial culture that fosters technology transfer. In addition to teaching and a well-organized research system, university policies should encourage academicians with some incentives that can be determined by the university to participate in commercialization activities with invention disclosures or establishment of spin-off companies after the phases of research and publishing. To achieve these, institutional capacity should be enhanced by the university and the entrepreneurial culture should be fostered for technology transfer and commercialization. Decter (2007) argues about the main missions of the university, which are not only teaching, publishing new knowledge and conducting basic and applied research but also patenting, licensing new technology and performing technology transfer activities. To establish a successful technology transfer system a university should perform the main improvements in; providing financial

support for its TTO with lower expectations of profit from the inventors, better reward possibilities, a better business understanding, employment of expert TTO personnel and finally form strong and efficient relationship with its TTO. Diamant (2007) mentions that a university should have a vision and a clear focus for successful technology transfer activities. The universities that have a clear focus on technology transfer can work more efficiently with their TTOs and have better progress compared to those that have not. When the necessary incentives for the technology transfer are not provided and when the university's procedures and executions are inflexible, a relatively insufficient level of technology transfer activities may occur. These issues may also incite the academicians to look for informal ways commercialization for their knowledge and technology without consulting the TTOs. These results may also derive when technology transfer culture is not generalized enough by the hosting university. This cultural insufficiency decreases the effectiveness of vertical technology transfer and eventually the efforts that are provided by the TTOs. According to Siegel (2004) the university administrators should implement rewarding systems, flexible policies for commercialization activities and should work to eliminate cultural and information barriers. There is also clear evidence that the universities that applied these implementations generate more invention disclosures, patents, establishes more companies and creates more commercial value for the markets.

In European Commission's Knowledge Transfer Study 2010-2012 Final Report, main challenges for the PROs and universities on technology transfer were summarized as:

- Incongruence of KT costs and benefits
- Academic rationales in favour of publishing
- Conflicts of interest
- Imperfect information about commercial potential
- Lack of market transparency
- Lack of KT professionals
- Cultural differences between PROs and companies
- Not-invented-here phenomenon: Enterprises may not necessarily be ready to adopt a technology that was invented elsewhere
- Lacking IP expertise in enterprises (European Commission, 2013: 272)

Organizational Structure of TTO - Since the TTOs are public / private institutions, the mission and vision statements of an institution, its management, institutional

identity, resource planning, orientation with the ecosystems of the university and industry and many other organizational concepts are crucial for its efficiency. Indeed, the organizational structures that are established accurately can determine the success and even life cycle of a TTO. Tornatzky (2000) in his research to identify common practices of the TTOs, highlights seven critical characteristics for the organizational structure of TTOs. A TTO should state a clear mission statement, should form transparent policies and procedures for their operations, should establish strong and sustainable links with its industrial partners, should attain the support of the university administration and community, should be able to access to financial capitals, should procure entrepreneurial staffing for its personnel and finally should establish friendly relations with the ecosystem. When measuring the efficiency of the US TTOs with their hosting universities, one of the outcomes that was attained by Anderson, Daim and Lavoie (2007) is that a TTO's organizational structure, policy and operational procedures directly affects the TTO's efficiency and success. Sorensen and Chambers (2008) performed a research on evaluating the performance of academic technology transfer. As a consequence of the research four qualitative metrics are proposed as; accessibility of knowledge, alliance management, capacity building in technology transfer fields and finally the contribution to the regional economic development. For a TTO's organizational structure, Young (2007) emphasizes the importance of TTO's mission statement and how necessary it is to overlap with the TTO's aim and current state. The statement may focus on service, income or economic development as a primary function. Nelsen (2007) presents ten propositions, which are some of the most important policy and strategy issues about establishing a TTO and determining its organizational structure. According to her, clear policies and procedures should be defined to conduct the TTO operations. Procedures of IP ownership, role distribution and interactions with the stakeholders, and other ground rules should be set up effectively for a strong operating structure and efficient technology transfer activities.

Human Capital and Quality - Working in the field of the technology transfer, as a necessity of its very nature, requires high professional qualifications and talent. The personnel should be experienced in both academia and industry, should be skillful in business development and establishing effective social relationships and in addition

should be experienced in many context-specific tasks of the technology transfer process. Thus, working with the appropriate personnel with a sufficient sophisticated skill set for this specific kind of position is essential. This makes the quality of the TTO staff a significant qualitative measure for the performance of the TTO. About the sufficiency and qualification of the TTO personnel, Nelsen (2007) mentions a detailed combination of qualifications as:

- an understanding of state-of-the-art research, often over a fairly broad range of technologies in a multidisciplinary university. (This usually requires a solid background in science or engineering.)
- an understanding of the language of industry (Officers must be familiar with markets, how technology is developed into products, accounting and finance principles, and decision- making processes.)
- at least a minimal understanding of venture capital, spinout formation, and small company operation
- more than a passing familiarity with patent law
- an understanding and sympathy with how academia operates, academic principles, and the career development paths and aspirations of students and professors
- outstanding written and verbal communications skills in both formal and informal situations
- good negotiation skills—or the innate talent, intelligence, emotional control, and "people skills" needed to learn them
- ability to deal with multiple constituencies with conflicting objectives, most of whom one has no authority over
- ability to deal with highly ambiguous, confusing situations
- both the drive and creativity to solve complex multidimensional problems and arrive at win-win solutions
- drive to get the job done, or follow through
- very high personal integrity and the wisdom to avoid situations that get *close to the line* on ethics—no matter how profitable the situation may be to the university, a faculty member, or the licensor.
- the willingness to work at a university salary because of the inherent satisfactions of the technology transfer job: great technology, complex and always-interesting issues, the satisfaction of seeing new companies form and new technologies reach the market, and, above all, the opportunity to contribute to the university, its students, and the community (Nelsen, 2007: 542)

Without dispute, a TTO manager who is the leader of the institution has a vital role for the performance of a TTO. His/her main mission to coordinate and manage the TTO includes leading and cultivating the TTO staff as well. Campbell (2007) analyzes the key elements that are involved in building a TTO for both its structure and staffing. TTO manager and its staff are emphasized as the key points for a TTO's success and performance. Since this business requires high skills of social relationship, TTO managers should ensure to contact with the people from all levels and factions of the

society. They should be capable of engaging with the environment of the industry and university at the same time with great flexibility and skill. According to Young (2007) a TTO manager should be experienced in both science and engineering education; in addition they should be equipped with management, marketing and business development skills.

Financial Resource Accessibility, Management and Sustainability - is another qualitative metric that is mentioned in the literature. Since TTOs are institutions that employ human resource and have a broad portfolio of work packages, they have various fixed and variable expenses. Therefore, ability of a TTO to acquire income and manage the profit from its activities are essential issues for its existence. Abrams, Leung and Stevens (2009) conducted research that consisted of surveys and interviews of US TTO managers about how they are organized and financed. They reached the following outcomes: %47 of all TTOs receive their budgets form the hosting university as funds, and receive the remaining part from their TT activities, and only %16 of all TTOs retain enough income to fulfill their objectives and cover costs. The results show that operating a TTO is actually costly despite the fact that most view them as a source of income. It is also noted that the revenue generation may not be the ultimate goal, however in any case it is crucial to sustain and continue transferring new knowledge and technology for the welfare of the public. According to the findings there is a direct correlation between the institution's budget and its profitability. When the financial capabilities are sufficient enough, a well-managed TTO is more active, confident and profitable which makes the relationship between the budget and profitability almost linear (Abrams et al., 2009). That is why accessibility to financial resources, managing them functionally and achieving financial sustainability are necessities. Nelsen (2007) points out that operating a technology transfer office needs a substantial amount of investment and it may not be able to make any financial contributions to the institution because of the high expenses of running a TTO.

In addition to the accessibility to financial resources, TTO's own strategies for making its own profit in terms of financial sustainability is also important. Since university funds and external financial resources cannot be available permanently or at least at

the desired levels, TTOs should have efficient business plans to increase their income from the activities that they perform.

Quality and Efficiency of the Partnerships with Stakeholders - Establishing and sustaining strategic relationships with the stakeholders for knowledge and technology transfer activities are essential for TTOs. Even though a TTO is perfect in terms of its staff and organization, it cannot sustain without establishing influential relationships, since it is a fact that these relationships with the ecosystem are critical for the efficient technology transfer activities. OECD (2006) defines knowledge transfer partnership as an agreement which benefits all that are involved, brings out the results that are achieved together and lessens the efforts for all sides compared to the case of engaging such activities individually. Success of this partnership is highly dependent on the effective use of the resources, its efficiency on promoting an innovative approach and a strong commitment between the parties. Campbell (2007) mentions the importance of the partnerships and how critical they are for the success of a TTO. These relationships can be formed with the academicians, industrial partners, and regional and governmental authorities. In most times more than two sides involve in a relationship. Since the whole process of technology transfer is demand driven, the TTO should understand its external partner's needs and should offer the right span of services. Ternouth, Garner, Wood and Forbes (2012) in their research examining the contributions of efficient partnerships to technology transfer state that, in building successful collaborative relationships with partners, the TTO should evaluate both the internal and external barriers arising from the nature of coping with the different sides. The TTO's managerial and organizational practices have a major role in this process. According to the research the most important barriers to form strong relationships are; finding the right partner, understanding the specific business needs, managing the costs, management of the relationship, and finally designating the legal form of the relationship and other legal procedures of the agreement.

As a consequence of the literature review, to summarize the findings, quantitative metrics that are mentioned in Section 2.3.1 and qualitative metrics that are mentioned in this section are gathered, repetitions are eliminated and metrics are grouped according to the regions/countries that they are used. In addition to the metrics that are

obtained from the literature, the quantitative metrics[2] and qualitative metrics[3] that are used by TÜBİTAK to measure the performance of Turkish TTOs are included as well. All metrics are grouped into eight different sections according to the set of tasks and activities that TTOs perform. These sections respectively are: (1) Awareness, Advertising, Informing and Education Oriented Activities, (2) Scientific Research & Funds, (3) University and Industry Collaboration, (4) Intellectual Property Rights Management & Licensing Activities, (5) Commercialization and Entrepreneurship Operations, (6) TTO Metrics, (7) University Metrics and (8) Qualitative Metrics. With respect to the classification that is mentioned above, quantitative metrics are given in Table 2.1 and qualitative metrics are given in Table 2.2.

Tables 1 and 2 indicate that, the metrics that are used in USA, Europe and Turkey are different from each other, although some of the metrics are commonly used. This shows that the results of some activities and tasks are accepted as a metric for measurement of performance while some of them are not. The point is that this acceptance differs across countries. Moreover, some metrics are unique to one region only. For instance the metrics in the section of Scientific Research & Funds are unique to Turkish TTOs only mostly because of the difference of the Turkish TTO model from those of the USA and Europe. Such differences among countries are examined in detail in Chapter 3.

[2] TÜBİTAK Technology Transfer Offices Support Program, Performance Indicators. Retrieved in September 2016 from https://www.tubitak.gov.tr/tr/duyuru/teknoloji-transfer-ofislerine-yonelik-2015-cagrisi

[3] TÜBİTAK Technology Transfer Offices Support Program, Annual Activity Report. Retrieved in September 2016 from https://www.tubitak.gov.tr/tr/destekler/sanayi/ulusal-destek-programlari/1513/icerik-formlar-2

Table 2.1: **Quantitative Metrics Used in American, European and Turkish TTOs**

	No	USA	EUROPE	TURKEY
Awareness, Advertising, Informing and Education Oriented Activities	1	# of Seminars, Meetings, Courses and Education Programs Held	# of Seminars, Meetings, Courses and Education Programs Held	# of Seminars, Meetings, Courses and Education Programs Held
	2	# of Workshops, Trade Shows and Fairs	# of Workshops, Trade Shows and Fairs	# of Workshops, Trade Shows and Fairs
	3		# of People, Students Attended to Courses, Seminars, Education Programs	# of People, Students Attended to Courses, Seminars, Education Programs
	4		# of People Met at Events Which Led to Other Knowledge Transfer Activities	
	5		Income Generated from Courses, Seminars, Education Programs	
	6			Amount of Education TTO Personel Have Annually (in hours)
	7	# of Telephone Calls		
	8	# of Company Visits		
	9	# of Newsletters		
	10	# of Assistance		
	11	# of Database Searches		
	12	# of Referrals		
	13	# of Fact Sheets		
	14			# of Advertisement Oriented Publishings of TTO
Scientific Research & Funds	15			# of National Scientific Research Projects Applied
	16			# of National Scientific Research Projects Accepted
	17			# of Interational Scientific Research Projects Applied
	18			# of International Scientific Research Projects Accepted
	19			Total Amount of Scientific Research Project Budgets
	20			Total Amount of Scientific Research Projects Income (Overheads)
	21			# of Academicians in Scientific Research Projects
	22			The Ratio of Total # of Scientific Research Projects / Total # of Academicians

Table 2.1: Quantitative Metrics Used in American, European and Turkish TTOs (continued)

University and Industry Collaboration	23	# of Consultancy Agreements	# of Consultancy Agreements	# of Consultancy Agreements
	24	Amount of Consultancy Research Expenditures	Amount of Consultancy Research Expenditures	Amount of Consultancy Research Expenditures
	25	Amount of Income Generated from Consultancy Agreements	Amount of Income Generated from Consultancy Agreements	Amount of Income Generated from Consultancy Agreements
	26		% of Consultancy Income Relative to Total Research Income	
	27	# of Collaborative Research Agreements	# of Collaborative Research Agreements	
	28	Amount of Collaborative Research Expenditures	Amount of Collaborative Research Expenditures	
	29	Amount of Income Generated from Collaborative Research Agreements	Amount of Income Generated from Collaborative Research Agreements	
	30		% of Collaborative Research Income Relative to Total Research Income	
	31	# of Contracted Research Agreements	# of Contracted Research Agreements	# of Contracted Research Agreements
	32	Amount of Contracted Research Expenditures	Amount of Contracted Research Expenditures	Amount of Contracted Research Expenditures
	33	Amount of Income Generated from Contracted Research Agreements	Amount of Income Generated from Contracted Research Agreements	Amount of Income Generated from Contracted Research Agreements
	34		% of Contracted Research Income Relative to Total Research Income	
	35		# of Technical Services Executed	
	36			# of Academicians in University-Industry Collaboration Projects
	37		# of Companies & Other Entities that TTO Generates Income	
	38		Length of Client Company Relationships	
	39		Total Amount of University-Industry Collaboration Project Budgets	Total Amount of University-Industry Collaboration Project Budgets
	40		Total Income Generated from University-Industry Collaboration Projects (Overhead)	Total Income Generated from University-Industry Collaboration Projects (Overhead)
IPR Management & Licensing Activities	41	# of Invention Disclosure	# of Invention Disclosure	# of Invention Disclosure
	42			# of Academicians that Disclosed Invention
	43	# of Patent Application	# of Patent Application	# of Patent Application
	44	# of Patents Granted	# of Patents Granted	# of Patents Granted
	45	Amount of Legal Expenditures on Protection of IP		
	46	# of Licensing Agreement	# of Licensing Agreement	# of Licensing Agreement
	47	# of Active Licenses		
	48	Amount of Licensing Income	Amount of Licensing Income	Amount of Licensing Income
	49		# of Products Arose from Licenses	

Table 2.1: Quantitative Metrics Used in American, European and Turkish TTOs (continued)

Commercialization and Entrepreneurship Operations	50			# of Enterpreneurs in Incubation
	51			# of Enterpreneurs in Pre-incubation
	52			# of Enterpreneurs Having Operational Possibilities/Suppots (education, business mentor etc.)
	53			# of Enterpreneurs Having Physical possibilities/suppots (office, infrastructure etc.)
	54	# of Start-up Companies Formed	# of Start-up Companies Formed	# of Start-up Companies Formed
	55		# of Succesful Start-up Companies	# of Succesful Start-up Companies
	56		# of Start-up Companies Realized a Capital Increase	# of Start-up Companies Realized a Capital Increase
	57		# of Start-up Companies Ceased Operation	
	58		Market Value of Start-up Companies	
	59		Amount of Revenues Start-up Companies Generated	
	60		Amount of External Investment Raised to Start-up Companies	
	61	# of Spin-off Companies Formed	# of Spin-off Companies Formed	# of Spin-off Companies Formed
	62		# of Succesful Spin-offs Companies	# of Succesful Spin-offs Companies
	63		# of Spin-off Companies Realized a Capital Increase	# of Spin-off Companies Realized a Capital Increase
	64		# of Spin-off Companies Ceased Operation	
	65		Market Value of Spin-offs Companies	
	66		Amount of Revenues Spin-off Companies Generated	
	67		Amount of External Investment Raised to Spin-offs Companies	
	68	# of New Commercial Products Created		
	69		Amount of Seed Capital Invested Annually	
	70	Total amount from Royalty Incomes (Licenses, Spin-offs, Start-ups)		Total amount from Royalty Incomes (Licenses, Spin-offs, Start-ups)
TTO Metrics	71		Amount of Annual TTO Budget	
	72		Share of TTO Budget (From Total Incomes)	
	73	# of Full Time Professional of TTO		
	74	Amount of Increase in Revenues		
	75	Amount of Decrease in Operating Costs		

Table 2.1: Quantitative Metrics Used in American, European and Turkish TTOs (continued)

University Metrics	76		# of Investments of PRO (For University, PRO etc.)	
	77	Amount of Investments of PRO (For University, PRO etc.)	Amount of Investments of PRO (For University, PRO etc.)	
	78		Graduation Rate of Students (For University, PRO etc.)	
	79		Hire Rate of Graduated Students (For University, PRO etc.)	
	80	# of Published Articles (For University, PRO etc.)		
	81	School Size (For University, PRO etc.)		

Table 2.2: Qualitative Metrics Used in American, European and Turkish TTOs

	No	USA	EUROPE	TURKEY
Qualitative Metrics	1	University / PRO's Support to TTO	University / PRO's Support to TTO	
	2	University / PRO's Strategy and Policy for TTO	University / PRO's Strategy and Policy for TTO	University / PRO's Strategy and Policy for TTO
	3	University / PRO's Integration with TTO	University / PRO's Integration with TTO	University / PRO's Integration with TTO
	4	Organizational Structure of TTO (institutionalism, processes, procedures, mechanisms etc.)	Organizational Structure of TTO (institutionalism, processes, procedures, mechanisms etc.)	
	5	Human Capital and Quality		
	6	Financial Sustainability		Financial Sustainability
	7	Resorce Accessibility and Management		
	8	Quality and Efficiency of Partnerships and Relationships with Stakeholders in University / PRO	Quality and Efficiency of Partnerships and Relationships with Stakeholders in University / PRO	
	9	Quality and Efficiency of Partnerships and Relationships with Stakeholders in Industry	Quality and Efficiency of Partnerships and Relationships with Stakeholders in Industry	
	10	Economic Development (TTO's economic benefit and contribution that is provided in the ecosystem of university and neighborhood industry)	Economic Development (TTO's economic benefit and contribution that is provided in the ecosystem of university and neighborhood industry)	
	11	Public Benefit (Impacts and consequences of added value that TTO activities generate in university, industry and other public areas)	Public Benefit (Impacts and consequences of added value that TTO activities generate in university, industry and other public areas)	

Although there are small differences, the metrics in the sections of 2, 3 and 5 in Table 1 are more common for every country/region, since they consist of the main activities of the TTOs. TTO metrics and University metrics are not used in Turkish TTOs and they are unique to the USA and European TTOs. Main reason could be the content of the metrics. Looking at the Turkish metrics, it can be seen that nearly all of them are related to the activities and tasks of the TTOs. However the university and TTO metrics are more about the features rather than the activities. Since the concept of TTO is rather new for Turkey, it is possible that these kinds of metrics cannot be used, unlike the developed countries. Indeed, the metrics of the developed countries includes both the activities and the features that are related to the TTOs. The level of metric sophistication can more clearly be seen in the qualitative metrics. These metrics are more common to USA and European TTOs most of which are actively being used to evaluate the success of TTOs. However, they are not widespread in Turkish TTOs. Measurement with qualitative metrics requires sophisticated qualitative approaches and methods. To determine such metrics and the methods for their measurement, a country should at least have experienced different models of TTOs in different circumstances, observations should be made about this experience and the approaches should be developed according to these observations. Many developed countries had passed this period already. So it is much more feasible for them to define this kind of qualitative metrics and develop sophisticated methods for measurement.

As a consequence for the case of Turkish TTOs, a context-specific assessment for the measurement of TTO performance is required. Since, there are some metrics that are commonly used with USA and European TTOs, there is also a great number of metrics, which are not used in Turkey, while they are used in other countries/regions. University metrics, TTO metrics and qualitative metrics are examples to these unused metric sets. Moreover, there are also metrics, which are completely unique to the Turkish TTOs. A summary of country experiences around the world can be found in Chapter 3, which at least clarifies the differences in terms of approach to the concept of TTO. To analyze the nature of diversity and the differences in the metrics, a qualitative approach is designed in Chapter 4, since the research question demands an in-depth study to analyze the current metric set and propose a new one.

CHAPTER 3

THE CASE OF DEVELOPING COUNTRIES

For a nation, the role and contribution of technology transfer in innovation and growth are indisputable if the necessary conditions for the system are satisfied. Mansfield (1975) states that economists have long recognized the significance of technology transfer as a keystone for economic growth for both developed and developing countries. As being one of the fundamental processes and the main determinants of a nation's economic performance, extend and efficiency of the technology transfer is crucial for technological progress. In addition to revenue generation, technology transfer has two more benefits for a nation, which are: economic development and public benefit (McDevitt, 2014). Since the technology transfer promotes the formation of high value-added products and services, its socio-economic gains may be substantial for a country. Diamant (2007) summarizes the main benefits of technology transfer for a country as;

- Transformation of academic research into new life saving treatments and medications provides enormous benefit to the public
- Technology transfer activity encourages the creation of new companies and therefore facilitates employment
- It encourages the prosperity of knowledge industries
- It attracts foreign investments
- Taken together, technology transfer activity creates the infrastructure for economic growth
- Institutions benefit from the use of royalty income, to enhance and expand their research capabilities
- The industry/academia interface is mutually fertile – faculty obtain access to commercial research funds, state-of-the-art equipment and cutting-edge technologies, while industry benefits from the extensive knowledge and ingenuity of academic researchers (Diamant et al., 2007: 4)

In developed countries because of the improved Science, Technology & Innovation (STI) systems, conducting related technology transfer activities are more established and widespread. However, in developing countries, conducting innovative research, achieving continuous knowledge accumulation and performing successive technology transfer activities can be more difficult since there are already some incompatibilities more than those present in the developed countries. As an example, some of the major

drawbacks can be sorted as; macroeconomic uncertainty, instability, insufficient physical infrastructure, fragility in institutional levels, lack of culture and social awareness, risk-averse approach of enterprises; lack of entrepreneurs; existence of business barriers for start-up and spin-off companies and finally lack of policy instruments related to the innovation and technology transfer activities (Oslo Manual, 2005). Immature STI systems, economic and political fluctuations, market failures and lack of a coherent technology transfer ecosystem are other critical challenges regarding this issue. Liu and Liang (2013) perform an analysis on the progress of China in technology transfer within some sectors and state the main challenges of technology transfer for developing countries as; insufficient vision, strategy and policy framework, infrastructure constraints, inadequate human and institutional capacity and weak intellectual property (IP) protection policies / systems.

Knowledge and technology transfer, its diffusion and activities are fundamental sources, for innovation. In this regard, knowledge and technology transfer is connected to innovation by determining its framework, sustaining its infrastructure and maintaining its formation. Without producing new knowledge and technology, converting this knowledge to a product or service, establishing university, industry and public collaborations, creating an added-value for the public benefit and covering the needs of the society with the new advances, achieving an innovative approach is not possible. Since the concept of technology transfer has a vital importance for nations, measurement of it is ultimately important. By performing the measurement of technology transfer, public authorities and other performers can be informed of their performance and progress and they can provide an opportunity to improve the process further. However, this measurement process should be performed with accurate methods and measures to obtain correct results. On the measurement of technology transfer activities OECD (2006) identifies four fundamental problems encountered by performers, which are: Timing: the lapse between the research and its commercialization process' completion time with its returns to society; Attribution: crediting a proportion from the outputs of previous activities to the sources which will be used for generating new knowledge and technology; Appropriability: the difficulty

of identifying the phases of the process; and Inequality: skewed and incorrect results obtained as a result of lack of attention and skills.

3.1 Policy Infrastructure and Factors That Affect and Promote Technology Transfer

Technology transfer mechanisms are highly dependent on substantial and consistent policy infrastructures and regulations as a part of the country's National Innovation System (NIS). Finston (2007) claims that the technology transfer systems works best when there is a systematic government support on basic research and encouragement of market guidance, a robust IP protection system and private investment possibilities on research and commercialization. Finston mentions the three necessary core elements as;

> 1. A durable government commitment to science education, research, and related infrastructure. Governments create an enabling environment for science and technology by investing in education and training (both at home and abroad, at secondary and university levels), funding basic and early applied research, and improving technology-related physical infrastructure.
>
> 2. Broad rule-of-law protections, including strong IP protections. Rule-of-law protections give individuals the ability to enter into enforceable agreements or contracts with others; they promise predictable and timely judicial remedies in case these agreements or contracts are breached.
>
> 3. Reliance on market forces as the engine for technology transfer. Market-oriented policies encourage risk taking and increased private sector investment. These three pillars of technology transfer are like the three legs of a stool: all are necessary, and none of them is sufficient by itself (Finston, 2007: 199).

Graff (2007) examined the benefits of IP legislation and other regulations and laws for the developing countries to perform related technology transfer activities. According to the outcomes primary policy areas that affect the technology transfer are; eligibility of IP protection, regulations and laws about the ownership of IP and industrial property, availability of the necessary labor or employment possibilities for the human resource that performs technology transfer activities, condition of national R&D system and IP management capabilities. Particularly, it is the efficient patent laws, which are the key policies that can cause significant booms in NISs. When introducing US patent law, the so called Bayh-Dole act, Abrams (2009) claims that the Chinese

walls between the academic and corporate research had broken down which opened a way for integration in academic innovation. This act indeed reflected to the numbers. After a short time the law was executed, 3.641 new IP based products and 5.171 spin-offs had been created. Only in a year, 3.278 patents were issued, 4.932 licenses were signed, 627 spin-offs were formed and research institutes generated a total income of $1.4 billion. The most important benefit of the Bayh-Dole was that it reformed the commercialization path of outputs that were obtained from the federally funded R&D projects, by allowing and giving the exclusive rights to the institutions that are involved in commercialization activities (Diamant, 2007). After this attempt of USA, many countries copied the system and reformed their own national patent laws accordingly.

