THE EVALUATION OF AN INTERDISCIPLINARY POSTGRADUATE PROGRAM:
THE CASE OF SCIENCE AND TECHNOLOGY POLICY STUDIES (TEKPOL) AT METU

A THESIS SUBMITTED TO
THE GRADUATE SCHOOL OF SOCIAL SCIENCES
OF
MIDDLE EAST TECHNICAL UNIVERSITY

BY

AHMET ATAY

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR
THE DEGREE OF MASTER OF SCIENCE
IN
THE DEPARTMENT OF SCIENCE AND TECHNOLOGY POLICY STUDIES

DECEMBER 2019

Approval of the Graduate School of Social Sciences

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This is to certify that we have read this thesis and that in our opinion it is fully adequate, in scope and quality, as a thesis for the degree of Master of Science.

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ABSTRACT

THE EVALUATION OF AN INTERDISCIPLINARY POSTGRADUATE PROGRAM: THE CASE
OF SCIENCE AND TECHNOLOGY POLICY STUDIES (TEKPOL) AT METU

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December 2019, 110 pages

This thesis contributes to the literature on the evaluation of postgraduate studies
particularly looking at the science, technology and innovation policies. It focuses on the
case of Science and Technology Policy Studies (TEKPOL), METU, which has a history of
20 years. Established in 1997, METU-TEKPOL has an interdisciplinary approach to the
analysis of the economic, social and political factors that drive technological change and
innovation. In order to investigate the influence of the TEKPOL postgraduate programs,
official register data and questionnaire data are used to explore added-value effects of
TEKPOL on interdisciplinarity, careers of its graduates and innovation, science and
technology environment in Turkey. Based on an online questionnaire conducted to
TEKPOL graduates, the ways in which post-graduate programs had an impact on
Turkey's science, technology and innovation environment are explored.

Keywords: Education, Interdisciplinarity, METU-TEKPOL, Program Assessment, Science,
Technology and Innovation.

ÖZ

DİSİPLİNLERARASI BİR LİSANSÜSTÜ PROGRAM DEĞERLENDİRMESİ: ODTÜ BİLİM VE TEKNOLOJİ POLİTİKASI ÇALIŞMALARI (TEKPOL) ÖRNEĞİ

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Yüksek Lisans, Bilim ve Teknoloji Politikası Çalışmaları Bölümü

Tez Yöneticisi: Doç. Dr. İbrahim Semih Akçomak

Aralık 2019, 110 sayfa

Bu tez özellikle bilim, teknoloji ve inovasyon politikalarına bakarak, lisansüstü çalışmalarına yönelik değerlendirme çalışmalarına ilişkin literatüre katkıda bulunacaktır. Bu araştırma asıl olarak 20 yıllık bir tarihe sahip olan ODTÜ-TEKPOL örneği üzerine yoğunlaşmıştır. 1997'de kurulan ODTÜ-TEKPOL, teknolojik değişim ve inovasyona yön veren ekonomik, sosyal ve politik etkenlerin analiz edilmesine yönelik disiplinlerarası bir yaklaşıma sahiptir. TEKPOL lisansüstü programlarının etkisini araştırmak için, TEKPOL'ün disiplinlerarasılık, mezunlarının kariyerleri ile inovasyon, bilim ve teknoloji ortamına ne tür katma değer sağladığını ortaya çıkarmaya yönelik olarak resmi kayıt verisi ve anket verisi kullanılmaktadır. TEKPOL mezunlarına uygulanan çevrimiçi bir ankete dayalı olarak, lisansüstü programların Türkiye'nin bilim, teknoloji ve inovasyon alanlarına etkisi araştırılmaktadır.

Anahtar Kelimeler: Bilim Teknoloji ve İnovasyon, Disiplinlerarasılık, Eğitim, ODTÜ-TEKPOL, Program Değerlendirme

To My Family

ACKNOWLEDGMENTS

First of all, I would like to express my deepest gratitude to my thesis supervisor Assoc. Prof. Dr. İbrahim Semih Akçomak for his patience, advice, encouragement, tolerance and continuous support. Without him this thesis would not be possible and deemed much successful.

Finally, I would like to thank my dearest wife and daughter for their extensive support during this process and unrequited love.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

BTYK	Bilim ve Teknoloji Yüksek Kurulu
CV	Curriculum Vitae
EU	European Union
METU	Middle East Technical University
MSc	Master of Science
OECD	The Organization for Economic Co-operation and Development
PhD	Doctor of Philosophy
R&D	Research and Development
STI	Science, technology and innovation
STPS	Science and Technology Policy Studies
TEKMER	Teknoloji Geliştirme Merkezi
TEKPOL	Science and Technology Policy Studies
TÜBİTAK	Türkiye Bilimsel ve Teknolojik Araştırma Kurum
USA	United States of America

CHAPTER 1

INTRODUCTION

Although it is possible to say that the history of innovation is as long-standing as the history of humanity, the first definition of innovation is given by the famous economist Joseph Alois Schumpeter who is accepted as the founding father of the academic fields of innovation and entrepreneurship (Hartigh, 2017). Innovation is defined by Schumpeter as launch of a new product or a new quality of an existing product; identification of a new production procedure; opening of a new market; finding of a new source for the supply of raw materials or semi-finished products; or the new organization of an industry. It is impressive to see how these definitions are similar to the current definitions in the Oslo Manual of OECD. According to Schumpeter, an invention must be implemented to a production activity in order to create an innovation. Therefore, an invention is considered as an innovation as long as it is transformed into commercial success (Escarus, 2018).

Since then there has been an increase in the interest to innovation studies and science and technology policy in particular. Schmookler (1966), Becker and Whisler (1967), Knight (1967), Downs and Mohr (1979), Dosi (1982), Freeman (1982), Tushman and Moore (1982), Nelson and Winter (1982), Drucker (1985), Rothwell and Gardiner (1985), Rickards (1986), Dosi, Freeman, Nelson, Silverberg and Soete (1988), Porter (1990), Lundvall (1992), Freeman and Soete (1997), Fagerberg, Mowery and Nelson (2004), and Trott (2016) are just a few examples seminal research on innovation. Moreover, there were great efforts in the methodological sense in collecting R&D and innovation data. Frascati Manual - Guidelines for Collecting and Reporting Data on Research and Experimental development and Oslo Manual-Guidelines for Collecting, Reporting and

Using Data on Innovation are published by the OECD that provide basic definitions and measurement suggestions of R&D and innovation.[1] This collective effort in defining, measuring and researching R&D and innovation also necessitated collective effort of scientists and practitioners from diverse backgrounds. Thus, one can argue that innovation studies in general and science and technology policies in particular were interdisciplinary-born fields. "Innovation studies" is an emerging scientific field nourished by economics, management, geography, sociology and engineering (see Table 3 of Fagerberg and Verspagen, 2009). It is interesting to see "Turkish" scholars on innovation as a separated cluster in the study of Fagerberg and Verspagen (2009, see Table A1). The aim of this thesis is to assess the past 20 years of Middle East Technical University Science and Technology Policy Studies (STPS) programs. Established in 1998 Research Center for Science and Technology Policies (TEKPOL) and STPS merge research and education functions to create human capital and conduct research in science and technology policies within the general field of innovation studies. STPS and TEKPOL are generally used interchangeably and this thesis uses TEKPOL in addressing both postgraduate programs and the research center.

In order to create and circulate knowledge continuously, young scholars can be deemed as relevant sources. Young scholars serve also for the integration and creation of scientific work in methods that provide opportunities for research, employment, mobility and mostly, efficient contacts with the ecosystem out of academia (Bozeman and Mangematin, 2004; Mangematin and Robin, 2003). Strategic selections around collaboration and interaction cause the creation of relational capital through professional networks (Bozeman and Corley, 2004). Interdisciplinary collaborations

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[1] OECD, "Oslo Manual-Proposed Guidelines for Collecting and Interpreting Innovation Data" (http://www.oecd.org/science/inno/2367614.pdf) and "Guidelines for Collecting and Reporting Data on Research and Experimental Development" (https://www.oecd-ilibrary.org/docserver/9789264239012-en.pdf?expires=1574890854&id=id&accname=guest&checksum=71BDACE84807D81DBD5325DB7ED22575) accessed on 01.04.2019.

were utmost important also in the emergence of innovation studies in creating a mass of scholars and variety of research fields (Fagerberg and Verspagen, 2009).

Significant challenges our society encounters today necessitate solutions backed by scientific expertise because the globe is increasingly becoming knowledge-driven, thus, development of human capital at the knowledge frontier is critical for the sustainability of our society (Bozeman et al., 2001). The development of knowledge workers takes the form of postgraduate education where academic training has a significant role. Academic training is an important investment that costs students' several years, sometimes even longer and supervisors' significant time and effort (Stephan 2012). Contemporary academic training practices are criticized for failing to meet changing societal requirements and for creating excessive PhDs (National Research Council, 1998; Cyranoski et al., 2011). When we think about these problems in academic training, it can be suggested that they are somewhat assignable to a gap between mass education policies and science policies. Moreover, accountability is underlined in recent policy designs that is often translated into short-term and merit-based evaluations, but a relatively long-term payoff from academic training tend to be overlooked (Hackett, 1990).

The field of "innovation studies" emerged in the 1980s. The publication of "The Rate and Direction of Inventive Activity" edited by Richard Nelson (Nelson, 1962), the establishment of Sussex Policy Research Unit (SPRU) in 1965 and start of a new journal "Research Policy" in 1972 were imperative in the emergence of the field. Many research groups, centers and institutes were formed post 1980 based on the SPRU experiment. Major journals on innovation studies, scholarly societies such as the International Schumpeter Society (ISS) and academic conferences started in the 1990s. The establishment of METU-TEKPOL in 1997 coincides with such events and also with the

establishment of two influential research institutes in Europe: Maastricht Economic Research Institute on Innovation and Technology (MERIT) in 1988 and Danish Research Unit on Innovation Dynamics (DRUID) in 1995. METU-TEKPOL aimed at creating science and technology policy specific human capital and conduct research on innovation within and interdisciplinary setup. The must course structure of the MSc program (economics, history, politics) in 1998 and PhD program (economics, innovation studies, methodology, sociology) in 2005 reflects this interdisciplinary setup. Whether this interdisciplinary character still continues is of course a question that this thesis tackles. But more specifically, this thesis aims at evaluating the graduate programs of TEKPOL with specific reference to its impact on the careers of the graduates, where the impact partially accrues from this interdisciplinary character. This thesis also helps to see who is an average TEKPOL student in terms of education and work background, current work experience, reason of pursuing an academic degree at TEKPOL etc.

1.1. Interdisciplinarity and TEKPOL

Interdisciplinarity is one of the keywords among the drivers for change in the twenty first century. The word "interdisciplinarity" shows up in various platforms which reminds and comes with the concepts of innovation and collaboration (Klein, 2009). The aim of interdisciplinarity is "integrating knowledge or modes of thinking in two or more disciplines or established areas of expertise to produce a cognitive advancement" (Boix Mansilla and Durasing, 2007). When we look at higher education, it is seen that the disciplinary departmental structure is not agile in answering interdisciplinary problems (Brainard, 2002; National Institutes of Health, 2006; National Science Foundation, 2006; Borrego and Newswander, 2011). Thus, universities are increasingly getting engaged in interdisciplinarity (Gabelnick, 2002). Social sciences and humanities underline interdisciplinary teaching and scholarship whereas natural sciences highlight

interdisciplinary research and collaboration (Borrego and Newswander, 2011). Based on their study, interdisciplinarity focuses on two areas: interdisciplinary education for students and interdisciplinary research among faculty/university. Interdisciplinary programs in higher education develop individualized student learning experience (Holley, 2009). In order to think critically, interdisciplinary approach on the theoretical, practical, and pedagogical levels is also important for students (Riggs and Hellyer-Riggs, 2010). The field of "innovation studies" is by and large in interdisciplinary field, in both education and research in this aspect. As such the word "interdisciplinarity" is among the five keywords in the seminal Fagerberg and Verspagen (2009) paper together with innovation, network, invisible college and cognitive community.

Interdisciplinary research is defined as "any study or group of studies undertaken by scholars from two or more distinct scientific disciplines". Interdisciplinary change, however, is more complex because it runs counter to conventional ways of thinking, behaving, planning, and budgeting in academic institutions (Gaff, 1997).

In interdisciplinary study programs, students can select courses that matter to them most, which give them the chance to build their own academic pathway. However, one of the biggest challenges of achieving an interdisciplinary environment is facilitating collaboration between departments and instructors. Interdisciplinary learning can be maximized when departments from different disciplines work together helping students to make the meaningful connections between different subject fields.

Interdisciplinary instructions and teaching methods support the common objectives of the instructors in the classroom. These goals focus on engaging students; instructors wish to help students in order to develop self-confidence, self-efficacy, knowledge, insights, problem solving skills, and ambition for learning. Repko (2009) suggests that

interdisciplinary instruction develops advances in cognitive ability. In addition to that, other educational researchers (Kavaloski, 1979; Newell 1990; Field et al., 1994) have identified a number of explicit educational benefits of interdisciplinary learning such as "bias recognition", "critical thinking", "ambiguity toleration" and "acknowledgement and appreciation of ethical concerns".

This study provides an examination of TEKPOL's interdisciplinary approach in education and research. From the time of establishment at 1997, METU-TEKPOL has an interdisciplinary approach to the analysis of the economic, social and political factors that drive technological change and innovation. Research and training programs cover an extensive domain closely related to recent policy questions on national and international regulations of science, technology and innovation, with a specific focus on the networks of inter-organizational relations in addition to knowledge management issues. Although TEKPOL graduate programs are founded with an interdisciplinary mindset (i.e., the must course structure mentioned above), a simple comparison of now and ten years ago in terms of variety of courses, supervisors and lecturers show that interdisciplinarity has reduced. Using actual register data from 1997-2016, this thesis shows that this simple observation can be generalized over the 20-year period. When we look at the theses completed by TEKPOL graduates, it is seen that the number of unique supervisors is decreasing and the supervision task is levied on a limited number of TEKPOL researchers (details are given at Table 3.3 below). Particularly, number of unique supervisors per student decreases by time especially in the last years over the 20-year period which was not the case in the initial years of the MSc program (details are given at Table 3.2 below).

1.2. TEKPOL in an emerging technology and innovation ecosystem

When the development of Turkish economy is analyzed in brief, it can be seen that for a long time Turkey developed under a closed economy regime with varying degrees of protectionism (from 1923 to 1980). During this period, industrial production activities are mostly conducted in the form of technology transfer and the industrial sector does not make much effort to produce new technology. In a closed economy, industrialists are not expected to be involved in R&D activities.

In this period, technology policies are formed in accordance with the development plans. With the establishment of TÜBİTAK in 1963, for the first time an institutional structure was created to support research activities. In this era, the main objectives of TÜBİTAK were supporting scientific research and training researchers. In the third (1973-77) and fourth (1979-83) Five Year Plans, the concepts of technological development in the context of technology transfer and technology policies were mentioned the first time (Celep, 2016). As such, science, technology and innovation related issues have a short history of about 40 years in Turkey.

With the change in the economic system in 1980s, the import-substitution policies are abandoned, and open economy policies are adopted. However, the policies implemented in the following years were not successful to achieve targets in the investment and development of technology. In the following years, textile, chemical, soil, iron and steel, food, transportation, electricity and in general manufacturing sectors are determined as key areas where industrial strategies were formed. Nevertheless, transition from labor and resource-intensive exports to technology-intensive exports cannot be achieved and the percentage of technology-intensive exports remained low (Seyrek and Sarıkaya, 2008).

Turkey's first comprehensive science and technology policy study is conducted in 1983. One of the most important outcomes of "Turkish Science Policy: 1983-2003" is the establishment of the Supreme Council of Science and Technology (BTYK) (Celep, 2016). In relation to that, first attempt of Science, Technology and Innovation (STI) discipline to be institutionalized in Turkey goes back to 1990s where STI is in the undergraduate curriculum (Ansal, Ekinci and Kaşdoğan, 2018). Number of STI related courses increase around 2000 and master's programs started to emerge. But exact institutionalization of STI in Turkey starts with the opening of specific master's programs (Ansal, Ekinci and Kaşdoğan, 2018). Programs offered first at METU-TEKPOL in 1997, followed by İstanbul Technical University in 2000, Ankara University in 2013 are specific examples of these postgraduate education programs. Some foundation-backed universities such as Doğuş, Koç and Özyeğin also have master's programs addressing STI as well (Ansal, Ekinci and Kaşdoğan, 2018).

The current innovation ecosystem in Turkey is mostly as a result of increased government support (both in terms of amount and diversity in policy tools) after 2000 and compliance with the EU regulations. The establishment of Technology Development Centers (TEKMERs), Technology Development Zones, Technology Transfer Offices and university accelerators together with massive support on technology-based entrepreneurship was key to build today's technology and innovation ecosystem.

METU-TEKPOL was founded in 1997 at the Middle East Technical University with the specific goal of providing science and technology policy related human capital for the government institutions and other relevant institutions as well as to make research in science, technology and innovation policy issues. METU-TEKPOL is an interdisciplinary education and research body and one of the very few interdisciplinary academic bodies on innovation studies in Turkey that concurrently coordinates education and research

activities. It operates MSc and PhD programs in STI policy studies at the Graduate School of Social Sciences. METU-TEKPOL also conducts research on STI policy issues with the aim of addressing societal challenges, where such activities are coordinated by the Research Center for Science and Technology Policies organized under the METU Rectorate.

Research and training programs of TEKPOL cover a broad domain related to recent policy questions on national and international legislation of science, technology and innovation, with a specific focus on the networks of inter-organizational relations on the side of knowledge management issues. Thus, METU-TEKPOL has an interdisciplinary approach in order to analyze the economic, social and political factors that drive technological change and innovation. This establishment aim is reflected on the education programs through the design of the must course, the number of elective courses and diversity of the lecturers and supervisors in terms of education background and the faculties/departments they are affiliated. It is also worth to mention that there were always non-departmental elective courses offered to students in all education semesters (15-20 courses per each semester) during the period of 1997-2016.

All relevant aspects around emerging new technologies are of great significance for both developed and developing nations with the ongoing process of globalization and increased interdependence among nations. Design, formulation, implementation and evaluation of STI policies are of vital importance for creating and seizing opportunities. METU-TEKPOL MSc and PhD programs in Science and Technology Policy Studies aim at providing students with the notions, tools and methods required analyzing issues related to STI policies and conduct policy-relevant research. Up till the beginning of 2019-2020 semester, there were in total about 250 MSc and PhD graduates. At the moment, there are about 90 postgraduate students at TEKPOL.

When we look at the timing of the establishment of METU-TEKPOL, it falls in the period when R&D and STI concepts were evolving as popular topics for Turkey. At the time, TEKPOL has the specific goal of providing science and technology policy related human capital for the government institutions and other relevant institutions as well as to make research in science, technology and innovation policy issues. This aim is also aligned with the preference of such centers to be located within leading universities and prioritize long-term scientific research and education over short-term projects and activities (Nalbantoğlu, 2009). But selection of leading universities as the location of these centers is not enough alone to create long-term science and technology policies and an interdisciplinary environment since there are more important characteristic elements such as having relevant mindset and philosophy to drive and guide these centers (Nalbantoğlu, 2009). In this sense, TEKPOL education and research activities are also complementary to the emergence of the ecosystem and its main actors (universities, firms, technology parks, accelerators, Technology Transfer Offices). Looking back to the last 20 years, as it can be seen from the questionnaire results discussed in chapters 3.1 to 3.2, it can be argued that TEKPOL reached the goal of development of the human resources to work in STI related jobs in various types of institutions. Other part of the specific goal of making research on STI policy can be assessed from TEKPOL's academic CV and yearly activity reports. These issues are explored in detail in chapter 3.1 and 3.2.

1.3. Contributions and the synopsis of the thesis

This thesis uses official register data from 1997 to 2016 and data that comes from a specific questionnaire applied to graduates of TEKPOL. The register data provides detailed information of courses, supervisors, lecturers, the number of students registered in each course and supervised by researchers. This data is used to show the

scale of the graduate programs of TEKPOL and assess the interdisciplinarity of education programs. To complement this data, a specialized questionnaire was developed and applied to TEKPOL graduates to get better information about the graduates regarding demographic data, work experience, education background, why graduates study at TEKPOL and specific impact of the program. As such, this thesis contributed to academic program evaluation in Turkey, and it could well be the only comprehensive study in this manner.

Contributing to literature on the evaluation of post-graduate studies particularly looking at the STI field is rather unique. The literature on evaluation of education programs, particularly at the master's and doctoral levels (e.g., Lasfer et al., 2013) is a significant reference for this thesis. This literature assesses success of an education program based on indicators such as number of publications, promotion at work or projects. For instance, Zwanikken et al. (2014) looks at the impact of a master's program in public health for six low and middle-income countries. It is revealed that the programs have impact on the careers of graduates, especially in developing proposals and reporting in population health requirements. Lasfer et al. (2013) look at the success of an engineering program which has the goal of integrating industry to education. One other reason of conducting impact evaluations is to assess the extent to which economic benefits of a program exceed the costs of sustaining the program (Byrne et al., 2010). Thus, this thesis contributes to the literature on university program assessment in the wider sense.