3.2 Need of Special Metrics for Developing Countries

In developing countries, as it is mentioned before, innovation process is raw, inadequate and devoid the possibilities of an advanced knowledge-based economy. Consequently, the measurement of technology transfer becomes a harder task under these circumstances. Above all things, a developing country has its own unique case to learn, develop and catch-up. On the measurement of technology transfer, using the same framework and metrics that are used by the developed countries, may not yield accurate results since there are important differences among these countries. Quantitative metric sets that consist of statistical indicators can resemble and may be used commonly up to a point, while the qualitative metrics can be significantly different and case-specific for the countries or even regions. Kozlowski (2015), contrary to the popular belief, claims that innovation indices should be generated more distinctive and context-specific for different countries. He states the deficiencies of use of the same measurement systems for all countries, especially in developed and developing ones. Since the countries, regions and sectors have different socio-economic characteristics, the relationship between innovation and economic variables are context-sensitive. Instead of using a broad formula for every country, maintaining distinctive and thematic methodologies for different cases can yield more coherent results. Popular innovation indices can be a good measure for developed countries.

However they can present an inaccurate basis especially for the countries that try to catch-up (Kozlowski, 2015). Systems that were designed according to the use of more context-specific measures can provide a more simplistic and valid framework of measurement for the developing countries that are in the transition process for achieving advanced STI systems. Thus, after implementing the necessary policy infrastructures for knowledge and technology transfer activities and sustaining them with accurate intervention, defining and using more context-specific measurement systems by the authorities, can surely yield better results and can make the whole process valid, more controllable and efficient.

3.3 Country Cases

In this part some of the developing countries and Turkey is discussed regarding their position in technology transfer, TTO structures and laws and regulations that enable technology transfer activities.

Brazil – Starting from 1950 Brazil followed an aggressive science and technology policy and after 1971 some amendments were performed in the patent law. After political reforms in 1990 the law changed significantly and in 1998 issues about IP ownership and revenue sharing were improved. The regulations resulted a rapid growth in the number of patents. It reached to the numbers like 153 patents in a year compared to 264 for a total of 15 years. In 1982 the military regime established a central office for innovation and technology for the first time. This institution encouraged the concept of technology transfer and innovation in many universities. After a short period the number of technology transfer institutions increased to 12. Today more than 30 universities have their own TTOs operating (Graff, 2007).

China - Patent law entered China as a western import just after 5 years the Bayh-Dole act came into force in USA. As Chinese markets grow inside and outside of the country, the state regulated the system further. Especially in 1992 and 2000 the law was improved. As a remarkable reform, although the exclusive rights of the IPs remained in the state, the management and use of the inventions were given to the Chinese universities. Later in the year of 2003, the Chinese Bayh-Dole act was

performed and rights of the IP ownership were given to the institutions. As for technology transfer, China firstly adopted a law in 1996 and soon after this event, Chinese Ministry of Science and Ministry of Education began to operate specific technology transfer policies. While in 1998 only two of the universities, Beijing and Tsinghua, had TTOs, today most of the universities and public research organizations have their own TTOs (Graff, 2007). Since the Chinese system is market oriented, most of the TTOs, can be called as 'technomarts' in China. They are mostly private organizations rather than units of the public institutions. This structural advantage gives them more mobility and flexibility in the dynamic business world. Chinese TTOs are at a sufficient level in negotiating the license and spin-off shares by their incentives and are generally focused on self-sustaining activities (Young, 2007).

India - India started IP legislation process earlier than many developing countries. First patent law was adopted in 1856, and in 1911 the Indian patent law was improved according to the standards of the developed countries. After World Trade Organization (WTO) membership and TRIPS (Trade-Related Aspects of Intellectual Property Rights) agreements, India performed consecutive amendments in the patent law in 1999, 2002 and 2005. From the year of 2000, Indian Ministry of Science and Technology gave the full rights of IPs to the related institutions to manage and commercialize technology. In India, Indian Institutes of Technology (IITs) are the primary TTO structures. Except these institutions most of the organizations lack IP management and only a small portion of 277 Indian universities have their TTOs (Graff, 2007). In 2005, Society of Technology Management was formed by the state in order to follow and foster the technology transfer activities in the country. As public or private institutions, Indian TTOs are operating as profit centers mainly focusing on self-sustaining by well-organized business plans (Young, 2007).

Russia - During the Soviet period the state aggressively pushed and owned full rights of the IPs and innovations that was generated in the universities and industry. From 1992, the establishment of the Russian Federation, more functional IP legislations were adopted respectively in 1992, 1996 and 2003. After the final regulations, the rights of the inventions that invented as an output of a state-funded project were

assigned to the institutions that conducts the research, unless the agreement states that the research belongs to the government. Since strict technology policies were followed and many technological state companies have been formed during the Soviet period, today technology transfer institutions that conduct considerable technology transfer activities are widespread in Russia. Also in 2005 an umbrella technology transfer association named Eurasian Association of Technological Transfer Managers (EATTM) was formed in Russia (Graff, 2007). Actually, Russia had a great influence from the U.S. about the establishment of TTOs. With an agreement between U.S. Civilian Research and Development Foundation (CRDF) of USA and Russian Ministry of Education, two institutions submitted proposals about TTO establishment and funding mechanisms in order to enhance R&D opportunities and technology transfer activities. This attempt was substantial for the progress of Russia in terms of improving its TTOs. Additionally, Russian Academy of Science, an umbrella institution for many research centers, is conducting majority of the scientific research funded by the government and various technology transfer activities (Young, 2007).

3.4 Turkey

In 2015 Innovation Union Scoreboard, Turkey was labeled as a modest innovator, which is below the average of European countries. However, Turkey is performing strongly in “non-R&D innovation expenditures” with a high growth rate of 7%, which is significantly greater than EU average. Especially from 2014 onwards there is a notable increase in Turkey’s innovation performance (European Commission, 2015). In Turkey, applications of university technology transfer started at the eve of the new millennia where the term "TTO" started to appear. In 2011, TÜBİTAK had executed a policy related to TTOs and initiated the 1513 Technology Transfer Offices Program in 2012 in order to raise the academic research capacity in universities and encourage technology transfer activities to increase the university-industry collaborations, IP management, licensing, commercialization and establishment of spin-off / start-up companies. First TTO was established in Ege University in 1994 focusing mainly on university-industry collaboration. Then at the beginning of 2000 Hacettepe University and Middle East Technical University followed Ege University. However in 2012,

after the execution of TÜBİTAK's TTO support program, many universities founded their TTOs whether they are supported by the program or not. There are more than 75 TTOs in Turkey right now and 45 of them are financially supported by TÜBİTAK. Given that Turkey has more than 180 universities right now, TTO number is relatively high compared to many European and Asian countries. Most of the TTOs are established in big cities because universities are clustered in these cities. Right now there are 8 TTOs in Ankara, 13 TTOs in İstanbul, 4 TTOs in İzmir, 3 TTOs in Kocaeli, 2 TTOs in Konya and 2 TTOs in Eskişehir. Also the most established universities in cities of Kayseri, Bursa, Sakarya, Düzce, Edirne, Isparta, Denizli, Antalya, Mersin, Adana, Antep, Elazığ and Erzurum have a TTO. This picture indicates that TTOs are spread nearly all regions of the country. In Turkey, TTOs can operate in both state and private universities. Right now there are 29 state university TTOs, 12 private university TTOs and 4 technology park TTOs which are not associated to any university. As for their institutional structure, Turkish TTOs can be private companies as well as the formal units of state and private universities. Providing that, in both of the models they must have an organic link with their universities.

Unlike the global TTO model that merely focuses on licensing, commercialization and start-up / spin-off establishment, TÜBİTAK formally introduced 3 more activity modules for TTOs which can be expressed as preliminary modules before licensing and commercialization activities. These three modules are; (i) awareness, advertising, informing and education oriented activities for both academic and industrial environment, (ii) operations to benefit from funding and national / international support programs, and (iii) university-industry collaboration. Each of the three modules have their different set of functions, tasks and performance indicators. Since Turkey is a developing country with an ecosystem that have the drawbacks which are mentioned before, TTOs need a continuous accumulation of new knowledge and generation of IPs to commercialize. These preliminary modules are aimed to foster knowledge accumulation and also the culture that encourages these activities. Although some TTOs that are in the other countries are conducting these extra activities, TÜBİTAK's policy in TTO program makes the Turkish TTO model significantly different compared to its counterparts in the world. As the support

program for TTOs extends and the number of TTOs increases, the necessity of the measurement of performance became an important task and a real-time problem. The measurement of TTO performance is a hard and complex task, since there are too many variables that should be evaluated in the context-specific environment of a country (Diamant, 2007). Being a developing country makes it more difficult to decide on which metrics should be used for the measurement of TTO performance in Turkey.

In national strategy documents and plans, there are significant goals that Turkey aims to achieve. Based on the The National Science, Technology and Innovation Strategy 2011-2016, Erdil and Pamukçu (2013) summarizes them as: human resources development for science, technology and innovation; commercialization of research outputs into products and services; emphasizing the role of SMEs, R&D infrastructures, interdisciplinary research and international cooperation. Additionally, Turkey aims to develop policy tools to increase the number of R&D intensive start-ups; to spread the innovation and entrepreneurship culture in universities; to promote domestic patent licensing, technology transfer activities and establishment of new science centers. Most of these goals are either directly or indirectly related to the technology transfer activities.

Laws and regulations that promotes technology transfer activities exist in many developing countries as mentioned in Section 3.3. It is a fact that they have a great role in improving the technology transfer activities. However this issue is a disadvantage for Turkey, since it delayed an efficient patent law for decades. When we look at the global examples and their consequences, Turkey lacked a Bayh-Dole kind of patent law and this delay was one of the main obstacles, which prevents the transition to an innovation driven and knowledge-based economy. However in 2017 a new patent law was legislated. Before the new law, in most of the universities, inventors were the only owners of inventions rather than the universities. Unfortunately there were serious systematic confusions on sharing the rights of IPs between the inventors, universities and other public institutions. These problems also mirrored to the next phases of the technology transfer by preventing added-value contributions and formation of the economic returns that would be obtained from the research, product or service.

However the new law aims to solve these problems as giving the full ownership of IPs to universities. Additionally, the new regulations provide an opportunity to the state universities as giving them the chance to establish their TTO as a private firm and facilitate the process of IP commercialization. Since the law is new, its impacts will be seen soon.

3.5 Conclusion

Examinations from Chapter 2 and Chapter 3 indicate that majority of the metrics that are used in the measurement of technology transfer are common in developed and developing countries. Given that it is not possible to directly obtain much information about the metrics that are used in developing countries, it is mentioned in Chapter 2 that many of these countries directly use the American metrics for the measurement of TTO performance. Developed countries determined and upgraded their metrics according to long years of observations, experience and timely systemic improvements. Policy makers in the developing countries either did not consider context-specificity argument when deciding on their indicator set or perhaps their ecosystems are considered to be suitable for the use such of metrics.

However, the findings acquired so far emphasize that Turkey differentiates from both developed and developing countries regarding the metrics that are used in the measurement of TTO performance. First, Turkey's indicator set is not a direct copy of the ones used in developed countries. Some of the metrics are common while some of them are not. Second, given the context-specificity argument there are some metrics that are completely unique to Turkey which reflects differences in the TTO model as well. All these points verify the argument of the necessity of a context-specific assessment for the metrics that should be used in Turkey.

CHAPTER 4

METHODOLOGY

This chapter gives a brief and concise framework of methodology of the research. First of all, the main research problem of the thesis is identified and the research question and some related sub-questions considering the background and real-life case are presented. Secondly, quantitative and qualitative research methods are mentioned and mixed design of the methods is discussed which imparts a novelty of the research. Then, methods that are applied during the different phases are explained clearly in the data collection and data analysis sections. This chapter ends with information about participants of this research, interviewee profiles, limitations and research ethics.

4.1 Problem Identification

As it is mentioned in the Chapter 2, a standard developed country has strong National Innovation System (NIS), sophisticated TTO structure with developed performance measuring systems and an ecosystem with continuous knowledge accumulation of universities to form a productive circle of value-added services and products to establish a sustainable knowledge-based economy. Developing countries lack most of these and, moreover, they have characteristic unique to their own cases. They all have social, regional and economic characteristics affecting their science, technology and innovation systems. These claims bring out the question whether developing countries require different methods and metric sets on measuring the performance of their TTOs. After all, replication and direct use of the metric sets in developed countries may not be appropriate for the developing world.

As mentioned before, metrics that are used for measuring the performance of TTOs in U.S., Europe and Turkey most of the time differ while some are identical. Although most of the developing Asian countries are replicating developed countries' metric sets, Turkey uses a mix of some common metrics and a set of distinct metrics unique to the Turkish case. In addition, while qualitative metrics are used in both USA and Europe in measuring TTO performance, it is quite limited in Turkey with only few

metrics. Another important point is that, model of Turkish TTOs differ from the global TTO model which mainly consists of licensing and commercialization modules. In fact, as mentioned in Chapter 3, there are three preliminary modules installed consisting preliminary activities for licensing and commercialization. To increase knowledge accumulation, to acquire inputs such as IPs or business ideas, and to increase licensing and commercialization activities, the preliminary modules of "Awareness, Advertising, Informing & Education Oriented Activities, Scientific Research & Funds and University-Industry Collaboration" were added to the Turkish model. This is another point that makes Turkey's case distinct.

Considering all the issues expressed above, we can come out with a hypothesis as:

> Since Turkey is a developing country with context-specific characteristics, metrics that measure the performance of TTOs are different from the metrics that are used in the world and even in some cases unique metrics are required.

4.2 Research Question

This research aims to propose metrics that can be used for the measurement of performance of the Turkish TTOs to solve a real-time measurement problem. Both to obtain such metrics, examine the issues mentioned in Section 4.1 and to test the hypothesis, the main research question is determined as:

- *Which metrics should be used to measure the performance of technology transfer organizations in Turkey?*

Following sub-questions related to the main question, can further be asked.

- *Are metrics that are used in different countries (U.S., European and Asian countries) suitable for the Turkish TTOs? Can they be used directly?*
- *Is the currently used metric set by TÜBİTAK appropriate for Turkish TTOs? Should it be changed? If so how?*
- *In addition to quantitative metrics, should qualitative metrics be used in the measurement of TTO performance?*
- *Which new metrics should be developed and used for this process?*

Findings and evaluation of the results for the research question addressed will help to come up with policy recommendations on the measurement of the TTO performance in Turkey with wide implications to other developing countries.

4.3 Research Design and Methodology

In social sciences, quantitative and qualitative research methods are widely used by the researchers. Some research questions require quantitative approach while some others requires qualitative approach. However, for some research questions it is possible (and better) to design a mixed methodology. This research has also a mixed approach, including both qualitative and quantitative methods. Before getting into more detail, a brief research methods discussion is given.

4.3.1. Research Methods and Discussion

Quantitative research is a widely used approach to observe and investigate a research issue empirically by using mathematical or statistical methods. It uses quantitative data in numerical forms by employing mathematical methods to test hypothesis and theories (Given, 2008). Qualitative research however mostly uses anthropological methods to study a social phenomenon. It deals with *how* and *why* questions, rather than dealing only with *what* and *when* questions. As an approach of inquiry, qualitative research employs detailed case studies, interviews and surveys (Steckler et al., 1992). It requires more in-depth work and field studies and because of its advantages and the answers it provides for particular conditions, it is an indispensable research approach for some research disciplines. Table 4.1 summarizes prominent features of quantitative and qualitative approaches respectively (Steckler et al. 1992, p.2).

Both quantitative and qualitative approaches offer a great span of methods for research. Their mechanisms, methods and outcomes can vary by the nature of the problem. Indeed, a research's main question and context are key points for the selection of the approach. Some research requires interviews and surveys whereas some requires mathematical models and statistical methods. For this particular research, is it possible to use both approaches and come up with a mixed design?

As it is mentioned before, technology transfer concept is a new concept for Turkey and human resource in the field is recently growing. There are TTO managers, personnel and some other stakeholders from academia and industry related to the field.

Table 4.1 - Typology of Attributes of Quantitative and Qualitative Evaluation

Quantitative	***Qualitative***
Deductive	*Inductive*
Verification and outcome oriented	*Discovery and process oriented*
Measurement tends to be objective	*Measurement tends to be subjective*
Reliable	*Valid*
Technology is instrument (the evaluator is removed from the data)	*Self is instrument (the evaluator is close to the data)*
Generalizable	*Ungeneralizable*
The outsider's perspective	*The insider's perspective*
Population oriented	*Case oriented*

(Steckler et al. 1992, p.2)

The issue of determination of a metric set for measurement of a technology transfer organization's performance makes these people's opinions and suggestions critically important because they in fact constitute the backbone of the technology transfer ecosystem. To learn and utilize their ideas about the metrics from the first hand, qualitative methods such as interviews and surveys come forward.

As mentioned at the end of Chapter 2, there is a great number of metrics which are asked to the stakeholders of the field. To interpret the results that come out from their answers, the data should be quantified using certain statistics to obtain meaningful findings. At this point of the research, quantitative methods can be suitable. Usage of both approaches and requirements of the research brings out a mixed design.

Research that is conducted by using a mix of quantitative and qualitative methods is defined as mixed-method research (Sandelowski, 2000). Both of the approaches can be used sequentially or iteratively in a mixed design to deepen the study and accomplish more versatile findings. This kind of research presents a dynamic tool to

the researcher that expands the scope of the research and increase its analytical power. In addition, complexity of research and the human phenomena it includes, naturally requires more complex designs to capture more precise consequences (Sandelowski, 2000). Secherest and Sidani (1995) mentions some other areas of use of mixed-methodology such as; verification purposes of the methods, to provide some mechanisms on estimating measurement errors or probing data sets further to obtain more extensive results.

4.3.2 Research Design

In this research a mixed-method research design, including both qualitative and quantitative techniques, is used to achieve a complementary understanding of the research problem. As a qualitative method, interview technique is selected to obtain comprehensive results from the main stakeholders of technology transfer ecosystem. Two groups are determined for the interview phase of the research. First group consists of TTO managers from Turkey's first 10 leading TTOs and the second group is a focus group that consists of five members of Turkey's Technology Transfer Offices Support Program's steering committee. Interviews not only provide information on the opinions of the stakeholders about the metrics but also qualified information about why should a metric be used or why it should not be used and how should the approach be to measure TTO's performance. Both groups have performed a metric evaluation[4], suggested possible metrics and further provided many other useful inputs.

Interviews resulted in a handful of findings about the metrics. To understand, interpret and explain the meaning of these results in detail quantitative techniques, which are given in Section 4.3.4, are used. Data analysis with a number of statistics revealed an objective perspective about the metric data obtained by the interviews. Flexibility of the mixed design also provided the chance of further examining quantitative data analysis results to see whether they complement qualitative outcomes and explanations provided by the interviewees.

[4] Presented in Appendix B.

By this way, comprehensive outcomes are accomplished to answer the research question and sub-questions and more appropriate and accurate policy recommendations are proposed. The scheme of research design is given in Figure 4.1.

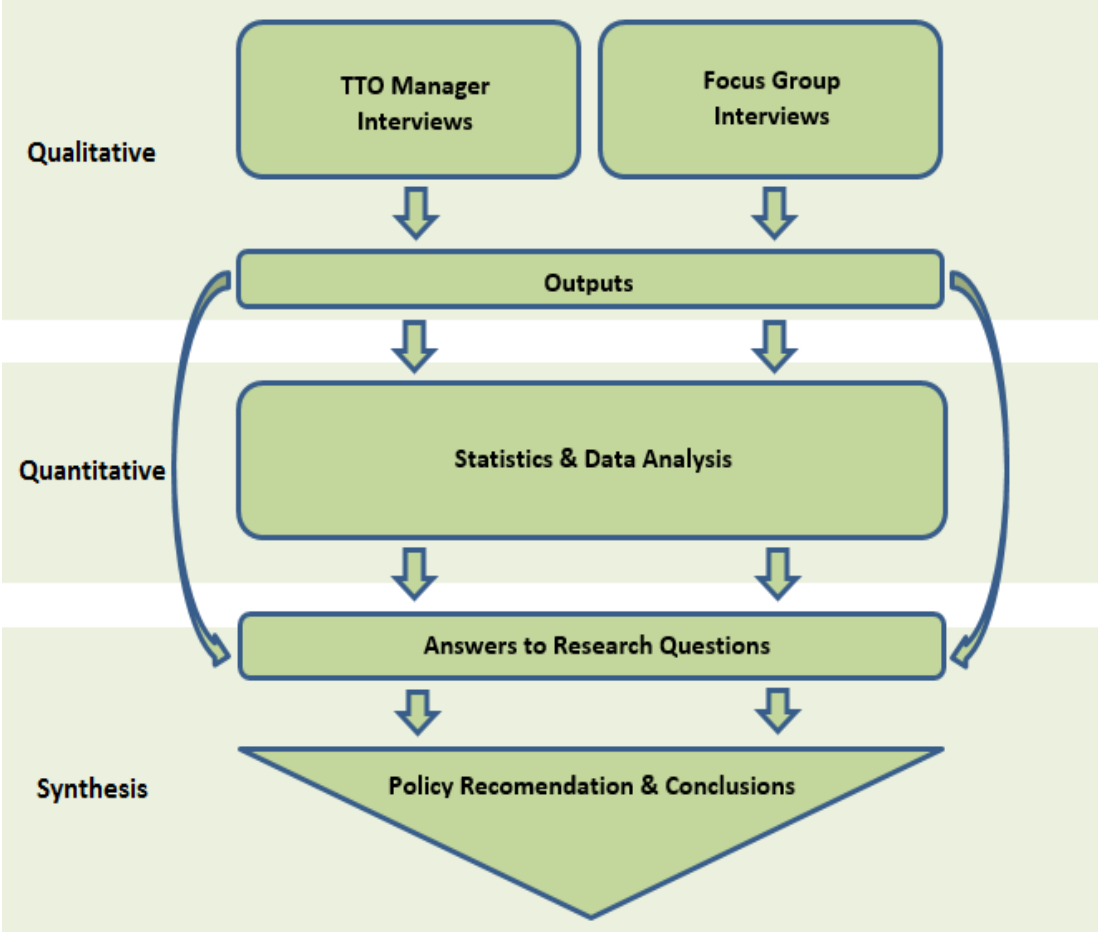

Figure 4.1 – Scheme of the Research Design

4.3.3 Research Methodology

To answer the research question, a methodology that is suitable for the mixed research design is followed. First of all existing metrics that are used in U.S., Europe, Asia and Turkey and their definitions are gathered from the literature. These metrics are used to compose an interview form[5]. Two different groups are formed for the interviews, TTO managers and experts. The groups are specifically separated and are not informed

[5] Full versions of the interview form can be found in Appendix A.

about each other and about the findings of the research. In addition to the metrics obtained from the literature, the interviews are the primary source for the research. Interviews are conducted by the researcher from March 2016 to June 2016. At the beginning of the each interview session, interviewee is verbally informed about the research and its goals. Interviews with TTO managers are conducted in TTO offices and in TÜBİTAK and interviews with the focus group are conducted in TÜBİTAK. All the interviewees are assured that the participant, TTO, university and company names will be kept confidential, will not be used in the research and will not be shared to third parties.

The interview form includes questions on;

- *Basic information about the participant and TTO*
- *Work experience of the participant*
- *Participant's level of education*
- *Participant's educational background*
- *81 quantitative metrics*
- *11 qualitative metrics*
- *Proposed metrics*

For every metric in the form, interviewees are asked to determine the importance of use of a metric to evaluate TTO performance. A 5-point Likert scale is used in all questions, more specifically;

1: *the metric should definitely not be used*

2*: the metric should not be used*

3*: undecided*

4*: the metric should be used*

5*: the metric should definitely be used*

Interviewees are also asked to propose metrics that does not exist in the interview form.

4.3.3.1 Interviewee Profiles

Important features of the participants of the two interview groups are listed in Tables 4.2 and 4.3. First group consists of 10 TTO managers from Turkey's first 10 leading

TTOs, which operate in the universities of; Boğaziçi, Ege, Hacettepe, İTÜ, Koç, METU, Özyeğin, Sabancı, Şehir and Yıldız. As it is mentioned, Turkish TTOs can operate as public units of universities as well as private firms. When we look at the profiles two structure types –public and private firms- are equally present. In addition, six of the TTOs are in public universities and four of them are in the private universities. This indicates that our sample do not show any particular dominance in terms of the structure of the TTOs and type of universities. Since the types of TTO structures are equally present, there are no major advantages or disadvantages provided by the technology transfer ecosystem on TTO structures, whether it is a public unit or a private firm. Majority of the managers are over 40 years of age. Thus, "TTO manager" in Turkey is a middle-aged job even though these structures are dynamic bodies that demands young and dynamic personnel. It is also interesting that there is not a male dominance for the TTO manager status. All of the managers have public and private sector experience (except one) and about half of the managers have more private sector experience than public sector experience. TTO managers are well educated. All managers, except one, have MSc or a higher degree which is an indication of existence of human capital. The educational backgrounds of the managers are diverse from social sciences to engineering and when their post-studies are considered one can see the multi-disciplinary feature of technology transfer officers. As a consequence, looking at the education background, gender, experience type of universities and structure of the TTOs our selected sample is representative and evenly distributed.

The second group selected for the interviews is a focus group that consists of 5 professionals whom also are the 5 members of the steering committee, which is the executive board for the 1513 and 1601 TTO programs of TÜBİTAK. The focus group is assigned for five years to make annual visits, observations and evaluations for more than 40 TTOs which makes their know-how ultimate for technology transferring structures and its ecosystem in Turkey. All of the members are male and over 40 years of age. All of the members have minimum 15 years of private sector experience and three of them are actively involved in business transactions (i.e., owning technology firms).

Table 4.2 – TTO Manager Profiles

TTO	TTO 1	TTO 2	TTO 3	TTO 4	TTO 5	TTO 6	TTO 7	TTO 8	TTO 9	TTO 10
TTO Structure	Company	Public Unit	Company	Public Unit	Company	Company	Public Unit	Public Unit	Public Unit	Company
Public University	✓	✓	✓		✓	✓				✓
Private University				✓			✓	✓	✓	
Age & Gender	50 - 60 Male	40 - 50 Male	40 - 50 Female	40 - 50 Female	40 - 50 Male	50 - 60 Male	50 - 60 Female	30 - 40 Female	40 - 50 Male	30 -40 Male
Work Experience (in years)	30	16	16	14	24	36	15	18	25	17
Public Sector	5	16	7	6	11	35	12	12	20	2
Private Sector	25	-	9	8	13	1	3	6	5	15
Level of Education	MSc	PhD	PhD	MSc	PhD	PhD	PhD	BSc	MSc	PhD
Educational Background	Engineering	Social Sciences	Engineering	Social Sciences	Engineering	Social Sciences	Engineering	Social Sciences	Engineering	Engineering

Thus it is obvious that the focus group members have more private sector experience. All of the members have a PhD degree; two are academics and three actively teach in universities. Four of them are coming from the engineering disciplines and one of them

Table 4.3 – Focus Group Member Profiles

Focus Group Member	Member 1	Member 2	Member 3	Member 4	Member 5
Age & Gender	50 - 60 Male	50 -60 Male	50 - 60 Male	40 - 50 Male	40 - 50 Male
Work Experience (in years)	31	35	32	28	24
Public Sector	8	35	32	4	4
Private Sector	23*	13*	20*	24	20
Level of Education	PhD	PhD	PhD	PhD	PhD
Educational Background	Engineering	Engineering	Engineering	Engineering	Social Sciences

*members who run their own companies while working in the public sector

is from social sciences. However all of the members have a considerable amount of experience in both private sector and academia; continue their educational careers and are actively involved in business life which makes the focus group versatile.

When we make a brief benchmarking between the TTO managers and the focus group some noticeable points are as follows;

- Average of age in the focus group is higher than the TTO managers.
- There is a gender dominance in the focus group while TTO managers are evenly distributed in terms of gender.
- There is not a major difference in their private and public sector experience levels. The focus group has slightly higher experience in the private sector compared to the TTO managers.
- The level of education is significantly higher for the focus group members.
- While TTO managers are heterogeneous in terms of educational background, there is a dominance of engineering background in the focus group.

4.3.4 Data Collection and Analysis

The interview results of 10 TTO managers and 5 focus group members are separately analyzed. For the quantitative analysis phase seven different statistics are constructed which are computed for all of the metrics for both groups. In calculating the statistics, for each metric, 5 rankings in the interview form are converted into points from 0 to 100, as: 0 for 1, 25 for 2, 50 for 3, 75 for 4 and 100 for 5. The seven statistics that constructed respectively are:

1: Average Value: for each metric average values of rankings are calculated.

2: Section Average Value: for each of the eight metric sections, the average values of all metrics in that section are calculated.

3: Dominance: Average Value / Section Average Value, is calculated for each metric.

4: Min / Max Count: for each metric, number of minimum (0) and maximum (100) ranking points are counted.

5: Below / Above 50 Count: for each metric, number of below 50 points and above 50 points are counted.

6: Private / Public Sector Averages: 10 TTO managers are divided into two groups according to their work experience (i.e., whether managers have private or public sector experience). For each metric, the metric averages of the two groups are calculated separately.

7: Private / State University TTO Averages: 10 TTOs are grouped in two with respect to the type of their universities. For each metric, metric averages of the two groups' are calculated separately.

As for an example that represents how the statistics work, the *# of Patent Applications* metric is chosen. TTO managers ranked the importance of this metric in using in evaluation as; 4, 0, 1, 5, 5, 5, 3, 5, 5, 5. Firstly, these ranking values are converted into points in 0-100 scale respectively as; 75, 0, 25, 100, 100, 100, 50, 100, 100, 100. For this metric the statistics are calculated as:

1. Average Value: (75+0+25+100+100+100+50+100+100+100) / 10 = 75
2. Section Average Value: (Other Metric Averages + 75) / 9 = 80,27
3. Dominance: 75 / 80,27 = 0,93

4. Min Count = 1
   Max Count = 6
5. Below 50 Count = 2
   Above 50 Count = 7
6. Private Sector Average = (75+25+100+100+100) / 5 = 80
   Public Sector Average = (0+100+50+100+100) / 5 = 75
7. Private University TTO Average: (100+50+100+100) / 4 = 87,5
   Public University TTO Average: (75+0+25+100+100+100) / 6 = 66,6

All of the seven statistics are calculated for the results of TTO manager interviews and first five statistics are calculated for the results of the focus group interviews since the last two statistics are not suitable for the focus group considering the features of the group.

As for the last phase, there is a wide assessment chapter where the results of both groups are evaluated in detail (chapter 5). For each metric section, tables showing the results of the statistics are given. Each metric is assessed according to the seven statistics explained above. After the metrics are evaluated quantitatively according to the statistics, findings and important issues are pointed out. The main focus of the analysis is to make robust decisions about the use of metrics. Consequently, on the basis of each metric, quantitative findings are subjected to a qualitative assessment according to the remarks of the focus group interviewees. Finally, for each metric section a benchmark analysis is performed to compare the quantitative and qualitative results of two groups. After the assessment phase, at the end of each metric section the outcomes are summarized to obtain a synthesis in order to propose a metric.

Since rating procedure of the metrics by TTO managers and the focus group form the backbone of this research in terms of input, reliability of this process is important for the robustness of the research. The results of the interviews are quantified, analyzed with a number of statistics and outcomes are expressed according to the findings. This procedure makes the level of agreement and consistency of the interviewees on the metrics essential. If the level of agreement is low or majority of the rater results are not consistent than either the interviewees are not experienced enough or the scale used for the measurement is defective. To examine this issue, an Inter-rater Reliability

(IRR) Analysis, which provides a statistical indicator to investigate the consensus and consistency of the raters, is performed. Among many IRR methods, Intraclass Correlation (ICC) is chosen. This method is used to assess the consistency and conformity of rater results when there are multiple raters for the same quantity and measurements are made on units which are grouped differently (Shrout and Fleiss, 1979). Since there are fifteen interviewees of two different groups, and all of the metrics are grouped into eight different sections, ICC method is considered as more appropriate. To run the ICC reliability analysis SPSS software package is used. The results of the analysis are given at the end of Chapter 5.

4.4 Limitations and Ethics

One of the limitations during the research was the limited data that was provided by TÜBİTAK. Since it is a public institution, there is permission only for the use of the open accessed data and documents. The performance indicators of Turkish TTO's were obtained by this way. Another point is that, some of the metrics that are not used in Turkey were not fully understood by the interviewees. On this point the researcher explained the metrics further so that the interviewee can understand what the metric measures and answer the question properly. This was an advantage of conducting face to face interviews with both groups. All of the limitations were manageable and none of them affect the process of the research significantly.

In all processes of the research, utmost precautions are taken to safeguard the rights and data of every university, company, TTO and individual that contributed to the research. Because of the privacy and sensitivity of TTOs the institutional data will never be shared with third parties and the identities of the interviewees will not be disclosed. In all stages of the research, documents and computer files are kept secure.

CHAPTER 5

EVALUATION

In this chapter, the results of the interviews are evaluated according to the research methodology. Metrics gathered from the literature are grouped into eight sections in accordance with TTO activity modules and specifications. Sections which consist of quantitative metrics that are grouped according to TTO activities are: (1) Awareness, Advertising, Informing and Education-Oriented Activities, (2) Scientific Research and Funds, (3) University-Industry Collaboration, (4) Intellectual Property Management and Licensing Activities, (5) Commercialization and Entrepreneurship Operations, (6) TTO Properties and (7) University Properties. Complementary to these there is a section for qualitative TTO metrics (8) and a section for the proposed TTO metrics (9) which are suggested by TTO managers and the focus group.

In each section, detailed tables which were used for quantitative analyses are given for both the focus group and TTO managers. Tables also include the results of statistics that are defined in Chapter 4 and the rankings of the metrics determined by the interviewees. The results for the quantitative analysis are interpreted in detail in each section in addition to the qualitative assessments. Furthermore, there is a synthesis part at the end of each section that benchmarks the results of TTO managers and the focus group.

5.1 Awareness, Advertising, Informing & Education Oriented Activities

Metrics in this section were considered as the second least important metrics by TTO managers and the least important metrics by the focus group. Results and calculations are given in Table 5.1. The detailed results and calculations of all metrics are given in Appendix B.

Table 5.1 – Awareness, Advertising, Informing & Education Oriented Activities Results

Panel A – TTO Manager Results

	No	Quantitative Metrics	I - AVERAGE	II - METRIC SECTION AVERAGE	III - DOMINANCE	IV - MAX / MIN COUNT		V - ABOVE 50 / BELOW 50 COUNT		VI - PRIVATE / PUBLIC SECTOR AVGs		VII - STATE / PRIVATE UNIVERSITY AVGs	
						max	min	Above 50	Below 50	Private Avg	Public Avg	State Uni. Avg	Private Uni. Avg
Awareness, Advertising, Informing & Education Oriented Activities	1	# of Seminars, Meetings, Courses and Education Programs Held	52,5	47,75	1,10	1	1	5	4	45	60	42	69
	2	# of Workshops, Trade Shows and Fairs	67,5		1,41	2	1	8	2	70	65	63	75
	3	# of People, Students Attended to Courses, Seminars, Education Programs	45		0,94	1	2	4	5	40	50	50	38
	4	# of People Met at Events Which Led to Other Knowledge Transfer Activities	40		0,84	1	3	3	5	50	30	42	38
	5	Income Generated from Courses, Seminars, Education Programs	32,5		0,68	0	3	2	6	30	35	21	50
	6	Amount of Education TTO Personel Have Annually (in hours)	70		1,47	3	0	7	2	65	75	63	81
	7	# of Telephone Calls	12,5		0,26	0	7	0	8	5	20	4	25
	8	# of Company Visits	65		1,36	3	1	7	3	40	90	67	63
	9	# of Newsletters	55		1,15	1	0	5	4	45	65	54	56
	10	# of Assistance	56		1,17	2	2	6	2	42	70	68	38
	11	# of Database Searches	47,5		0,99	1	1	3	4	50	45	58	31
	12	# of Referrals	47,5		0,99	1	1	3	4	55	40	58	31
	13	# of Fact Sheets	25		0,52	0	4	0	6	30	20	21	31
	14	# of Advertisement Oriented Publishings of TTO	52,5		1,10	1	1	4	3	45	60	50	56

Panel B – Focus Group Results

	No	Quantitative Metrics	I - AVERAGE	II -METRIC SECTION AVERAGE	III - DOMINANCE	IV - MAX / MIN COUNT		V - ABOVE 50 / BELOW 50 COUNT		VI - PRIVATE / PUBLIC SECTOR AVGs		VII - STATE / PRIVATE UNIVERSITY	
						max	min	Above 50	Below 50	Private Avg	Public Avg	State Uni. Avg	Private Uni. Avg
Awareness, Advertising, Informing & Education Oriented Activities	1	# of Seminars, Meetings, Courses and Education Programs Held	35	36,42	0,96	1	1	1	4	n/a		n/a	
	2	# of Workshops, Trade Shows and Fairs	40		1,10	1	2	2	3				
	3	# of People, Students Attended to Courses, Seminars, Education Programs	30		0,82	1	2	1	4				
	4	# of People Met at Events Which Led to Other Knowledge Transfer Activities	50		1,37	1	1	2	2				
	5	Income Generated from Courses, Seminars, Education Programs	40		1,10	1	1	1	3				
	6	Amount of Education TTO Personel Have Annually (in hours)	45		1,24	0	1	2	2				
	7	# of Telephone Calls	0		0,00	0	5	0	5				
	8	# of Company Visits	35		0,96	1	1	1	3				
	9	# of Newsletters	40		1,10	1	2	2	3				
	10	# of Assistance	55		1,51	2	0	2	3				
	11	# of Database Searches	35		0,96	1	2	1	3				
	12	# of Referrals	25		0,69	0	3	1	3				
	13	# of Fact Sheets	35		0,96	0	2	2	3				
	14	# of Advertisement Oriented Publishings of TTO	45		1,24	1	1	2	3				

Results obtained from the TTO managers demonstrate that, metric average values are ranging between 12.5 and 70 points with a section average value of 47.75 for 14 metrics, which implies that these metrics are not found important for measuring TTO performance in general. *# of Workshops, Trade Shows and Fairs organized, Amount of Education TTO Personnel Have Annually* and *# of Company Visits* are the three metrics that have the highest values for average, dominances, max counts and above 50 counts. These metrics are seen as essential activities for TTO managers as they are necessary to accomplish outputs for various TTO operations. The *Amount of Education TTO Personnel Have Annually* metric has the highest average value of the section. This rating represents the opinion of TTO managers about the necessity of education and shows how important it is for high skills and experience required for TTO activities. *# of Seminars, Meetings, Courses and Education Programs Held, # of People, Students Attended to Courses, Seminars, and Education Programs, # of Newsletters, # of Assistance, # of Database Search, # of Referrals* and *# of Advertisement Oriented Publishing of TTO* are the metrics that are averaged around 50 and are close to each other in terms of importance. Their dominances, min/max counts and above/below 50 counts are at very similar values as well. This shows that managers are not sure whether these metrics should be used or not. *# of People Met at Events Which Led to Other Knowledge Transfer Activities, Income Generated from Courses, Seminars and Education Programs, # of Telephone Calls* and *# of Fact Sheets* are the lowest averaged and weighted metrics and also have the highest min counts and below 50 counts. The metric about events that led other technology transfer activities was considered complex and hard to track by managers. The income generated from these activities is also considered negligible and insufficient compared to other TTO income sources such as the ones obtained from research funds, collaborations and commercialization activities. Low values of telephone calls and fact sheets are also considered as old and unnecessary methods besides some others. In Public / Private Sector Averages comparison, two metrics came forward: which are *# of Company Visits* and *# of Assistance.* The rest of the metrics are at close values. The managers who are experienced in the public sector considers these two metrics highly important, unlike those who are experienced in the private sector. This can be attributed to effective results that they observed from the application of these activities

by eluding public routines and to the resulting efficient service for their customers. Since managers coming from the private sector are already concerned with these activities, they do not consider these metrics as much as the other group. As for Public / Private University TTOs comparison, there are interesting results for the two metrics. *# of Seminars, Meetings, Courses and Education Programs Held* and *Income Generated from Courses, Seminars and Education Programs* are ranked significantly higher by private university TTOs than by public university TTOs. This can be attributed to private TTOs' objectives which are clearly more profit-focused and have a higher disposition for being more visible in the ecosystem than the public TTOs.

The results of the focus group demonstrate that the interviewees resolutely ranked this section's metrics with minimum importance. All metrics were averaged below 50 points except one metric which is *# of Assistance* with 55 points. The next highest ranked metrics are: *# of People Met at Events Which Led to Other Knowledge Transfer Activities, Amount of Education TTO Personnel Have Annually* and *# of Advertisement Oriented Publishing of TTO* ranging between 45 and 50 points. The rest of the metrics were averaged below 40 points, with high minimum and below 50 counts. This section's average value is 36.5 which is the lowest section average for the focus group. This indicates that in this section, the majority of the metrics are not found to be necessary for the measurement of TTO performance. According to them, this does not mean that the metrics are useless. These activities are important for TTO's awareness and visibility in the ecosystem however they should not be the direct measures for performance measurement. They should be treated as supplementary activities for TTOs' operations.

Synthesis – The results illustrate that TTO managers and the focus group correspond to each other for this section since their section average values are both under 50 points and are really close. TTO managers think that some of the metrics which are: *# of Workshops, Trade Shows and Fairs organized, Amount of Education TTO Personnel Have Annually* and *# of Company Visits* are important and should be used for the measurement of a TTO's performance. In fact, managers claim that these metrics are labor-intensive metrics for TTOs. The focus group's results for these metrics are ranked lower, around 40 points, except the education metric with a slightly higher

difference. These three metrics can be proposed despite the moderate rankings of the focus group because they are less severe when compared to other metrics for the focus group and they are ranked higher by TTO managers. The *# of Assistance* metric is also averaged around 55 points for the two groups. Although its point interval claims that the metric is undecided, it has the highest weight for the focus group perhaps because it contains a bunch of qualified services for TTO customers. Such activities are important for TTOs as they can used to tap into knowledge hubs besides increasing the visibility of TTOs. As a consequence *# of Workshops, Trade Shows and Fairs organized, Amount of Education TTO Personnel Have Annually, # of Company Visits* and *# of Assistance* metrics are proposed from the metrics in this section.

5.2 Scientific Research & Funds

Metrics in this section are unique to Turkish TTOs and are not used as metrics in other contexts although these activities are performed nearly in every TTO or university in the world. Interviewees' attitude toward this section is one of the most exciting parts of this research. Indeed, both TTO managers and focus group confirmed this issue and ranked these metrics extremely high, emphasizing the necessity of these metrics for the performance of Turkish TTOs. Results and calculations are given in Table 5.2.

TTO managers ranked all eight metrics between 67.5 and 92.5 points and the section average value is 81.87, which is the highest one of all sections. The *# of National Scientific Research Projects Applied and accepted, # of International Scientific Research Projects Applied and Accepted, Total Amount of Scientific Research Project Budgets, Total Amount of Scientific Research Projects Income (Overheads)* and *# of Academicians in Scientific Research Projects* metrics are averaged at 72.5 points and higher with nearly top maximum and above 50 counts. *The Ratio of Total # of Scientific Research Projects / Total # of Academicians* metric has the lowest average and dominance value among the other metrics in this section.

Table 5.2 – Scientific Research & Funds Results

Panel A – TTO Manager Results

	No	Quantitative Metrics	I - AVERAGE	II - METRIC SECTION AVERAGE	III - DOMINANCE	IV - MAX / MIN COUNT		V - ABOVE 50 / BELOW 50 COUNT		VI - PRIVATE / PUBLIC SECTOR AVGs		VII - STATE / PRIVATE UNIVERSITY AVGs	
						max	min	Above 50	Below 50	Private Avg	Public Avg	State Uni. Avg	Private Uni. Avg
Scientific Research & Funds	15	# of National Scientific Research Projects Applied	92,5	81,87	1,13	7	0	10	0	85	100	92	94
	16	# of National Scientific Research Projects Accepted	92,5		1,13	7	0	10	0	85	100	92	94
	17	# of Interational Scientific Research Projects Applied	87,5		1,07	6	0	9	0	85	90	92	81
	18	# of International Scientific Research Projects Accepted	87,5		1,07	6	0	9	0	85	90	92	81
	19	Total Amount of Scientific Research Project Budgets	82,5		1,01	4	0	9	0	80	85	83	81
	20	Total Amount of Scientific Research Projects Income (Overheads)	72,5		0,89	4	0	7	2	60	85	63	88
	21	# of Academicians in Scientific Research Projects	72,5		0,89	3	0	7	1	60	85	63	88
	22	The Ratio of Total # of Scientific Research Projects / Total # of Academicians	67,5		0,82	1	1	8	1	70	65	58	81

Panel B – Focus Group Results

	No	Quantitative Metrics	I - AVERAGE	II -METRIC SECTION AVERAGE	III - DOMINANCE	IV - MAX / MIN COUNT		V - ABOVE 50 / BELOW 50 COUNT		VI - PRIVATE / PUBLIC SECTOR AVGs		VII - STATE / PRIVATE UNIVERSITY	
						max	min	Above 50	Below 50	Private Avg	Public Avg	State Uni. Avg	Private Uni. Avg
Scientific Research & Funds	15	# of National Scientific Research Projects Applied	70	73,75	0,95	2	0	3	1	n/a		n/a	
	16	# of National Scientific Research Projects Accepted	70		0,95	2	0	3	1				
	17	# of Interational Scientific Research Projects Applied	75		1,02	3	0	3	1				
	18	# of International Scientific Research Projects Accepted	80		1,08	3	0	3	0				
	19	Total Amount of Scientific Research Project Budgets	75		1,02	3	0	3	1				
	20	Total Amount of Scientific Research Projects Income (Overheads)	85		1,15	3	0	4	0				
	21	# of Academicians in Scientific Research Projects	65		0,88	1	1	4	1				
	22	The Ratio of Total # of Scientific Research Projects / Total # of Academicians	70		0,95	1	0	4	0				

Incorporating academicians and making them contribute to the knowledge accumulation cycle is a hard task. On the other hand, this metric has the potential to underestimate the performance of the TTOs that are established in big universities since there are too many academicians for TTOs' reach (thus the denominator is high). However, it is a very useful indicator to monitor TTO's extensiveness within the university ecosystem. The metric relevant to a TTO, which is overheads from the research funds, is also ranked as high. Although there are some bureaucratic and functional problems in universities for transferring this kind of funds to TTOs, there is a strong awareness on the part of TTO managers for such activities mostly because income generated from this kind of activities are important for sustaining TTOs financially. Private / State University TTO Averages also expose some remarkable points. The following metrics: *Total Amount of Scientific Research Projects Income (Overheads)*, *# of Academicians in Scientific Research Projects* and *The Ratio of Total # of Scientific Research Projects / Total # of Academicians* are ranked significantly lower by state university TTOs compared to private university TTOs. This indicates two points; making profit is not as preferential for state university TTOs compared to private university TTOs and state universities are not as compulsive to their academicians as private universities are. As an example, many private universities have certain performance indicators that are determined for measuring the performance of their academicians, such as # of publishing, # of national and international projects participated, # of university-industry collaboration projects, etc. Since majority of the state universities devoid such indicators and attitude towards measuring academic performance they do not act as compulsive as private universities do.

The focus group results for this metric section are averaged between 65 and 85 points with a section average of 73.75 points which is nearly at the border of the claim "the metric should be used". Similar to the results of TTO managers, the focus group's max counts, above 50 counts and dominance results are high for this section. The metric which has the highest dominance and average value for the group is the *Total Amount of Scientific Research Projects Income (Overheads)*. In their opinion, all TTOs should definitely make profit from such activities since the research projects have high

budgets and TTOs offer an effective service scope for them. The lowest averaged and weighed metric is *# of Academicians in Scientific Research Projects*. The focus group thinks that this metric is not necessary when there are metrics like research project quantities and project / academician ratio. On the other hand, *# of Academicians in Scientific Research Projects* and *The Ratio of Total # of Scientific Research Projects / Total # of Academicians* metric is averaged significantly higher by focus group than by TTO managers. According to the focus group this metric is critical while observing TTO's impact on academicians and the university ecosystem.

Synthesis – Findings state that both TTO managers and focus group put emphasis on the metrics of this section. Considering Turkey's technology transfer ecosystem, both sides are aware of the situation that the research capacity of universities should be buffered by TTOs. The main reason for this situation can be the insufficient knowledge accumulation of Turkish universities compared to U.S. and European universities. TTO managers and focus group consider these metrics as a challenge and a footstep for two important reasons; first, they are bolstering knowledge accumulation and research capacity in the university ecosystem and, second, they are preliminary key activities for main TTO operations since they generate university-industry partnerships and intellectual property. It is evident that these characteristic metrics of Turkish TTOs should be used for the measurement of TTO performance. As a result all metrics in this section are proposed for the measurement of TTO performance.

5.3 University and Industry Collaboration

The concept of university and industry collaboration is one of the main tools for knowledge transfer from university to industry. These activities are vital since they are considered as inputs to generate industrial know-how and intellectual property for later TTO activities. High rankings of this metric section by TTO managers and focus group verify these inferences and highlight the significance of these metrics. Results and calculations are given in Table 5.3.