This thesis has three main findings. Firstly, it shows that interdisciplinarity in terms of diversity in courses, lecturers and supervisors gradually decreases over time. Today all must-courses and most elective courses are taught by TEKPOL core researchers and more importantly most theses are supervised by the core research and education team.

Support from the university departments and faculties in this manner has decreased considerably. Second, this thesis gives answer to the question of who is an average TEKPOL graduate. This information is important for current students and candidate students who wish to apply to TEKPOL. Third, the results show that TEKPOL has specific impact on the career of the graduates in terms of new position, promotion and better salary. Such results are presented under 6 chapters. Second chapter "Methodology" explains the participant recruitment, questionnaire and the analysis conducted, third chapter "Findings" discusses the register data and results of the questionnaire responses. Fourth chapter "Network" talks about the internal and external communications of TEKPOL. Fifth chapter "Recommendations from the graduates" gives specific suggestions of the TEKPOL alumni that drives from the questionnaire and sixth chapter "Conclusion" covers concluding remarks of this thesis.

CHAPTER 2

METHODOLOGY

2.1. Participant recruitment

Since this thesis is based on a questionnaire to gather all the relevant information from the graduates, first step is to prepare the list of the target audience (list of METU-TEKPOL graduates). Register data of METU-TEKPOL courses, supervisors and lecturers in the period of 1997-2016 is provided by the METU administration. The data is cleaned and merged in Excel and Stata. According to this register data, there are 227 MSc and PhD graduates between 1999 and 2016. After having the information (names, graduation year, program) of graduates, contact information for most are completed by the help of university resources, personal networks and social media accounts. There was several missing contact information but after all the population was about 220 graduates whom a questionnaire was sent.

2.2. Questionnaire

Questionnaire design has a great importance on the success of the study since it is critical to include all the relevant indicators and questions, which let the responders reflect their valuable insights. It is seen in the studies of both Fagerberg and Verspagen (2009) and World Bank (2010) that they test sample questions before applying the questionnaire. As the basis for this study, we also apply the same approach to design a web-based questionnaire instrument. Appendix A includes a copy of the questionnaire. Some of the questions in this study tend to build a general profile of METU-TEKPOL MSc and PhD holders by age, gender, year of start/completion of MSc and PhD studies, work

after graduation and so on. Based on Fagerberg and Verspagen (2009), some questions, which allow the study of cognitive and organizational characteristics of METU-TEKPOL alumni working in the broad field of innovation studies are included as well. Fields of work, academic and other professional activities, social and academic interactions with the community of METU-TEKPOL graduates are questioned. Our questionnaire is piloted once, and it is improved based on suggestions from 14 participants (7 TEKPOL MSc or PhD holders and 7 TEKPOL academicians).

We identify a total of 227 graduates who obtain their MSC or PhD degree from METU-TEKPOL by the end of 2016. The reason why we include the graduates till the end of 1st semester of 2016-2017 academic year is explicitly not being affected by the sharp increase of the number of students due to the transfer of Turkish Military Academy Technology Management Program post-graduate students to METU-TEKPOL after the coup attempt in 2016. Given that, this study analyses pre-2017 period before the Turkish Military Academy post-graduate students moved to METU-TEKPOL. From 90 MSc and PhD students that were transferred to METU-TEKPOL only 65 have registered.

The questionnaire is conducted, and the data is collected in the period of end June-mid December 2016. Two separate reminders are also shared with the questionnaire participants to reach the maximum participation level. A total of 113 METU-TEKPOL MSc and PhD holders contribute to the questionnaire with a response rate of 49.5% (based on 227 graduates). We also use social media, such as LinkedIn, and other publicly available sources of information - personal web pages and CVs; to complete data on general characteristics for those who do not respond to the questionnaire. As mentioned, there was no contact information for about 10 students. Non-responses do also include people whose email bounce back. Since we reach the number of 113, which

is half of the graduates, our questionnaire collects general information for the majority population of METU-TEKPOL MSc and PhD holders up to December 2016.

2.3. Analysis

In this study, multiple techniques are used for data analysis including graphic network representations to visualize METU-TEKPOL graduates as well as their contributions to innovation studies. In order to explore the social and scientific networks of the graduates, a network analysis is conducted as well which helps to find out the extent of social and scientific interactions among graduates, and between graduates and others; moreover, to identify the overall position of each individual graduate in social and scientific interactions. The names of the graduates and the actors in the network are not provided due the ethical reasons.

In terms of methodology, Fagerberg and Verspagen (2009) and World Bank (2010) are the basis for this study. World Bank's methodology is a biannually made tracer study in order to follow up the Joint Japan/World Bank Graduate Scholarship Program beneficiaries. From this document, some indicators are used which fit to learn about both the performance of higher education programs and the characteristics of the alumni. Since this thesis focuses on a higher education program, we adapt two types of indicators to this study: Output and outcome indicators. Main characteristics of these indicators are like the following as stated in World Bank (2010):

- Output indicators are the ones focusing on program deliverables. Number of graduates who complete their MSc or PhD degree, networking behavior measures within the relevant scientific community and employability status in

activities which helps to leverage newly acquired skills through the academic program are among these output indicators.

- Outcome indicators are used in order to measure the impact on the overall socioeconomic development. The number of graduates who gain employment in the public sector, academia, NGOs and the private sector are among this type of indicators.

World Bank (2010) advises on the use of analyses in "before and after" mode where appropriate which enables to catch the changes in certain indicators that help understand performance of the graduate program, or the individuals attending the postgraduate education. In this study, the same approach is useful to study the expectations of METU-TEKPOL MSc and PhD holders before joining the program and after graduation.

In summary, relevant literature reviewed for this study was helpful in methodological approach, particularly for the questionnaire design and network analysis. Fagerberg and Verspagen (2009) and World Bank (2010) help to integrate "to-the-point questions" into the questionnaire in order to understand the impacts of MSc and PhD programs better. In addition to better design of the questionnaire, related literature also helps in a way that networking behaviors among the METU-TEKPOL graduates are sought by the help of the relevant questions directed to the graduates, which constitute the inputs for the network analysis. All relevant literature is also analyzed before starting this study in order to both understand the similar previous studies to leverage knowledge and prevent the duplication. As a result of this general literature review, it is also figured out that this study contributes to the literature to be a reference for impact evaluation of postgraduate education on STI.

2.3.1. Characterizing METU-TEKPOL MSc and PhD holders

Looking back to the history of first 20 years of METU-TEKPOL, the population of METU-TEKPOL graduates can be grouped into two: MSc graduates and PhD graduates. From the establishment of the program, there are 227 graduates in total until the end of 2016: 210 MSc holders and 17 PhD holders. The main characteristics of METU-TEKPOL graduates are based on the responses given to questionnaire. Table 2.1 summarizes key indicators.

Table 2.1. Main statistics of METU-TEKPOL graduates

		MSc	PhD	Total
Gender (all graduates	Female	91	7	98
	Male	119	10	129
Nationality (all graduates)	Turkish	208	17	225
	Non-Turkish	2	0	2
Gender*	Female	42	7	49
	Male	54	10	64
Age*	20-29	5	0	5
	30-39	61	8	69
	40-49	29	7	36
	50-59	1	2	3
Employment Status*	Full-time employee	85	15	100
	Part-time employee	2	1	3
	Unemployed	9	1	10
Work Location*	Ankara	72	11	83
	İstanbul	13	3	16
	İzmir	2	1	3
	Other Turkish cities	2	1	3
	USA	2	0	2
	Europe	5	1	6
Undergraduate Education*	Engineering	41	7	48
	Economy and	39	9	48
	Social and applied sciences	6	1	7
	Natural sciences	4	0	4
	Architecture	3	0	3
	Statistics	2	0	2
	Medical sciences	1	0	1

*These statistics are for the 96 MSc and 17 PhD graduates who responded the questionnaire.

Table 2.1 shows the general profile of TEKPOL graduates. We can see from the register data that male graduates are higher than female both for MSc and PhD alumni (among all graduates): male graduates are 56.66% for MSc and 58.82% for PhD. Register data again demonstrates that Turkish graduates are a big majority with only 0.88% of all graduates are non-Turkish.

96 MSc and 17 PhD graduates who responded the questionnaire also helped to profile TEKPOL alumni. It is seen that PhD graduates are older than MSc graduates: Average age of the MSc graduates is 36.67, whereas it is 41.53 for PhD graduates. When we look at the distribution of ages, 63.50% of the MSc holders are at their 30s in addition to 30% at their 40s. For the PhD graduates, majority (47%) of them are at 30s with 41.17% at 40s. It is also observed that employment rate for TEKPOL graduates is high. Most of the graduates are currently employed: 90.63% of MSc and 88.24% of PhD graduates. Ankara is the most common work location for all graduates: 75% for MSc and 64.70% for PhD graduates work in Ankara. Engineering and, economy and administrative sciences are by far the faculties with the highest shares where TEKPOL graduates have received their undergraduate degree. 42.71% of MSc and 41.18% of PhD graduates have an engineering background, in addition to 40.63% of MSc and 52.94% of PhD graduates from economy and administrative sciences. These numbers show that TEKPOL alumni's undergraduate education does not show diversity in education background, which can be a factor impacting interdisciplinarity.

CHAPTER 3

FINDINGS

3.1. Register data

Register data acquired from the METU administration covers many significant statistics on indicators such as student numbers, number of different courses given per year by various instructors and academic backgrounds of METU-TEKPOL teaching staff.

The MSc program produced 4 graduates in 1999 and 2000 as its first graduates. Then there has been an increase in the average number of graduates per year. Number of graduates reaches to the maximum level of 21 in the year 2004. The first two PhD graduates are in 2011.

Based on the register data between 1997-2016, it is observed that the average number of MSc graduates is about 11 (11.66) whereas the average number of PhD graduates is about 1 (0.94) per year.

Out of this register data, there are several critical outputs, which show the main characteristics of the METU-TEKPOL programs.

3.1.1. Number of students enrolled in METU-TEKPOL programs

As it can be seen in Table 3.1, number of post-graduate students is increasing for the first 5 years after establishment of METU-TEKPOL, and then there are minor fluctuations in between 2003-2015. But in 2016, there is a rapid increase in the total number since

PhD students' number more than doubles in 2015-2016 from 34 to 80. The main reason of this rapid increase in the total number of METU-TEKPOL students is the transfer of Turkish Military Academy post-graduate students to METU-TEKPOL in 2016 after the coup attempt.

Table 3.1. Number of METU-TEKPOL students (1997-2016)

Year	Total	MSc	MSc thesis	PhD	PhD/total	Thesis students /total
1997	27	27	2			0,07
1998	40	40	4			0,10
1999	65	65	7			0,11
2000	67	67	10			0,15
2001	79	79	13			0,16
2002	90	90	21			0,23
2003	81	81	27			0,33
2004	72	72	28			0,39
2005	74	65	22	9	0,12	0,42
2006	84	64	21	20	0,24	0,49
2007	77	52	15	25	0,32	0,52
2008	107	76	19	31	0,29	0,47
2009	101	67	29	34	0,34	0,62
2010	83	47	24	36	0,43	0,72
2011	109	67	37	42	0,39	0,72
2012	75	37	29	38	0,51	0,89
2013	75	35	28	40	0,53	0,91
2014	64	34	29	30	0,47	0,92
2015	79	45	33	34	0,43	0,85
2016	141	61*	24	80*	0,57	0,74

*Number of students transferred from Turkish Military Academy added

3.1.2. Diversity of people and courses within METU-TEKPOL programs

Figure 3.1 illustrates that METU-TEKPOL is struggling to meet its specific goal set at the establishment stage, which is having an interdisciplinary approach both in terms of teaching staff and supervisor compositions and courses. The pattern on falling diversity is clearly seen at Figure 3.1 in all 3 different dimensions: Lecturers, supervisors and courses.
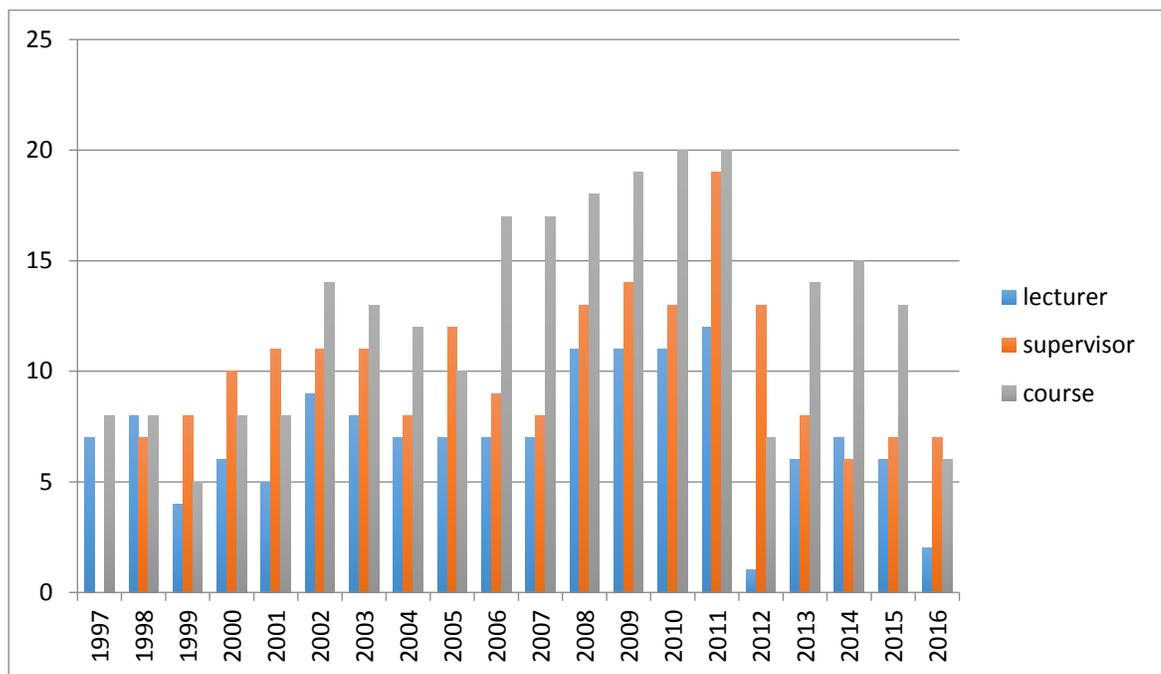
Figure 3.1: Number of distinct Lecturers, supervisors and courses at METU-TEKPOL (1997-2016)

Figure 3.1 shows number of lecturers and supervisor between 1997-2016. Each number is calculated by the subtraction of 3 METU-TEKPOL academicians (Prof. Dr. Erkan Erdil, Prof. Dr. Teoman Pamukçu and Assoc. Prof. Dr. İbrahim Semih Akçomak) from the total number. The main reason for that is to show the diversity in a more meaningful way.

The current team includes Assist. Prof. Umur Arsev Aydınoğlu who joined TEKPOL in 2016.

When the number of distinct lecturers by time (excluding the TEKPOL team) is analyzed, it is easily seen that it differs between 1 and 12 in the period of 1997-2016. It remains at the maximum levels of 11 and 12 between 2008-2011 but with a very rapid decrease, it falls down to 1 in 2012. 43 distinct lecturers offering courses at METU-TEKPOL between 1997-2016 are given in detail in Table 3.2.

The number of distinct supervisors follow a similar path as well: It reaches the highest number (19) in 2011 and then with a rapid decrease hits rock the bottom of 7 in 2015 and 2016. 64 distinct supervisors of MSc and PhD theses in the period of 1997-2016 are given in Table 3.3.

Number of courses is at the highest numbers in the period of 2006-2011. It reaches the maximum level of 20 courses in 2010 and 2011. Then with an incredible fall in 2012, it comes back to 7 (when the program did not admit any new students for a year in 2012). When the courses offered with the highest frequency are analyzed, it is seen that the current elective course of "History of Science and Technology" is taught in all years except 2012 and 2016 in the MSc program. History of Science and Technology was a must course till 2016 but became elective due to Council of Higher Education (YÖK) regulation that forces that the maximum number of must courses in a graduate program cannot exceed 50% of the required number of courses to graduate (7 in our case). Again at the MSc program, in addition to ""History of Science and Technology", must courses of "Economics of Science, Technology and Innovation" and "Knowledge, Science and Technology in the Information Age" are taught in all years except 2012. For the PhD program, it is also observed that some courses are offered in most of the years. Must

22

courses of "Innovation Technology and Economic Development" is offered in 9 years and also "Technology and Industrial Strategy" and "Research Methods, Analytical Techniques and Ethics" are offered in 10 years in the period of 2005-2016 after PhD program is started at METU-TEKPOL. All details of the 40 distinct courses offered at METU-TEKPOL in the period of 1997-2016 are given at Table 3.4.

Table 3.2. Lecturers involved in METU-TEKPOL programs - 1997-2016 (teaching)

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
AKDEVE ERDAL													X	X	X					
AKÇAY MEHMET								X												
AKÇOMAK IBRAHIM SEMIH															X	X	X	X	X	X
AKÖZER EMEL	X	X		X		X														
ARIAK NILUFER							X													
ARKIS BARIS						X	X	X	X											
AYDINOGLU ARSEV UMUR																		X		
BASARAN ÖZDEMIR FUNDA										X	X	X	X	X	X	X	X	X	X	X
DURGUN SERDAR MEHMET						X	X	X	X	X	X	X	X	X	X					
DURGUT METIN	X	X	X	X	X	X	X		X											
ELÇI ÖZSOY SIRIN														X	X		X	X		
EMIROGLU ALI ULAS																			X	
ERBAS HAYRIYE														X	X		X		X	
ERDIL ERKAN			X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
ERKAN TURAN ERMAN						X	X													
ERKIP NESIM	X	X																		
GERAY HALUK			X	X	X		X													
KARADELI CEM							X	X										X	X	
KEPENEK EMEK BARIS													X	X	X					
KEPENEK YAKUP	X	X	X	X	X					X	X	X								
MEDENI TUNÇ DURMUS													X	X	X					
NALBANTOGLU HASAN ÜNAL	X	X	X	X	X															
PAMUKCU MEHMET TEOMAN										X	X	X	X	X	X	X	X	X	X	X
SOMEL MUHITTIN CEM	X	X	X	X	X															
TANDOGAN VEDAT SINAN															X		X	X		
TARHAN BELKIZ						X	X	X	X											
TAYMAZ EROL		X																		
TOMAK MEHMET	X	X																		
TÖZER AYHAN										X	X									
TÜRKCAN ERGÜN					X	X														
YALÇINER UGUR GÜRSAD						X	X	X	X	X	X	X	X	X	X		X	X	X	X
YILDIRIM ONUR													X	X	X	X				
YÜCESAN ÖZDEMIR GAMZE													X							
ÇAKMAKCI AHMET METE												X								
ÇAKMUR BARIS										X	X	X								
ÇETINKAYA UMUT YILMAZ																		X	X	
ÇOLAKOGLU MUSTAFA HILMI												X			X					
ÖCAL NADIR												X	X							
ÖZEL HÜSEYIN																	X			
ÖZMAN ARIFE MÜGE								X	X											
ÖZOGLU POÇAN BURÇAK								X	X	X	X									
ÜVEY MEHMET CÜNEYT													X	X	X					
ÜÇER AHMET S.												X		X						

24

Table 3.3. Supervisors involved in STPS programs - 1997-2016 (thesis)

|	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
AGIR MUNIS SEVEN															X	X			
AKDEVE ERDAL													X						
AKSIT BAHATTIN	X	X	X		X	X													
AKÇOMAK IBRAHIM SEMIH															X	X	X	X	X
AKÖZER EMEL			X																
ALPASLAN FERDANUR					X														
ARKIS BARIS							X												
BALAMIR MURAT								X											
BASARAN ÖZDEMIR FUNDA									X	X				X	X	X			
BULUT SAFURE				X	X														
COSKUNOGLU OSMAN				X															
DEVECI CEM																	X	X	X
DURGUN SERDAR MEHMET						X						X	X	X					
DURGUT METIN	X	X	X	X	X	X	X												
EGE AYLIN						X	X	X	X										
ELÇI ÖZSOY SIRIN													X						
ERDIL ERKAN				X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
ERKIP NESIM	X	X	X	X	X														
ERZEN JALE ADILE										X									
GERAY HALUK				X	X	X	X	X	X	X									
GÜÇLÜ AYDIN NUSRET													X						
INAM AHMET	X	X	X	X	X			X											
KAHRAMAN SEVILAY													X						
KAYA AHMET RASIT											X	X	X	X	X	X			
KEPENEK YAKUP	X	X	X	X															
MEDENI TUNÇ DURMUS												X	X	X					
NALBANTOGLU HASAN ÜNAL		X	X	X															
OKYAYUZ MEHMET					X														
ORAN ADIL															X	X	X	X	
PAMUKCU MEHMET TEOMAN									X	X	X	X	X	X	X	X	X	X	X
PEHLIVANTÜRK BAHADIR														X					
RITTERSBERGER HELGA IDA							X	X											
SAYIN EROL RIFAT	X	X	X	X	X	X	X	X	X										
SEN MUSTAFA								X			X	X		X					
SEN TAYYAR DURMUS						X		X											
SEVAIOGLU OSMAN												X							
SOMEL MUHITTIN CEM		X	X																
SOYTAS UGUR											X			X					
TANSEL AYSIT												X	X	X	X	X	X	X	X
TARHAN BELKIZ						X	X	X											
TAYMAZ EROL	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X			X
TIGREK SAHNAZ														X					
TOMAK MEHMET										X									
TOPAL ÇAGATAY											X	X		X					
TUNCEL SÜLEYMAN GÜRDAL						X													
TÖZER AYHAN										X	X								
TÜRKCAN ERGÜN						X			X										
WASTI PAMUKSUZ SYEDA NAZLI															X	X	X	X	X
YALÇINER UGUR GÜRSAD						X	X	X	X	X	X	X	X	X					
YILDIRIM IBRAHIM SONER											X	X							
YILDIRIM ONUR													X			X			
YILMAZ CENGIZ														X			X	X	X
ÇAKIR SERHAT											X	X		X				X	X
ÇAKMAK EROL HASAN													X						