Table 5.3 – University and Industry Collaboration Results

Panel A – TTO Manager Results

	No	Quantitative Metrics	I - AVERAGE	II - METRIC SECTION AVERAGE	III - DOMINANCE	IV - MAX / MIN COUNT		V - ABOVE 50 / BELOW 50 COUNT		VI - PRIVATE / PUBLIC SECTOR AVGs		VII - STATE / PRIVATE UNIVERSITY AVGs	
						max	min	Above 50	Below 50	Private Avg	Public Avg	State Uni. Avg	Private Uni. Avg
University and Industry Collaboration	23	# of Consultancy Agreements	72,5	72,08	1,01	3	0	8	2	60	85	75	69
	24	Amount of Consultancy Research Expenditures	55		0,76	2	2	6	4	40	70	46	69
	25	Amount of Income Generated from Consultancy Agreements	70		0,97	3	0	7	2	60	80	71	69
	26	% of Consultancy Income Relative to Total Research Income	57,5		0,80	1	1	6	3	55	60	63	50
	27	# of Collaborative Research Agreements	72,5		1,01	4	1	8	2	70	75	63	88
	28	Amount of Collaborative Research Expenditures	70		0,97	3	1	8	2	70	70	63	81
	29	Amount of Income Generated from Collaborative Research Agreements	75		1,04	3	1	9	1	80	70	71	81
	30	% of Collaborative Research Income Relative to Total Research Income	65		0,90	2	2	8	2	80	50	67	63
	31	# of Contracted Research Agreements	92,5		1,28	7	0	10	0	90	95	96	88
	32	Amount of Contracted Research Expenditures	67,5		0,94	3	2	8	2	65	70	58	81
	33	Amount of Income Generated from Contracted Research Agreements	82,5		1,14	4	0	9	0	85	80	83	81
	34	% of Contracted Research Income Relative to Total Research Income	67,5		0,94	3	2	8	2	85	50	71	63
	35	# of Technical Services Executed	72,5		1,01	2	0	8	1	70	75	83	56
	36	# of Academicians in University-Industry Collaboration Projects	75		1,04	3	1	9	1	80	70	71	81
	37	# of Companies & Other Entities that TTO Generates Income	82,5		1,14	3	0	10	0	75	90	79	88
	38	Length of Client Company Relationships	50		0,69	1	2	5	4	65	35	50	50
	39	Total Amount of University-Industry Collaboration Project Budgets	85		1,18	4	0	10	0	85	85	88	81
	40	Total Income Generated from University-Industry Collaboration Projects (Overhead)	85		1,18	4	0	10	0	85	85	88	81

Panel B – Focus Group Results

	No	Quantitative Metrics	I - AVERAGE	II -METRIC SECTION AVERAGE	III - DOMINANCE	IV - MAX / MIN COUNT		V - ABOVE 50 / BELOW 50 COUNT		VI - PRIVATE / PUBLIC SECTOR AVGs		VII - STATE / PRIVATE UNIVERSITY	
						max	min	Above 50	Below 50	Private Avg	Public Avg	State Uni. Avg	Private Uni. Avg
University and Industry Collaboration	23	# of Consultancy Agreements	70	69,16	1,01	2	0	3	1	n/a		n/a	
	24	Amount of Consultancy Research Expenditures	60		0,87	1	0	2	1				
	25	Amount of Income Generated from Consultancy Agreements	70		1,01	2	0	3	1				
	26	% of Consultancy Income Relative to Total Research Income	60		0,87	1	0	2	1				
	27	# of Collaborative Research Agreements	55		0,80	1	0	2	2				
	28	Amount of Collaborative Research Expenditures	55		0,80	1	0	2	2				
	29	Amount of Income Generated from Collaborative Research Agreements	70		1,01	1	0	3	0				
	30	% of Collaborative Research Income Relative to Total Research Income	65		0,94	0	0	3	0				
	31	# of Contracted Research Agreements	85		1,23	3	0	4	0				
	32	Amount of Contracted Research Expenditures	75		1,08	1	0	4	0				
	33	Amount of Income Generated from Contracted Research Agreements	80		1,16	2	0	4	0				
	34	% of Contracted Research Income Relative to Total Research Income	70		1,01	1	0	3	0				
	35	# of Technical Services Executed	55		0,80	1	0	2	2				
	36	# of Academicians in University-Industry Collaboration Projects	65		0,94	1	0	3	1				
	37	# of Companies & Other Entities that TTO Generates Income	70		1,01	1	0	4	1				
	38	Length of Client Company Relationships	75		1,08	1	0	4	0				
	39	Total Amount of University-Industry Collaboration Project Budgets	85		1,23	3	0	4	0				
	40	Total Income Generated from University-Industry Collaboration Projects (Overhead)	80		1,16	2	0	4	0				

TTO managers ranked all metrics above 50 points with a metric section average of 72.08. Consultancy Agreements, Collaborative Research Agreements and Contracted Research Agreements constitute the backbone for this section's activities and nearly all other activities and metrics revolve around them. Due to this fact, the *# of Consultancy Agreements*, *# of Collaborative Research Agreements* and *# of Contracted Research Agreements* metrics are highly ranked. *# of Contracted Research Agreements* are ranked significantly higher than other agreement types because they represent more context-specific and core R&D projects that are demanded and signed by industrial firms themselves, and have more possibilities to generate profit, know-how and IP than consultancy and collaborative projects. For the same reason, three other metrics that are related to contracted research agreements are also rated higher. The amount of expenditures of all three project types is ranked slightly lower than other metrics regarding agreements. Actually, TTO managers weigh the expenditures of the projects less than their incomes and outputs. According to them, outcomes of the projects can vary independently from their expenditures. For instance in some cases, low-budget projects can generate efficient results while high-budget projects don't. Due to this attitude expenditures might be ranked lower than other indicators of collaborative agreements. *# of Technical Services Executed* and *# of Academicians in University-Industry Collaboration Projects* are other metrics that are ranked high by managers. *# of Technical Services Executed* includes the solutions that TTOs provide for their industrial partners and most of the time university's academic members are used for these services. Number of academicians that are assigned in these activities is also an indicator monitoring how many academicians of a discipline or department of a university take part in university-industry collaboration projects. The metrics about TTO income which are; *# of Companies & Other Entities that TTO Generates Income*, *Total Amount of University-Industry Collaboration Project Budgets* and *Total Income Generated from University-Industry Collaboration Projects (Overhead)* are ranked significantly higher. Indeed, the more customers and project budgets TTOs have, the more income they will generate. Generating income from university-industry collaborations is important for all TTOs. This can be the main cause of high ratings. As for the metric of the *Length of Client Company Relationships*, it is the lowest ranked

metric of the section. Managers' common opinion about this metric is that it has a qualitative nature and it is hard to track. Whether the managers have long or short relationships with firms, they are more concerned about the solutions that they develop for the problems during the process and the outputs they attain. In the private / public sector statistic, the *% of Collaborative Research Income Relative to Total Research Income, % of Contracted Research Income Relative to Total Research Income* and *Length of Client Company Relationships* metrics were ranked significantly higher by private sector experienced managers. This can be attributed to the prevalence of high profit and customer oriented policies of the private sector. *Length of Client Company Relationships* metric is considered important by private sector experienced managers which shows that strong ties are still important even while they operate TTOs. In the private / state university TTOs statistic, all three research project expenditure metrics are ranked higher by private university TTOs. It seems that private university TTOs show more interest in research expenditures than public university TTOs because higher budget projects provide higher profits from TTO shares. This issue is considered more important by private university TTOs.

The focus group rankings are averaged at 69.16 for this section and the lowest metric base point is 55. Contracted research and its related metrics are ranked higher by the focus group than other agreement metrics due to the same reason that led TTO managers to rank them high. However collaboration agreement metrics are slightly low ranked by the focus group. This is because of the complexity of collaboration projects where it becomes more difficult to form and proceed the agreements than the case is in relatively more focused consultancy and contracted research projects. According to the focus group, consultancy and contracted research agreements are more suitable for TTOs in the Turkish ecosystem in the short term. For collaborative university-industry agreements the major penalties are the low quality of relationships and the insufficient culture. The *# of Companies & Other Entities that TTO Generates Income, Total Amount of University-Industry Collaboration Project Budgets* and *Total Income Generated from University-Industry Collaboration Projects (Overhead)* metrics are also ranked high by the focus group. According to them income generation from university-industry collaboration projects is vital since they are more profitable

and since they are common activities for TTOs. Although licensing an intellectual property can be much more profitable than a university-industry collaboration project, these projects are always demanded by industry and TTOs can gain much from this demand more than the other activities. The *# of Technical Services Executed* metric is one of the lowest ranked metrics of the focus group for this section. For this metric the focus group's opinion is that, many other metrics are directly or indirectly related to these services and a new metric for it is unnecessary.

Synthesis – concerning university-industry collaboration metrics, both the managers and the focus group point out their significance and use. In this regard, section average values and many other statistics are close to each other. All three university-industry agreement types and their related metrics are ranked high by both groups. However, the focus group ranked collaboration agreement metrics lower than the managers. Reconciling the academia and industry is already a hard task since it requires combining two different personality types and environments. Furthermore, collaboration projects require more than two sides in a single project. This issue is considered difficult for the focus group in comparison with other more focused agreement types. However it is encouraging to see that TTO managers are motivated regarding this issue. All income metrics got the highest points by both groups highlighting the fact that they have the same opinion concerning the significance of this issue. Conducting these activities is really important in terms of revenue generation for TTOs since there will always be a continuous demand and funds to develop more projects. What really matters is that a TTO should be experienced and should deliver high-quality services as an interface. There is a remarkable difference between the two groups regarding the *# of Technical Services Executed* metric. While TTOs are more interested in this metric, the focus group thinks that this metric is unnecessary. However, according to the managers, some TTO services in university-industry collaboration activities may not lead to projects by TTOs, but they are still services from which both that academia and industry benefit from. For example, a TTO can match an academician and a firm in response for a demand that comes from the firm. The two parties may not start a shared project under the umbrella of TTOs, but they can do that between themselves independently of TTO. Such cases can occur and

the TTO is still involved in terms of providing services. There is also a difference between the managers' and the group's results in terms of the *Length of Client Company Relationships* metric. The focus group ranked this metric high while the TTO managers were doubtful. For TTO managers this metric is considered as hard to track and complex. However, the TTO business is mainly qualified and service focused. So the relationship length can be a sign for good services. That is why the focus group considers it important and necessary. To sum up, all metrics are ranked high by the two groups while a couple of lowest ranked metrics stand as undecided. In cases of difference between the two groups' opinions regarding one metric, either of the groups ranks it high while the other one remains undecided but not unfavorable. As a result, all metrics in this section are proposed as relevant metrics for performance measurement.

5.4 IPR Management and Licensing Activities

Intellectual property management and licensing activities are accepted as one of the two main modules of the global TTO model and it includes principal tasks for TTO operations. Unlike the previous three sections of activities, these activities are directly intended for high value-added outcomes. Correspondingly, this section's metrics form one of the highest ranked metric sections among all the others for both TTO managers and the focus group. The results are given in Table 5.4.

TTO managers ranked this section's metrics high in all statistics with a metric section average of 80,27 which is the third highest ranked metric section. The *# of Invention Disclosure, # of Licensing Agreement* and *Amount of Licensing Income* metrics are the highest ranked among all indicators. Invention disclosures constitute the main input for this section's activities. After these disclosures are obtained, it is assessed whether the disclosure has a valuable intellectual property, whether a national / international patent application should be filed, whether it should be licensed as know-how and whether its technology readiness level (TRL) should be increased further. The *# of Academicians that Disclosed Invention* metric is also considered as important because one can see whether inventive activities are distributed across academicians or there are star academicians with many inventions.

Table 5.4 – IPR Management & Licensing Activities

Panel A – TTO Manager Results

	No	Quantitative Metrics	I - AVERAGE	II - METRIC SECTION AVERAGE	III - DOMINANCE	IV - MAX / MIN COUNT		V - ABOVE 50 / BELOW 50 COUNT		VI - PRIVATE / PUBLIC SECTOR AVGs		VII - STATE / PRIVATE UNIVERSITY AVGs	
						max	min	Above 50	Below 50	Private Avg	Public Avg	State Uni. Avg	Private Uni. Avg
IPR Management & Licensing Activities	41	# of Invention Disclosure	92,5	80,27	1,15	7	0	10	0	90	95	92	94
	42	# of Academicians that Disclosed Invention	85		1,06	5	0	9	0	90	80	83	88
	43	# of Patent Application	75		0,93	6	1	7	2	80	70	67	88
	44	# of Patents Granted	80		1,00	4	0	9	1	70	90	79	81
	45	Amount of Legal Expenditures on Protection of IP	67,5		0,84	4	0	6	3	65	70	63	75
	46	# of Licensing Agreement	95		1,18	8	0	10	0	90	100	96	94
	47	# of Active Licenses	72,5		0,90	5	2	8	2	90	55	79	63
	48	Amount of Licensing Income	90		1,12	6	0	10	0	85	95	92	88
	49	# of Products Arose from Licenses	65		0,81	4	1	6	3	70	60	67	63

Panel B – Focus Group Results

	No	Quantitative Metrics	I - AVERAGE	II -METRIC SECTION AVERAGE	III - DOMINANCE	IV - MAX / MIN COUNT		V - ABOVE 50 / BELOW 50 COUNT		VI - PRIVATE / PUBLIC SECTOR AVGs		VII - STATE / PRIVATE UNIVERSITY	
						max	min	Above 50	Below 50	Private Avg	Public Avg	State Uni. Avg	Private Uni. Avg
IPR Management & Licensing Activities	41	# of Invention Disclosure	80	82,77	0,97	2	0	4	0	n/a		n/a	
	42	# of Academicians that Disclosed Invention	70		0,85	1	0	4	1				
	43	# of Patent Application	75		0,91	2	0	4	1				
	44	# of Patents Granted	85		1,03	4	0	4	1				
	45	Amount of Legal Expenditures on Protection of IP	60		0,72	1	0	2	1				
	46	# of Licensing Agreement	100		1,21	5	0	5	0				
	47	# of Active Licenses	90		1,09	4	0	4	0				
	48	Amount of Licensing Income	95		1,15	4	0	5	0				
	49	# of Products Arose from Licenses	90		1,09	3	0	5	0				

As a consequence of this distribution, TTOs can estimate the situation and can develop more efficient operations and complete new strategies either to enhance the services to the present academics or to extend the number of academics that they serve. In addition, *# Patent Applications* and grants are considered as useful metrics because they are the indicators that represents the numbers of invention disclosures that are turned into a patent application and that are granted. The *Amount of Legal Expenditures on Protection of IP* metric is the second lowest ranked metric by TTO managers with 67.5 points. Actually, this metric cannot be used directly in terms of measuring TTO performance because, # of active IPs is affected by many other factors such as the strictness/flexibility of IP valuation process, the kind of the IP and amount of other expenditures that the university, the TTO and other stakeholders have. As a result, a TTO can manipulate its strategy on protection investments for IPs, whether to hold them high or low independently from accepting this as an indicator. The *# of Licensing Agreement* and *Amount of Licensing Income* metrics are two of the highest ranked metrics which in fact directly indicates a TTO's qualification and success among this section's activities. Thus, the TTO managers verify this situation. *# of Active Licenses* however was not ranked as high as any other licensing metric. Active licensing is only one of the many kinds of licensing types. Owners or TTOs can have active licenses and continue to obtain profit from these licensing agreements. Yet, they can also license it exclusively and have the total profit at once. Since this metric includes only one type of licensing and does not include the other types, it may not be ranked among the highest ones. *# of Products Arose from Licenses* is the lowest ranked metric of the section by the managers with 65 points of average. TTO managers can avoid ranking this metric high because the process of invention disclosure, patenting and licensing of a product can take extremely long in some cases. The process may take long years or a decade due to area of usage, market, production dynamics, etc. of the products. The IP may even not turn into a product in some unwanted conditions. So, managers can think that using this indicator as a metric cause difficulties for TTOs in terms of tracking or perhaps seems as a case of failure for the TTO at the end of the process. Regarding the private / public sector and private / public university TTO comparisons no remarkable findings are observed since all of the managers ranked all the section's metrics decisively.

The focus group ranked this section's metrics high as well with a metric section average of 82.77 which is their second highest average of all other metrics. *# of Licensing Agreement, Amount of Licensing Income, # of Active Licenses* and *# of Products Arose from Licenses* are the top ranked metrics in all the statistics. This is a remarkable example of the focus group's result-oriented perspective in relation to the measurement of TTO performance. Indeed, metrics about licensing and its income are the main indicators of a TTO's success and performance. Invention disclosures and the academicians who participated in it are also important metrics for the focus group. By using these metrics, the amount of IP inputs and their distributions on academicians can be observed. According to the focus group, the academicians of the natural sciences and engineering departments should more carefully be observed by TTOs because these disciplines are pioneers in generating innovation and technological IP. As for the patent application and grant numbers, they as well are necessary metrics that the focus group ranked high in terms of tracking the rest of the IP process towards licensing. Such metrics also aim to monitor the IP valuation process of TTOs for knowing how many of the IPs are evaluated and resulted for patent applications and how many of the applications are granted. The *Amount of Legal Expenditures on Protection of IP* metric is the lowest ranked one by the focus group. According to the focus group, IP protection expenditures are not always considered an indicator for a TTO's performance. According to the strategy concerning the roadmap of the IP, it can be patented for licensing while the protection time is minimized; it can be patented only for the protection which means long protection time and high expenditures to maintain the patent or it can be licensed quickly as know-how without a patent application. Since there are many different ways, expenditures and their levels may not be directly related to TTO's performance. However, this metric monitors whether a TTO has a continuous and active patent portfolio. This may be the reason why the metric is ranked above the undecided rating.

Synthesis – Metrics of this section are rated high by both groups. This is an indication of a common perspective for two groups concerning the necessity of these metrics. The framework of the metric section leads the main finding that this section's metrics are sequential activities of IPR management as a whole. It starts with the step of

invention disclosures and ends with licensing and income generation. As a consequence, both groups agree on the usage of these metrics for the measurement of performance of this sequential process. The *# of Academicians that Disclosed Invention* metric is ranked slightly higher by TTO managers. Since TTOs operate mainly in the field, this metric has more importance to them in terms of motivating and encouraging the university ecosystem. As in examples mentioned in the former sections, the focus group is more concerned with the outputs rather than the numbers of the participating university members. Although the rankings of both of the groups are high, there is a remarkable gap between their rankings of the *# of Active Licenses* metric. The focus group cares much more about this metric than managers because this is an indicator that shows the capacity and activeness of a TTO in licensing. In addition, active license agreements are excellent financial resources, which provide continuous profit during the time of activeness. There is also a considerable gap between the rankings of the *# of Products Arose from Licenses* metric. For the focus group, although this metric poses difficulties to TTOs, it has a way to motivate TTOs and draw their attention to commercialization and valuation of IPs. Nevertheless, all the TTOs' and other stakeholders' efforts are for the sake of delivering knowledge to the public and social ground as a product or service that leads to an added value. When IP process fails licenses only return as a loss of financial and other types of resources. Therefore, keeping up and becoming successful in this process is important. Thus, because of high rankings of indicators and common attitudes of the groups, all the metrics of this section are proposed as viable indicator.

5.5 Commercialization and Entrepreneurship Operations

This section's metrics are about the other path of commercialization; that is, the activities of entrepreneurship and incorporation. At the last phase of the vertical technology transfer, other than licensing, the transfer can be conducted upon a company established with the related business idea and business model which is suitable for the output. The majority of this section's metrics were ranked high by both groups. The results are given in Table 5.5.

The metric section average is set at 70 by the TTO managers. The following metrics are the highest ranked in this section: *# of Entrepreneurs in Incubation, # of Entrepreneurs in Pre-incubation, # of Entrepreneurs Having Operational Possibilities/Supports (education, business mentor etc.), # of Start-up Companies Formed, # of Spin-off Companies Formed* and *Total Amount from Royalty Incomes (Licenses, Spin-offs, Start-ups).* Turkish TTOs' entrepreneurship activities are mainly formed around start-up entrepreneurship which represents entrepreneur students, rather than spin-off entrepreneurship that represents entrepreneurs from the academia. This attitude of TTOs drives managers to rank the metrics of start-up entrepreneurship and its preliminary activities such as the metrics of incubation, pre-incubation, operational and physical supporting etc., higher than the spin-off related metrics. Initiating and encouraging entrepreneurship at the level of students is far easier than at the level of academia. Students are far more willing and motivated to have their own companies for their business idea than the academicians. Although sometimes it is very profitable for an academician to form and sustain his/her own company established for his/her own IP, product or knowledge, majority of the academicians in Turkey prefers to remain completely dedicated to the academic world and only few of them prefers to set-up a company. Given that it is mainly the spin-off companies that are established as an IP or a specific knowledge-based structure, it is more likely for academic spin-off companies than for student-operating start-up companies to contribute to the ecosystem and public in terms of social and economic benefits. Yet, this does not mean that start-ups do not have much contribution. They are definitely very important structures for bolstering the entrepreneurship culture and for participation of new entrepreneurs to the ecosystem. However, the point is that, spin-offs are possibly more focused, long-lasting and profitable technology-based firms since they have a proper invention, product, service or know-how and they are established for certain demand from the market.

Table 5.5 – Commercialization and Entrepreneurship Operations

Panel A – TTO Manager Results

	No	Quantitative Metrics	I - AVERAGE	II - METRIC SECTION AVERAGE	III - DOMINANCE	IV - MAX / MIN COUNT		V - ABOVE 50 / BELOW 50 COUNT		VI - PRIVATE / PUBLIC SECTOR AVGs		VII - STATE / PRIVATE UNIVERSITY AVGs	
						max	min	Above 50	Below 50	Private Avg	Public Avg	State Uni. Avg	Private Uni. Avg
Commercialization and Entrepreneurship Operations	50	# of Entrepreneurs in Incubation	95	70,00	1,36	8	0	10	0	95	95	96	94
	51	# of Entrepreneurs in Pre-incubation	95		1,36	8	0	10	0	95	95	96	94
	52	# of Entrepreneurs Having Operational Possibilities/Supports (education, business mentor etc.)	90		1,29	6	0	10	0	95	85	92	88
	53	# of Entrepreneurs Having Physical Possibilities/Supports (office, infrastructure etc.)	75		1,07	4	1	8	1	70	80	83	63
	54	# of Start-up Companies Formed	92,5		1,32	7	0	10	0	90	95	96	88
	55	# of Successful Start-up Companies	72,5		1,04	5	2	8	2	90	55	79	63
	56	# of Start-up Companies Realized a Capital Increase	62,5		0,89	3	1	5	2	80	45	67	56
	57	# of Start-up Companies Ceased Operation	67,5		0,96	3	1	7	2	80	55	63	75
	58	Market Value of Start-up Companies	42,5		0,61	1	3	3	4	50	35	46	38
	59	Amount of Revenues Start-up Companies Generated	50		0,71	1	1	3	3	50	50	54	44
	60	Amount of External Investment Raised to Start-up Companies	72,5		1,04	2	1	9	1	80	65	63	88
	61	# of Spin-off Companies Formed	87,5		1,25	5	0	10	0	80	95	88	88
	62	# of Successful Spin-offs Companies	65		0,93	3	2	7	2	75	55	67	63
	63	# of Spin-off Companies Realized a Capital Increase	60		0,86	2	1	5	2	75	45	63	56
	64	# of Spin-off Companies Ceased Operation	65		0,93	2	1	7	2	75	55	58	75
	65	Market Value of Spin-offs Companies	45		0,64	1	3	4	4	55	35	50	38
	66	Amount of Revenues Spin-off Companies Generated	52,5		0,75	1	1	4	3	55	50	58	44
	67	Amount of External Investment Raised to Spin-offs Companies	67,5		0,96	2	1	8	2	80	55	54	88
	68	# of New Commercial Products Created	75		1,07	4	0	8	2	85	65	75	75
	69	Amount of Seed Capital Invested Annually	55		0,79	2	1	5	4	55	55	58	50
	70	Total Amount from Royalty Incomes (Licenses, Spin-offs, Start-ups)	82,5		1,18	5	0	9	1	90	75	79	88

Panel B – Focus Group Results

	No	Quantitative Metrics	I - AVERAGE	II -METRIC SECTION AVERAGE	III - DOMINANCE	IV - MAX / MIN COUNT		V - ABOVE 50 / BELOW 50 COUNT		VI - PRIVATE / PUBLIC SECTOR AVGs		VII - STATE / PRIVATE UNIVERSITY	
						max	min	Above 50	Below 50	Private Avg	Public Avg	State Uni. Avg	Private Uni. Avg
Commercialization and Entrepreneurship Operations	50	# of Entrepreneurs in Incubation	70	70,71	0,99	2	1	4	1	n/a		n/a	
	51	# of Entrepreneurs in Pre-incubation	75		1,06	3	1	4	1				
	52	# of Entrepreneurs Having Operational Possibilities/Supports (education, business mentor etc.)	60		0,85	1	1	3	1				
	53	# of Entrepreneurs Having Physical Possibilities/Supports (office, infrastructure etc.)	50		0,71	1	1	2	2				
	54	# of Start-up Companies Formed	65		0,92	0	0	4	1				
	55	# of Succesful Start-up Companies	80		1,13	1	0	5	0				
	56	# of Start-up Companies Realized a Capital Increase	80		1,13	2	0	4	0				
	57	# of Start-up Companies Ceased Operation	65		0,92	1	0	3	1				
	58	Market Value of Start-up Companies	75		1,06	2	0	3	0				
	59	Amount of Revenues Start-up Companies Generated	65		0,92	1	0	2	0				
	60	Amount of External Investment Raised to Start-up Companies	65		0,92	2	1	3	1				
	61	# of Spin-off Companies Formed	80		1,13	2	0	4	0				
	62	# of Succesful Spin-offs Companies	75		1,06	1	0	4	0				
	63	# of Spin-off Companies Realized a Capital Increase	75		1,06	2	0	3	0				
	64	# of Spin-off Companies Ceased Operation	65		0,92	1	0	3	1				
	65	Market Value of Spin-offs Companies	75		1,06	2	0	3	0				
	66	Amount of Revenues Spin-off Companies Generated	70		0,99	1	0	3	0				
	67	Amount of External Investment Raised to Spin-offs Companies	65		0,92	2	0	2	1				
	68	# of New Commercial Products Created	80		1,13	2	0	4	0				
	69	Amount of Seed Capital Invested Annually	65		0,92	1	0	2	0				
	70	Total amount from Royalty Incomes (Licenses, Spin-offs, Start-ups)	85		1,20	2	0	5	0				

As mentioned, in Turkey start-up entrepreneurship is more widespread and preferable by TTOs. This can explain the situation of higher ranked metrics related to start-ups. Also, as a highly ranked one, the income generation metric related to entrepreneurship activities is an indicator of managers' interest in income generation and the financial sustainability of TTOs. The metrics related to start-up and spin-off companies'; success, capital increase, cease operation and external investment raised are slightly ranked higher by managers. Although the managers did not emphasize the certainty of using these metrics, they are still important indicators for this section's activities and are ranked high. The metrics related to the amount of revenue generation, market values and seed capital invested were ranked around middle levels by managers. Using these metrics for companies is considered difficult and complex for TTO managers since they require very close observation and a high service load for TTOs to assist companies for accomplishment in these issues. That is the main reason of their rating at undecided level. The *# of New Commercial Products Created* metric is also ranked high by managers since it is a complete indicator for the result-oriented perspective in entrepreneurial TTO activities. Commercial products created as outputs of newly-formed companies are potential value-added outcomes for the ecosystem. Private sector experienced managers and managers of private university TTOs ranked the following metrics significantly higher than their public counterparts did: *# of Successful Start-up Companies*, *# of Start-up and Spin-off Companies Realized a Capital Increase*, *# of Start-up Companies Ceased Operation* and *Amount of External Investment Raised to Start-up and Spin-off Companies*. The positive progress of companies, capital increases and receiving external investments are excellent indicators for spin-off/start-up companies in terms of improvement and profitability. It is not surprising that dealing with these concepts is far more essential and interesting for the private sector experienced managers.

The focus group ranked this section's metrics high with a section average set at 70.71 points since they are directly related to commercialization. They ranked the metrics about spin-off companies, capital increases, market values, royalty incomes and new commercial products higher than other metrics in the section. The focus group ranked spin-off company metrics higher than start-up company metrics. For them spin-off

companies are more important because of their potential outcomes compared to start-up companies. Profitability metrics like capital increases, market values and investment amounts received are also considered essential for observing a company's progress. All these indicators are directly related to the quality of services and assistance provided by TTOs to entrepreneurs. The metric of royalty incomes that TTOs acquired is the highest ranked metric of the section. Commercialization and entrepreneurship operations are especially excellent activities from which TTOs can make serious profits. TTOs are able to make remarkable amounts of profit according to the agreements that they signed with spin-off/start-up companies. As the companies receive external investments, when they exit or simply when they develop and make profit, TTOs can also have profits according to the agreements and their shares in the companies. So, this condition makes the incomes from this section's activities significantly crucial. The *# of Entrepreneurs Having Operational Possibilities/Supports (education, business mentor etc.)* and *# of Entrepreneurs Having Physical possibilities/supports (office, infrastructure etc.)* metrics are the two lowest ranked metrics. Although these possibilities provided to entrepreneurs are useful and necessary, these supports are commonly given by Turkish TTOs for a couple of years. Indeed, the group is more interested in the quality and outcomes of these supports rather than their availability.

Synthesis – This section includes significant metrics about the commercialization phase of technology transfer. Although there are some differences between the groups' attitudes, their metric section averages are nearly identical. This can be a sign for their consensus about the necessity of the metrics. One interesting finding is that the focus group ranked spin-off company metrics significantly higher than TTO managers did, and this illustrates that TTOs' spin-off outputs are more important to the experts than they are to the managers. In addition, the focus group express their opinion about these metrics by giving higher rankings and imply the importance of them which should be slightly more effective in the measurement of TTO performance in this context of activities. The main reason is that potential of contributing to the ecosystem is higher with spin-off companies, as mentioned before. However a notable point raised by the focus group is that wide spreading corporatization in the academia via spin-off

companies is important. TTOs should also focus on this task just like the wide spreading entrepreneurship culture at the student level. There is also a remarkable difference between the two groups' ratings in the metrics of physical and operational services that are provided to entrepreneurs by TTOs. These two metrics were ranked higher by TTO managers. Managers naturally want these metrics to be used in performance measurement since they require a remarkable amount of financial and operational resources and supporting entrepreneurs at the beginning when their need is great. Given that the focus group's ratings are not below the undecided level, they care less about these metrics since these supports are common and indirectly related to the outcomes of companies. For the same reason, the metrics about incubation and pre-incubation were also ranked less by the focus group. Finally, the ratings of the metrics about companies' market values and revenue generations are around the undecided level for TTO managers while they are pretty high for the focus group. Although conducting the activities that these metrics imply are considered as difficult by managers, these indicators are directly related to the services that TTOs deliver. For instance, matching the entrepreneurs with true angel investors, presenting a qualified business mentoring service and assisting them in making efficient business connections are critical factors of success for entrepreneurs. The focus group is more interested in this point and ranked these metrics higher than managers did. To sum up, for this section, when some metrics were set near the undecided level by one of the groups, the same metrics were ranked interestingly high by the other group. As a result, when the two groups' approximate attitudes and rankings of the metrics are considered, all of the metrics can be proposed.

5.6 TTO Metrics

This section deals with a few number of quantitative metrics about TTOs' features and with what accomplishments they can achieve. In this section, all of the metrics have an utmost importance for the focus group since it is the highest averaged section by them. However, the TTO managers ranked the majority of the metrics only slightly higher than the undecided level. This difference in attitudes is discussed in details in the synthesis part. The results are given in Table 5.6.

The *Amount of Annual TTO Budget* metric is rated the highest among all by the TTO managers. TTOs have a wide array of services presented to their partners regarding both the university and industry most of which consist of qualified services. Indeed, this makes TTO expenses quite variable and high. Since TTOs have so much expenses, their budget criterion highly effects their performance. The amount of budget is directly proportional with the TTO's expenses, because it determines the quality and extent of the services. If a TTO has a high budget or if its owning institution provides a high budget for it, the TTO can hire more qualified personnel or can have more qualified service procurements. This is why the budget metric is important for the managers. The *Share of TTO Budget (From Total Incomes)* and *Amount of Increase in Revenues* metrics are not ranked high by the managers although the income metrics of the previous sections received high values. Managers considered them as rather useless. The share metric implies a share or a proportion value of the total income. According to managers, it is infeasible to measure it because overheads are variable which change depending on the type of activity. For instance, the overhead of funds is variable depending on the source of the fund, whether it is from a national or an international project and on the amount the university takes from the fund. Similarly, university-industry collaboration agreements and license agreements vary according to the type of agreement or product. This makes the determination or measurement of a share infeasible. In addition, annual revenues are directly related to the type and progress of agreements. Revenues may not increase annually on a regular basis. Most of them bring out profits in later years rather than in the year when the agreements took place. The *# of Full Time Professional of TTO* metric is the second highest ranked metric of the section and it is ranked higher by state university TTO managers. TTO activities require much experience and skill. Moreover, there are not many experienced personnel in the field since the field is new in Turkey and the concept of human resources is recently forming. This makes professionals even more important.

Table 5.6 – TTO Metrics

Panel A – TTO Manager Results

	No	Quantitative Metrics	I - AVERAGE	II - METRIC SECTION AVERAGE	III - DOMINANCE	IV - MAX / MIN COUNT		V - ABOVE 50 / BELOW 50 COUNT		VI - PRIVATE / PUBLIC SECTOR AVGs		VII - STATE / PRIVATE UNIVERSITY AVGs	
						max	min	Above 50	Below 50	Private Avg	Public Avg	State Uni. Avg	Private Uni. Avg
TTO	71	Amount of Annual TTO Budget	85	61,00	1,39	4	0	10	0	80	90	88	81
	72	Share of TTO Budget (From Total Incomes)	62,5		1,02	1	0	6	2	70	55	58	69
	73	# of Full Time Professional of TTO	70		1,15	2	1	8	1	70	70	79	56
	74	Amount of Increase in Revenues	52,5		0,86	0	0	4	3	60	45	58	44
	75	Amount of Decrease in Operating Costs	35		0,57	0	2	2	6	40	30	38	31

Panel B – Focus Group Results

	No	Quantitative Metrics	I - AVERAGE	II -METRIC SECTION AVERAGE	III - DOMINANCE	IV - MAX / MIN COUNT		V - ABOVE 50 / BELOW 50 COUNT		VI - PRIVATE / PUBLIC SECTOR AVGs		VII - STATE / PRIVATE UNIVERSITY	
						max	min	Above 50	Below 50	Private Avg	Public Avg	State Uni. Avg	Private Uni. Avg
TTO	71	Amount of Annual TTO Budget	95	87,00	1,09	4	0	5	0	n/a		n/a	
	72	Share of TTO Budget (From Total Incomes)	85		0,98	3	0	4	0				
	73	# of Full Time Professional of TTO	90		1,03	3	0	5	0				
	74	Amount of Increase in Revenues	90		1,03	3	0	5	0				
	75	Amount of Decrease in Operating Costs	75		0,86	3	0	3	1				

In the case of state university TTOs, most of the university managements employ existing university employees if the university established a TTO. Although these employees are experienced in some university tasks, they are not experienced in various high skill-required TTO tasks. In state university TTOs, the existing university employees are more than the professionals hired from outside the university. This can be the exact attitude of state university TTO managers towards this metric. The *Amount of Decrease in Operating Costs* is the lowest rated metric and the managers do not want it to be used mainly because they believe it is irrelevant to the measurement of TTO performance. Since TTOs differ from regular companies their operations also differ from those of regular companies. Actually, TTO operating costs mainly consist of personnel salaries and some fixed costs of TTOs. All remaining costs are highly variable and do not have a regular annual pattern. Thus, the decrease in this kind of costs like salaries and fixed cost are not predictable as this type of costs always tends to increase in later years. This fact makes the use of this metric irrelevant according to managers.

This metric section has the highest metric section average for the focus group because they are direct indicators for TTOs' features and accomplishments which are crucial for a TTO's sustainability. The *Amount of Annual TTO Budget* is an excellent indicator for a TTO in terms of its economic power. A high and substantial amount of budget makes TTOs directly affect accessibility, flexibility and sustainability according to the focus group. *# of Full Time Professional of TTO* is another criterion for a TTO's performance since all of its activities depend on full-time qualified professionals. In addition, according to the focus group increasing the personnel number cannot always be the choice. Thus, increasing the quality and capacity of the existing personnel continuously is an option as important as increasing the numbers. The *Amount of Increase in Revenues* and *Share of TTO Budget (From Total Incomes)* metrics are also rated high by the focus group because of their concern of financial sustainability. As long as a TTO can increase its revenues and have regular shares from its various income sources, its financial restrictions will be minimized which will enhance the quantity and quality of services. The *Amount of Decrease in Operating Costs* is the lowest ranked metric by the focus group. If TTOs can achieve regular annual or longer

termed decrease of costs, they can economize and save more financial resources in order to be used for other expenses.

Synthesis – while TTO managers are not interested so much in the metrics of this section, the focus group ranked these metrics high. The *Amount of Annual TTO Budget* and *# of Full Time Professional of TTO* are two metrics which both of the groups agree on. However, there are remarkable differences between the two groups concerning the other three metrics. The *Share of TTO Budget (From Total Incomes)* metric is rated significantly lower by the TTO managers. Given that TTO overheads from their incomes are considered extremely important for both groups, the remarks of TTO managers are quite reasonable. It is not feasible to determine a common overhead amount and correspondingly a total share since there are various different activities and agreements. The overheads from the income are more appropriate to be used. It is a fact that all the overhead metrics of the sections were ranked pretty high by the TTO managers. Hence, instead of using this metric in a common way, using it separately for all activity sections can be much more fitting for the measurement. The *Amount of Increase in Revenues* metric is ranked considerably higher by the focus group. As for the managers, they ranked this metric low since the type and time options of revenues are highly variable. However, what the focus group mentions is not concerned with achieving an increase in revenues but rather diversifying the resources. If TTOs can increase their capacities by bringing more funds, conducting more agreements and representing more qualified services, new financial resources will be formed which is crucial for sustainability. That is the main reason why the focus group has a greater interest in this metric. The *Amount of Decrease in Operating Costs* is the lowest ranked metric of the section. Although the focus group ranked this metric higher, it was ranked extremely low in all responses of the TTO managers. The main reason is the incompatibility of the metric with TTOs' operating structure. Their operating costs cannot be decreased like those of an ordinary company or factory since nearly all of these operations consist of highly qualified services. These operations are conducted mainly in two ways either by using their own human resource in service provision or by service procurement from outside the TTOs. These possibilities make it irrelevant to obtain continuous cost decreases in annual terms, since this kind of expenses often

tend to increase. That is why this metric may not be used. In summary, for this section, the metrics of *Amount of Annual TTO Budget, # of Full Time Professional of TTO* and *Amount of Increase in Revenues* can be proposed.

5.7 University Metrics

TTO hosting Public Research Organizations (PRO) and mostly universities play important role for their TTOs since they are the source of knowledge that TTO transfers. However, there is a greater role for universities in terms of affecting TTO's performance. Some features and attitudes of universities that are related to TTO performance are discussed in this section. In general, the TTO managers and the focus group rated this section's metrics extremely lower than any metric section. This indicates that the majority of the metrics should not be used in the measurement of TTO performance. The results are given in Table 5.7

This metric section has the lowest section average of all sections by the TTO managers. The *Amount of Investments of PRO (for University, PRO etc.), # of Investments of PRO (for University, PRO etc.)* and *School Size (for University, PRO etc.)* metrics are the ones that were averaged close to undecided level but were rated rather high by the TTO managers. The number and amount of the investment of universities is an important matter for TTOs. Because the operating of TTOs is dependent on the relevant universities, the funds and investment provided by the universities are crucial, especially that the funds TTOs receive from other public institutions such as TÜBİTAK or Ministry of Science, Industry & Technology are limited in size and period of time. Such funds will not continue to flow as long as the TTO operates. In addition, TTO expenses are high and increase even further considering that both the impact area and service range of TTOs grow. All these factors make the university funds that received by TTOs critically important. These are perhaps the reasons why managers ranked these two metrics high. The school size metric was also ranked high because managers think that a bigger school size represents more academicians and students reflecting a bigger impact area.

Table 5.7 – University Metrics

Panel A – TTO Manager Results

	No	Quantitative Metrics	I - AVERAGE	II - METRIC SECTION AVERAGE	III - DOMINANCE	IV - MAX / MIN COUNT		V - ABOVE 50 / BELOW 50 COUNT		VI - PRIVATE / PUBLIC SECTOR AVGs		VII - STATE / PRIVATE UNIVERSITY AVGs	
						max	min	Above 50	Below 50	Private Avg	Public Avg	State Uni. Avg	Private Uni. Avg
University	76	# of Investments of PRO (For University, PRO etc.)	52,8	38,10	1,39	1	1	5	4	50	55	55	50
	77	Amount of Investments of PRO (For University, PRO etc.)	58,3		1,53	1	1	6	3	62,5	55	55	63
	78	Graduation Rate of Students (For University, PRO etc.)	12,5		0,33	0	7	1	9	5	20	8	19
	79	Hire Rate of Graduated Students (For University, PRO etc.)	15,0		0,39	0	6	1	9	5	25	13	19
	80	# of Published Articles (For University, PRO etc.)	32,5		0,85	2	5	3	7	20	45	33	31
	81	School Size (For University, PRO etc.)	57,5		1,51	3	3	6	3	50	65	58	56

Panel B – Focus Group Results

	No	Quantitative Metrics	I - AVERAGE	II -METRIC SECTION AVERAGE	III - DOMINANCE	IV - MAX / MIN COUNT		V - ABOVE 50 / BELOW 50 COUNT		VI - PRIVATE / PUBLIC SECTOR AVGs		VII - STATE / PRIVATE UNIVERSITY	
						max	min	Above 50	Below 50	Private Avg	Public Avg	State Uni. Avg	Private Uni. Avg
University	76	# of Investments of PRO (For University, PRO etc.)	60	43,33	1,38	1	0	3	2	n/a		n/a	
	77	Amount of Investments of PRO (For University, PRO etc.)	70		1,62	1	0	4	1				
	78	Graduation Rate of Students (For University, PRO etc.)	15		0,35	0	1	0	5				
	79	Hire Rate of Graduated Students (For University, PRO etc.)	20		0,46	0	1	0	4				
	80	# of Published Articles (For University, PRO etc.)	50		1,15	0	0	1	1				
	81	School Size (For University, PRO etc.)	45		1,04	0	0	1	2				

This enlarged possibility space of TTOs means more inputs in terms of publication, knowledge, university-industry collaboration agreements, intellectual properties and business ideas to deal with. The *Graduation Rate of Students (for University, PRO etc.), Hire Rate of Graduated Students (for University, PRO etc.)* and *# of Published Articles (for University, PRO etc.)* metrics are the lowest ranked ones by managers. This can be attributed to the fact that, these metrics were considered completely irrelevant for the measurement of TTO performance. Graduation and the hire rate of students and published article numbers can be indicators to measure the performance of a university but not that of a TTO.

Regarding the focus group, their results are not so different from those of the managers. This section is the second lowest section average of all. The focus group ranked the metrics about the number and amount of investments higher than any other metrics. They also have the same concerns of TTO managers and think that university funds for TTOs are important because after the financial support funds of other public institutions come to an end, the only remaining option will be the university funding. So, this is an important factor for TTOs' sustainability. The *School Size* and *# of Published Articles* metrics are ranked around the undecided level by the focus group. According to them, these two metrics can be related to the inputs that the TTO can obtain. Yet, even if these metrics are not directly related to the measurement of TTO performance, they are indicators which only monitors the amount of potential inputs that a TTO can acquire. However, the progress about TTO's performance starts after this point. The metrics about students' graduation and hire rates have the lowest values and were considered completely irrelevant to the measurement of TTO performance by the focus group.

Synthesis – the results of the two groups emphasize that some of the metrics of this section do not correspond to the situation of Turkish TTOs. Metrics about graduation and hire rate of students can be more likely be measurement of performance indicators for universities but not for TTOs. Although these metrics are acquired from the literature, they are probably used for highly engaged university-TTO structures. For both groups, it is clear that these metrics are not suitable in the case of Turkish TTOs.

The *School Size* and *# of Published Articles* metrics are considered as not directly related to TTO performance. In any case, these metrics can represent the potential input for TTO activities, but they are not appropriate for the measurement of TTO performance directly since these indicators are out of TTOs intervention and reach. In addition, using these metrics is unfair and would affect some TTOs of small universities negatively because in Turkey the established state universities have so much larger school size, and therefore greater number of academicians and published articles, than many newly-founded universities and private universities. Thus, using these factors will introduce bias from the start. The metrics about the number and amount of investments are rated higher than other metrics and above the undecided level by both groups. In Turkey, universities reserve a certain amount of funds from the annual budget only for their TTOs. These funds combine with other funds - if TTOs have any - and with TTO incomes acquired from various services and activities. When other financial funds cease or a low-income cycle is experienced, TTOs can have serious economic problems. This is why university funds and investments are important. As a result, the: *# of Investments of PRO (for University, PRO etc.)* and *Amount of Investments of PRO (for University, PRO etc.)* metrics can be proposed in this section.

5.8 Qualitative Metrics

The consideration and discussion of qualitative metrics is one of the novelties of this research. These metrics are not as common as quantitative TTO metrics because they require an exhaustive qualitative approach to be used. However, cases from the literature show how important and effective they are indeed. Practically, they may not be used like a quantitative metric since it may be difficult to quantify a qualitative metric. In this manner, they can be accepted as factors or indicators that are important for the measurement of a TTO's performance since they refer either to an affecting factor or a result of the strategies of TTO. This kind of metrics are not included in the TÜBİTAK's Performance Indicators Metric Set used for TTOs; however, as mentioned in Chapter 3, some of them are referred to in some of TÜBİTAK's

documents of the TTO Program. Nevertheless most of them are not used as metrics in measuring TTO performance in Turkey.

Findings imply that qualitative metrics are considered extremely important by both TTO managers and the focus group. In general, the metrics proposed in this research were rated high collectively even though the groups were uninformed of each other's answers and they pointed out the metrics' necessity and significance for TTOs. The results are given in Table 5.8.

The metrics; *University / PRO's Support to TTO, University / PRO's Strategy and Policy for TTO* and *University / PRO's Integration with TTO* represents the level of adoption of a TTO by its hosting university. A TTO can be much more operational and sustainable in many aspects if the hosting university supports it operationally, physically, financially etc., accommodates its TTO effectively in its strategical plans, determines an efficient policy for its TTO's development and provides a complete integration with all the elements of that university. Both the managers and the focus group pointed out that in case that such aspects lack, TTOs may greatly suffer in terms of their impact and even may cease to exist. For instance, universities can terminate their support for TTOs in conditions of changing universities' top management, when TTOs are not included in strategic plans or when they, politically do not see their TTOs as a necessary technology transfer institution but a temporary unit maintained during a short publicly-supported period. Without universities' positive approach of this kind, TTOs can encounter serious problems and may not survive or operate in the ecosystem. Likewise, TTOs that are adopted effectively by their universities in terms of the aforementioned factors can surely bring out a far better performance. This is the main reason why these metrics are highly rated by both groups.

There are also qualitative metrics that are related to the TTO itself and that critically impact its performance. These metrics were rated high by both groups and their necessity was emphasized. These metrics are: *Organizational Structure of TTO (institutionalism, processes, procedures, mechanisms etc.), Human Capital and Quality, Financial Sustainability, Resource Accessibility and Management* and

Table 5.8 – Qualitative Metrics

Panel A – TTO Manager Results

	No	Qualitative Metrics	I - AVERAGE	II - METRIC SECTION AVERAGE	III - DOMINANCE	IV - MAX / MIN COUNT		V - ABOVE 50 / BELOW 50 COUNT		VI - PRIVATE / PUBLIC SECTOR AVGs		VII - STATE / PRIVATE UNIVERSITY AVGs	
						max	min	Above 50	Below 50	Private Avg	Public Avg	State Uni. Avg	Private Uni. Avg
Qualitative Metrics	1	University / PRO's Support to TTO	85	81,36	1,04	7	1	9	1	75	95	79	94
	2	University / PRO's Strategy and Policy for TTO	87,5		1,08	7	0	9	1	90	85	92	81
	3	University / PRO's Integration with TTO	82,5		1,01	8	1	8	2	80	85	83	81
	4	Organizational Structure of TTO (institutionalism, processes, procedures, mechanisms etc.)	82,5		1,01	5	0	9	1	85	81,25	92	67
	5	Human Capital and Quality	77,5		0,95	4	0	8	1	85	70	79	75
	6	Financial Sustainability	85		1,04	5	0	9	0	95	75	92	75
	7	Resource Accessibility and Management	82,5		1,01	3	0	10	0	80	85	83	81
	8	Quality and Efficiency of Partnerships and Relationships with Stakeholders in University / PRO	85		1,04	4	0	10	0	85	85	88	81
	9	Quality and Efficiency of Partnerships and Relationships with Stakeholders in Industry	82,5		1,01	3	0	10	0	80	85	83	81
	10	Economic Development (TTO's economic benefit and contribution that is provided in the ecosystem of university and neighborhood industry)	72,5		0,89	2	0	7	0	70	75	71	75
	11	Public Benefit (Impacts and consequences of added value that TTO activities generate in university, industry and other public areas)	72,5		0,89	2	0	7	0	70	75	71	75

Panel B – Focus Group Results

	No	Qualitative Metrics	I - AVERAGE	II -METRIC SECTION AVERAGE	III - DOMINANCE	IV - MAX / MIN COUNT		V - ABOVE 50 / BELOW 50 COUNT		VI - PRIVATE / PUBLIC SECTOR AVGs		VII - STATE / PRIVATE UNIVERSITY	
						max	min	Above 50	Below 50	Private Avg	Public Avg	State Uni. Avg	Private Uni. Avg
Qualitative Metrics	1	University / PRO's Support to TTO	75	79,54	0,94	2	0	3	0	n/a		n/a	
	2	University / PRO's Strategy and Policy for TTO	85		1,07	3	0	4	0				
	3	University / PRO's Integration with TTO	75		0,94	2	0	3	0				
	4	Organizational Structure of TTO (institutionalism, processes, procedures, mechanisms etc.)	70		0,88	2	0	2	0				
	5	Human Capital and Quality	80		1,01	2	0	4	0				
	6	Financial Sustainability	90		1,13	3	0	5	0				
	7	Resource Accessibility and Management	80		1,01	2	0	4	0				
	8	Quality and Efficiency of Partnerships and Relationships with Stakeholders in	80		1,01	1	0	5	0				
	9	Quality and Efficiency of Partnerships and Relationships with Stakeholders in	85		1,07	2	0	5	0				
	10	Economic Development (TTO's economic benefit and contribution that is provided in the ecosystem of university and neighborhood industry)	80		1,01	2	0	4	0				
	11	Public Benefit (Impacts and consequences of added value that TTO activities generate in university, industry and other public areas)	75		0,94	2	0	3	0				

Quality and Efficiency of Partnerships and Relationships with Stakeholders in University / PRO / Industry. A TTO's level of institutionalism and level of maturity in its related processes and procedures are critical elements for a strong and developed organizational structure. In conditions of changes in management, economic stagnations or any other risks, TTOs with a strong organizational structure can cope with these changes better. If its system and operational mechanisms are not well-established, TTOs can become vulnerable. According to managers and the focus group, all these issues make this factor critical for TTOs.

Since TTO tasks highly require proficiency and context-specific experience, *Human Capital and Quality* becomes one of the crucial factors for TTOs' success. Being a TTO officer requires using a connective language for addressing stakeholders both from the academia and industry, a highly dynamic working environment and a wide array of experience due to multiple tasks of TTOs. If TTO personnel are not suitable for a certain TTO position or if they lack the required skills this may greatly jeopardize the applications and accomplishments of TTO. Managers and focus group consider this issue really important as the metric was highly rated by them.

The *Financial Sustainability, Resource Accessibility and Management* metrics are the highest ranked metrics by both groups. As mentioned in the previous sections of this chapter, quantitative metrics about overheads and incomes are highly rated and emphasized by the two groups. However many qualitative indicators can be considered in addition to these quantitative indicators. For instance, does TTO attach enough importance to its financial sustainability? Is there an effective policy for income generation and an efficient income-expenditure management? How much does a TTO perform to access financial resources and what is the quality of this performance? Is the TTO public fund-dependent or does it really perform to increase its incomes with various strategies? Undoubtedly, many more questions can be asked, but all of them demonstrate that a qualitative approach can reveal many issues about a TTO's performance in terms of its financial sustainability, resource accessibility and management.

TTOs are natural interfaces and their main task is building necessary bridges between the academia and industry. In addition, they need to construct an efficient cooperation to commercialize R&D results. These requirements makes the *Quality and Efficiency of Partnerships and Relationships with Stakeholders in University / PRO / Industry* metrics critical for TTOs. Since TTOs are interface structures, their relationships are the main factor that determine the affairs, results and outcomes for their common tasks. For instance, if a TTO conducts a high quality of relationships with its stakeholders in the industry and develop solutions effectively for their problems, these partners may further enhance relationship with the TTO. The same is also applicable to the academia. In the end, all these relationships return as benefits to TTOs in terms of input, activity, profit and social / financial accomplishment. Since managers and the focus group are aware of this they rated these metrics high.

Economic Development (TTO's economic benefit and contribution that is provided in the ecosystem of university and neighborhood industry) and *Public Benefit (Impacts and consequences of added value that TTO activities generate in university, industry and other public areas)* are two metrics which were ranked relatively lower than other qualitative metrics. These metrics are mainly about the final outcomes of TTO activities in the ecosystem. Since TTOs are expected to make contributions for economic development and create added value by means of their output, the outcomes they provide to the ecosystem are important. In fact, TTOs can provide their maximum benefit if only they can turn their outputs into economic and social impact. For both groups, these metrics were considered as important but at the same time they are extremely hard to measure. Determining an economic or social contribution is a complex task and requires completely different methods. However, this does not mean that they cannot be measured. This is why managers and the focus group did not rank these metrics low. To measure these kinds of concepts qualitative approaches can be developed. The models of countries that are using these metrics can be examined. For instance, a product licensed by a TTO may constitute a great added value for the public or even the country. This may turn into a product or a service that effectively solves a common problem, can create a great economic value, employment, profit, etc. As a

consequence, these issues can also be measured with qualitative approaches, which is out of the scope of this thesis.