Table 3.3. Supervisors involved in STPS programs - 1997-2016 (thesis) (cont'd)

	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
ÇAKMUR BARIS									x	x	x	x							
ÇOLAKOGLU MUSTAFA HILMI											x								
ÖCAL NADIR													x						
ÖZKAN YILDIRIM SEVGI														x					
ÖZMAN ARIFE MÜGE								x											
ÖZOGLU POÇAN BURÇAK										x	x	x		x					
ÖZVEREN YASAR EYÜP						x					x	x	x	x	x				
ÜSTÜNER MUSTAFA YILMAZ											x	x	x		x	x	x	x	x
Supervisors with 5-9 theses																			
Supervisors with 10 and more theses																			

26

Table 3.4. Courses offered in METU-TEKPOL programs - 1997-2016

Course Code	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
8310501	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	
8310503	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X
8310505	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	X
8310507																X	X	X	X	X
8310510					X	X	X													
8310512										X	X	X	X	X	X	X	X	X	X	X	X
8310514										X								X		
8310515													X	X			X			
8310516														X						
8310517													X	X						
8310519														X			X			
8310521		X	X	X	X	X		X		X	X	X	X	X	X					
8310522						X	X	X	X	X	X	X	X	X	X					
8310524	X			X	X	X				X	X					X	X	X	X	
8310526										X	X	X	X							
8310531						X	X	X	X	X	X	X	X	X	X		X	X	X	X
8310532						X	X	X	X	X	X	X	X	X	X					
8310542						X	X	X												
8310543	X	X	X	X	X			X	X				X	X		X		X		
8310544	X	X		X		X														
8310545																		X		
8310546	X	X																		
8310547						X	X	X	X											
8310548						X	X	X							X					
8310549													X	X						
8310550						X	X													
8310552												X		X		X				
8310553																	X		X	
8310554												X								
8310555																		X		
8310557																		X		
8310560	X	X		X	X		X	X		X	X		X	X	X			X		
8310590							X					X	X	X	X				X	
8310601									X	X	X	X	X	X	X		X		X	
8310602									X	X	X	X	X	X	X	X	X	X		
8310603										X	X	X	X	X	X		X		X	
8310604										X	X				X					
8310605										X	X	X	X	X	X	X	X	X	X	X
8310611											X	X	X	X				X		X
8310612												X	X							

### 3.1.3. Diversity of departments within METU-TEKPOL programs
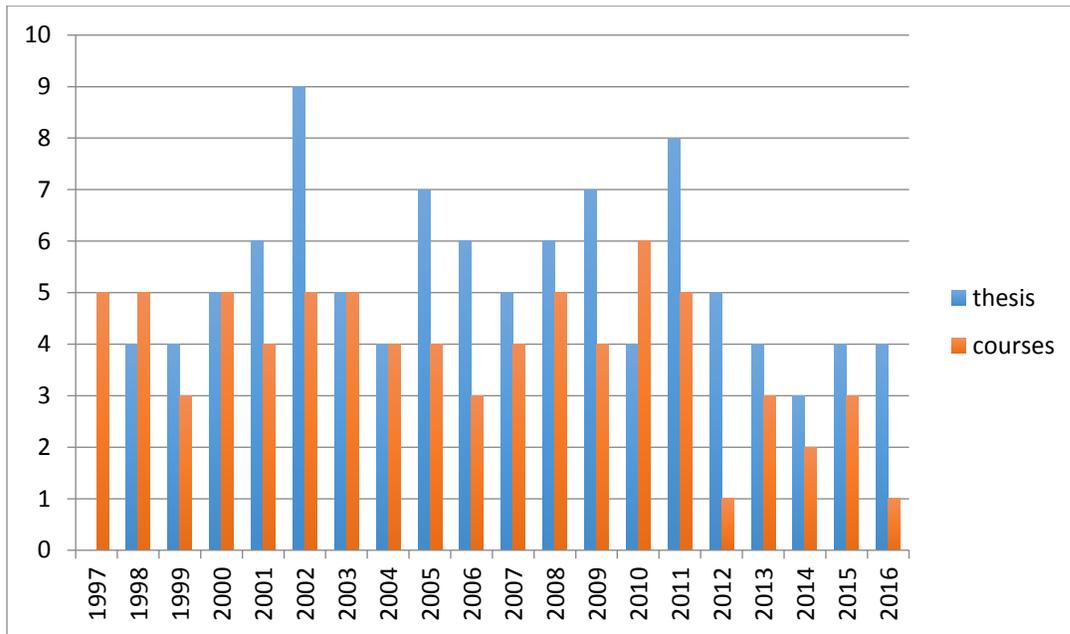
Figure 3.2: Departmental diversification at METU-TEKPOL (1997-2016)

Another important area analyzed is the number of different departments within METU-TEKPOL programs. Lecturers and supervisors from 19 different departments are involved into TEKPOL programs: Computer Engineering, Environmental Engineering, Industrial Engineering, Electronical Engineering, Mechanical Engineering, Education, Philosophy, Physics, Economics, Communications, Management, Statistics, Public Administration, Architecture, Sociology, History, International Relations, METU-TEKPOL (the core four lecturers) and TEKPOL-affiliated. These TEKPOL-affiliates are in fact lecturers affiliated to TEKPOL at certain times and have different backgrounds: 3 mechanical engineering, 2 electronics engineering, 2 sociology and 1 business administration. Interdisciplinarity is observed in terms of the educational backgrounds of the TEKPOL-affiliated lecturers whereas it is not the seen among TEKPOL-core lecturers. It is also worth to mention that TEKPOL-affiliates offered variety of courses

with various teaching and evaluation methods. Figure 3.2 shows the diversity of departments at METU-TEKPOL from 2 dimensions: thesis and courses. The figure shows the total number of distinct departments involved except METU-TEKPOL and METU-TEKPOL affiliates. As it is seen in Figure 3.2 number of distinct departments involved both in thesis and courses decline in the last 5 years. Specifically, there are no lecturers to thesis supervisors from Sociology, Computer Engineering, Industrial Engineering, Philosophy and Architecture in this 5-year period which is an important factor to explain this trend of disappearing interdisciplinarity. Thus, though interdisciplinarity between departments and faculties declined, there is still some degree of interdisciplinarity within TEKPOL based on the backgrounds of TEKPOL-affiliates.

3.1.4. Diversity of fields within METU-TEKPOL programs (Thesis)

Similar analysis is also conducted to figure out the distinct education and research fields that supervisors at TEKPOL belong to. Supervisors from distinct fields enrich the program in terms of research topics, different methodologies and particular style of doing research. There are 6 involved fields between 1997-2016 except TEKPOL: Administrative, Architecture, Arts, Communications, Engineering, Natural Sciences and TEKPOL. As it is clear from Figure 3.3 the diversity of fields rapidly declines especially after the first 3-4 years of the MSc program. Especially after 2006 theses are predominantly supervised by TEKPOL members. But perhaps the most intriguing finding is the absence of engineering faculty in the past 5-6 years and dominance of administrative sciences (economics and administrative sciences including economics of technology and innovation, science and technology policy, thus TEKPOL).
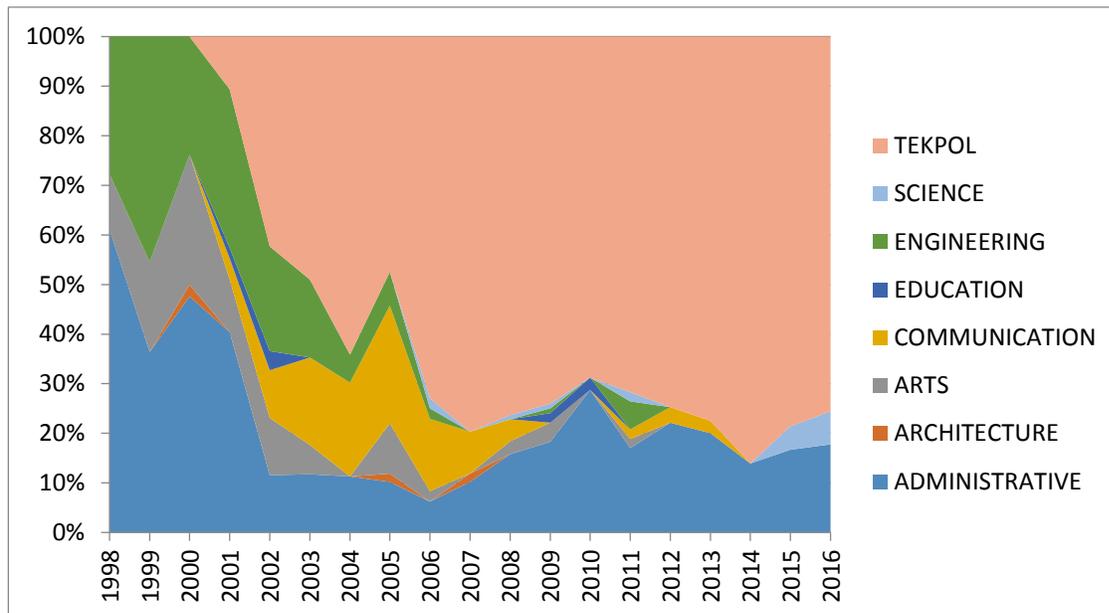
Figure 3.3: Diversification of METU-TEKPOL thesis supervisors in terms of affiliated faculty (1998-2016)

3.1.5. Diversity of fields within METU-TEKPOL programs (Courses)

Diversity of fields in courses taught within TEKPOL programs is another area of research for this study. Figure 3.4 shows that though there is more diversity at the beginning, which declines by time and TEKPOL again dominates the courses that are taught in the last 10 years just as in the case of Figure 3.3 when diversity of supervisors in teaching and research fields is analyzed. As in the case of diversity in thesis, there is only some degree of diversity within social sciences. In the beginning of the program lecturers from all 5 faculties at METU were teaching at TEKPOL, which continued for several years. Currently all lecturers are either somehow affiliated to TEKPOL. However, there is certain degree of diversity within TEKPOL lecturers as three of them who actively teach have engineering background. But the main conclusion does not change: diversity within TEKPOL courses in terms of background of the lecturers gradually declined over the years.

30
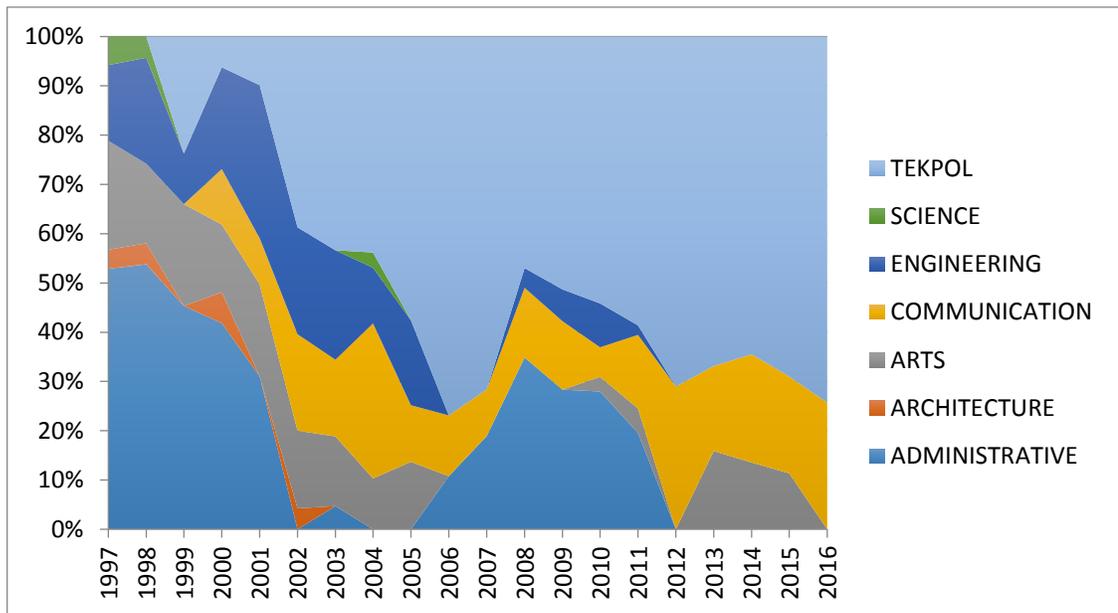
Figure 3.4: Diversification of METU-TEKPOL course lecturers in terms of affiliated faculty

(1997-2016)

3.1.6. Ratio of TEKPOL in all involved lecturers and supervisors
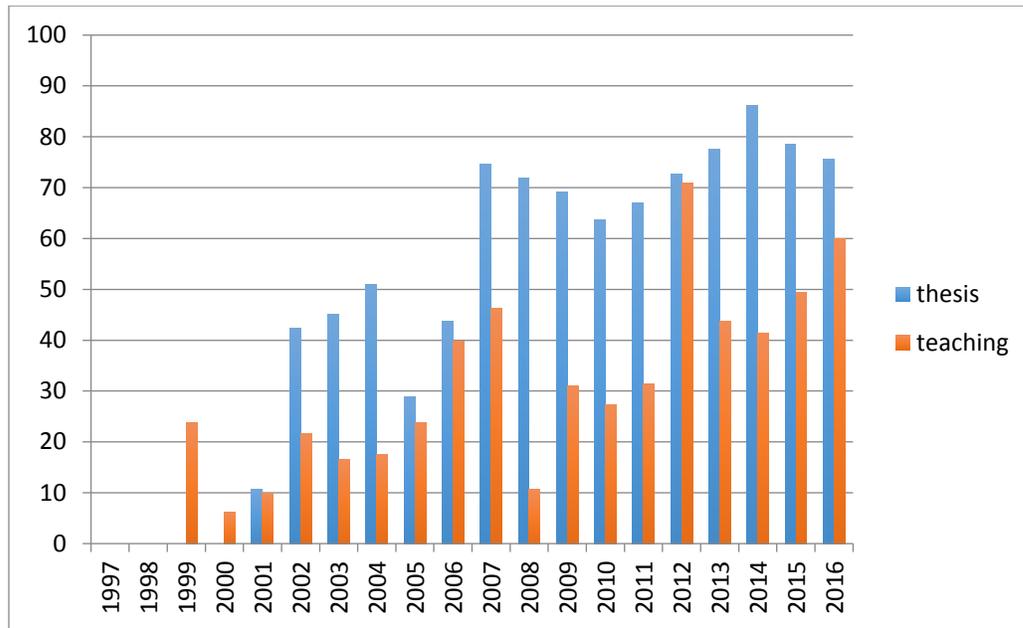
Figure 3.5: Diversification of METU-TEKPOL lecturers (1997-2016)

To sustain the interdisciplinary approach, diversity of lecturers and supervisors is key. In Figure 3.5 above, in contrast with the concept of "sustainable" interdisciplinarity, it can be seen that majority of thesis are supervised, and considerable part of courses are taught by TEKPOL academic staff. Ratio of TEKPOL academic staff involvement in teaching and research activities has increased gradually over the years.

Gradual decline in interdisciplinary character of the programs can be due to several developments over the years. First of all, in the earlier years, TEKPOL was managed by academic staff from Department of Economics and did not have full time employees under TEKPOL. During the years at different times three full-time academic staff have been employed who start teaching almost all must courses in the program. However, this development cannot be separated from the university-wide departmental policy

that academic staff has to teach two courses per semester where courses taught in the interdisciplinary programs do not count. Thus, courses in the interdisciplinary programs were most of the time taught as an additional third course of an academic staff. Over the years this made METU academic staff to focus on disciplinary courses under departments and finding lecturers in the interdisciplinary programs became difficult. To alleviate such problems interdisciplinary programs started to seek full-time scholars. Third, the student profile (mostly working at TÜBİTAK, government agencies and defense companies) may have been influential in reducing the demand for different courses taught by professors from engineering, arts and culture and, natural sciences faculties. This in turn may have affected the diversity in thesis supervisors. Such issues will be discussed further in the concluding section.

3.2. Results

The questionnaire that is used in this thesis includes questions to understand the general profile of METU-TEKPOL MSc and PhD holders by gender, age, year of start/completion of MSc and PhD studies. Studies using tracer study methodology underline the importance of analyzing quantitative structural data on employment and career paths, the character of work and related competencies, and information on the professional orientation and experiences of graduates from higher education programs (Heidemann, 2011; Schomburg, 2003; World Bank, 2010). Related questions on "work after graduation" in this thesis focus on such areas.

Out of the total number of 227 graduates (210 MSc and 17 PhD) as of the beginning of 2017, we got response to the questionnaire from 109 graduates where all 17 PhD graduates responded in addition to 96 MSc graduates (4 of the respondents completed both MSc and PhD programs in METU-TEKPOL so the total number is 109). The

responses given by the respondents to all questions are analyzed in detail to find particular interesting patterns. These responses are reflected into the figures (and tables where necessary) that illustrate the findings in a more understandable way.

Register data and results out of the questionnaire show many similarities in various ways. Indeed, many findings that are elaborated in this chapter support the decline of interdisciplinary approach, which is explained in detail in Chapter 1.

We have conducted analysis for the same indicator separately for MSc and PhD graduates in most of the cases. Based on this analysis, most of the results explained and/or shown in tables or figures are separate for METU-TEKPOL MSc and PhD graduates. But some results on certain indicators are shown for all METU-TEKPOL graduates (including both MSc and PhD holders) in order to showcase the overall results in a more meaningful way. Findings from the questionnaire are categorized into 5 main areas: program, thesis topics, employment, academic studies and impact. Critical outputs out of these findings are as follows.

3.2.1. Program

3.2.1.1. Duration of completion of METU-TEKPOL programs

We check the duration in between start and graduation dates of METU-TEKPOL graduates. For the MSc graduates, average graduation duration is 2.94 years. Majority of the MSc holders (44%) complete in 3 years but there are 2 exceptions: 10 and 13 years of graduation which is due to adaptation (i.e., the amnesty laws) options provided for students who, for various reasons, dropped out of the program in earlier years. For the PhD holders, average graduation time is 6.65 years. The most common duration is

7 years with 41% of graduates which consists of students who received correction of their thesis and had to defend their thesis a second time within 6-months or 1 year.

In order to understand the above-mentioned numbers in a better way, it is also important to look at the "Amnesty Laws" in Turkey. By the help of these laws, some METU-TEKPOL students who were dismissed from the programs had the chance to continue back with their postgraduate education. Related legislation which METU-TEKPOL graduates made use of are as follows:

- Law no 5316[2] on Addition of Provisional Articles to Higher Education Law dated 17 March 2005
- Law no 5806[3] on Amendment of Higher Education Law dated 28 October 2008
- Law no 6111[4] on Restructuring of Certain Receivables and Amendment to the Law on Social Insurance and Certain Other Laws and Decree Laws dated 25 February 2011.
- Law no 6353[5] on Amending Some Acts and Decree Laws dated 12 July 2012.
- Law no 6569[6] on Establishment of Health Institutes Presidency of Turkey and Amending Some Acts and Decree Laws dated 26 November 2014.
- Law no 7143[7] on Regarding Amendment of Certain Laws and Restructuring Tax Receivables and Other Certain Receivables dated 18 May 2018. Pursuant to Law no 7143 on Academic Amnesty and Provisional Article 78 added to Higher

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[2] https://www.resmigazete.gov.tr/eskiler/2005/03/20050318-3.htm

[3] https://www.resmigazete.gov.tr/eskiler/2008/10/20081028M1-1.htm

[4] https://www.resmigazete.gov.tr/eskiler/2011/02/20110225M1-1.htm

[5] https://www.resmigazete.gov.tr/eskiler/2012/07/20120712-11.htm

[6] https://www.resmigazete.gov.tr/eskiler/2014/11/20141126-3.htm

[7] https://www.resmigazete.gov.tr/eskiler/2018/05/20180518-3.htm

Education Law no 2547, students who withdrew or were expelled from the university before 18 May 2018 may apply to for re-enrollment.