Synthesis – The results of the summary statistic of the qualitative metrics are among the highest values of all metrics -quantitative and qualitative- for both groups which shows the importance attached to the metrics by the evaluators. An interesting point is that; although these metrics are considered difficult and complex to be used in measurement, they were rated extremely high. In the previous sections it is observed that, when a metric was complex and hard to measure, the groups' attitude was rating it low. However in this section, as an exception, all the metrics were ranked high. Three metrics about the university were rated slightly higher by TTO managers which can be attributed to the direct involvement of TTO managers in issues related with universities. Since they always have to work with the university and its management, managers pay attention to these issues more than the focus group. In addition, if these metrics are used, university managements will act accordingly regarding the issues covered by qualitative assessment. Even this is sufficient for TTOs to demand qualitative measurement, which will indirectly improve their position in the university ecosystem. The metrics of *Economic Development* and *Public Benefit* are ranked relatively lower by both groups because of the difficulty of measurement. The metrics about the organizational structure, human capital and quality, financial sustainability, resource accessibility and quality & efficiency of TTO's partnerships with its stakeholders are commonly ranked high where a difference of opinion between the managers and the focus group was not observed. To sum up, although these metrics are difficult to quantify and cannot be used as smoothly as a quantitative metric, it was emphasized that with proper qualitative approaches and methods, all of these qualitative metrics can be used in the measurement of performance because they not only reflect the inputs and outputs of TTOs but also provide valuable information which cannot be captured by quantitative metrics.

5.9 Suggested Metrics by TTO Managers and Focus Group

Interviewees were also asked for the metrics which are not in the interview form, but can be suggested for measuring TTO performance. In this regard, a small number of metrics were proposed.

The metrics suggested by TTO managers are;

- *# of Firms Contacted to Commercialize a Product / Service*, for IPR Management and Licensing Activities section, to observe the number of attempts to commercialize a research output,
- *# of Investors Contacted to Provide External Investment for Start-up / Spin-off Companies*, for Commercialization and Entrepreneurship Operations section, to observe the number of attempts to find an investor for a company that TTO assists,
- *# of Investors That Actually Invested in Start-up / Spin-off Companies*, for Commercialization and Entrepreneurship Operations section, to observe the number successful attempts for finding an investor for a company that TTO assists,
- *Total Amount of Experience of TTO Personnel*, for TTO Metrics section, to observe the experience level of TTO's human capital in this field,
- *Variety of TTO Incomes from its Activities (in Terms of 5 Modules)*, for TTO Metrics section to observe: whether there is a diversity in TTO's income types or majority consist of a certain type of income. Income diversity was suggested to enhance the TTO's incomes from multiple and if possible all of the TTO modules' activities. It is believed that TTOs with diverse income types are stronger in terms of financial sustainability.

The metrics suggested by the focus group are;

- *Average Working Period of TTO Personnel in TTO*, for TTO Metrics section, to observe how many years personnel work in the TTO. This metric was suggested to observe the turnover rate of TTO personnel. If the turnover

rate is high, then the TTO most probably lacks a mature and systematic human capital which is critical for its operations.

- *Proportion of TTO's Expenditures to its Outputs*, for TTO Metrics section, to observe the productivity and efficiency of TTO. This metric was suggested since a TTO's productivity can be a key indicator for its performance.

Ratings for these metrics are not possible since they were suggested separately by a TTO managers or focus group members during the interviews.

5.10 Reliability of Findings

The metrics that can be used in measurement of TTO performance in Turkey are proposed according: statistics of quantified rating results indicated by interviewees and qualified explanations of the interviewees. Therefore, the opinions of raters constitute one of the main inputs and basis for the quantitative analysis, which makes the reliability of raters and their results essential. As mentioned in Chapter 4, rating result of TTO managers and the focus group are put into an IRR Analysis, to examine the level of agreement and consistency of the raters. For each metric section and for each group reliability statistics are examined separately. The results are given in Table 5.10.

Table 5.10 **IRR Statistics**

Metric Section No	TTO Managers IRR Statistics	Focus Group IRR Statistics
1	0,712**	0,211
2	0,743***	0,462*
3	0,548*	0,201
4	0,502*	0,463*
5	0,810***	0,370
6	0,899***	0,696**
7	0,934***	0,765***
8	0,427*	0,585*
Average	**0,70**	**0,47**

* : Fair
** : Good
*** : Excellent

Cicchetti (1994), gives the following guidelines for interpretation of ICC IRR measures. If reliability statistic is;

Less than 0,40	⇒	Poor,
Between 0.40 and 0.59	⇒	Fair,
Between 0.60 and 0.74	⇒	Good,
Between 0.75 and 1.00	⇒	Excellent.

As the reliability statistic value approaches to 1, the similarity between the ratings increase, whereas similarity reduce as it approaches to 0. As it is seen from Table 5.10, majority of the statistics and their average values are above the fair level which is a positive indication for the result of the IRR analysis. Moreover, the reliability statistics of TTO managers are higher than the focus group. Its main reason is the low reliability statistics of sections 1, 3 and 5 in focus group ratings while the rest of the section statistics are above the fair level. These three sections have relatively more metrics than other sections. In addition, ratings of the focus group members are more diversified for these three sections and eventually these variations return with lower IRR statistics. However, its effect on context is considerably minor since the results of the other statistics, mentioned in the previous sections, revealed that there is not an inconsistency on the proposition of metrics rated by the focus group. As a consequence we can safely assume that our results are reliable in proposing metrics for evaluating TTO performance.

CHAPTER 6

CONCLUSION

This chapter describes about the main findings of the research, the policy recommendations that are proposed and finally the concluding remarks.

6.1 Summary and Main Findings

The aim of this research is to investigate the metrics that can be used in the measurement of TTO performance in Turkey. TTOs are the main interfaces of the ecosystem that provide knowledge and technology transfer from universities to industry. This specific task makes the expectations from TTOs great in terms of contributing to value added, creating public benefit and enhancing the socioeconomic structure of a country. Thus, having effective TTOs in the ecosystem is important for a country's National Innovation System. For this reason, measuring the performance of TTOs becomes an essential issue. There are various metrics that are used in U.S., Europe and Asia. Compatibility of these metrics to a developing country like Turkey is a complex issue worth investigating. Developing countries have specific characteristics and a weak system of innovation which invites a context-specific approach. Direct usage or adoption of the metrics from the developed countries may not be suitable for a developing country.

In order to investigate this issue, a qualitative approach is followed mainly involving interviews with a group of 10 TTO managers and 5 Focus Group members, experienced in the field. Interviewees were asked to rate the metrics used in the measurement of TTO performance gathered from the literature, to determine whether or not they should be used as a metric in Turkey. The results were quantified and interpreted using a number of statistics and qualitative expressions of the interviewees. To illustrate the robustness of the research, an IRR analysis is conducted which resulted in a high reliability statistics for the raters. Proposed metrics obtained from the results of the interviewees' ratings in Chapter 5 are given in Table 6.1. Table includes managers and focus groups choices regarding each metric and a final evaluation based on the overall qualitative analysis. Interviewees were also asked for

novel metrics that are not considered in the literature thus not included in the interview form. These metrics are given in Table 6.2.

Table 6.1 – Proposed Metrics

	No	Quantitative Metrics	TTO Manager Results	Focus Group Results	Proposition
Awareness, Advertising, Informing & Education Oriented Activities	1	# of Seminars, Meetings, Courses and Education Programs Held	○		
	2	# of Workshops, Trade Shows and Fairs	○		
	3	# of People, Students Attended to Courses, Seminars, Education Programs			
	4	# of People Met at Events Which Led to Other Knowledge Transfer Activities		○	●
	5	Income Generated from Courses, Seminars, Education Programs			
	6	Amount of Education TTO Personel Have Annually (in hours)	●		●
	7	# of Telephone Calls			
	8	# of Company Visits	○		
	9	# of Newsletters	○		
	10	# of Assistance	○	○	
	11	# of Database Searches			
	12	# of Referrals			
	13	# of Fact Sheets			
	14	# of Advertisement Oriented Publishings of TTO			
Scientific Research & Funds	15	# of National Scientific Research Projects Applied	●	●	●
	16	# of National Scientific Research Projects Accepted	●	●	●
	17	# of Interational Scientific Research Projects Applied	●	●	●
	18	# of International Scientific Research Projects Accepted	●	●	●
	19	Total Amount of Scientific Research Project Budgets	●	●	●
	20	Total Amount of Scientific Research Projects Income (Overheads)	●	●	●
	21	# of Academicians in Scientific Research Projects	●	○	
	22	The Ratio of Total # of Scientific Research Projects / Total # of Academicians	○	●	●
University and Industry Collaboration	23	# of Consultancy Agreements	●	●	●
	24	Amount of Consultancy Research Expenditures	○	○	●
	25	Amount of Income Generated from Consultancy Agreements	●	●	●
	26	% of Consultancy Income Relative to Total Research Income	○	○	
	27	# of Collaborative Research Agreements	●	○	●
	28	Amount of Collaborative Research Expenditures	●	○	●
	29	Amount of Income Generated from Collaborative Research Agreements	●	●	●
	30	% of Collaborative Research Income Relative to Total Research Income	○	○	
	31	# of Contracted Research Agreements	●	●	●
	32	Amount of Contracted Research Expenditures	○	●	●
	33	Amount of Income Generated from Contracted Research Agreements	●	●	●
	34	% of Contracted Research Income Relative to Total Research Income	○	●	
	35	# of Technical Services Executed	●	○	
	36	# of Academicians in University-Industry Collaboration Projects	●	○	●
	37	# of Companies & Other Entities that TTO Generates Income	●	●	
	38	Length of Client Company Relationships		●	

Table 6.1 – Proposed Metrics (continued)

	39	Total Amount of University-Industry Collaboration Project Budgets	●	●	●
	40	Total Income Generated from University-Industry Collaboration Projects (Overhead)	●	●	●
IPR Management & Licensing Activities	41	# of Invention Disclosure	●	●	●
	42	# of Academicians that Disclosed Invention	●	●	●
	43	# of Patent Application	●	●	●
	44	# of Patents Granted	●	●	●
	45	Amount of Legal Expenditures on Protection of IP	○	○	
	46	# of Licensing Agreement	●	●	●
	47	# of Active Licenses	●	●	
	48	Amount of Licensing Income	●	●	●
	49	# of Products Arose from Licenses	○	●	
Commercialization and Entrepreneurship Operations	50	# of Entrepreneurs in Incubation	●	●	●
	51	# of Entrepreneurs in Pre-incubation	●	●	●
	52	# of Entrepreneurs Having Operational Possibilities/Supports (education, business mentor etc.)	●	○	
	53	# of Entrepreneurs Having Physical Possibilities/Supports (office, infrastructure etc.)	●		
	54	# of Start-up Companies Formed	●	○	●
	55	# of Successful Start-up Companies	●	●	
	56	# of Start-up Companies Realized a Capital Increase	○	●	●
	57	# of Start-up Companies Ceased Operation	○	○	
	58	Market Value of Start-up Companies	○	●	
	59	Amount of Revenues Start-up Companies Generated		○	●
	60	Amount of External Investment Raised to Start-up Companies	●	○	
	61	# of Spin-off Companies Formed	●	●	●
	62	# of Successful Spin-offs Companies	○	●	
	63	# of Spin-off Companies Realized a Capital Increase	○	●	●
	64	# of Spin-off Companies Ceased Operation	○	○	
	65	Market Value of Spin-offs Companies	○	●	
	66	Amount of Revenues Spin-off Companies Generated		●	●
	67	Amount of External Investment Raised to Spin-offs Companies	○	○	
	68	# of New Commercial Products Created	●	●	●
	69	Amount of Seed Capital Invested Annually	○	○	
	70	Total Amount from Royalty Incomes (Licenses, Spin-offs, Start-ups)	●	●	●
TTO	71	Amount of Annual TTO Budget	●	●	●
	72	Share of TTO Budget (From Total Incomes)	○	●	
	73	# of Full Time Professional of TTO	●	●	
	74	Amount of Increase in Revenues		●	●
	75	Amount of Decrease in Operating Costs		●	
University	76	# of Investments of PRO (For University, PRO etc.)		○	
	77	Amount of Investments of PRO (For University, PRO etc.)	○	●	●
	78	Graduation Rate of Students (For University, PRO etc.)			
	79	Hire Rate of Graduated Students (For University, PRO etc.)			
	80	# of Published Articles (For University, PRO etc.)			
	81	School Size (For University, PRO etc.)	○		

Table 6.1 – Proposed Metrics (continued)

	No	Qualitative Metrics			
Qualitative Metrics	1	University / PRO's Support to TTO	●	●	●
	2	University / PRO's Strategy and Policy for TTO	●	●	●
	3	University / PRO's Integration with TTO	●	●	●
	4	Organizational Structure of TTO (institutionalism, processes, procedures, mechanisms etc.)	●	●	●
	5	Human Capital and Quality	●	●	●
	6	Financial Sustainability	●	●	●
	7	Resource Accessibility and Management	●	●	●
	8	Quality and Efficiency of Partnerships and Relationships with Stakeholders in University / PRO	●	●	●
	9	Quality and Efficiency of Partnerships and Relationships with Stakeholders in Industry	●	●	●
	10	Economic Development (TTO's economic benefit and contribution that is provided in the ecosystem of university and neighborhood industry)	●	●	●
	11	Public Benefit (Impacts and consequences of added value that TTO activities generate in university, industry and other public areas)	●	●	●

O : weak inclination towards the use of metric

● : strong inclination towards the use of metric

A blank cell corresponding to a metric reflects no inclination

Table 6.2 – New Metrics Suggested by the TTO Managers and Focus Group

	No	New Metrics Suggested by TTO Managers & Focus Group
New Metrics	1	# of Firms Contacted to Commercialize a Product/Service
	2	# of Investors Contacted to Provide External Investment for Start-up/Spin-off Companies
	3	# of Investors That Actually Invested in Start-up/Ppin-off Companies
	4	Total Amount of Experience of TTO Personnel
	5	Variety of TTO Incomes from Its Activities (In Terms of 5 Modules)
	6	Average Working Period of TTO Personnel in TTO
	7	Proportion of TTO's Expenditures to Its Outputs

The results revealed important findings regarding the metrics that can be used in the measurement of TTO performance in Turkey. First of all, the results for the proposed metrics indicate that nearly half of the metrics are proposed for the measurement of TTO performance. 51 out of 92 metrics are proposed and 41 metrics were found unsuitable for various reasons that are discussed in chapter 5.

Majority of the rejected metrics are in Section 1, which is Awareness, Advertising, Informing & Education Oriented Activities. These metrics mainly consist of activities that are related with the presence of TTOs in the ecosystem and forming relationships that can constitute inputs for TTOs' subsequent operations. TTO managers and the

focus group jointly rated these metrics low since in the last decade there is already a level maturity in the ecosystem regarding awareness towards TTOs and technology transfer activities in general. Indeed, TTOs had passed this period of early development and begin to focus more on their main tasks. The *Amount of Education TTO Personnel Have Annually* metric is proposed and *# of Workshops, Trade Shows and Fairs organized*, *# of Company Visits* and *# of Assistance* metrics are not proposed because as a performance indicator what is important is not the number of awareness activities that a TTO perform, but the efficiency of these activities and the actual results of these awareness activities such as, the number of people that are involved in other technology transfer activities as a consequence of these meetings. Thus *# of People Met at Events Which Led to Other Knowledge Transfer Activities* is proposed.

In Section 2, all metrics except one are proposed. The metric *# of Academicians in Scientific Research Projects* is not proposed because the metric *The Ratio of Total # of Scientific Research Projects / Total # of Academicians* gives a brief idea about the number of academicians that participated to the research projects from academia.

In Section 3 the metrics about the percentages of consultancy, contracted research and collaboration agreement incomes relative to the total research income are not proposed since the Turkish ecosystem is not ready for a detailed scaling, analysis and measurement for university-industry collaboration. At present, Turkish TTOs try to perform and to make profit from all three agreement types. *# of Technical Services Executed* and *# of Companies & Other Entities that TTO Generates Income* metrics are not proposed since this data is indirectly related to the metrics that are about the number of university-industry collaboration projects. For simplicity and to prevent duplication these metrics are not proposed. Finally, the *Length of Client Company Relationships* metric is not proposed since it is difficult to measure and also quality of these relationships can only be measured using qualitative metrics.

In Section 4, the metric *Amount of Legal Expenditures on Protection of IP* is not proposed since it is not an indicator of performance. Big universities can have large patent portfolios while smaller ones don’t. So the amount of these expenditures may not fully reveal the performance of TTOs: on the contrary it may result in measurement

bias favoring large universities. On the other hand, it is not important for TTOs to hold and maintain the patents in their portfolio that they cannot commercialize for long periods. *# of Active Licenses* is not proposed because it is not a generalized metric for licensing like the metric *# of Licensing Agreements*. For instance the exclusive licenses that TTOs fully transferred to a customer in exchange for profit are not included to this metric while they are common for Turkish TTOs. Finally *# of Products Arose from Licenses* is not proposed because after a licensing agreement signed, TTOs are not able to involve in the remaining process. The recipient may not turn the IP immediately into a product or there can be a commercial failure.

In Section 5, the metrics about the physical and operational supports that are given by TTOs to entrepreneurs are not proposed since nearly all of the Turkish TTOs already provides these supports. *# of Successful Start-up / Spin-off Companies* metrics are not proposed because these metrics conflict with other metrics that measures the success of companies such as revenue generation, capital increase or external investments. *# of Start-up / Spin-off Companies Ceased Operation* metrics are not proposed because they measure failure, not success. Moreover, it is a fact that only a small percentage of entrepreneurs become successful, so that following the number of failed companies may not reveal the TTO performance, especially when we consider many other factors that may play role in success and failure. Thus, the metrics may cause measurement error. The metrics *Market Value of Start-up / Spin-off Companies* are not proposed since it is difficult to measure for TTOs and other performers. Besides, market value of a company diversifies according to the nature of the business idea that the entrepreneur created. TTOs can support the companies that can achieve a big market value in a short period of time but they also support, the smaller companies with much less financial value. So again success and failure in terms of market value may not be directly related to the performance of TTOs. The metrics *Amount of External Investment Raised to Start-up / Spin-off Companies* are not proposed since they duplicate with the metrics that measures the capital increase of companies. Finally, the metric *Amount of Seed Capital Invested Annually* is not proposed because the important point for TTO is choosing the true company to invest the seed capital, not

to invest seed capitals in many companies to have large amounts of investment in companies.

The remaining rejected metrics are in the TTO Metrics and the University Metrics sections. As it is mentioned in Chapter 5, the main reason of these metrics' rejection is their incompatibility with the case of Turkish TTOs. As an opposition to the interviewees, *# of Full Time Professional of TTO* metric and *# of Investments of PRO (For University, PRO etc.)* metrics are not proposed. Number of TTO officers varies according to the size of the hosting university, so that it is not fair to use this metric for small universities and TTOs. *# of Investments of PRO (For University, PRO etc.)* metric is not proposed since the amount of investments are measured by another metric and it is the total amount that determines the magnitude of the investment, rather than its number.

Second main finding is that: majority of the metrics which reflect the Turkish TTO characteristics are rated high and nearly all of these metrics are proposed. As mentioned in Chapter 3, unlike the global TTO model, Turkish TTOs have three preliminary modules before licensing and commercialization activities to provide and bolster the input for these operations. The metrics in the sections that reflect these preliminary modules were ranked high and proposed by TTO managers and the focus group. Both groups agreed on the usage of metrics that show context-specific characteristics of Turkish TTOs, rather than directly replicating the metric set of a country or region. So in the other words, the interviewees verified the propositional statement that the assessment or the measurement of TTO performance of a developing country should be made in its own context and with its own characteristics.

Finally, qualitative metrics, which is one of the novelties of this research, were rated high and they are unquestionably proposed for usage by TTO managers and the focus group. Majority of these metrics are not used as a metric in Turkey at present, while they are more common in U.S. and European countries. However, results of this study revealed that main stakeholders of technology transfer ecosystem in Turkey deemed qualitative metrics significant and proposed their usage in the measurement of TTO performance. Although using qualitative metrics is complex and they do not have

quantitative measures like other metrics, they can present a different angle and provide a valuable complementary measurement aspect for TTO performance. To be informed of a TTOs institutional and economic sustainability, quality of its relationships, social and economic impacts of its operations are important for observing TTO performance. In this regard, these metrics were considered necessary and proposed to be used in measuring the performance of Turkish TTOs.

6.2 Policy Recommendations

This research proved the necessity of a context-specific metric set for Turkey, which can be used in measuring the performance of TTOs. In addition to a number of metrics that obtained from the literature, many metrics that are unique to Turkey are proposed by TTO managers and the focus group. Moreover, the interviewees also proposed a number of metrics which are not in the literature and can be used in Turkey. These findings indicate that on measuring the performance of TTOs, related authorities such as TÜBİTAK and MoSIT should consider the case of Turkish TTOs in their own context and should make their assessment on a context-specific metric set. Measurement and assessments without considering Turkey's ecosystem and its level of development in technology transfer, may not reveal accurate results of the performance of TTOs. For instance because of weak knowledge accumulation of Turkish universities, the metrics in section 2 are determined by TÜBİTAK and used for measuring the TTO performance to encourage both TTOs and universities to foster knowledge exchange and accumulation. These unique metrics are rated high and accepted as important by the stakeholders of the ecosystem. As a consequence, this exercise is a nice real-time example of context-specific measurement.

Another point is the importance of the use of qualitative metrics. These metrics are not as common in Turkey as they are in U.S. and European countries in measuring the performance of TTOs. However, these metrics were rated high and were strongly proposed for the measurement of TTO performance. Although their usage is not as simple as the quantitative metrics since they require a demanding qualitative framework, related authorities can determine the appropriate approaches to use qualitative metrics on measurement of TTO performance. Given that these metrics are

already used in some countries they can be adapted with related methods for Turkey as well. TÜBİTAK or MoSIT may increase the capacity of their units to perform the qualitative measurement for TTO performance, or they can authorize an external observer to perform this qualitative measurement.

Thirdly, the findings revealed that TTOs self-assess their performance. Opinions of TTO managers consists an important part of this research. As practitioners from the field they have considerable knowledge about activities and more importantly mechanics of the TTOs. They have jointly contributed to this research about measuring the performance of TTOs to find out which metrics should be used. At this point a metric set which is suitable for measuring the performance of Turkish TTOs, eventually presents a self-assessment tool for observing TTO performance. Moreover, independent of this research, their interest in self-assessment will lead to a beneficial process where TTOs learn from themselves. By this way TTOs can continuously improve and optimize themselves. In addition, TÜBİTAK or MoSIT can provide useful tools and perhaps create incentives for TTOs to involve in self-assessment. For instance, according to the data and performance indicators that TTOs provide, a simple software program that provides feedback and information to TTOs about the position of a particular TTO among all TTOs may act as a starter for self-assessment.

Finally, universities also have important roles for enhancing the performance of their TTOs, since in the case of Turkey, they are the actor who is hosting and managing the TTOs. Majority of the features and activities that are mentioned in both quantitative and qualitative metrics are directly related to the opportunities that the hosting university provides. So that, as long as universities strategically and operationally support their TTOs, regulate the university ecosystem on compatibility with TTOs and have necessary involvement when required, TTOs will clearly be more successful and effective. University managements should be aware of how critic this issue is and care for their TTOs if they truly want to pass scientific knowledge to the community and to create value added, public benefit and welfare.

6.3 Concluding Remarks

This research introduces a set of quantitative and qualitative metrics which can be used in measurement of TTO performance in Turkey considering the characteristics of Turkey as a developing country. In this regard the research presents important findings for TTOs and their position in the ecosystem.

The research also makes a significant contribution to the literature of the measurement of technology transfer organization's performance since to our knowledge it is the only comprehensive research using a novel methodology design based on interviews with the main stakeholders of the TTO ecosystem in Turkey. Using the proposed metric set Turkish TTOs can be informed of critical factors for their performance; they can manage their activities according to these and also can self-assess their performance. In addition to TTOs, hosting universities can benefit from these metrics and can redefine their roles, policies and applications for the success of their TTOs. Finally, private organizations that work with TTOs and public institutions which are authorized for observation and improvement of technology transfer ecosystem and its elements, can make use of the outcomes of this research. Additionally, this research can be complemented further by testing the proposed metrics and examining appropriate qualitative approaches and methods for the use of qualitative metrics in the measurement of TTO performance. As the technology transfer ecosystem and the culture enhance other stakeholders such as academicians and industrial firms can contribute to this field of research.

It is a fact that vertical technology transfer is a key concept for technological development which is instrumental in achieving a knowledge-based economy. Since TTOs are the main actors of vertical technology transfer between science and industry, their success and effectiveness are of utmost importance. To determine success measurement of their performance, its content, methods and approaches are critical which invites more research efforts.

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APPENDICES

A. INTERVIEW FORM

Name / TTO :

Experience in the field: …..years of total exp. …..years of private sector exp.

Education status :…..BC …..MSc …..Phd

Background :…..Social Sciences …..Nature Sciences …..Engineering

1. According to you which of these metrics should be used as an indicator on measuring the performance of a TTO? Below, please rank the metrics due to five ratings nearby where;
   1: the metric should definitely not be used
   2: the metric should not be used
   3: undecided
   4: the metric should be used
   5: the metric should definitely be used
   (You can mark with "X")

	No	Quantitative Metrics	1	2	3	4	5
Awareness, Advertising, Informing & Education Oriented Activities	**1**	# of Seminars, Meetings, Courses and Education Programs Held					
	2	# of Workshops, Trade Shows and Fairs					
	3	# of People, Students Attended to Courses, Seminars, Education Programs					
	4	# of People Met at Events Which Led to Other Knowledge Transfer Activities					
	5	Income Generated from Courses, Seminars, Education Programs					
	6	Amount of Education TTO Personnel Have Annually (in hours)					
	7	# of Telephone Calls					
	8	# of Company Visits					
	9	# of Newsletters					
	10	# of Assistance					
	11	# of Database Searches					
	12	# of Referrals					

	13	# of Fact Sheets					
	14	# of Advertisement Oriented Publishing of TTO					
Scientific Research & Funds	**15**	# of National Scientific Research Projects Applied					
	16	# of National Scientific Research Projects Accepted					
	17	# of International Scientific Research Projects Applied					
	18	# of International Scientific Research Projects Accepted					
	19	Total Amount of Scientific Research Project Budgets					
	20	Total Amount of Scientific Research Projects Income (Overheads)					
	21	# of Academicians in Scientific Research Projects					
	22	The Ratio of Total # of Scientific Research Projects / Total # of Academicians					
University and Industry Collaboration	**23**	# of Consultancy Agreements					
	24	Amount of Consultancy Research Expenditures					
	25	Amount of Income Generated from Consultancy Agreements					
	26	% of Consultancy Income Relative to Total Research Income					
	27	# of Collaborative Research Agreements					
	28	Amount of Collaborative Research Expenditures					
	29	Amount of Income Generated from Collaborative Research Agreements					
	30	% of Collaborative Research Income Relative to Total Research Income					
	31	# of Contracted Research Agreements					
	32	Amount of Contracted Research Expenditures					
	33	Amount of Income Generated from Contracted Research Agreements					
	34	% of Contracted Research Income Relative to Total Research Income					
	35	# of Technical Services Executed					
	36	# of Academicians in University-Industry Collaboration Projects					
	37	# of Companies & Other Entities that TTO Generates Income					
	38	Length of Client Company Relationships					
	39	Total Amount of University-Industry Collaboration Project Budgets					
	40	Total Income Generated from University-Industry Collaboration Projects (Overhead)					
IPR Management & Licensing Activities	**41**	# of Invention Disclosure					
	42	# of Academicians that Disclosed Invention					
	43	# of Patent Application					
	44	# of Patents Granted					
	45	Amount of Legal Expenditures on Protection of IP					

	46	# of Licensing Agreement					
	47	# of Active Licenses					
	48	Amount of Licensing Income					
	49	# of Products Arose from Licenses					
Commercialization and Entrepreneurship Operations	**50**	# of Entrepreneurs in Incubation					
	51	# of Entrepreneurs in Pre-incubation					
	52	# of Entrepreneurs Having Operational Possibilities/Supports (education, business mentor etc.)					
	53	# of Entrepreneurs Having Physical Possibilities/Supports (office, infrastructure etc.)					
	54	# of Start-up Companies Formed					
	55	# of Successful Start-up Companies					
	56	# of Start-up Companies Realized a Capital Increase					
	57	# of Start-up Companies Ceased Operation					
	58	Market Value of Start-up Companies					
	59	Amount of Revenues Start-up Companies Generated					
	60	Amount of External Investment Raised to Start-up Companies					
	61	# of Spin-off Companies Formed					
	62	# of Successful Spin-offs Companies					
	63	# of Spin-off Companies Realized a Capital Increase					
	64	# of Spin-off Companies Ceased Operation					
	65	Market Value of Spin-offs Companies					
	66	Amount of Revenues Spin-off Companies Generated					
	67	Amount of External Investment Raised to Spin-offs Companies					
	68	# of New Commercial Products Created					
	69	Amount of Seed Capital Invested Annually					
	70	Total Amount from Royalty Incomes (Licenses, Spin-offs, Start-ups)					
TTO	**71**	Amount of Annual TTO Budget					
	72	Share of TTO Budget (From Total Incomes)					
	73	# of Full Time Professional of TTO					
	74	Amount of Increase in Revenues					
	75	Amount of Decrease in Operating Costs					
University	**76**	# of Investments of PRO (For University, PRO etc.)					
	77	Amount of Investments of PRO (For University, PRO etc.)					
	78	Graduation Rate of Students (For University, PRO etc.)					
	79	Hire Rate of Graduated Students (For University, PRO etc.)					
	80	# of Published Articles (For University, PRO etc.)					
	81	School Size (For University, PRO etc.)					

2. On measurement of TTO performance, in addition to the quantitative metrics, qualitative metrics are also used. These indicators are important for the measurement of the issues such as; the level of institutionalism, management, policies, strategies, processes and impacts. According to you which of these metrics should be used as an indicator on measuring the performance of a TTO?

	No	Qualitative Metrics	1	2	3	4	5
Qualitative Metrics	1	University / PRO's Support to TTO					
	2	University / PRO's Strategy and Policy for TTO					
	3	University / PRO's Integration with TTO					
	4	Organizational Structure of TTO (institutionalism, processes, procedures, mechanisms etc.)					
	5	Human Capital and Quality					
	6	Financial Sustainability					
	7	Resource Accessibility and Management					
	8	Quality and Efficiency of Partnerships and Relationships with Stakeholders in University / PRO					
	9	Quality and Efficiency of Partnerships and Relationships with Stakeholders in Industry					
	10	Economic Development (TTO's economic benefit and contribution that is provided in the ecosystem of university and neighborhood industry)					
	11	Public Benefit (Impacts and consequences of added value that TTO activities generate in university, industry and other public areas)					

3. At this part, please suggest new metrics that does not exist on the list and should be used on the measurement of TTO performance? You can give a short commentary for your metric also.

B. DETAILED STATISTICAL RESULTS

TTO Manager Results

	No	Quantitative Metrics	TTO 1	TTO 2	TTO 3	TTO 4	TTO 5	TTO 6	TTO 7	TTO 8	TTO 9	TTO 10
Awareness, Advertising, Informing & Education Oriented Activities	1	# of Seminars, Meetings, Courses and Education Programs Held	25	0	25	75	25	100	75	75	50	75
	2	# of Workshops, Trade Shows and Fairs	100	0	25	75	75	100	75	75	75	75
	3	# of People, Students Attended to Courses, Seminars, Education Programs	75	0	25	0	25	100	25	75	50	75
	4	# of People Met at Events Which Led to Other Knowledge Transfer Activities	50	0	0	25	100	25	0	75	50	75
	5	Income Generated from Courses, Seminars, Education Programs	75	0	25	25	0	0	75	50	50	25
	6	Amount of Education TTO Personel Have Annually (in hours)	25	50	25	100	100	100	75	75	75	75
	7	# of Telephone Calls	0	0	0	0	0	0	0	50	50	25
	8	# of Company Visits	25	100	25	0	75	100	75	100	75	75
	9	# of Newsletters	25	25	25	25	75	100	75	75	50	75
	10	# of Assistance	10	100	75	0	75	100	0	75	75	50
	11	# of Database Searches	75	100	25	25	75	25	0	50	50	50
	12	# of Referrals	100	25	25	25	75	75	0	50	50	50
	13	# of Fact Sheets	0	0	25	25	50	0	0	50	50	50
	14	# of Advertisement Oriented Publishings of TTO	50	0	25	25	75	100	75	75	50	50
Scientific Research & Funds	15	# of National Scientific Research Projects Applied	100	100	75	75	100	100	100	100	100	75
	16	# of National Scientific Research Projects Accepted	100	100	75	75	100	100	100	100	100	75
	17	# of International Scientific Research Projects Applied	100	100	75	75	100	100	100	100	50	75
	18	# of International Scientific Research Projects Accepted	100	100	75	75	100	100	100	100	50	75
	19	Total Amount of Scientific Research Project Budgets	100	75	75	75	75	100	100	100	50	75
	20	Total Amount of Scientific Research Projects Income (Overheads)	100	50	25	75	25	100	100	100	75	75
	21	# of Academicians in Scientific Research Projects	75	50	25	75	50	100	100	100	75	75
	22	The Ratio of Total # of Scientific Research Projects / Total # of Academicians	75	0	75	75	50	75	75	100	75	75
Uni	23	# of Consultancy Agreements	100	75	75	25	25	100	75	100	75	75

	24	Amount of Consultancy Research Expenditures	0	0	75	25	25	100	75	100	75	75
	25	Amount of Income Generated from Consultancy Agreements	100	50	75	25	25	100	75	100	75	75
	26	% of Consultancy Income Relative to Total Research Income	75	50	75	25	25	75	0	100	75	75
	27	# of Collaborative Research Agreements	25	0	75	75	100	100	75	100	100	75
	28	Amount of Collaborative Research Expenditures	25	0	75	75	100	100	75	100	75	75
	29	Amount of Income Generated from Collaborative Research Agreements	75	0	75	75	100	100	75	100	75	75
	30	% of Collaborative Research Income Relative to Total Research Income	75	0	75	75	100	75	0	100	75	75
	31	# of Contracted Research Agreements	100	100	75	75	100	100	75	100	100	100
	32	Amount of Contracted Research Expenditures	0	0	75	75	100	100	75	100	75	75
	33	Amount of Income Generated from Contracted Research Agreements	100	50	75	75	100	100	75	100	75	75
	34	% of Contracted Research Income Relative to Total Research Income	100	0	75	75	100	75	0	100	75	75
	35	# of Technical Services Executed	75	75	75	25	100	100	75	50	75	75
	36	# of Academicians in University-Industry Collaboration Projects	75	0	75	75	100	100	75	100	75	75
	37	# of Companies & Other Entities that TTO Generates Income	75	100	75	75	75	75	75	100	100	75
	38	Length of Client Company Relationships	0	25	75	75	100	25	0	75	50	75
	39	Total Amount of University-Industry Collaboration Project Budgets	100	75	75	75	75	100	75	100	75	100
	40	Total Income Generated from University-Industry Collaboration Projects (Overhead)	100	75	75	75	75	100	75	100	75	100
IPR Management & Licensing Activities	**41**	# of Invention Disclosure	75	100	75	100	100	100	75	100	100	100
	42	# of Academicians that Disclosed Invention	75	50	75	100	100	100	75	100	75	100
	43	# of Patent Application	75	0	25	100	100	100	50	100	100	100
	44	# of Patents Granted	75	100	25	75	100	100	75	100	75	75
	45	Amount of Legal Expenditures on Protection of IP	25	25	25	75	100	100	50	100	75	100
	46	# of Licensing Agreement	100	100	100	75	100	100	100	100	100	75
	47	# of Active Licenses	100	100	100	75	100	0	0	100	75	75
	48	Amount of Licensing Income	75	100	100	75	100	100	100	100	75	75
	49	# of Products Arose from Licenses	50	100	25	75	100	25	0	100	75	100
Commercializatio	**50**	# of Entrepreneurs in Incubation	100	100	75	100	100	100	75	100	100	100
	51	# of Entrepreneurs in Pre-incubation	100	100	75	100	100	100	75	100	100	100
	52	# of Entrepreneurs Having Operational Possibilities/Supports (education, business mentor etc.)	100	75	75	100	100	100	75	100	75	100

	53	# of Entrepreneurs Having Physical Possibilities/Supports (office, infrastructure etc.)	100	50	75	0	100	100	75	100	75	75
	54	# of Start-up Companies Formed	100	100	75	75	100	100	75	100	100	100
	55	# of Successful Start-up Companies	100	100	75	75	100	0	0	100	75	100
	56	# of Start-up Companies Realized a Capital Increase	100	50	75	75	100	25	0	100	50	50
	57	# of Start-up Companies Ceased Operation	50	0	75	100	100	75	25	100	75	75
	58	Market Value of Start-up Companies	50	0	75	0	75	25	0	100	50	50
	59	Amount of Revenues Start-up Companies Generated	50	50	75	0	75	25	25	100	50	50
	60	Amount of External Investment Raised to Start-up Companies	75	0	75	100	75	75	75	100	75	75
	61	# of Spin-off Companies Formed	100	100	75	75	75	100	75	100	100	75
	62	# of Successful Spin-offs Companies	100	100	75	75	75	0	0	100	75	50
	63	# of Spin-off Companies Realized a Capital Increase	100	50	75	75	75	25	0	100	50	50
	64	# of Spin-off Companies Ceased Operation	50	0	75	100	75	75	25	100	75	75
	65	Market Value of Spin-offs Companies	50	0	75	0	75	25	0	100	50	75
	66	Amount of Revenues Spin-off Companies Generated	50	50	75	0	75	25	25	100	50	75
	67	Amount of External Investment Raised to Spin-offs Companies	75	0	75	100	75	25	75	100	75	75
	68	# of New Commercial Products Created	75	100	75	100	100	25	25	100	75	75
	69	Amount of Seed Capital Invested Annually	0	75	75	25	100	25	25	100	50	75
	70	Total Amount from Royalty Incomes (Licenses, Spin-offs, Start-ups)	100	100	75	100	100	25	75	100	75	75
TTO	**71**	Amount of Annual TTO Budget	75	100	75	75	100	100	75	100	75	75
	72	Share of TTO Budget (From Total Incomes)	75	50	75	75	50	25	25	100	75	75
	73	# of Full Time Professional of TTO	75	75	75	50	75	100	0	100	75	75
	74	Amount of Increase in Revenues	75	50	75	25	75	25	25	50	75	50
	75	Amount of Decrease in Operating Costs	25	0	75	0	75	25	25	50	50	25
University	**76**	# of Investments of PRO (For University, PRO etc.)	25	75	-	25	75	25	0	100	75	75
	77	Amount of Investments of PRO (For University, PRO etc.)	25	75	-	75	75	25	0	100	75	75
	78	Graduation Rate of Students (For University, PRO etc.)	0	0	0	0	25	25	0	75	0	0
	79	Hire Rate of Graduated Students (For University, PRO etc.)	0	25	0	0	25	25	0	75	0	0
	80	# of Published Articles (For University, PRO etc.)	0	0	75	0	25	100	0	100	25	0
	81	School Size (For University, PRO etc.)	0	75	75	75	100	100	0	100	50	0

	No	Qualitative Metrics										
Qualitative Metrics	1	University / PRO's Support to TTO	100	100	0	100	75	100	75	100	100	100
	2	University / PRO's Strategy and Policy for TTO	100	100	75	100	75	100	25	100	100	100
	3	University / PRO's Integration with TTO	100	100	0	100	100	100	25	100	100	100
	4	Organizational Structure of TTO (institutionalism, processes, procedures, mechanisms etc.)	100	100	75	75	75	100	25	100	75	100
	5	Human Capital and Quality	100	100	75	100	75	50	25	100	75	75
	6	Financial Sustainability	100	50	100	75	100	100	75	75	75	100
	7	Resource Accessibility and Management	100	100	75	75	75	75	75	100	75	75
	8	Quality and Efficiency of Partnerships and Relationships with Stakeholders in University / PRO	100	100	75	75	75	75	75	100	75	100
	9	Quality and Efficiency of Partnerships and Relationships with Stakeholders in Industry	100	100	75	75	75	75	75	100	75	75
	10	Economic Development (TTO's economic benefit and contribution that is provided in the ecosystem of university and neighborhood industry)	75	100	75	75	75	50	75	100	50	50
	11	Public Benefit (Impacts and consequences of added value that TTO activities generate in university, industry and other public areas)	75	100	75	75	75	50	75	100	50	50

Focus Group Results

	No	Quantitative Metrics	M1	M2	M3	M4	M5
Awareness, Advertising, Informing & Education Oriented Activities	1	# of Seminars, Meetings, Courses and Education Programs Held	25	25	100	25	0
	2	# of Workshops, Trade Shows and Fairs	25	75	100	0	0
	3	# of People, Students Attended to Courses, Seminars, Education Programs	25	25	100	0	0
	4	# of People Met at Events Which Led to Other Knowledge Transfer Activities	50	75	100	25	0
	5	Income Generated from Courses, Seminars, Education Programs	25	0	100	50	25
	6	Amount of Education TTO Personel Have Annually (in hours)	50	75	75	25	0
	7	# of Telephone Calls	0	0	0	0	0
	8	# of Company Visits	0	100	50	25	0
	9	# of Newsletters	25	100	75	0	0
	10	# of Assistance	25	100	100	25	25
	11	# of Database Searches	50	100	0	0	25
	12	# of Referrals	50	0	75	0	0
	13	# of Fact Sheets	25	75	75	0	0
	14	# of Advertisement Oriented Publishings of TTO	25	100	75	25	0
Scientific Research & Funds	15	# of National Scientific Research Projects Applied	25	100	100	75	50
	16	# of National Scientific Research Projects Accepted	25	100	100	75	50
	17	# of International Scientific Research Projects Applied	50	100	100	100	25
	18	# of International Scientific Research Projects Accepted	50	100	100	100	50
	19	Total Amount of Scientific Research Project Budgets	50	100	100	100	25
	20	Total Amount of Scientific Research Projects Income (Overheads)	75	100	100	100	50
	21	# of Academicians in Scientific Research Projects	75	100	75	75	0
	22	The Ratio of Total # of Scientific Research Projects / Total # of Academicians	75	50	75	100	50
University and Industry Collaboration	23	# of Consultancy Agreements	25	75	100	100	50
	24	Amount of Consultancy Research Expenditures	25	75	100	50	50
	25	Amount of Income Generated from Consultancy Agreements	25	75	100	100	50
	26	% of Consultancy Income Relative to Total Research Income	25	75	100	50	50
	27	# of Collaborative Research Agreements	50	100	75	25	25
	28	Amount of Collaborative Research Expenditures	50	100	75	25	25
	29	Amount of Income Generated from Collaborative Research Agreements	50	100	75	75	50
	30	% of Collaborative Research Income Relative to Total Research Income	75	75	75	50	50
	31	# of Contracted Research Agreements	75	100	100	100	50

	32	Amount of Contracted Research Expenditures	75	75	100	75	50
	33	Amount of Income Generated from Contracted Research Agreements	75	75	100	100	50
	34	% of Contracted Research Income Relative to Total Research Income	75	75	100	50	50
	35	# of Technical Services Executed	50	25	100	25	75
	36	# of Academicians in University-Industry Collaboration Projects	50	75	75	100	25
	37	# of Companies & Other Entities that TTO Generates Income	75	25	75	75	100
	38	Length of Client Company Relationships	75	75	100	50	75
	39	Total Amount of University-Industry Collaboration Project Budgets	50	100	100	75	100
	40	Total Income Generated from University-Industry Collaboration Projects (Overhead)	50	75	100	75	100
IPR Management & Licensing Activities	**41**	# of Invention Disclosure	75	75	100	100	50
	42	# of Academicians that Disclosed Invention	75	75	75	100	25
	43	# of Patent Application	100	75	75	100	25
	44	# of Patents Granted	100	100	100	100	25
	45	Amount of Legal Expenditures on Protection of IP	50	100	75	50	25
	46	# of Licensing Agreement	100	100	100	100	100
	47	# of Active Licenses	100	100	100	50	100
	48	Amount of Licensing Income	100	75	100	100	100
	49	# of Products Arose from Licenses	100	75	100	75	100
Commercialization and Entrepreneurship Operations	**50**	# of Entrepreneurs in Incubation	100	75	100	75	0
	51	# of Entrepreneurs in Pre-incubation	100	100	100	75	0
	52	# of Entrepreneurs Having Operational Possibilities/Supports (education, business mentor etc.)	50	100	75	75	0
	53	# of Entrepreneurs Having Physical Possibilities/Supports (office, infrastructure etc.)	50	100	75	25	0
	54	# of Start-up Companies Formed	75	75	75	75	25
	55	# of Successful Start-up Companies	75	75	75	75	100
	56	# of Start-up Companies Realized a Capital Increase	75	50	75	100	100
	57	# of Start-up Companies Ceased Operation	50	25	75	75	100
	58	Market Value of Start-up Companies	50	50	75	100	100
	59	Amount of Revenues Start-up Companies Generated	50	50	75	50	100
	60	Amount of External Investment Raised to Start-up Companies	50	0	75	100	100
	61	# of Spin-off Companies Formed	50	75	75	100	100
	62	# of Successful Spin-offs Companies	50	75	75	75	100
	63	# of Spin-off Companies Realized a Capital Increase	50	50	75	100	100
	64	# of Spin-off Companies Ceased Operation	50	25	75	75	100
	65	Market Value of Spin-offs Companies	50	50	75	100	100

	66	Amount of Revenues Spin-off Companies Generated	50	75	75	50	100
	67	Amount of External Investment Raised to Spin-offs Companies	50	25	50	100	100
	68	# of New Commercial Products Created	100	75	75	50	100
	69	Amount of Seed Capital Invested Annually	50	50	50	75	100
	70	Total amount from Royalty Incomes (Licenses, Spin-offs, Start-ups)	75	75	100	75	100
TTO	**71**	Amount of Annual TTO Budget	100	75	100	100	100
	72	Share of TTO Budget (From Total Incomes)	100	75	100	50	100
	73	# of Full Time Professional of TTO	100	75	100	75	100
	74	Amount of Increase in Revenues	100	75	100	75	100
	75	Amount of Decrease in Operating Costs	100	50	100	25	100
University	**76**	# of Investments of PRO (For University, PRO etc.)	75	25	100	25	75
	77	Amount of Investments of PRO (For University, PRO etc.)	75	75	100	25	75
	78	Graduation Rate of Students (For University, PRO etc.)	0	0	25	25	25
	79	Hire Rate of Graduated Students (For University, PRO etc.)	0	0	25	50	25
	80	# of Published Articles (For University, PRO etc.)	50	75	50	50	25
	81	School Size (For University, PRO etc.)	25	50	50	75	25
Qualitative Metrics	**No**	**Qualitative Metrics**					
	1	University / PRO's Support to TTO	100	100	50	75	50
	2	University / PRO's Strategy and Policy for TTO	100	100	50	75	100
	3	University / PRO's Integration with TTO	100	100	50	50	75
	4	Organizational Structure of TTO (institutionalism, processes, procedures, mechanisms etc.)	50	100	50	50	100
	5	Human Capital and Quality	100	75	100	50	75
	6	Financial Sustainability	100	75	100	75	100
	7	Resource Accessibility and Management	75	50	100	75	100
	8	Quality and Efficiency of Partnerships and Relationships with Stakeholders in University / PRO	75	75	100	75	75
	9	Quality and Efficiency of Partnerships and Relationships with Stakeholders in Industry	75	75	100	75	100
	10	Economic Development (TTO's economic benefit and contribution that is provided in the ecosystem of university and neighborhood industry)	75	75	100	50	100
	11	Public Benefit (Impacts and consequences of added value that TTO activities generate in university, industry and other public areas)	50	50	100	75	100

C. TURKISH SUMMARY

Üniversite teknoloji transferi son yıllarda bir ülkenin bilimsel ve ekonomik olarak kalkınmasında dünyada son derece önemli bir kavram haline gelmiştir. Üniversitede üretilen yeni bilgi ve teknolojinin ticari bir ürün ya da servise dönüşebilmesi, toplumsal fayda için katma değer oluşumu ve sosyoekonomik kalkınmanın elde edilebilmesi açısından çok önemli bir hale gelmiştir. Bu, ayrıca bilgi destekli bir ekonominin geliştirilebilmesi için de mühim bir etkendir. Teknoloji transfer ofisleri (TTO) ekosistemde üniversite teknoloji transferini yürüten ana kuruluşlar olarak karşımıza çıkmaktadır. TTO'lar ara yüz yapılarındaki kuruluşlar olarak, üniversite-sanayi işbirliğini, araştırma sonuçlarından elde edilen fikri hakların ticarileşmesini ve son olarak da bilgi ve teknoloji tabanlı yeni firmaların oluşturulmasında aktif olarak görev almaktadırlar.

Geçtiğimiz kırk yıllık süre zarfında TTO'lar hem ABD hem de Avrupa'da kendilerine has model ve sistemleri ile yayılım göstermişlerdir. Bugün neredeyse bütün gelişmiş ülkeler üniversitelerinde üretilen bilgi ve teknolojilerin ticarileşme işlemini TTO ve benzeri kuruluşlar vasıtasıyla yapmaktadır. Gelişmekte olan ülkeler de bu süreci gerçekleştirmek adına çeşitli adımlar atmış olup, TTO ve benzeri yapıların oluşumunu sağlayacak politikalar geliştirerek üniversite teknoloji transferinin oluşumunu sağlamaya çalışmaktadır. Gelişmekte olan bir ülke olarak Türkiye ise TTO'ların kurulumu ve çalışması kapsamında 10-15 yıllık bir tarihe sahiptir. Özellikle TÜBİTAK'ın oluşturmuş olduğu 1513 Teknoloji Transfer Ofislerine Yönelik Destek Programı ile bugün ülkenin çeşitli bölgelerinde 75'in üzerinde TTO, bir üniversite birimi ya da özel şirket olarak faaliyet göstermektedir.

TTO'lar ve onların ortaya koymuş oldukları çalışmalar bilimsel ve teknolojik kalkınmanın elde edilebilmesi için gerçekten kritik bir etken olduğundan, onların performanslarının ölçülmesi başarılı olabilmeleri açısından önemli bir husus haline gelmiştir. TTO'ların üniversite ekosisteminde oluşan fikri hakları ve başarılı iş fikirlerini takip ederek ticarileştirebilmesi için, TTO'lar birçok faaliyetinde verimli bir şekilde çalışmalı, çeşitli kaynaklara ulaşılması ve bunların yönetimi hususunda etkin olmalı ve hem üniversite hem de sanayi ekosisteminde yer alan müşterilerine yüksek

kalitede servis sunabilmelidir. Bu kapsamda TTO'ların performansının ölçülmesi çok önemlidir. Çünkü bu sayede, üniversite yönetimleri, süreçle alakalı bir takım kamu kuruşluları ve TTO'ların bizzat kendileri performanslarından, başarı düzeylerinden ve eksikliklerinden haberdar olabilecek ve buna bağlı olarak ileriye dönük iyileştirme ve gelişme olanakları yakalayabilecektir.