### 3.2.1.2. Sources of learning METU-TEKPOL programs

In this thesis, it is also questioned how the graduates learn about METU-TEKPOL MSc and/or PhD programs. Respondents had the chance to give more than one source regarding where they heard about METU-TEKPOL programs.
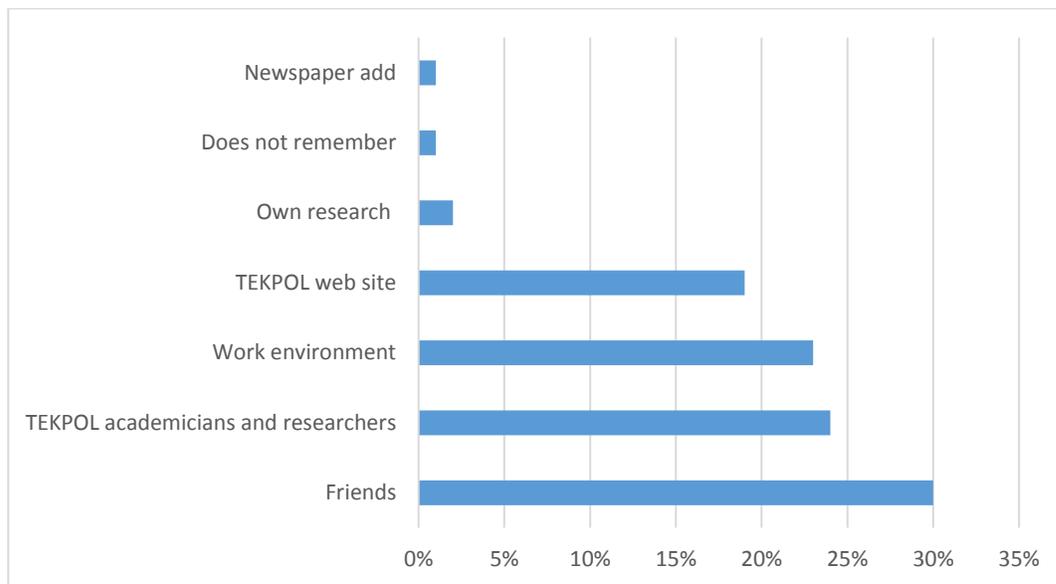
Figure 3.6. Where did MSc graduates hear about TEKPOL programs?

As it can be seen from Figure 3.6, "friends" (mainly consisted of METU-TEKPOL alumni when their profile is further analyzed) and TEKPOL staff have the highest ratios of being sources for MSc graduates to learn about METU-TEKPOL programs before applying for MSc program. It shows that these two actors (friends, and TEKPOL academicians and researchers) are the main sources of promoting METU-TEKPOL MSc programs which is an important indicator for the network and alumni activities and which even indirectly

implies a certain degree of positive impact of the program as former graduates or students advice new applicants.
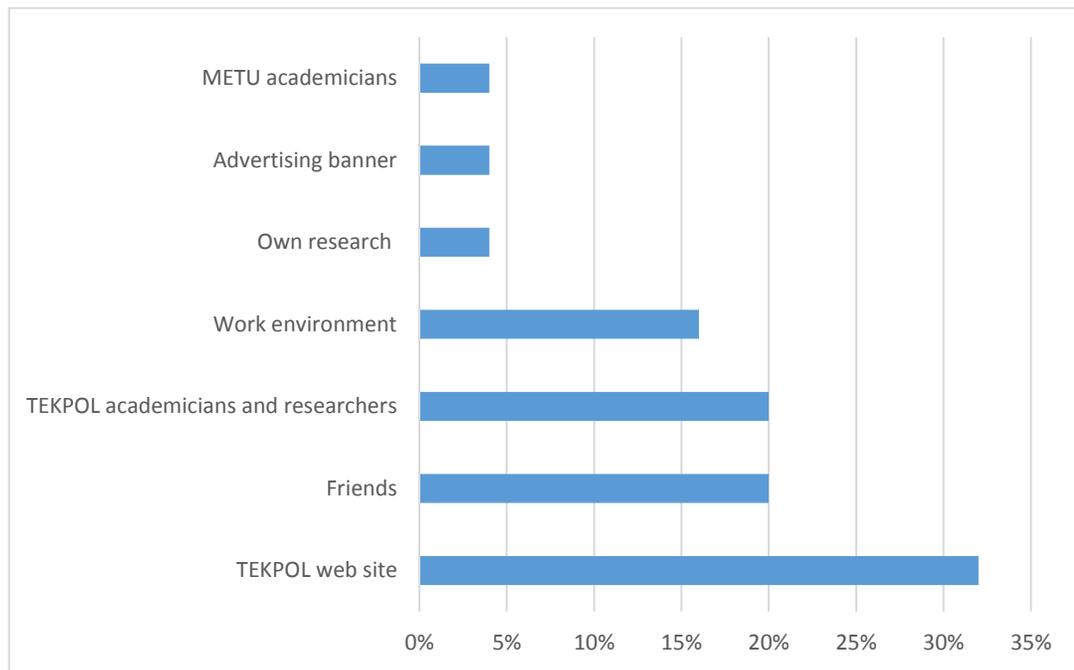
Figure 3.7. Where did PhD graduates hear about TEKPOL programs?

Figure 3.7 shows that "TEKPOL web site" is the main source where PhD graduates hear about METU-TEKPOL programs. Next highest ratios are "friends" (mainly consisted of METU-TEKPOL alumni) and "TEKPOL staff" for PhD graduates to learn about METU-TEKPOL programs before applying to METU-TEKPOL. As also mentioned for MSc graduates, information sources with highest ratios are TEKPOL web site, friends, and TEKPOL academicians and researchers which implies networking opportunities with the alumni and information sharing strength of the TEKPOL website which has been updated frequently giving information on the program, courses, projects and academic events.

3.2.1.3. Main expectations

Another area which is questioned is the "main expectations" of the graduates before applying to METU-TEKPOL programs. It has been a critical indicator in order to better understand the image of METU-TEKPOL postgraduate education for the applicants. In the relevant question of the questionnaire, it is possible for the respondents to pick more than one answer, so the numbers show the accumulated ratio of all questionnaire participants. As it can be seen from Figure 3.8, "contribution to accumulation of knowledge" is the major expectation of MSc holders followed by "contribution to academic career".
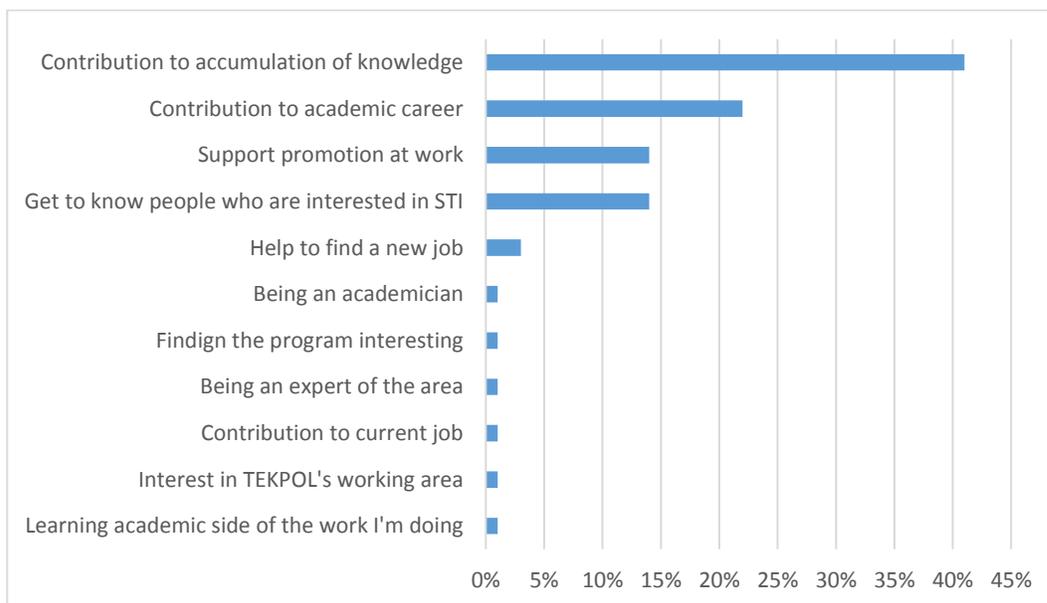
Figure 3.8. Main expectations of MSc holders

Main expectations before starting to study is questioned among the PhD graduates as well and most popular expectation is "contribution to academic career" by 12 respondents. "Contribution to accumulation of knowledge" by 8 graduates is coming before 5 responses for "get to know people who are interested in science, technology

38

and innovation". "Support promotion at work" is selected by 3 PhD holders which highlights the human resources policy of some governmental organizations that support (sometimes even force) its employees to obtain PhD to become chief expert. "Using at work" and "being an academician" was given by one respondent each. It is worth to mention that "Help to find a new job" was not selected by anyone.
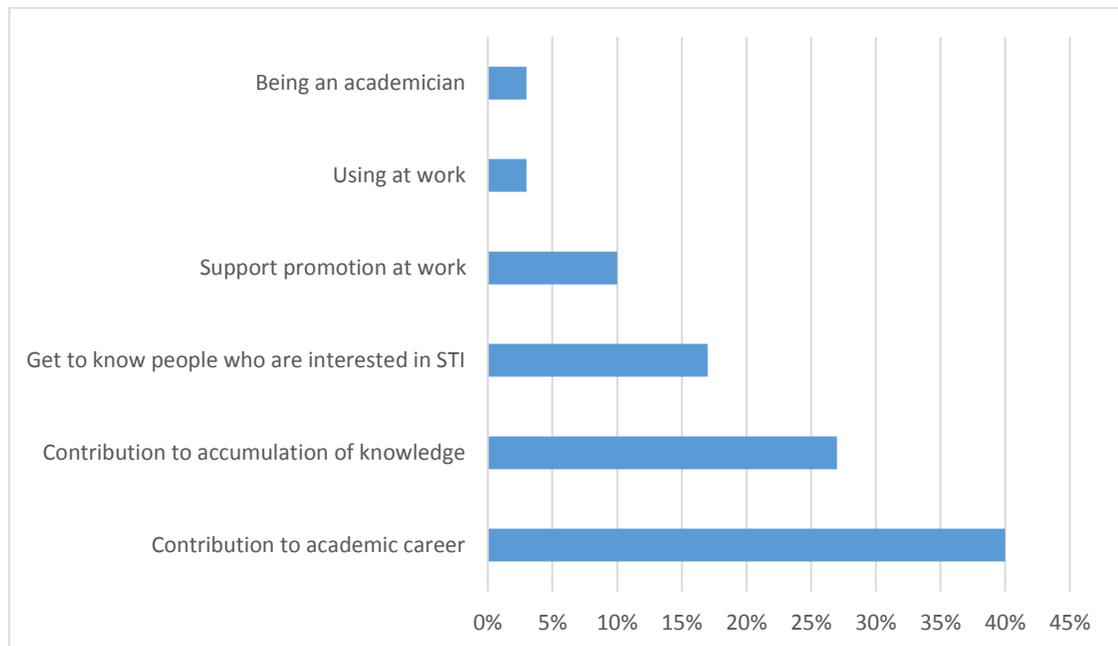
Figure 3.9. Main expectations of PhD holders

As it is seen from both Figures 3.8 and 3.9, main expectations differ for MSc and PhD graduates. "Contribution to accumulation of knowledge" is the highest expectation for MSc graduates which has the highest ratio before starting postgraduate education. But then most common expectation for PhD graduates is "contribution to academic career" which shows that PhD holders are mainly aiming at continuing with their academic career after the PhD education at METU-TEKPOL, maybe not pursuing 100% contracts in academia but through part-time education and research activities. Among 17 graduates 5 pursued full-time academic careers after completing the PhD program.

3.2.1.4. Satisfaction from METU-TEKPOL programs

After trying to understand what expectations METU-TEKPOL MSc and PhD graduates have before studying at METU-TEKPOL, to what extent these graduates are satisfied is another factor worth investigating. When we look at the satisfaction level of the graduates, it is observed that there are no dissatisfied MSc graduates. 74 of them (77% of the graduates) said that the MSc program "met their expectations" and the rest 22 replied saying that "program partially met their expectations". This is an impressive finding because it seems that METU-TEKPOL MSc program satisfies all graduates one way or another.

The results for PhD holders show that 82% of the graduates' (14 graduates) "expectations were met" where 3 holders which constitute 18% say that "program partially met their expectations". This finding also underlines that METU-TEKPOL PhD programs do not have any dissatisfied graduates.

For the MSc graduates who are partially satisfied with the program, we also try to understand the reasons of their partial satisfaction.

**Table 3.5.** Areas of partial satisfaction among METU-TEKPOL graduates

	MSc	PhD	Total
Contribution to accumulation of knowledge	15	0	15
Contribution to academic career	10	2	12
Get to know people interested in STI	4	2	6
Support promotion at work	3	0	3
Help to find a new job	2	0	2
Knowledge on company level innovation and R&D management	1	0	1

For the partially satisfied METU-TEKPOL graduates, the questionnaire gives the flexibility to state more than one satisfaction area. Among the 22 partially satisfied MSc holders, the main areas of partial satisfaction are "contribution to accumulation of knowledge" by 43% and "contribution to academic career" by 29%. When we look at the 3 partially satisfied PhD holders, areas for partial satisfaction are "contribution to academic career" and "get to know people interested in STI" options. This result shows that for both MSc and PhD holders, contribution to academic career and accumulation of knowledge are important satisfaction areas. This result is consistent with the earlier findings on expectations when applying the programs. As it is seen in Figure 4.3, "contribution to accumulation of knowledge" is the highest expectation of MSc graduates whereas "contribution to academic career" is one of the main expectations of PhD holders.

3.2.2. Thesis/Dissertation topics

We then classify which topics are covered within the theses/dissertations of METU-TEKPOL graduates. For the MSc holders, most popular area is "science, technology and

innovation policies" with 39%, and among the PhDs it is "national, regional and sectoral innovation systems" with 18%.
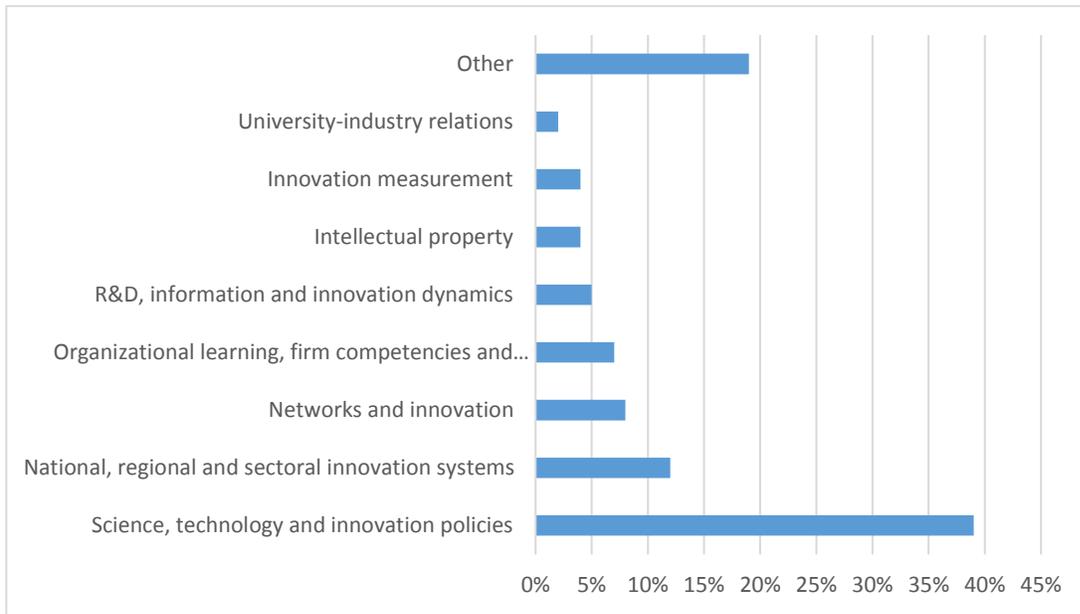
Figure 3.10. Thesis/dissertation topics for MSc graduates
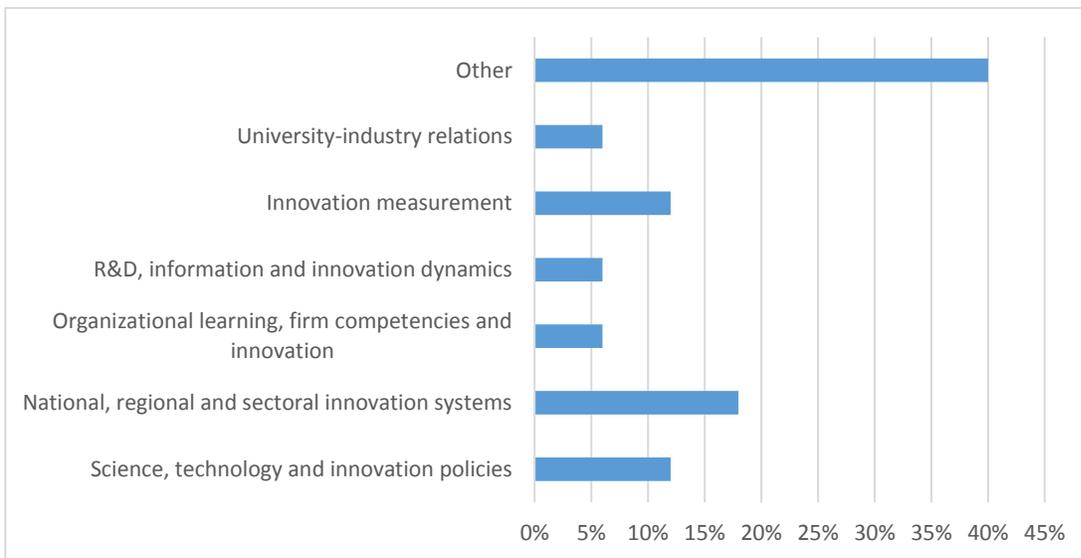
Figure 3.11. Thesis topics for PhD graduates

Thesis topics categorized under "other" include all theses which do not fall into the main categories stated in Figures 3.10 and 3.11. Among such areas, "history of technology", "innovation finance", "intellectual property rights" for MSc theses and "media policies", "impact assessment of public support programs" for PhD theses can be listed.

Regarding the supervisors of MSc theses and dissertations, there are 34 distinct academicians MSc holders had worked with. Prof. Dr. Erkan Erdil with 18 thesis/dissertations (19%) and Assoc. Prof. Dr. İbrahim Semih Akçomak with 14 (15%) are the highest among these academicians. Among the PhD holders, Prof. Dr. Erkan Erdil has the highest score again with 8 theses (47%) followed by Prof. Dr. Teoman Pamukçu with 5 (29%). In addition to that there are 4 more different academicians whom PhD holders had worked with. These results can be interpreted together with the results from the register data that showed that interdisciplinarity in terms of the background of thesis supervisors was declining gradually.

STI related areas can indeed be expected to be selected more by the PhD students compared to other fields. But when the thesis topics of PhD graduates are analyzed, it can be easily seen that STI policy is less studied than MSc holders (39% for MSc graduates and 12% for PhD holders).

3.2.3. Employment

The questionnaire included questions on the employment status of graduates as well. Among the MSc holders, 89% are full-time employees in addition to 2% part-time employees and 9% unemployed.

The numbers for the PhD graduates are: 88% full-time employees, 6% part-time employees and 6% unemployed. As it can be seen from these numbers, more than 90% of both MSc and PhD graduates are currently working.

3.2.3.1. Sectoral distribution of work

Another important topic we searched within this thesis is in which sector graduates currently work (among the full-time or part-time employed). Our results show that 34% of MSc holders work in public sector, 32% in academic/research institutions and 29% in private sector. The lowest numbers are 4% in NGOs and 1% in international organizations.

Among the employed PhD graduates, 50% of them work at academic/research institutions in addition to 30% in public sector and 20% in private sector.

These results are consistent with the work locations of the METU-TEKPOL graduates as well. When we look at the sectors, majority of the graduates work in public sector and universities which is also in line with where majority of the graduates live in: Ankara.
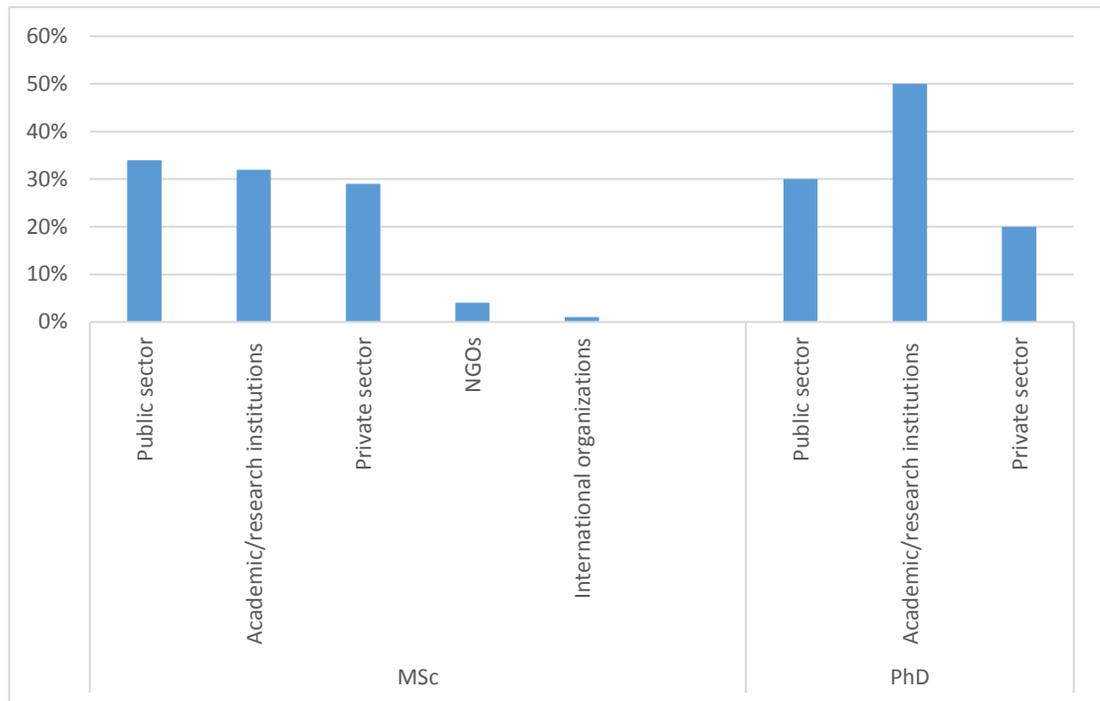
Figure 3.12. Sectors - all graduates

3.2.3.2. Job titles

Titles METU-TEKPOL graduates carry at their current jobs differ. Among the MSc holders, most common one is "expert", where "expert" and "academic member" are the titles with the highest numbers for the PhD graduates. This finding is also aligned with the sectoral distribution of the graduates: Most graduates working at public sector and universities carry the titles of expert and academic member.
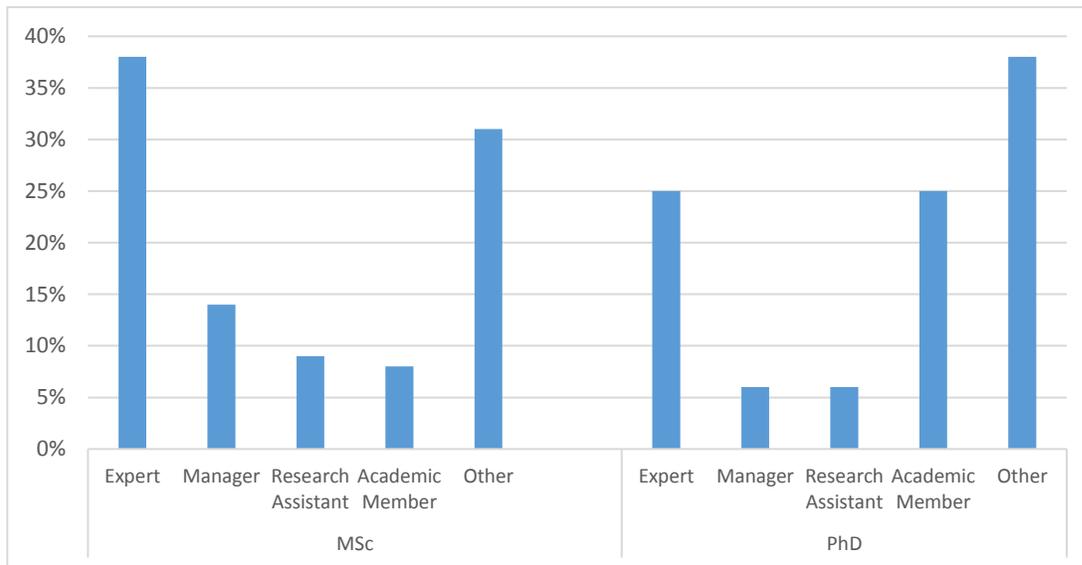
Figure 3.13. Current job titles - all graduates

3.2.3.3. Current additional jobs

We also question among the currently employed graduates whether they have jobs at other institutions or not (double-affiliation). For the MSc holders, numbers show that 9% do currently have jobs at other institutions. Out of this 9%, most work at "academic/research institutions" or "private sector" and the remaining work at NGOs. Compared to MSc graduates, PhD holders have more double-affiliation: 31% of the employed PhD graduates do have jobs at other institutions at the same time. Majority (80%) of them work at an "academic/research institutions" and the remaining in "private sector" in addition to their primary job.

3.2.3.4. Duration of work at current job

Another point that is analyzed is the time spent at the current job by the employed graduates. The average time spent at current job for the employed MSc holders is 86

months, whereas it is 103 months for employed PhD holders. These numbers are calculated only for the graduates who are continuing to work at their current jobs.

Results also show that graduates who have an undergraduate degree in engineering work more in the private sector compared to other education backgrounds. 49% of the MSc holders with engineering degree have jobs at private sector. Similar result is also valid for PhD graduates: 33% of the PhD holders with undergraduate degree in engineering have jobs at private sector.

3.2.3.5. Previous work experience

In this study, it is also investigated whether graduates have previous work experience or not. 59% of the MSc holders do have previous work experience. It is also worth to mention that majority of the unemployed MSc graduates (which represent 9% of total MSc holders) do not have previous work experience.

Among the PhD holders, 88% have previous work experience. When we look at this number for the unemployed PhD graduates (which 6% of all PhD holders), all have previous work experience.

3.2.3.6. Number of previous jobs

For the METU-TEKPOL graduates who have previous work experience, we also figured out how many different jobs they had before. Among the MSc holders having previous work experience, 77% have worked before in 1 job only. The ratios for the ones who worked for 2 or more jobs before their current jobs are: 12% for 2 jobs, 5% for 3 jobs, 4% for 4 jobs and 2% for 5 jobs. Among PhD holders having previous work experience, these numbers are: 67% for 1 job, 27% for 2 jobs and 6% for 3 jobs.

We then question previous work experience durations of the graduates. Among the unemployed MSc holders who have previous experience, average duration of previous work experience is 79 months, whereas it is 231 months among the unemployed PhD holders. For the employed MSc graduates having previous work experience, the average is 69 months, while it is 97 months among the employed PhD holders.

3.2.4. Academic studies

It is an important finding that TEKPOL graduates tend to continue (full-time, part-time and even within leisure time) academic studies (academic papers, books, chapters, participating into conferences, joint research with others etc.) after graduation. Among the MSc holders, 69% do carry on with academic studies whereas the ratio among the PhD holders is 94%.

3.2.4.1. Academic study areas

For the graduates who continue academic studies after graduation, we also seek for their research areas/topics. The most popular area among both MSc and PhD holders who continued with academic studies after graduation is "science, technology and innovation policies".

As it is discussed in section 4.2, main area of thesis for MSc graduates is STI with 39%, but PhD graduates worked much less on this topic (12%). But when we look at the areas on which TEKPOL graduates continue their academic studies, it is observed that science, technology and innovation studies take an important place. It is the most common area for both MSc and PhD graduates for the academic studies.
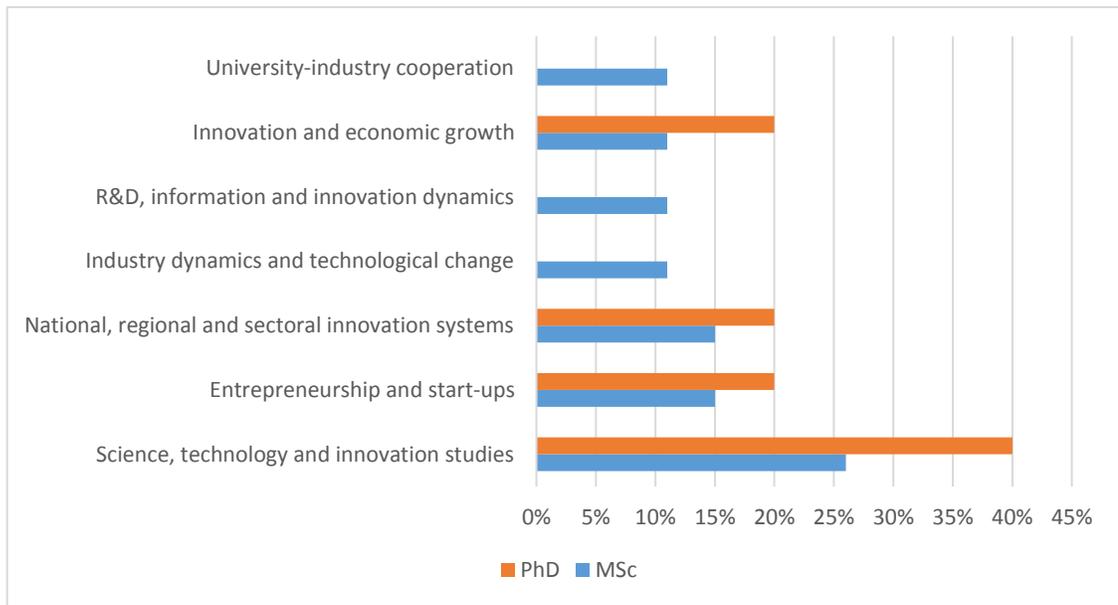
Figure 3.14. Most popular areas among the METU-TEKPOL graduates continuing academic studies

3.2.4.2. Publications

Another area we question within this study is whether graduates have academic publications (articles published at academic journals, books, scientific/policy reports, etc.) or not. The ratio of having publications among MSc graduates is 48%, whereas the number stands for 65% for PhD graduates.

3.2.4.3. Number of publications

We also search the number of publications of the graduates. Among the MSc and PhD degree holders who have publications, the number of publications can be seen in Figure 3.15.
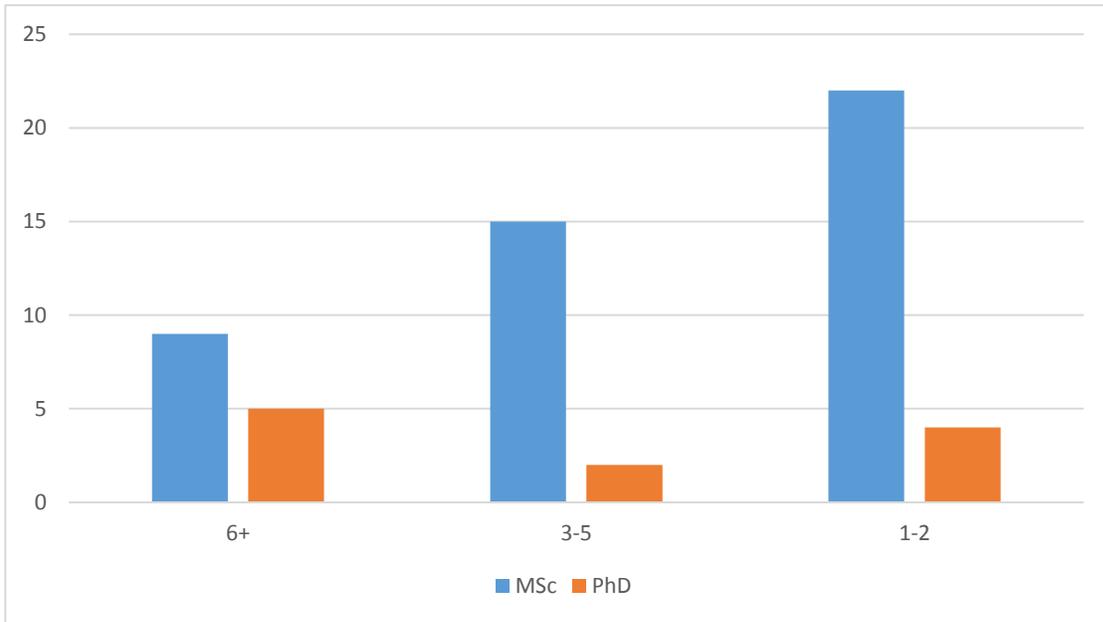
Figure 3.15. Number of publications among METU-TEKPOL graduates who have publications

3.2.5. Impact

Table 3.6. Impact of being a METU-TEKPOL graduate

		MSc	PhD	Total
In workplace	**Positive**	53	11	64
	Negative	3	0	3
	No impact	40	6	46
On career	**Positive**	46	10	56
	Negative	0	0	0
	No impact	50	7	57

Another area, which this study focuses on is the impact of being a METU-TEKPOL graduate at the workplace. Majority of both MSc and PhD graduates think that being a METU-TEKPOL graduate had a positive impact where they had seen "positively different treatment at workplace".

Importantly, 3 MSc graduates state that they face with "negatively different treatment" at workplace. The questionnaire does not include a question asking for the reason for this negatively different treatment but when we look at the profile of these 3 graduates, it is seen that they are all working for public organizations. So potentially what makes them feel like being "negatively treated" may be their colleagues' negative attitude towards them when they leave the office for MSc lessons. One other reason may be jealousy of the co-workers. When we look at the PhD graduates, there is no PhD holder thinking that they see negatively different treatment at workplace with the reason of being a METU-TEKPOL graduate.

We also question if being a METU-TEKPOL MSc or PhD graduate make any direct impact (such as a new job, a different job position, higher salary, etc.) on the careers of the graduates. This is also a very key indicator in order to show the perception of the impact of METU-TEKPOL programs. The ratio for the MSc holders who think being a METU-TEKPOL graduate affected their career is 48% where the same ratio for the PhD holders is 59%.

Both for the impact on workplace and career, we did not question the reason behind the responses of "no impact". So, the grounds behind having no impact of being a TEKPOL graduate are not explored in this thesis.

3.2.5.1. Timeframe of impact on career

We also look at the timeframe of the impact of being a METU-TEKPOL graduate on the careers of the graduates. Among the 46 MSc holders who think being a METU-TEKPOL graduate make a direct impact on their career, the ratio of graduates who think that this effect is visible in the short-term (in 1 year) is 46%, whereas 39% think the impact is seen in mid-term (in 2-3 years) and the rest (15%) reported that it is seen in the long-term (in more than 3 years).

Among the 10 PhD holders who reply that being a METU-TEKPOL graduate make a direct impact on their career, the graduates thinking it is seen in short-term and mid-term are equal (40%) and the rest 20% think it is seen in long-term. Thus, we can say that about 60% of the graduates reported that being a TEKPOL graduate had impacted their career and resulted in positive treatment at job. This effect is mostly visible in the short and medium-term (within 3 years after graduation).

3.2.5.2. Types of impact on career

Based on the timeframe of the career impact of being a TEKPOL graduate, we also analyze the types of career impacts. For the relevant questions in the questionnaire, respondents have the flexibility to pick more than one impact area (new job, new position, higher income etc.).
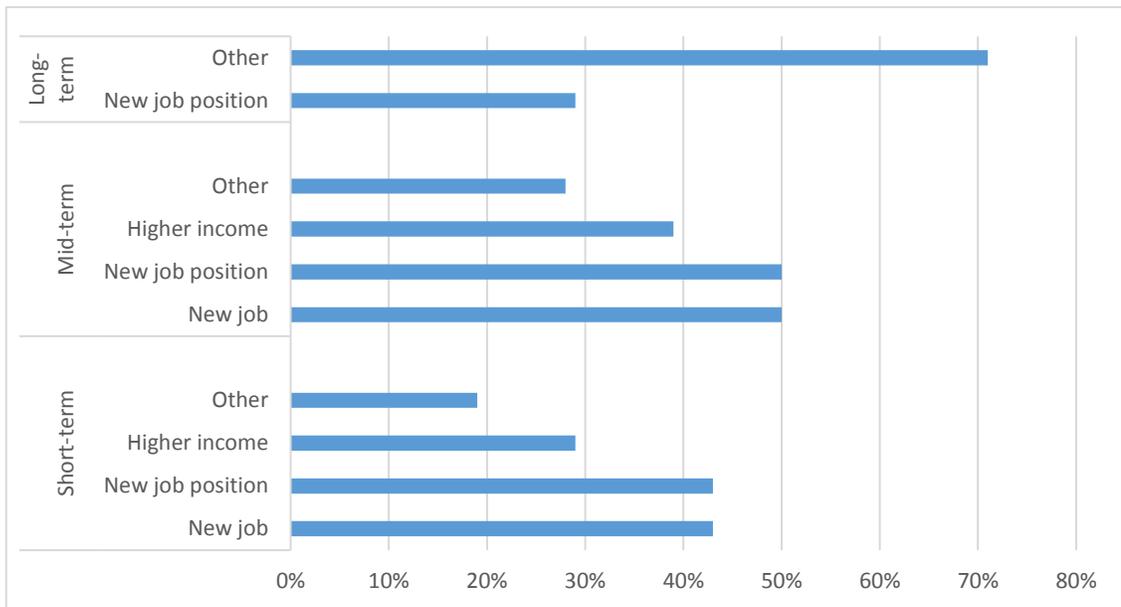
Figure 3.16. Types of impact on career for MSc graduates

As it is seen at Figure 3.16, being a TEKPOL MSc graduate show its impact in both short-term and mid-term mainly with "new job" and "new job position". For the long-term, the main impact is again "new job position". MSc graduates also received higher income after graduation in short and mid-terms about 30% of the cases.
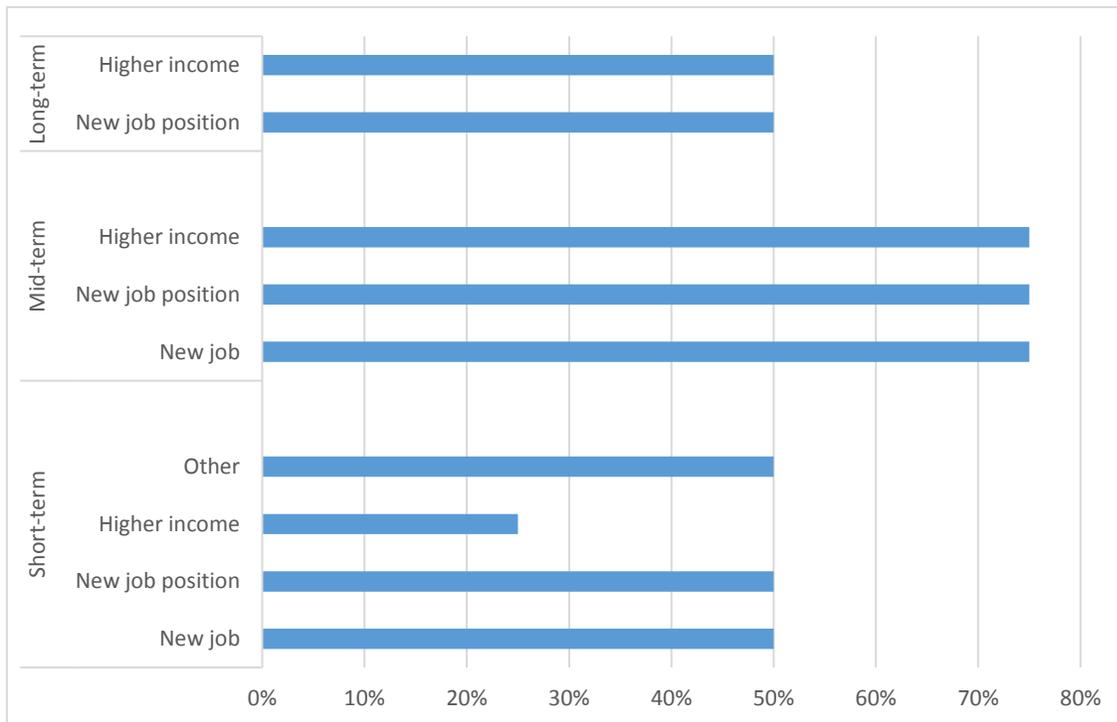
Figure 3.17. Types of impact on career for PhD graduates

For the PhD graduates, compared to MSc graduates the impacts are much stronger. In the short-term the major impact areas are getting a "new job" or a "new job position". This shows that being a TEKPOL PhD graduate makes a direct impact for at least half of the graduates in just 1 year. In the mid-term, results show that PhD graduates think they see the impacts of "higher income", "new job" and "new job position" equally. Most PhD graduates have seen the impact of the PhD degree within 3 years in the form of a new job, a better position or a higher pay.

3.2.6. Summary profile of TEKPOL MSc and PhD graduates

This section summarizes the results by profiling TEKPOL MSc and PhD graduates. In this, one can see what an average MSc and PhD graduate look like. This information is also useful for the candidates who wish to apply to TEKPOL graduate programs.

A MSc graduate of TEKPOL is in general at the age of 30s having undergraduate degree most probably from engineering or economy and administrative sciences. MSc graduates complete the program almost in 3 years on average and their main source where they hear about TEKPOL graduate program is their friends. A MSc holder mainly expects contributing to accumulation of knowledge and nearly all MSc graduates are satisfied with the program. They tend to work on STI in their theses. A MSc holder is most probably working in a current job at public sector, academia or private sector. Majority of the MSc holders continue their academic studies mainly on STI policies. Finally, a TEKPOL MSc graduate tends to see the positive impact of being a TEKPOL graduate.