TTO'ların performansının ölçümü gayet karmaşık bir husus olmaklar beraber, dünya üzerinde bu işlemin uygulayıcılarının kullandıkları birçok farklı metot ve araç bulunmaktadır. Bu konuyla alakalı iki temel soru öne çıkmaktadır: Ölçüm nasıl yapılmalı? Ve ölçüm işleminde hangi metrikler kullanılmalıdır? Literatürde TTO'ların performanslarının ölçümü hususunda ABD ile çeşitli Avrupa ve Asya ülkelerinde hem nicel hem de nitel metotlar kullanılmaktadır. Diğer bir taraftan, bu işlem için TTO'ların faaliyet gösterdiği ülkenin iç dinamiklerinin de hesaba katılması önem arz etmektedir. Bilindiği üzere, gelişmiş ülkelerde bilim, teknoloji ve yenilik sistemleri daha fazla olgunlaşmış ve gelişmiş durumdadır. Buna bağlı olarak bilgi ve teknoloji transferi yapan ara yüz yapıları ve bu yapıların performanslarının ölçülebileceği sistemler ve uygulamalar da gelişmiş durumdadır. Ancak gelişmekte olan ülkelerde henüz tam olarak olgunlaşamamış bilgi, teknoloji ve yenilik sistemlerinden ötürü teknoloji transferi yapan yapıların kurulumu ve işletilebilmesi gelişmiş ülkelere nazaran daha problemli olabilmektedir. Buna bağlı olarak bu yapıların performansının ölçümü hususu da daha karmaşık bir hale gelmektedir. Ayrıca gelişmekte olan ülkelerin birçok sistemi ve altyapısı gelişmiş ülkelerinki kadar olgunlaşmadığından ve bu ülkelerin teknoloji transferi ekosistemlerinde bir takım kendine has dinamikler barındırmasından dolayı, hâlihazırda teknoloji transferinin ölçümünde gelişmiş ülkelerde kullanılmakta olan ölçüm modellerinin kullanımı, gelişmekte olan ülkeler için iyi bir seçenek olmayabilir. Bu modellerin gelişmekte olan ülkelerde doğrudan kopyalanarak kullanımı sağlıklı sonuçlar doğurmayabilir. Sonuç olarak, doğru ve etkin ölçüm modellerinin tanımlanabilmesi için gelişmekte olan ülkelerin durumlarını ve sanayi ile üniversite ekosisteminin bilimsel ve teknolojik kapasitesi, bu çevrelerden gelen ve fikri hakların temelini oluşturan bilgi akışının yoğunluğu, bu alandaki hukuk sistemi ve diğer prosedürler vb. gibi kendilerine has dinamiklerini hesaba katan spesifik ölçüm modelleri tanımlanmalıdır. Bu kapsamda bazı gelişmiş ve gelişmekte

olan ülkelerin bu alandaki çalışmalarının ve modellerinin incelenmesi önemli bir adım olarak karşımıza çıkmaktadır.

Türkiye birçok ülkeye nazaran TTO'lar hakkında çok kısa bir tarihe sahip olsa da, barındırdığı TTO sayısı birçok ülkeden fazladır. Bu hususta birçok farklı kamu kuruluşunun politikaları ve bu kapsamda tanımladığı destek mekanizmaları etkili olmuştur. Türkiye'nin bilimsel ve teknolojik kalkınmaya ciddi şekilde ihtiyaç duyması ve hatırı sayılır miktarda üniversitesinde TTO bulunmasından dolayı, TTO'ların performansının ölçülmesi konusu Türkiye için de artık önemli bir araştırma konusu olmuştur. Türkiye'nin gelişmekte olan bir ülke olarak kendine has dinamiklerini hesaba katan ve teknoloji transfer ekosisteminde gelişme ve etkinlik kazanmasını sağlayacak doğru ve işlevsel bir performans ölçüm sistematiğine ihtiyaç duyulmaktadır. Bu çerçevede, bu tezin amacı Türkiye'de teknoloji transferinin performans ölçümünde kullanılabilecek metrikleri barındıran kullanışlı ve sistematik bir performans ölçüm modelinin ortaya çıkartılması ve önerilmesidir.

Literatürde teknoloji transferinin ölçülmesi hususunda gayet az sayıda kaynak bulunmaktadır. Bu kaynakların da çok büyük bir kısmı konuyla alakalı gelişmiş ülkelerde yapılmış araştırmalardan oluşmaktadır. Bu araştırmanın gelişmekte olan bir ülke için yapılması, araştırmanın ve sonuçlarının alanında yenilikçi olabilmesi açısından büyük önem taşımaktadır. Literatür taraması kapsamında öncelikle bilgi ve teknoloji transferinin tanımı, tarihi ve türleri konusunda kısa bir giriş yapılmıştır. Daha sonra ise bu alanda dünya üzerinde kullanılan metotlar ve metrikler incelenmiştir. Teknoloji transfer performansının ölçülmesi konusunda iki farklı yaklaşım ön plana çıkmaktadır. Bunlar kısaca sayısal göstergeler vasıtasıyla izlenebilen nicel yaklaşım ve sayısal göstergeler aracılığıyla izlenemeyip daha farklı uygulamalar gerektiren nitel yaklaşımdır. Araştırmada her iki yaklaşıma ait metrikler literatür taraması sonucunda elde edilmiştir.

Literatür taramasının ilk aşamasında sayılarla ölçüm yapabilmeye olanak sağlayan nicel metrikler araştırılmıştır. Bu kapsamda AUTM, ACCT, Pro-Ton gibi dünya üzerinde aktif olarak faaliyet gösteren köklü çatı teknoloji transfer platformlarının kullandığı metrik setlerinden yararlanılmıştır. Buna ek olarak ABD, Avrupa ve

Asya'daki teknoloji transfer ofislerinin, bunlarının faaliyetlerinin ve performanslarının ölçümü konusunda yazılan birçok makaleden de yararlanılmıştır. Bu çerçevede, literatür taraması vasıtasıyla toplanan kaynaklardan yararlanılarak toplamda 81 adet nicel metrik belirlenmiştir. Yine literatür taraması sonucunda bu metriklere ek olarak dünyanın çeşitli yerlerindeki TTO'ların performansının ölçümünde kullanılmakta olan 11 adet nitel metrik de belirlenmiştir. Bu metrikler sırasıyla; Farkındalık, Tanıtım, Bilgilendirme ve Eğitim Amaçlı Faaliyetleri, Bilimsel Araştırma ve Fonlar, Üniversite-Sanayi İşbirliği, Fikri Sınai Mülkiyet Hakları Yönetimi ve Lisanslama Faaliyetleri, Ticarileşme ve Girişimcilik Hizmetleri, TTO Metrikleri, Üniversite Metrikleri ve Nitel Metrikler başlıkları altında gruplandırılmıştır. Bütün metrikler ayrıca analitik bir bakış açısı sunabilmesi açısından kullanılmakta olduğu bölge ve ülkelere göre de gruplandırılmıştır.

Literatürde bulunan nicel ve nitel metriklerin belirlenmesine ek olarak, bir takım gelişmekte olan ülkeler detaylı olarak incelmemiştir. Brezilya, Çin Hindistan ve Rusya ülkelerinin oluşturduğu bu inceleme kapsamında ilgili ülkelerin, teknoloji transferi geçmişleri, TTO yapıları ve varsa bunların ölçümüne yönelik sistemler, ülkelerin bu alana taalluk eden hukuksal altyapıları vb. gibi hususlar incelenmiş. Son olarak Türkiye özelinde detaylı bir inceleme yapılmış ve bu ülkeler Türkiye ile ilgili konularda kıyas edilmiştir.

Literatür taraması sonrasında bir takım sonuçlara ulaşılmıştır. Öncelikle Türkiye'de TÜBİTAK aracılığıyla TTO'ların performansının ölçümü için tanımlanan metriklere bakıldığında, bu metriklerin bir kısmı diğer ülkelerle ortak olarak kullanılmasına karşın, bir kısmı hiç kullanılmamakta ve bir kısmı ise sadece Türkiye'de kullanılmaktadır. Mesela TTO metrikleri, Üniversite metrikleri ve nitel metrikler Türkiye'de kullanılmamakta olup, Bilimsel Araştırma ve Fonlar bölümündeki metrikler ise sadece Türkiye'ye has metrikler olarak öne çıkmaktadır. İkinci olarak, bazı gelişmekte olan Asya ülkelerinde rastlanan durumun aksine, Türkiye hiçbir gelişmiş ülkenin kullandığı bir metrik setini kullanmamaktadır. Üçüncü olarak, nitel metriklerin kullanımına olanak sağlayabilecek bir yaklaşım Türkiye'de bulunmamaktadır ve bu tarz metrikler kullanılmamaktadır. Nitel metriklerin kullanımı

nicel metrikler kadar kolay ve anlaşılır olmadığından bu hususta bir takım zorluklar ile karşılaşılması muhtemeldir. Ancak bu metrikler ABD ve birçok Avrupa ülkesinde yaygın olarak kullanılmaktadır. TTO performansının ölçümüne yönelik, nicel metrikler aracılığıyla ölçülemeyecek birçok önemli noktanın tespitinde kullanılabilecek nitel metrikler performans ölçümü açısından çok önemli görülmektedir.

Türkiye'nin diğer ülkeler ile metriklerin kullanılması hususunda oluşan farklarına ek olarak bir takım karakteristik özellikleri de mevcuttur. Mesela Türkiye'de kurgulanan TTO modeli ABD ve bazı Avrupa ülkelerindeki modellerden farklılık göstermektedir. Ticarileşme ile alakalı modüllere ek olarak Türkiye'deki TTO'lara, Farkındalık, Tanıtım, Bilgilendirme ve Eğitim Amaçlı Faaliyetleri, Bilimsel Araştırma ve Fonlar ve Üniversite-Sanayi İşbirliği modülleri de eklenmiştir. Bu modüller üniversite ve sanayiden gelen bilgi akışının kapasitesinin artırılması amacıyla tanımlanmıştır. Çünkü TTO'ların ticarileştirme faaliyetlerinde bulunabilmesi üniversite ve sanayi cephelerinden gelen yeni bilgi ve teknolojiler barındıran girdilerine ihtiyaç duymaktadır. Bu faktörlere Türkiye'nin gelişmekte olan bir ülke olmasından ileri gelen bazı faktörler de eklendiğinde, yukarıda özetlenmiş birçok Türkiye'ye özel şartın dikkate alındığı nitel ve derinlemesine bir çalışmanın yapılması gereği ortaya çıkmaktadır.

Literatürde yer alan boşluklar ve varsayımlar dâhilinde aşağıdaki araştırma soruları oluşturulmuştur:

- Türkiye'de bulunan TTO'ların performanslarının ölçülmesinde hangi metrikler kullanılmalıdır?
    - Diğer ülkelerde kullanılmakta olan metrikler Türkiye'de bulunan TTO'lar için uygun mudur?
    - Hâlihazırda TÜBİTAK tarafından kullanılmakta olan metrikler Türkiye için uygun mudur? Değişmeleri gerekli midir?
    - Nicel metriklere ek olarak nitel metrikler de TTO performansı için kullanılmalı mıdır?
    - Bu süreç için literatürde bulunmayan yeni metrikler geliştirilebilir mi?

Bu kadar kapsamlı ve ülkemiz şartlarında daha önce çalışılmamış bir araştırma konusu için, alanla ilgili Türkiye'nin kendine has iç dinamiklerin derinlemesine analiz yöntemi ile ortaya çıkarılması önemlidir. Bu nedenle araştırma metodolojisi, birçok kaynaktan az sayıda veri edinmek yerine, az sayıda kaynaktan detaylı, kapsamlı ve bütünleyici bilgi edinmeyi sağlayan nitel analiz üzerine kurgulanmıştır. Nitel analiz için ise birden fazla sayıda mülakat yöntemi benimsenmiştir. Bu kapsamda Türkiye'deki teknoloji transfer ekosisteminin ana paydaşlarının katılım göstereceği birbirinden farklı iki adet grup oluşturulmuştur. İlk grup 10 adet TTO yöneticisinden oluşturulmuştur. TTO'ların seçimi TÜBİTAK'ın 1513 Programının ilk çağrılarında desteklenmekte olan TTO ve kuruluşu diğer TTO'lara göre daha eski yıllara dayanan TTO'lar arasından yapılmıştır. TTO yöneticileri Türkiye'de TTO tarafında bu alandaki en fazla birikim ve saha deneyimine sahip olan kritik bir kitleyi oluşturmaktadır. TTO yöneticilerinin TTO kariyerleri öncesinde hem özel sektör hem de kamu sektörü tecrübeleri bulunmaktadır. Yöneticilerin bir kısmında akademi deneyimi de bulunmaktadır. İkinci grup ise TÜBİTAK'ın 1513 Programının Yürütme Komitesini oluşturan 5 adet üyeden oluşan bir odak gruptur. Bütün üyelerin programın kurulduğu yıldan itibaren TTO'ların seçimi, değerlendirilmesi ve izlenmesi süreçlerinde yer almaları, onları konu ile ilgili Türkiye'de belki de en önemli bilgi birikimine sahip kişiler durumuna getirmektedir. Odak grup üyelerinin tamamının hem özel sektör hem de kamu sektörü tecrübeleri bulunmaktadır. Üyelerin büyük bir kısmının akademi tecrübesi ve aynı zamanda kendilerine ait ticari teknoloji firmaları da bulunmaktadır.

Literatür aracılığı ile toplanan 92 adet metrik ile bir mülakat formu oluşturulmuştur. Formda mülakat yapılacak kişilerden bu metriklerin kullanılması ya da kullanılmaması kapsamında likert ölçeğine göre bir derecelendirme yapmaları istenmiştir. Bu metriklere ek olarak kişilerden formda yer almayan yeni metrikleri tanımlamaları da istenmiştir. İki grubun mülakatları da farklı zamanlarda yapılmış olup, gruplar ve kişiler birbirlerinin sonuçlarından kesinlikle haberdar olmamışlardır. Mülakatlar sonucunda toplanmış verilerin analizinde, kapsamlı bir anlayış sunulabilmesi açısından hem nicel hem de nitel tekniklerin kullanıldığı karma bir metot tasarımı yapılmıştır. Bu kapsamda ilk olarak mülakatların sonuçları konsolide edilmiştir.

Sonuçların nicel teknikler kullanılarak yorumlanabilmesi için 7 adet istatistik tanımlanmıştır. Bu 7 adet istatistiğe göre bütün metrikler tek tek analiz edilmiştir. İstatistik sonuçlarına ek olarak mülakatlar sonucunda elde edilen nitel bulgular da mevcuttur. Sonuç olarak araştırma sorularının cevaplanabilmesi ve paydaş görüşleri kullanılarak Türkiye'ye uygun bir metrik seti oluşturulabilmesi için bu iki grup bulgu kullanılmıştır. Bütün metrikler bu iki grup bulguya göre detaylı bir şekilde tek tek yorumlanmış, iki adet grubun da sonuçları arasında kapsamlı karşılaştırmalar yapılmış ve yapılan sentezler neticesinde her iki grup bulguya göre de önerilmesi uygun bulunan metrikler önerilmiştir. Son aşamada grupların görüşleri neticesinde önerilen metrikler arasında nihai bir değerlendirme yapılmış ve araştırmacının da görüşleri eklenmiştir.

Mülakat yapılan kişilerin belirtmiş olduğu görüşler araştırmanın en önemli girdisini teşkil etmektedir. Bundan dolayı mülakat yapılan kişilerin belirtmiş olduğu sonuçların güvenilirliği ve kişilerin sonuçlar üzerindeki anlaşma düzeyi, araştırma sonuçlarının sıhhati ve gerçekliği konusunda büyük önem taşımaktadır. Bu sebeple mülakatlar neticesinde elde edilen veriler güvenilirliklerinin test edilebilmesi için bir değerleyici güvenebilirliği analizine tabi tutulmuştur. Analiz kapsamında hem TTO yöneticilerinin vermiş olduğu sonuçlar hem de odak grup üyelerinin vermiş olduğu sonuçlar ayrı ayrı analiz edilmiştir. Sonuç olarak elde edilen güvenilirlik istatistikleri, her iki grup için de yüksek ve güvenilirlik limitleri arasında çıkmış, böylece elde edilen bulguları riske atacak bir durumla karşılaşılmamıştır.

Araştırma sonucunda elde edilen ana bulgular TTO'ların performansının ölçülmesiyle alakalı önemli sonuçlar ortaya koymuştur. İlk olarak literatürden elde edilen ve mülakatlar kapsamında gruplara sorulan 92 adet metrikten 51 tanesi kullanılmak üzere önerilmiş, 41 tanesinin kullanımı ise uygun bulunmamıştır. Uygun bulunmayan metriklerin büyük bir kısmı Farkındalık, Tanıtım, Bilgilendirme ve Eğitim Amaçlı Faaliyetleri bölümünde yer almaktadır. Üniversite ve sanayi ekosisteminde TTO'ya karşı olan farkındalığın artırılması ve TTO'nun diğer modüllerinde yer alan faaliyetlerin etki alanının artırılmasına yönelik etkinliklerin düzenlenmesi önemli bir faktör olmasına karşın, geçtiğimiz 4-5 yıllık süre zarfında bu farkındalık ekosistemde belli bir olgunluğa eriştiğinden diğer modüllere odaklanılması beklenen bir durumdur.

Özellikle TTO'nun diğer modüllerine karşılık gelen metrik bölümlerine baktığımızda: Bilimsel Araştırma ve Fonlar, Üniversite-Sanayi İşbirliği, Fikri Sınai Mülkiyet Hakları Yönetimi ve Lisanslama Faaliyetleri, Ticarileşme ve Girişimcilik Hizmetleri bölümlerindeki metriklerin birçoğu önerilmiş ve performans ölçümü için kullanılması gerekli görülmüştür. Buna karşın, TTO Metrikleri bölümünde yer alan metriklerin yarısından fazlası ve Üniversite Metrikleri bölümünde yer alan metriklerin büyük bir kısmı önerilmemiştir. Bunun en büyük sebebi bu bölümlerde yer alan metriklerin büyük bir kısmının Türkiye'de yer alan TTO'ların durumu ile uyumsuz olmalarından kaynaklanmaktadır. Bunun yanında TTO yöneticileri ve odak grup tarafından tanımlanmış 7 adet yeni metrik de önerilmiştir.

İkinci ana bulgu diğer ülkelerde kullanılmakta olanların dışında, sadece Türkiye'de kullanılmakta olan metriklerin her iki grup tarafından da gayet yüksek oranlarla önerilmiş olması ve yine Türkiye'deki TTO'ların durumuna uymadığı için bazı metriklerin reddedilmesidir. Daha önce de belirtildiği gibi Türkiye'nin gelişmekte olan bir ülke olması ve Türkiye'de kullanılan TTO modelinin daha farklı olması gibi sebeplerden ileri gelen bir takım karakteristik özelliklerden kaynaklanan farklılıklar değerleyiciler tarafından dikkate alınmış ve metrikler de bu doğrultuda önerilmiştir ya da reddedilmiştir. Bulgular neticesinde elde edilmiş bu durum, ekosistemdeki ana paydaşların araştırmada yer alan bu argümanı da desteklediğini göstermektedir. Sonuç olarak gelişmekte olan ülkelerde TTO performansının ölçümü ile alakalı ülkelerin kendi özelinde değerlendirme yapmak ve bu değerlendirme neticesinde de ülkelerin kendilerine has durumlarını dikkate almanın gereği ortaya çıkmıştır.

Son olarak, bu araştırmanın yenilik içeren taraflarından birisi olan nitel metriklerin tamamının yüksek oranlarda her iki grup tarafından da kullanılmak üzere önerilmiş olmasıdır. Bu metrikler ABD ve birçok Avrupa ülkesinde kullanılmasına rağmen ülkemizde metrik olarak kullanılmamaktadırlar. Ancak elde edilen bulgular, ülkemizde yer alan ana paydaşların bu metriklerin gerekliliği hakkında hem fikir olduğunu göstermektedir. Bu metriklerin kullanımı nicel metriklere kıyasla her ne kadar zor olsa ve bir takım karmaşık nitel yaklaşımlar gerektirse de, bu bölümde yer alan bütün metrikler, nicel metriklerin ölçemediği birçok hususu ve faktörü dikkate

alarak, TTO'ların performansları hakkında önemli geri bildirimlere olanak sağlamaktadır. Bu husus önerilmelerindeki en büyük sebep olarak karşımıza çıkmaktadır.

Bu araştırma sonuçları itibariyle, gelişmekte olan bir ülke olarak Türkiye'nin ilgili alan ile alakalı karakteristik özelliklerini de dikkate alarak, TTO'ların performansının ölçülmesinde kullanılabilecek bir metrik seti ortaya çıkarmıştır. Bu setin ortaya çıkmasında ülkede yer alan ana paydaşların büyük katkıları olmuş ve Türkiye için kendi özelinde bir değerlendirme yapılmıştır. TÜBİTAK, Bilim, Sanayi ve Teknoloji Bakanlığı vb. gibi politika yapıcıların çeşitli politika araçları ve bunlara yönelik geliştirme, değerlendirme gibi uygulamalarını yaparken Türkiye'nin kendine has özelliklerini hesaba katması çok önemlidir. Başka ülkelerde görülen ve alınan bir takım uygulamaların doğrudan kullanımının sağlıklı sonuçlar üretememe riski yüksek görülmektedir.

TTO performansının ölçümünde kullanılabilecek nitel metriklerin önemi bu araştırmada yer alan derinlemesine yapılan nitel bir çalışma ile ortaya çıkmıştır. Ancak bu metriklerin kullanımında ilk etapta, nicel metriklerin kullanımının aksine zorluklarla karşılaşılma olasılığı yüksek olarak değerlendirilse de, bu metriklerin TTO performansı hakkında sağlayabileceği geri bildirimler çok önemlidir. TTO'ların performansını izlemek ile yetkilendirilmiş kamu kuruluşlarının bu metriklerin kullanımı doğrultusunda inisiyatif göstermesi isabetli olarak değerlendirilmiştir. Bu kapsamda ilgili kuruluşlar ölçümlerde bu metriklerin de kullanılabilmesi için mevcut kapasitesini geliştirebilir ya da bu işi profesyonel biçimde yapabilecek ikinci bir kuruluşu değerlendirici olarak yetkilendirebilir. Böylece bu metriklerin de kullanımı sağlanabilecektir.

Bir diğer husus, bu araştırmada yer alan metriklerin ve TTO performansının ölçümünde kullanılabilecek diğer metriklerin her zaman için TTO'lara yönelik bir öz değerlendirme aracı sunmasıdır. Türkiye'de bulunan TTO yöneticilerinin bu araştırmaya önemli katkıları olmuştur. Bu husus aynı zamanda onların TTO performansı ölçülmesinde önemli fikirleri olduğunu da ortaya çıkarmıştır. Sonuç olarak belli metriklerin kullanılarak TTO'ların performanslarına yönelik bir öz

değerlendirme yapabilmesi her zaman için TTO'lara faydalı geri bildirimler sunacak ve birçok sürecini iyileştirmesine ve geliştirmesine imkân sağlayacaktır. Diğer bir taraftan bu hususta TTO'lara ev sahipliği yapan üniversitelere de önemli görevler düşmektedir. Türkiye'de yer alan TTO'ların neredeyse tamamı bir üniversite içerisinde faaliyet göstermektedir. Bundan dolayı üniversite yönetimleri TTO'lar üzerindeki en etkili ve belki de tek yönetim mekanizmalarıdır. Performans ölçümü için kullanılabilecek metriklerde yer alan aktivitelerin büyük bir kısmı üniversitenin TTO'ya sunmuş olduğu imkânlar ve verdiği destekler ile doğrudan ilişkilidir. Üniversitelerin TTO'lara sağlayacağı politik, stratejik ve operasyonel destekler, üniversite ekosisteminin TTO ile uyumlu hale getirilmesine yönelik uygulamalar, gerektiğinde TTO lehine yapılabilecek müdahaleler, TTO'lar için hayati önem taşımaktadır. TTO'ların performansının ölçülmesi de bu uygulamalardan biri olabilir. Unutulmamalıdır ki, TTO'lara ev sahipliği yapan üniversitelere, TTO'ları üzerinden yapabilecekleri birçok katkı neticesinde kendi bünyelerinde üretilen bilgi ve teknolojinin toplum tabanına yayılarak katma değer oluşturmasında birçok kritik görev düşmektedir.

Bu tez literatüre üç ana boyutta önemli katkılar yapmaktadır. İlk olarak, bu araştırma gelişmekte olan ülkelerde teknoloji transferi yapan kuruluşların performansının ölçülmesi konusunda kapsamlı ve derinlemesine bir analiz ortaya koyarak özgün bir metrik seti ortaya çıkarmıştır. Bu bağlamda araştırma, ihtiva ettiği metodoloji ve içerik bakımından özgün bir çalışma olarak literatürde yerini alacaktır. Ayrıca, önerilen metrik seti, Türkiye'deki paydaşlar için TTO performansının ölçümünde bir taban teşkil edebilecektir. İkincisi, nitel bir yaklaşımın sonucu olarak mülakatlar sonucunda elde edilen veri, TTO performansı ölçümündeki birçok belirleyici faktörün ortaya çıkmasına sebep olmuştur. Bu faktörler literatür taramasının yanı sıra, Türkiye'deki teknoloji transfer ekosisteminin ana paydaşları vasıtasıyla elde edilmiştir. Literatürde rastlanan TTO performansının ölçümüne yönelik yapılmış az sayıda çalışmanın aksine, bu araştırma sadece nitel ya da nicel metrikleri konu almamış, her iki metrik grubunu da gelişmekte olan bir ülkenin perspektifinden detaylı olarak ele almıştır. Son olarak, bu araştırma gelişmekte olan bir ülke olarak Türkiye'yi ele alan ve nitel bir yaklaşımla TTO performansının ölçümü hakkında ülkedeki ana paydaşların

görüşlerinin de dâhil edildiği ilk ve tek araştırmadır. Bu bakımdan bu araştırma, ülkemizde yeni oluşmaya başlamış bakir bir araştırma alanı için giriş niteliğinde bir çalışma ve gelecekte bu alanda yapılabilecek diğer araştırmalar için bir kilometre taşı teşkil edebilecektir.

Bu araştırmanın genişletilebilmesi ve bu alanda sonradan yapılabilecek araştırmalar için aşağıdaki öneriler geliştirilmiştir.

Bu araştırma sonucu ortaya konan metrik seti, başka araştırmalara konu olabilecek şekilde uygulayıcı kuruluşlar ya da TTO'lar tarafından test edilebilir ve bunun sonucunda bir takım geri bildirimler sağlanabilir. Buna ek olarak, bu araştırmada Türkiye'de yer alan TTO yöneticileri ve konuyla alakalı alanında uzmanlaşmış bir odak grup kullanılmıştır. Araştırmaya katılan paydaşlar arasında hem akademisyenler hem de firma sahipleri olmasına karşın, ülkemizde teknoloji transfer ekosistemi ve kültürü yaygınlaştıkça bu tarz araştırmalara üniversitelerin akademik üyeleri ve sanayide yer alıp, TTO'lar ile çalışmakta olan firmalar da dâhil edilerek paydaş kümesi genişletilebilir. Son olarak araştırma sonucu önerilen nitel metriklerin Türkiye'de kullanımı hususu ciddi bir önem arz etmektedir. Bu çerçevede, bu metriklerin TTO performansının ölçümü dâhilinde kullanımına yönelik metot ve yaklaşımlar içeren araştırmalara ihtiyaç duyulabilir.

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