TEKPOL PhD graduate's common profile shows some differences with an average MSc graduate. A PhD graduate is probably in his/her 30s or 40s with the background of having engineering or economy and administrative sciences undergraduate degree and mainly receives his/her PhD degree in 7 years. PhD holders' main source to learn about the TEKPOL PhD program is the TEKPOL website. A PhD graduate mainly expects from the PhD program to contribute to his/her academic career, which differs from a MSc graduate. An average PhD graduate is in general satisfied with the program and studies national, regional and sectoral innovation systems in the thesis. A PhD graduate is most probably currently employed and working in academia, public or private sector. A PhD

graduate continues academic studies and prefers mainly working on STI policies and also sees the positive impact of being a TEKPOL graduate in general.

CHAPTER 4

NETWORK

In this thesis, we focus on who the METU-TEKPOL MSc and PhD graduates are, what they did before, where they are currently working and what they do at the time of the research. In addition to these, one other important area is to identify whether the graduates maintain relations with METU-TEKPOL or not. For the graduates who continue their relationship with METU-TEKPOL, we then categorize these relationships and seek for social and scientific contacts after graduation.

Our questionnaire covers a specific part where we ask METU-TEKPOL graduates to share up to ten contacts from TEKPOL after graduation (responses include TEKPOL graduates, TEKPOL academic members and research assistants, current TEKPOL students and academic members outside of TEKPOL). We also ask for their frequency of contact in addition to the reasons of contact. To have a better understanding of different kinds of network, graduates can also play an important role in helping the improvement of both MSc and PhD programs leveraging different sources of network.


4.1. Continuation of relations with METU-TEKPOL

As of 2017 out of 96 MSc graduates in our sample, 67 which represents 70% of the total continue their relations with TEKPOL after graduation. Among the 17 PhD graduates, the same ratio stands for 88%, which is 15 PhD holders. It is expected that PhD graduates are better linked to TEKPOL after graduation compared to MSc students because PhD is an academic degree and to pursue academic career TEKPOL researchers

are an important source. However average number of contacts after graduation per each group is similar: 4.42 for MSc graduates and 4 for the PhD holders.

4.2. Follow-up of METU-TEKPOL publications and news

It is also worth to understand whether METU-TEKPOL graduates follow TEKPOL publications or news after graduation. We find out that 74% of MSc graduates continue to follow TEKPOL publications and/or news after graduation while the same ratio among PhD holders is 100%.
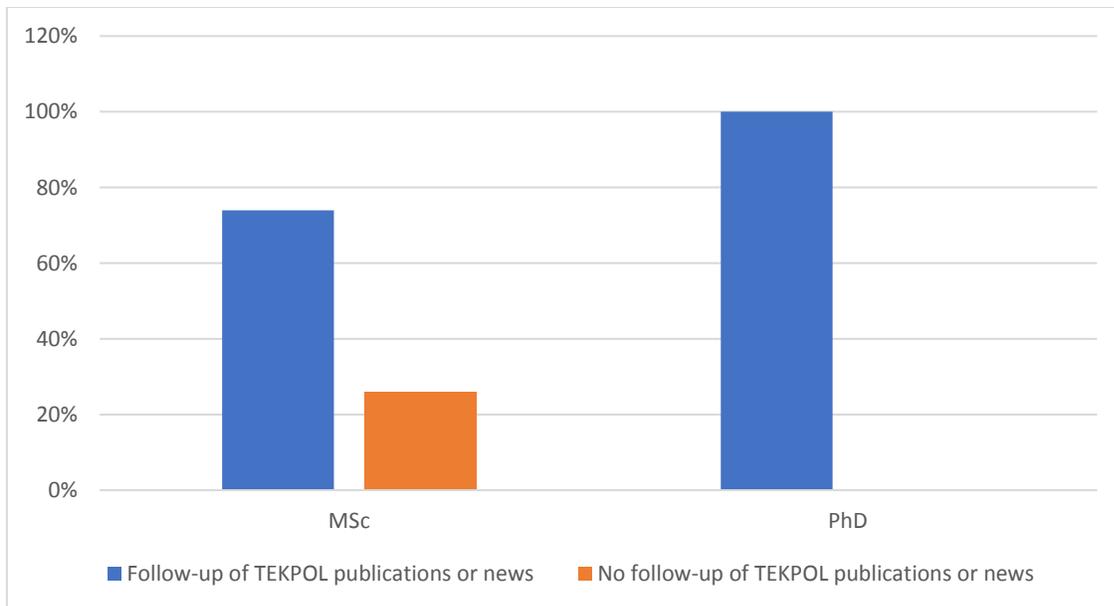
Figure 4.1. Follow-up of METU-TEKPOL publications or news

## 4.3. Channels of communications with METU-TEKPOL

Another important topic we clarify by the help of the questionnaire is to see the channels of information flow from TEKPOL to the graduates (i.e., what information sources do graduates use to follow TEKPOL research, events etc.?). We search on the 4

ways of communications: METU-TEKPOL web site, Facebook, Twitter and personal relations.

When we look at the results, "METU-TEKPOL web site" and "personal relations" are the most common ways of communications both for MSc and PhD graduates for following TEKPOL publications, news, events etc.

Findings for the abovementioned 4 channels of communications are as follows:

"Web site of METU-TEKPOL" is used by 97% of MSc holders while used by 95% of PhD graduates.
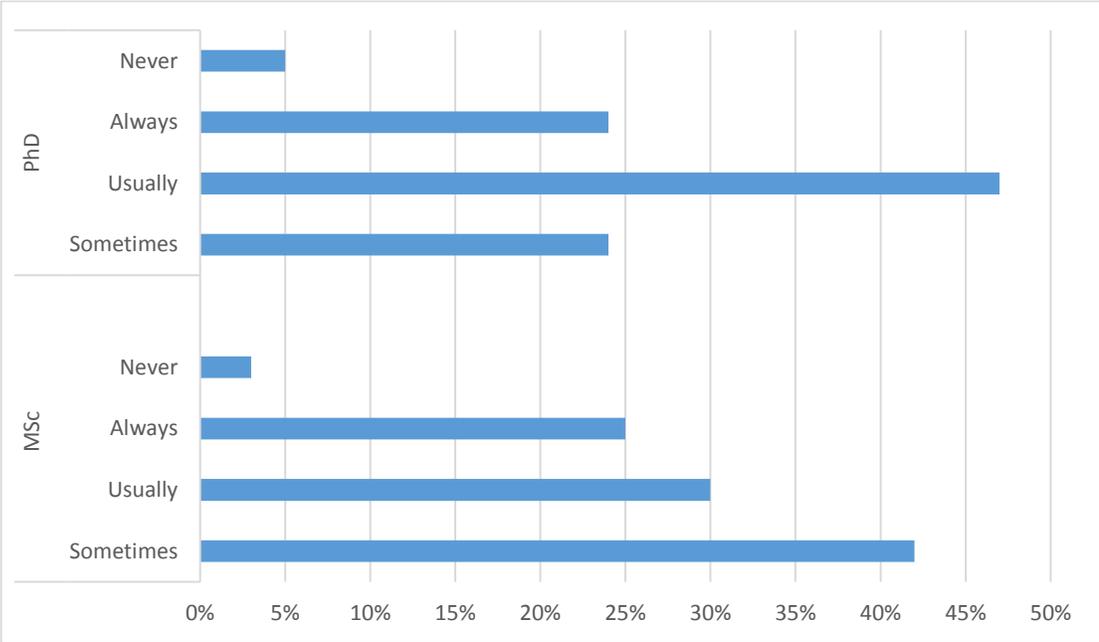

Figure 4.2. Usage of METU-TEKPOL web site by graduates

We also checked to what extent METU-TEKPOL MSc and PhD graduates use their "personal relations" to follow METU-TEKPOL publications or news. 87% of MSc holders and 100% of PhD graduates lean on personal contacts with the TEKPOL team. Specific

analysis on social network, which is given in section 5.4.2 is built on these personal relations and elaborates more on different types of these relations.
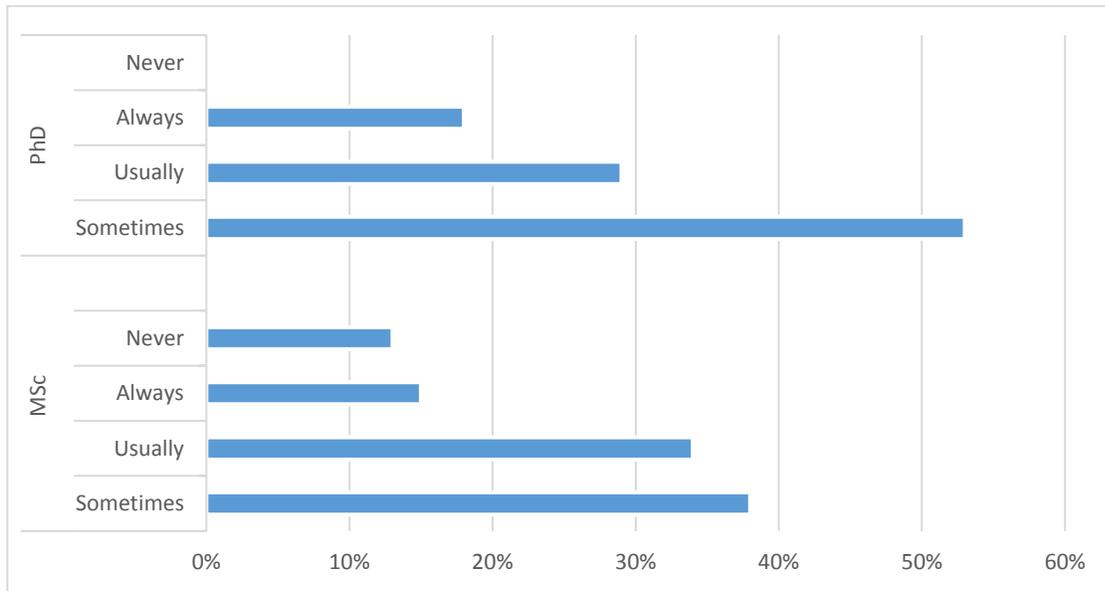

Figure 4.3. Usage of personal relations

Other sources we analyze are the social media tools. "Facebook" is used by 45% 47% of MSc and PhD graduates, respectively.
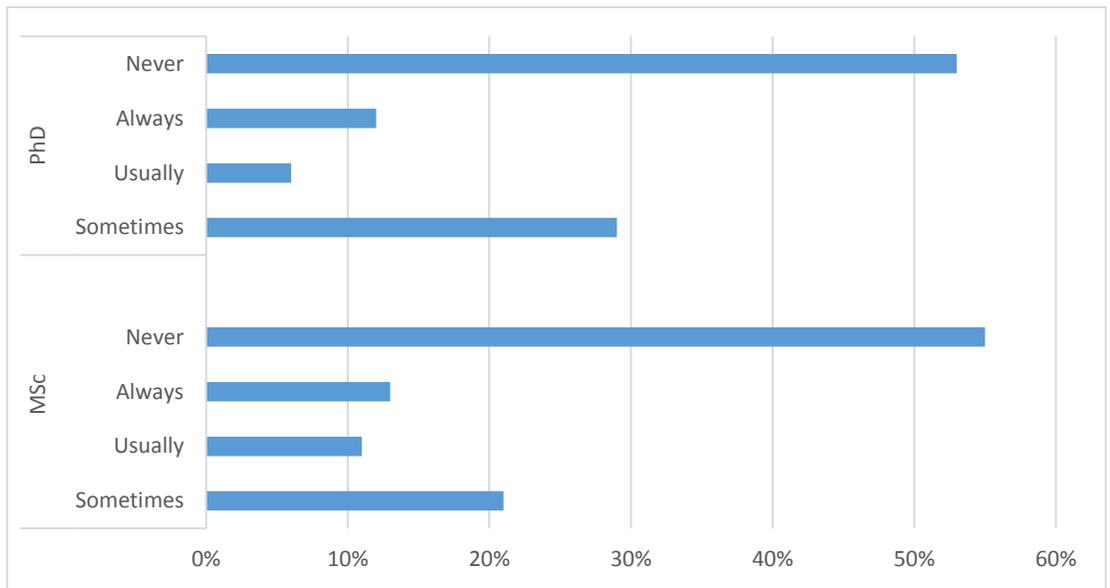
Figure 4.4. Usage of Facebook

For the usage of Twitter, the ratio of users among MSc holders is 37% while it is 48% for PhD graduates.
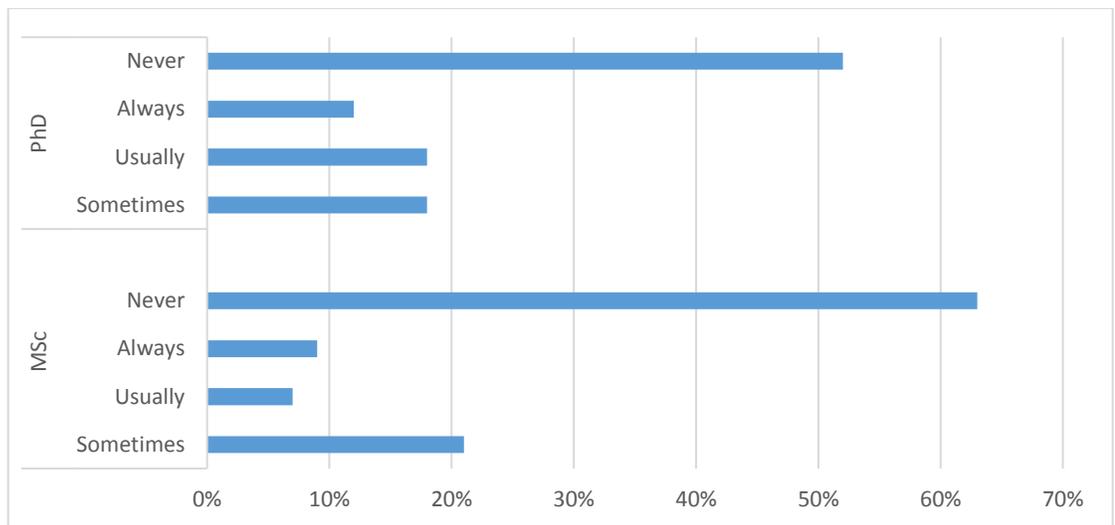
Figure 4.5. Usage of Twitter

It seems that the main source of impersonal contact or information gathering is the website and the role of social media (Twitter, Facebook and also Instagram) is limited. These findings either may suggest that TEKPOL admin should continue to improve the website (www.stps.metu.edu.tr) or it could also mean that due to previous improvements and frequent updates the website has become a main source for information gathering.

4.4. Network analysis

There are different software options for network analysis, therefore it is critical to select the most appropriate one in accordance with the suitability for the type of network analysis. Among all these options, Graphcommons software is selected in this thesis for measuring the network structure. Main reasons for the selection of Graphcommons are as follows:

- The software is simple and easy to use, and free.
- Visualization options and exporting alternatives after conducting the analysis are excessive with this software, which makes editing graphs easier.

Analyzing data via visual methods is helpful to gain better insight into complexity. In addition to that, mapping helps us navigate particular links among the actors while seeing the patterns in the bigger picture.

As a result of the responses we receive to the relevant questions in the questionnaire, we reach to a group with 150 distinct names for the network analysis. The questionnaire gives the chance to the respondents to share up to 10 contacts. It is also asked which group these contacts belong to, frequency of meeting with the contacts and also the

reasons of meeting the contacts in order to identify relevant inputs for the network analysis. We present the results for the overall network (social-scientific), social network and scientific network separately.

Table 4.1. Descriptive statistics of the social and scientific networks of TEKPOL alumni

	Social network	Scientific network
1) MSc (n=96)		
Average	3.35	1.07
Number of zero links	40	72
2) PhD (n=17)		
Average	2.41	1.59
Number of zero links	6	5

4.4.1. Social-scientific network

Figure 5.6 shows social-scientific network of the graduates where each node is weighted by the score of betweenness centrality. We can have a better understanding on the importance of a node for the knowledge exchange among two otherwise disconnected nodes thanks to betweenness centrality that is an indicator which reflects the significance of a node in knowledge exchange.
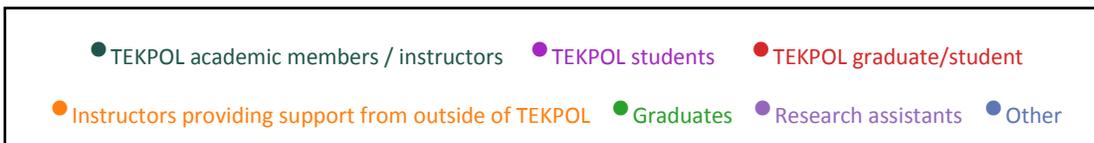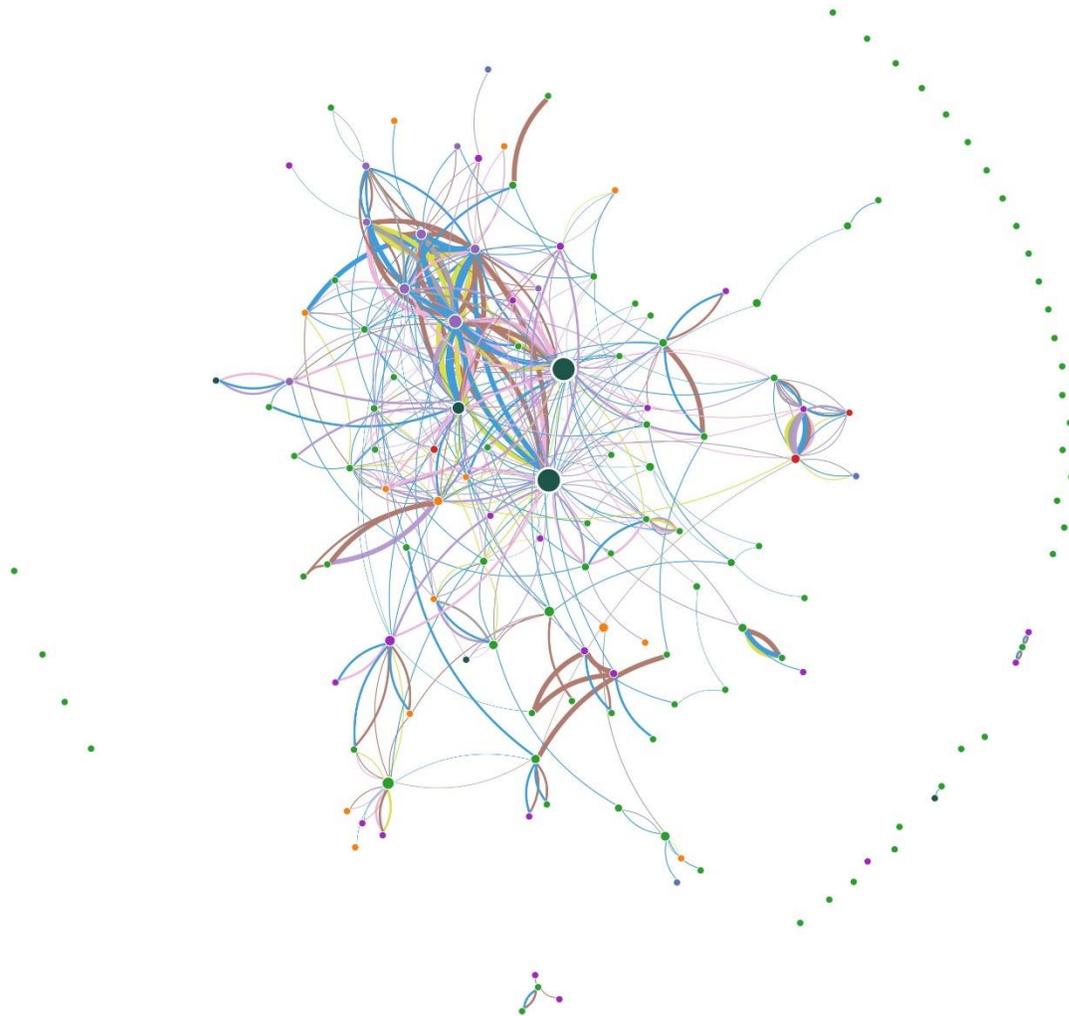
Figure 4.6. Social-scientific network of METU-TEKPOL alumni

In each figure the nodes are divided into seven different groups showed by different colors: TEKPOL academic members/instructors, TEKPOL students, TEKPOL graduate/student, instructors providing support from outside of TEKPOL, graduates,

research assistants and other (for a very small group of nodes that does not fit in any of these groups). Network analysis is a valuable tool to look at the social-scientific network of METU-TEKPOL graduates. There are three disconnected clusters in the social-scientific network (probably driven by current students-graduates who work in the same organization) with 2 main bridges existing as it can be seen from Figure 5.6. The unconnected nodes worth mentioning as some graduates use other ways of gathering information rather than personal contacts. Previously it was reported that 70% of the MSc and %88 of the PhD graduates continue their relations with TEKPOL. It seems that impersonal contacts or ways of information gathering is also important source for graduates because as can been seen in Figure 5.6 and Table 5.1 there are considerable number of nodes (i.e., graduates) with zero links indicating that such nodes have no personal contact with the TEKPOL team, alumni, students etc. It is expected the number of zero links is less for social network compared to scientific network because many graduates do not pursue academic work after they graduate even though they continue to form personal relations with the TEKPOL team, alumni and students. Table 5.1 confirms this expectation.

4.4.2. Social network

Figures 4.7 shows the social network established by METU-TEKPOL alumni. The unconnected nodes in the figure do not necessarily represent nodes without connection since they represent the nodes that may not be present in the social network. The social network includes all possible contacts established between the nodes except the ones related to scientific and academic cooperation. Social network interactions may include catching-up, meeting over a coffee, greeting someone, social media connections, friendship, co-workers and so on.
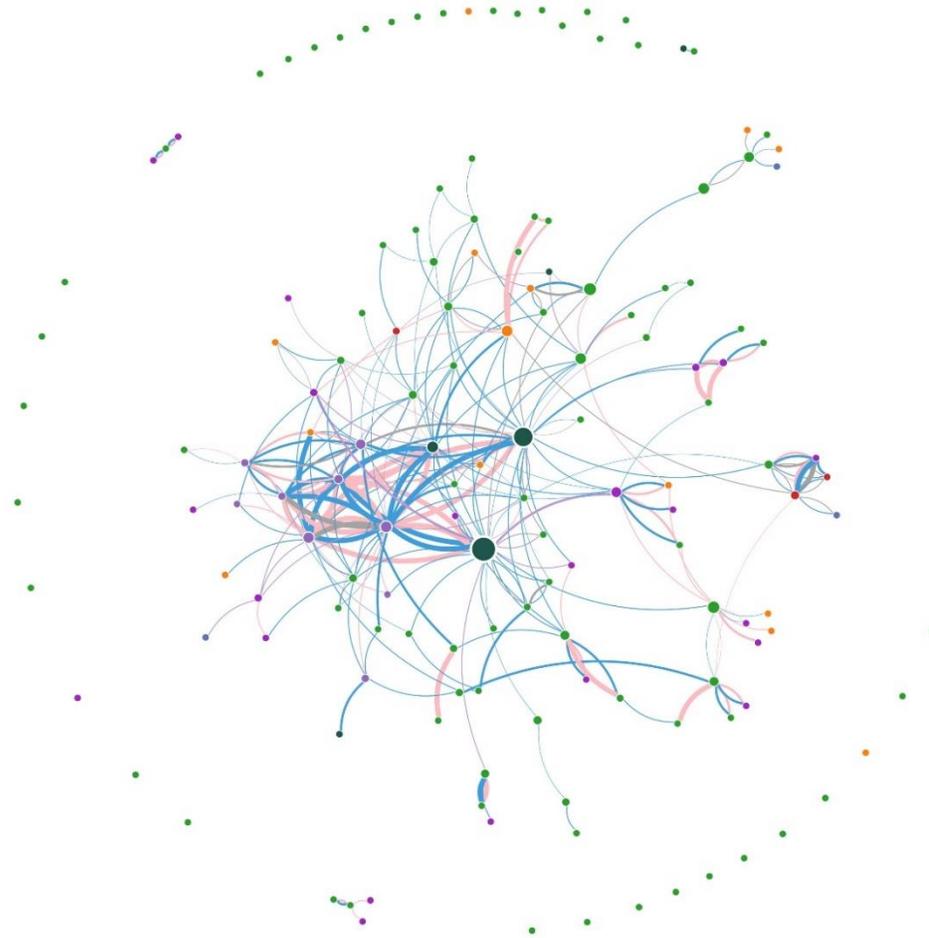
Figure 4.7. Social network of METU-TEKPOL alumni

4.4.3. Scientific network

As it can be seen from Figure 5.8, there is considerable level of participation to the scientific network but not of course as much as the social network. Main focus of the scientific network is again on the same nodes at the center. Even after graduation scientific connections seem to form over the TEKPOL research team and even certain researchers within the team. This may be due to connecting graduates to continuing research or scientific collaboration over academic papers after graduation (i.e., continuing supervisor-student relations after graduation). One other important observation is that since METU-TEKPOL has an interdisciplinary approach, there are several clusters where instructors outside of METU-TEKPOL bridge others. It is also worth to mention that there are no disconnected clusters in the scientific network. Scientific network covers interactions such as co-organization of scientific events, conducting joint scientific studies and joint-projects.

When social and scientific networks are compared, it can be argued that the social network is much denser than the scientific network, as we indicated earlier, since social network has more nodes and more connections between the nodes. It is difficult to have scientific contacts without a social contact, but the opposite is much more probable (that graduates have social contacts without having scientific contacts). One other point of comparison is that almost every group of people linked to TEKPOL in the social network, but the scientific network is more selective, it includes less nodes.
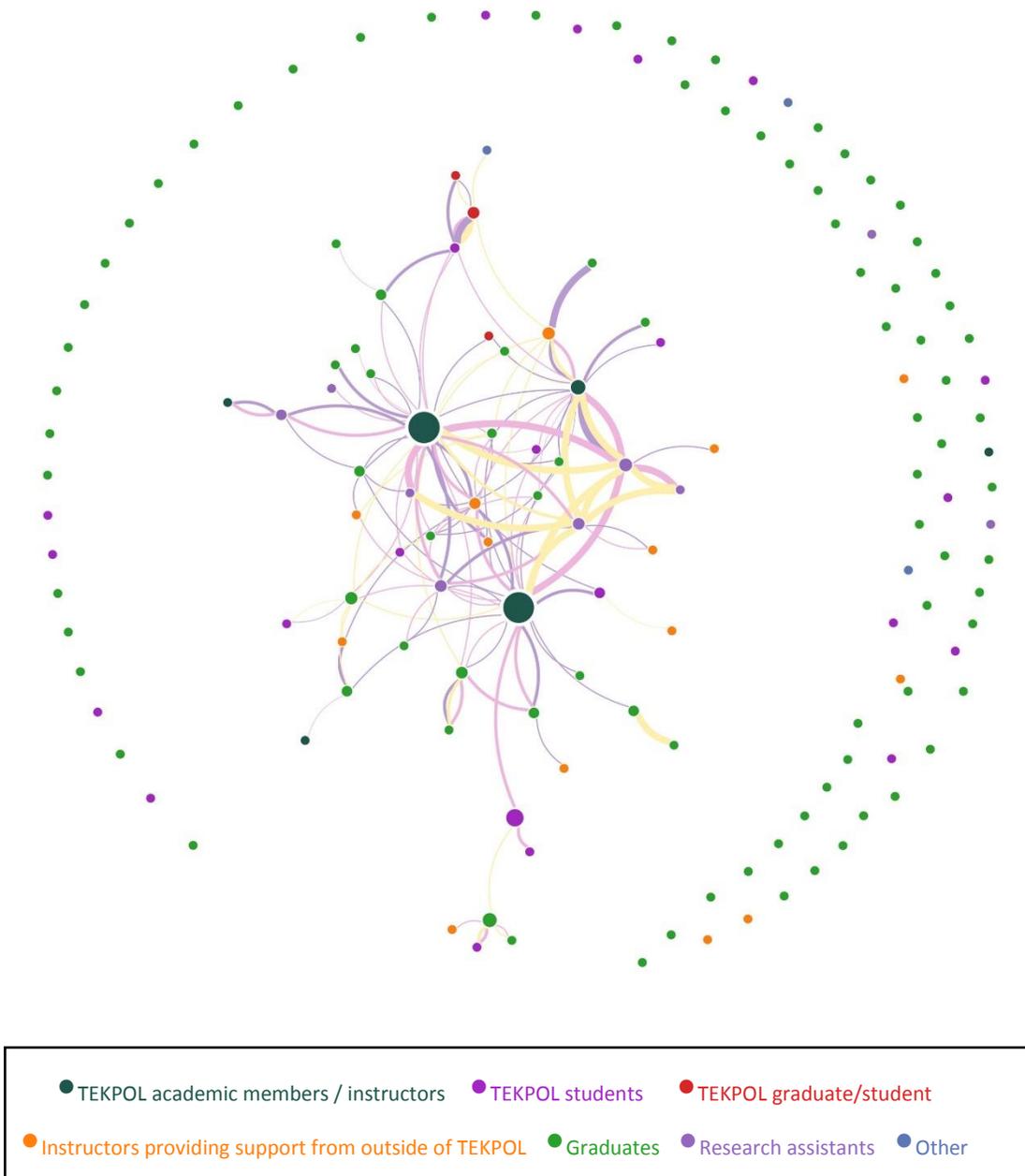
Figure 4.8. Scientific network of METU-TEKPOL alumni

When both the social network and the scientific network results are put together we can say that TEKPOL core research team has a central position and act as main gate for creating and disseminating information. In an interdisciplinary body, one should

observe distributed power within the network. In practical terms no instructors or supervisors who are at METU (who do not belong to TEKPOL core research and teaching team) are highlighted in the figures (i.e., having comparable betweenness score to TEKPOL team). This indicates that most social and scientific relations run over the core TEKPOL team supporting the results in chapter 3.1 using register data. TEKPOL has become a core body of STI research where social and scientific relations, education and research activities are concentrated on the core TEKPOL research team at the expense of gradual loss of interdisciplinarity.

CHAPTER 5

RECOMMENDATIONS FROM THE GRADUATES

Being the only academic unit in Turkey that concurrently coordinates education and research activities and also standing as the first educational program in the social studies of science and technology attribute a very substantial mission to METU-TEKPOL. First 20 years of METU-TEKPOL is full of many achievements, novel projects and unique contribution to the science and technology community both in Turkey and abroad. It is also worth to mention that development of METU-TEKPOL postgraduate programs has great importance. In this thesis, we also asked for direct feedback from the survey respondents. There was a specific free text area at the end of the questionnaire where they could share their recommendations and thoughts about the improvement of METU-TEKPOL education and research activities. Response rate to this direct feedback section was high: We received feedback from 107 of 113 respondents where only 6 graduates did not share their direct feedback. Based on the feedback received from the respondents of the survey, there are several recommendations and strategies which can help METU-TEKPOL for the future improvements. This part is specifically detached from the conclusion of the thesis to separate the conclusions and recommendations that come out of this research from the suggestions of the actual respondents. After reading all the recommendations to better reflect the thoughts of the respondents, the recommendations are categorized into few main topics. Each main area of improvement is presented below.

5.1. Increasing visibility

This is one of the main areas where many MSc and PhD holders agree for the improvement of METU-TEKPOL. Many graduates are of the opinion that METU-TEKPOL deserves more reputation but unfortunately lacks the adequate level of visibility. There are several specific suggestions for METU-TEKPOL to increase visibility:

- Visits by METU-TEKPOL staff to relevant government institutions (such as Ministry of Science and Technology, TÜBİTAK) in order to introduce and increase awareness of the MSc and PhD programs
- Leveraging METU-TEKPOL alumni to spread information about METU-TEKPOL to different audiences and scale-it up.
- Better usage of METU-TEKPOL social media channels
- Close relationship with key policy-makers via regular visits and meetings

5.2. Enriching postgraduate programs and curriculum

One of the main comments shared by the graduates is focusing on the development of the curriculum and programs of MSc and PhD education. The relevant suggestions can be listed as follows:

- Less theoretical courses, more practical courses
- More elective courses available on different areas to provide more interdisciplinary approach
- Having a course on "policy development"
- Decreasing the number of students per academician

- Having more academicians with different expertise from other departments and more visiting instructors with relevant experience
- Reviewing current must courses' programs to make required fine-tunings
- More case studies during the relevant lectures
- Analysis of international similar science and technology policy programs and reflecting the best practices from these programs into the METU-TEKPOL MSc and PhD curricula.

5.3. Improvement of communications

Another important area for the development of METU-TEKPOL is the improvement of internal and external communications of METU-TEKPOL. TEKPOL has a very diverse group of graduates (and also students). Having better communications with this alumni group will of course provide more visibility to TEKPOL as well as other opportunities. Specific recommendations related to this are:

- Better usage of METU-TEKPOL e-mail group
- Workshops and seminars with METU-TEKPOL alumni members
- Establishing a unique web site / blog for the communication with different interest groups

5.4. Improvement of institutional capacity

In order to sustain the improvement of METU-TEKPOL, some capacity building initiatives can be considered. Graduates shared some suggestions on the improvement of institutional capacity of METU-TEKPOL:

- Increased cooperation and projects with the international counterparts of METU-TEKPOL

- Development of projects with technology parks

- More joint-articles and joint-research with academicians

- Leveraging technology more at operations of METU-TEKPOL

- Development of co-projects with the industry

In the light of all above-mentioned recommendations, METU-TEKPOL can take actions in different timeframes. In order to carry characteristics of a think-tank, which can serve relevant communities in the market, METU-TEKPOL may need to take some measures. As a result of these measures and actions, METU-TEKPOL may play a key role in performing the following:

- be a hub to perform STI policy studies to support the formulation and implementation of relevant policies,

- promote popularization and increase awareness of science and technology in the society and relevant stakeholders,

- contribute to talented human resource development on science and technology policy studies.

As it can be seen from the above-mentioned recommendations, many METU-TEKPOL graduates have specific ideas and suggestions to improve the MSc and PhD programs. In order to leverage these recommendations with differing levels of experience and expertise areas of METU-TEKPOL alumni, conducting future projects (both academic and non-academic) with selected METU-TEKPOL graduates on these recommendations can be considered.

In addition, it is also known that there are other interdisciplinary postgraduate programs at METU.[8] The methodology and approach of this study can be used to evaluate other interdisciplinary programs as well. For that, METU Institutional Development and Planning Office can be a key partner in terms of selecting the most appropriate programs to study.

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[8] https://kgpo.metu.edu.tr/tr/odtu-disiplinlerarasi-program-listesi, accessed on 01.03.2019.

CHAPTER 6

CONCLUSION

The field of science, technology and innovation studies is imperatively significant for the social and economic progress of societies. In the globalized environment we live in, increasing levels of investment in research and innovation is critical. This is important both to create innovation in other areas bringing specific improvements to our life quality and for enhancing economic competitiveness. In order to become a knowledge-driven, dynamic and competitive economy, growing research capability as well as designing, evaluating and suggesting policy for research plays an essential role.

The progress till now has been significant but it is also critical to continue the motive to create a real knowledge-based society. It is obvious that new opportunities for social development and employment can be brought with such a knowledge-based society. This will certainly accelerate creative talents and communication skills. To encounter the opportunities and challenges offered by a fast changing and increasingly diverse environment, researchers and innovators with different backgrounds and expertise, including arts and humanities, natural and social sciences will come together. People are at the heart of the knowledge society. Success in the future will most probably depend on improving the skills of the population. This will create new demands on the education system from primary to postgraduate education. The graduate programs at METU-TEKPOL stand as the first educational program in the social studies of science and technology in Turkey that not only aim at increasing knowledge through research but also to create and enhance human capital within these fields. It is obvious that there is a growing need for science, technology and innovation to address economic and societal challenges. In order to spur innovation and sustainable growth, many academic and

research institutions, national and local governments and companies are working to find ways to design more effective and productive science, technology and innovation policies and strategies.

Industry 4.0 characterized by new technologies, which is mainly based on information and communication technologies is the precursor of the new age. Stereotype thinking in political, social, cultural and economic areas is abolished by the transformations in the last decades. It is obvious that there is a need now to assess these transformations not only from a technical perspective, but from different perspectives such as historical, political, sociological, cultural, ethical and philosophical. Thus, interdisciplinary thinking, research and education are important to address major transformations of today and tomorrow. In developing countries such as Turkey, which work to create their own development story through innovation and entrepreneurship, the issue of interdisciplinarity becomes highly critical. METU-TEKPOL postgraduate programs here aim at building a bridge between science and technology studies, and humanities and social sciences.

Contemporary policy research focuses on both desirable and undesirable societal impacts of scientific and technological advances. Economic and socio-political implications of science and technology development are frequently discussed by scholars, practitioners, the media and the public. Related government policies are naturally reflective of such discussions. Acknowledging the importance of this topic domain within the short narrative above, we attempt to characterize the past two decades of science and technology policy studies in Turkey with particular reference to METU-TEKPOL and provide directions for future research.

Science and technology policy studies the impact of science and technology on citizens and public via various dimensions. In addition to that it can also produce regulation recommendations when required. Those involved in a nation's science and technology policy make analysis and detailed studies to determine government strategies, policies, plans and programs as well as their impacts on domestic and international affairs. Most of the developed countries have specific public institutions dealing with science and technology policy since many political issues are also linked with scientific components. In our increasingly resource-constrained and hyper-connected globe, a new profile of policy expert with the accelerating new technologies is more required. Today, a policy expert must have capability of securing science and technology help create a better future for everyone. New skills will be required for these policy experts: Capacity to partner with policy makers and other stakeholders in the public and private sector as well as ability to integrate expertise across communication, policy, technology innovation, and responsible innovation are among the most important of such skills.

The primary question this thesis tackles is: What kind of added-value TEKPOL education programs provide to the science, technology and innovation environment in Turkey? Under this primary question, this thesis focuses on interdisciplinarity, the impact of being a METU-TEKPOL graduate and the postgraduation relationships of the METU-TEKPOL graduates. Main method used in order to find the correct answers to these questions is the analysis of the questionnaire that is conducted to the TEKPOL graduates. 96 MSc and 17 PhD graduates who have responded to the questionnaire (out of 220 graduates) made it possible to seek answers to the above-mentioned research questions. Additionally, this thesis uses official register data of TEKPOL programs from 1997 to 2016 provided by the METU administration. There is a slim literature on postgraduate program evaluation and this thesis contributes to this literature

specifically looking at an interdisciplinary program. As such to our knowledge this is the only interdisciplinary postgraduate program evaluation in Turkey.

Based on the responses given to the questionnaire by the respondents, there are few key results that we can underline. One of the most important finding of this thesis is the profile of an average TEKPOL graduate. Section 3.2.6 summarizes the profile of an average MSc and PhD graduate. This is not only important in knowing who is an average TEKPOL graduate (for TEKPOL admin and university admin) in terms of age, residence, education and work experience but also gives clues for candidate students. Though there are some commonalities between graduates according to program, we can say that average TEKPOL graduate works in government, related bodies of STI, high-technology firms and NGOs; has work experience or actually works when applied to TEKPOL; has an average age about 35-40; lives in Ankara and has engineering or administrative sciences background. With all these aspects, this thesis helps to showcase the average profile of TEKPOL graduates which is helpful for the potential applicants to the TEKPOL programs as well as for different audiences such as Higher Education Council or TÜBİTAK who want to learn more about TEKPOL.

Another key result of this thesis is the decrease in interdisciplinarity at TEKPOL. As it is discussed before, this can be mainly seen in the register data. The network analysis supports the findings in the register data. Further, interdisciplinarity is mentioned regularly in the recommendations of the questionnaire respondents (i.e., recommendations for more diverse elective course set, more diverse lecturers etc.). This finding is critical, and it is an important aspect to explore further since METU-TEKPOL has interdisciplinary approach at its roots, which is one of the main fundamental founding values of TEKPOL. The interdisciplinarity issue is also critical for the university

as the recent Strategic Plan of METU (2018-2022)[9] highlights interdisciplinarity strongly and even set performance indicators for the first time.

In this thesis, we also looked at the contribution of being a TEKPOL graduate. TEKPOL plays an important role in the lives of the graduates. Being a TEKPOL graduate has direct positive impacts on graduates in areas such as academic contribution, salary increase, new job opportunities and promotion at work.

All these findings and the questionnaire respondents' recommendations help us to understand the role of TEKPOL in the lives of the graduates. TEKPOL has an important role in the careers of the graduates but of course regarding the issues above there is much room for improvement. TEKPOL has some resource limitations (more importantly human capital) thus one should be aware of these limitations while working to improve TEKPOL. There are a few key suggestions that can be shared for TEKPOL. TEKPOL has a very unique history in STI environment of Turkey. In order to sustain the role and the impact of TEKPOL for different stakeholder groups, increasing visibility of TEKPOL could be enhanced. This may be planned in the short term through measures and activities where the TEKPOL network can be included. Second, increasing the interdisciplinarity of TEKPOL can be targeted by the TEKPOL admin (and more importantly by the university admin) based on the findings of this thesis. It should be mentioned that TEKPOL cannot do much to increase interdisciplinarity since most of the relevant measures are out of the control of TEKPOL admin. But at least some actions can be planned in the medium term such as recruiting visitor lecturers and co-supervisors with different academic backgrounds. In the long term, increasing the institutional capacity of TEKPOL in terms of human resources and financial capabilities can be targeted. This can also help TEKPOL to serve as a think-tank in STI where all the academic and

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[9] http://sp.metu.edu.tr/system/files/odtu_sp_2018_11_01.pdf, accessed on 01.04.2019.

institutional expertise of TEKPOL may be transferred to relevant interest groups via projects and initiatives to be developed and delivered.

Having all said, this thesis has also some limitations which need to be considered and discussed. First of all, only one interdisciplinary program (TEKPOL MSc and PhD programs) is studied in this thesis and recommendations are also based on the findings of the program. But it is questionable if this is enough to generalize the findings to other interdisciplinary programs as such programs at METU are organized in different ways (regarding its own academic staff, attachment to faculties, topic). Another limitation of this thesis is the methodology. We have conducted a questionnaire, which helped to answer the main research questions on interdisciplinarity and impact, and provided more details about TEKPOL. But this thesis is silent on how these effects actually are observed. The findings regarding fall in interdisciplinarity and impact are important, but we do not know the actual mechanisms behind such findings. This can only be achieved through qualitative analysis. Thus, future studies tackling postgraduate program evaluation could blend quantitative and qualitative techniques to identify actual mechanisms.

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APPENDICES

A. QUESTIONNAIRRE FOR METU-TEKPOL MSC AND PHD GRADUATES

METU-TEKPOL that was established in 1997 is celebrating its 20th anniversary. This questionnaire is applied within the MSc thesis to be prepared by me under the supervision of Assoc, Prof. Dr. Semih Akçomak to the precious MSc and PhD graduates of METU-TEKPOL that has 20 years of experience.

I thank you in advance for your contribution by fulfilling this questionnaire which would not take more than 20 minutes. All the answers will be assessed with confidentiality and also only be used within the scope of this study. You can always get in contact with me if you have any questions or concerns.
Thank you in advance for your contributions.

Ahmet Atay

1. About Yourself

1.1. Name-Surname

1.2. Gender

- o   Male
- o   Female

1.3. Year of Birth

1.4. Department of Undergraduate

- o   Economic and Administrative Sciences

- Engineering
- Basic Sciences
- Social Sciences
- Other

2. Program

2.1. How did you learn about the program? (more than one selection can be made)

- Work environment
- Friends
- Web site
- Social media
- Academic members and researchers of METU-TEKPOL
- Other

2.2. What were your expectations from the program?

- Help to find a new job
- Help for a new position or promotion at my current job
- Contribution to my academic career
- Increase in my accumulation of knowledge
- Get to know people interested in science, technology and innovation
- Other

2.3. Did the program meet your expectations?

- Yes
- No
- Partially

2.3.1. Which of your expectations were met partially?

- Help to find a new job
- Help for a new position or promotion at my current job

89

- o   Contribution to my academic career

- o   Increase in my accumulation of knowledge

- o   Get to know people interested in science, technology and innovation

- o   Other

2.4. Do you see different treatment at your workplace because of your MSc and/or PhD degree?

- o   Positively different treatment

- o   Negatively different treatment

- o   No positively or negatively different treatment

2.5. Did the program have a direct impact on your career? (a new job, a different job position, higher salary, etc.)

- o   Yes

- o   No

2.5.1. In what timeframe did you see the impact of the program on your career?

- o   Short-term (1 year)

- o   Mid-term (2-3 years)

- o   Long-term (more than 3 years)

2.5.2. What is the impact(s) of the program on your career you have seen? (more than one selection can be made)

- o   A new job

- o   A different job position

- o   Higher salary

- o   Other

3. MSc (with thesis-non thesis) / PhD Information

3.1. Do you have other MSc and/or PhD degree other than METU-TEKPOL (degree, university, name of the program, graduation year)

3.2. Which programs did you complete at METU-TEKPOL?

- o Completed MSc with thesis
- o Completed MSc with thesis and currently registered to METU-TEKPOL PhD program
- o Completed MSc non-thesis
- o Completed MSc non-thesis and currently registered to METU-TEKPOL PhD program
- o Completed PhD
- o Completed MSc with thesis and PhD
- o Completed MSc non-thesis and PhD

3.3. When did you start MSc/PhD program at METU-TEKPOL?

3.4. When did you complete MSc/PhD program at METU-TEKPOL?

3.5. Name of your thesis/dissertation supervisor (please only state name and surname, no academic or other titles are asked)

3.6. Thesis/dissertation subject

- o Innovation measurement
- o National, regional and sectoral innovation systems
- o Networks and innovation
- o Organizational learning, firm competencies and innovation
- o R&D, information and innovation dynamics
- o Science, technology and innovation policies
- o Trade, foreign direct investment, value chains and innovation
- o University-industry relations
- o Other

4. Employment status

- o   Not working
- o   Full-time employee
- o   Part-time employee

5. Institution/organization you are currently working for

5.1. Name of the institution/organization

5.2. Location of workplace (city and country)

5.3. Type of the Institution/organization you are currently working

- o   Central government institution (Ministry, Undersecretary, Regulator, etc.)
- o   Regional/local government institution (Municipality, Development Agency, etc.)
- o   Academic/research institution
- o   International organization
- o   Non-governmental organization (NGO)
- o   Private sector
- o   Other

5.4. Your title

- o   Assistant expert
- o   Expert
- o   Researcher
- o   Assistant manager
- o   Manager
- o   Academic member
- o   Instructor
- o   Research assistant
- o   Other

5.5. When did you start to work at this institution? (specify in month/year)

5.6. Do you currently have another job at another institution or organizations?

6. Previous Work Experience Status

6.1. Do you have previous work experience?

- o Yes
- o No

6.2. Previous Work Experience (List your previous work experience from the most recent to the oldest after METU-TEKPOL graduation)

6.2.1. Name of the institution/organization

6.2.2. Location of workplace (city and country)

6.2.3. Type of the Institution/organization you are currently working

- o Central government institution (Ministry, Undersecretary, Regulator, etc.)
- o Regional/local government institution (Municipality, Development Agency, etc.)
- o Academic/research institution
- o International organization
- o Non-governmental organization (NGO)
- o Private sector
- o Other

6.2.4. Your title

- o Assistant expert
- o Expert
- o Researcher
- o Assistant manager
- o Manager

- o Academic member

- o Instructor

- o Research assistant

- o Other

6.2.5. When did you start to work at this institution? (specify in month/year)

6.2.6. When did you finish to work at this institution? (specify in month/year)

6.2.7. Any other previous work experience you want to state?

- o Yes

- o No

7. Research Activities

7.1. Do you continue to do research?

- o Yes

- o No

7.2. Research fields/areas

- o Innovation: conceptual framework

- o Innovation measurement

- o R&D, information and innovation dynamics

- o National, regional and sectoral innovation systems

- o Clustering and economical geography

- o Networks and innovation

- o Entrepreneurship and start-ups

- o Financial markets and innovation funds

- o Organizational learning, firm competencies and innovation

- o Industry dynamics and technological change

- o Human capital, competencies and work organization

- o Trade, foreign direct investment, value chains and innovation

- o Inclusive innovation, gender and development

- o Innovation and economic growth

- o Innovation at developing economies

- o Green innovation and sustainable development

- o Innovation management

- o Science, technology and innovation policies

- o University-industry relations

- o Other

8. Publications (Consider articles published at academic journals, books, scientific/policy reports, etc.)

8.1. Do you have publications?

- o Yes

- o No

8.2. Please specify maximum 10 publications where your researches take part in the most efficient way.

- Specify only the name of the journal if you have a publication at an academic journal, e.g.: Research Policy.

- Specify only the name of the publishing house if you have a publication of a book, e.g.: Oxford University Press.

- Specify the name of the institution if you had prepared a report for an institution, e.g.: World Bank.

- Specify the name of the institution if you have a research or working paper, e.g.: Middle East Technical University.

- o Publication #1

- o Publication #2

- o Publication #3

- o Publication #4

- o Publication #5

- o Publication #6

- o Publication #7

- o Publication #8

- o Publication #9

- o Publication #10

9. Relations with METU-TEKPOL after graduation

9.1. Did you continue your relations with METU-TEKPOL after graduation? (Consider all who are currently working or have worked before at METU-TEKPOL and current or previous students at METU-TEKPOL)

- o Yes

- o No

9.2. List maximum 10 people whom you have been in contact most at METU-TEKPL after graduation. (Consider all who are currently working or have worked before at METU-TEKPOL and current or previous students at METU-TEKPOL)

9.3. Contact #1

9.3.1. Name-surname

9.3.2. Which group does this contact belong to?

- o Grad student

- o Current MSc or PhD students of METU-TEKPOL

- o Academic members or instructors of METU-TEKPOL

- o Research assistants

    o   Instructors providing support from outside of METU-TEKPOL

9.3.3. How often do you meet this contact?

    o   Few times in a week

    o   Few times in a month

    o   Few times in a year

    o   Less

9.3.4. What is the reason of meeting this contact? (more than one selection can be made)

    o   Social

    o   Work fellow

    o   Making an academic study/publication together

    o   Scientific study together

    o   Activity organization together

    o   Job referral

    o   Other

9.4. Do you follow METU-TEKPOL publications or news?

    o   Yes

    o   No

9.5. How do you follow METU-TEKPOL publications or news?

	Never	Sometimes	Usually	Always
o Web site				
o Facebook				
o Twitter				
o Personal relations				

10. Final comments

10.1. How can METU-TEKPOL MSc and PhD programs be improved? Please share your comments and recommendations.

10.2. Please share if you have any other comments or recommendations.

END OF QUESTIONNAIRRE. THANK YOU FOR YOUR SUPPORT.

B. COURSES OFFERED IN METU-TEKPOL PROGRAMS – 1997-2016

Course Code	Course Name
8310501	History of Science and Technology
8310503	Economics of Science, Technology and Innovation
8310505	Knowledge, Science and Technology in the Information Age
8310507	Research Methods and Ethics in Science and Technology Studies
8310510	Systems of Innovation
8310512	Technological Change in Developing Countries
8310514	Agent Based Simulation Models in Economics of Technological Change
8310515	Innovation Policy and Governance: Trends and Challenges
8310516	Science and Technology Places
8310517	Innovation and SMEs
8310519	R&D Policies and Evaluation Methods
8310521	Technology and Work Organization
8310522	Technology and Corporate Strategy
8310524	ICT: Socioeconomic and Regulatory Issues
8310526	Technological Change and the Labor Process
8310531	Intellectual Property Rights and Regulation
8310532	Intellectual Property Rights and Regulation II
8310542	Art, Technology and Visual Culture
8310543	Recent Trends in Science and Technology Policy Making
8310544	Technosphere, Environment and Culture
8310545	Knowledge and Technology Transfer in Innovation Systems
8310546	Megascience: An Appraisal of Policy Issues
8310547	Introduction to Information Network Security
8310548	Managing Information Technology: Policies And Standards
8310549	IT Governance
8310550	New Economy: Impacts and Applications
8310552	Globalization and Technology Management
8310553	Technology, Globalization and Labor
8310554	Management of Technological Innovation
8310555	Research Commercialization and Knowledge Intensive Entrepreneurship
8310557	Qualitative Research Methods in Science and Technology Studies
8310560	Seminar in New Technologies
8310590	Social Science Aspects of Innovation
8310601	Innovation, Technology and Economic Development
8310602	Technology and Industrial Strategy
8310603	Technology Society and Culture
8310604	Seminar in Doctoral Dissertation
8310605	Research Methods, Analytical Techniques and Ethics
8310611	Topics in Applied Econometrics I
8310612	Topics in Applied Econometrics II

C. TURKISH SUMMARY / TÜRKÇE ÖZET

DİSİPLİNLERARASI BİR LİSANSÜSTÜ PROGRAM DEĞERLENDİRMESİ: ODTÜ BİLİM VE TEKNOLOJİ POLİTİKASI ÇALIŞMALARI (TEKPOL) ÖRNEĞİ

İnovasyon tarihinin insanlık tarihi kadar eski olduğunu söylemek her ne kadar mümkün olsa da inovasyon tanımı ilk olarak inovasyon ve girişimcilik alanlarının kurucusu olarak kabul edilen ünlü ekonomist Joseph Alois Schumpeter tarafından yapılmıştır (Hartigh, 2017). İnovasyon Schumpeter tarafından, yeni bir ürün ya da mevcut bir ürünün daha kalitelisi, yeni bir üretim metodu, ham maddelerin veya yarı işlenmiş ürünlerin arzı için yeni bir kaynak bulunması ya da bir endüstrinin yeniden organizasyonu olarak tanımlanmaktadır. Bu tanımların OECD'nin Oslo Kılavuzu ile ne kadar benzer olduğunu görmek çok büyük önem arz etmektedir. Schumpeter'e göre, inovasyon yaratmak için bir buluşun üretim aktivitesine uygulanması gerekmektedir. Böylelikle bir buluş, ticari bir başarıya dönüştüğü durumda inovasyon olarak kabul edilmektedir (Escarus, 2018).

Bu zamandan sonra inovasyon çalışmalarına ve özellikle bilim ve teknoloji politikasına olan ilgi artmıştır. Schmookler (1966), Becker ve Whisler (1967), Knight (1967), Downs ve Mohr (1979), Dosi (1982), Freeman (1982), Tushman ve Moore (1982), Nelson ve Winter (1982), Drucker (1985), Rothwell ve Gardiner (1985), Rickards (1986), Dosi, Freeman, Nelson, Silverberg ve Soete (1988), Porter (1990), Lundvall (1992), Freeman ve Soete (1997), Fagerberg, Mowery ve Nelson (2004), ve Trott (2016) inovasyona dair çığır açıcı araştırmalar yapanlardan birkaç örnek olarak öne çıkmaktadır. Bunun yanında Ar&Ge ve inovasyon verisinin toplanmasına yönelik metodolojik çalışmalarda da önemli çabalar gözlemlenmiştir. Ar&Ge ve inovasyona ilişkin temel tanımları ve ölçüm önerilerini içeren Frascati Kılavuzu ve Oslo Kılavuzu OECD tarafından yayımlanmıştır.

İnovasyon çalışmalarının ve özellikle bilim ve teknoloji politikalarının disiplinlerarası alanlar olarak doğduğu iddia edilebilir. İnovasyon çalışmaları; iktisat, işletme, coğrafya, sosyoloji ve mühendislikten beslenen bir bilim alanıdır (Fagerberg and Verspagen, 2009, Tablo 3). Bu tezin amacı, 1998 senesinde bilim ve teknoloji politikalarına dair araştırma yapmak ve beşerî sermaye yaratmak için kurulan Orta Doğu Teknik Üniversitesi Bilim ve Teknoloji Politikası Çalışmalarının (TEKPOL) son 20 yılına dair bir değerlendirme yapmaktır.

Bilginin sürekli yaratılması ve yayılması için genç bilim insanları uygun bir kaynak olarak değerlendirilebilir. Genç bilim insanları ayrıca araştırma, istihdam, hareketlilik ve en çok akademik dünya ekosistemi ile etkin iletişim sağlayan bilimsel çalışmanın entegrasyonu ve şekillendirilmesi için de hizmet ederler (Bozeman ve Mangematin, 2004; Mangematin ve Robin, 2003). Disiplinlerarası iş birlikleri ayrıca bilim insanlarının ve araştırma alanlarının sayısını artıracak inovasyon çalışmaları açısından büyük önem taşımaktadır (Fagerberg and Verspagen, 2009).

Bu tez spesifik olarak TEKPOL lisansüstü programlarını, özellikle kısmen disiplinlerarası olma özelliğinden kaynaklanan mezunların kariyerlerine etkisine atıfta bulunarak değerlendirmeyi amaçlamaktadır. Ayrıca bu tez yine; eğitim ve iş geçmişi, mevcut istihdam durumu, TEKPOL'de eğitim alma nedeni vb. birçok açıdan ortalama bir TEKPOL mezununu anlamaya yardımcı olmaktadır.

Disiplinlerarasılık yirmi birinci yüzyılda değişimi sürükleyen anahtar kavramlardan biridir. Disiplinlerarasılık birçok platformda inovasyon ve iş birliği kavramları ile birlikte anılmaktadır (Klein, 2009).

Öğrenciler, disiplinlerarası programlarda kendileri için daha önem arz eden dersleri seçebilirler. Ancak özellikle disiplinlerarası bir ortam yaratmada en önemli zorluklardan

biri, bölümler ve öğretim elemanları arasında iş birliğine olanak sağlamaktır. Disiplinlerarası öğrenme, ancak farklı disiplinler öğrencilere farklı alanlar arasında bağlantı kurmaya yardımcı olduğu durumda arttırılabilir.

Bu çalışma, TEKPOL'ün eğitim ve araştırma alanlarındaki disiplinlerarası yaklaşımına yönelik bir inceleme sağlamaktadır. TEKPOL 1997'deki kuruluşundan bu yana, teknolojik değişime ve inovasyona yön veren ekonomik, sosyal ve politik faktörlerin analiz edilmesine yönelik disiplinlerarası bir yaklaşıma sahiptir. Her ne kadar TEKPOL lisansüstü programları disiplinlerarası bir bakış açısı ile oluşturulmuş olsa da bugünkü durumu ile on sene önceki durumu karşılaştırılacak olursa; ders, danışman ve öğretim görevlisi çeşitliliği bakımından disiplinlerarasılığın azaldığı görülmektedir. 1997-2016 yılları arasındaki kayıt verisi kullanılarak bu tez önümüzdeki 20 yıllık dönem için de genelleştirilebilecektir. TEKPOL mezunlarının tamamladığı tezlere bakıldığında, danışman sayısında azalma olduğu ve böylelikle danışmanlık işinin sınırlı sayıda TEKPOL öğretim görevlisinin üzerinde olduğu görülmektedir.

TEKPOL, 1997 senesinde kamu ve ilgili diğer kuruluşlara bilim ve teknoloji politikaları alanında insan kaynağı temin etmek ve ayrıca bilim, teknoloji ve inovasyon politika konularında araştırma yapmak amaçları ile ODTÜ'de kurulmuştur. TEKPOL disiplinlerarası bir eğitim ve araştırma birimidir ve Türkiye'de inovasyon çalışmaları üzerine yoğunlaşmış çok az sayıda disiplinlerarası yapıdan biri konumundadır. Sosyal Bilimler Enstitüsü bünyesinde bilim, teknoloji ve inovasyon alanlarında yüksek lisans ve doktora programları yürütmektedir. Teknolojik değişime ve inovasyona yön veren ekonomik, sosyal ve politik faktörlerin analiz edilmesine yönelik disiplinlerarası bir yaklaşıma sahip olan TEKPOL, bu amacı zorunlu ders tasarımı, seçmeli ders sayısı ile ders ve öğretim görevlisi çeşitliliği yolu ile yansıtmaktadır.

TEKPOL yüksek lisans ve doktora programları öğrencilere bilim, teknoloji ve inovasyon politikalarına ilişkin sorunları analiz etme ve politika ile ilgili araştırma yapmak için gerekli araç ve metotları sağlamaktadır. 2019-2020 öğretim yılı başlangıcı itibariyle toplam 250 yüksek lisans ve doktora mezunu bulunmaktadır. Ayrıca şu anda TEKPOL'de 90 yüksek lisans ve doktora öğrencisi yer almaktadır.

Bu tezde 1997-2016 dönemine ait resmi kayıt verisi ile TEKPOL mezunlarına uygulanan spesifik bir anketten gelen veri kullanılmaktadır. Kayıt verisi; dersler, öğretim görevlileri, her derse kayıtlı öğrenci sayısı gibi verileri içermektedir. Buna ek olarak, özel bir anket geliştirilmiş ve coğrafi konum, iş deneyimi, eğitim geçmişi, TEKPOL'ün etkileri, TEKPOL'ü tercih etme nedenleri gibi konularda daha detaylı bilgi edinmek üzere TEKPOL mezunlarından bilgi toplanmıştır. Böylelikle bu tez, Türkiye'de akademik program değerlendirme alanına katkıda bulunmakta olup bu bağlamda alanındaki tek kapsamlı çalışma sayılabilir.

Bu tez üç temel bulguyu ortaya koymaktadır: Öncelikle ders, öğretim görevlisi ve danışman çeşitliliği açısından disiplinlerarasılık zaman içinde giderek azalmaktadır. İkinci olarak bu çalışma, ortalama bir TEKPOL mezunu profilini ortaya çıkarmaktadır. Üçüncü olarak da TEKPOL, mezunlarının kariyerlerinde yeni bir iş imkânı, terfi ve daha iyi maaş anlamında spesifik etkiye sahiptir. Tüm bu bulgular ayrıntılı olarak giriş sonrası yer alan beş bölümde ele alınmaktadır: metodoloji, bulgular, ağ yapısı, mezunların tavsiyeleri ve sonuç.

2016 sonu itibariyle 227 TEKPOL mezunu bulunmaktadır. Çalışmanın kapsamının 2016-2017 ilk dönemi sonu itibariyle sınırlandırılmasının nedeni, Kara Harp Okulu Teknoloji Yönetimi Programı'ndan TEKPOL'e geçiş yapan 90 öğrencinin etkisinden arındırmaktır.

Anket, 2016 Haziran ayı sonu ile Aralık ayı ortası arasındaki dönemde uygulanmıştır. 227 toplam mezundan 96 yüksek lisans, 17 doktora olmak üzere 113 mezun ankete cevap vermiştir.

Tezde, TEKPOL mezunlarını ve inovasyon çalışmalarına katkılarını görselleştirmek için grafik ağ gösterimleri de dahil olmak üzere farklı teknikler veri analizi için kullanılmıştır. Mezunların sosyal ve bilimsel ağlarının daha iyi anlaşılması için bir ağ analizi de uygulanmıştır.

TEKPOL'ün 20 yıllık tarihine bakıldığında, TEKPOL mezunları yüksek lisans ve doktora mezunları olarak iki gruba ayrılabilir. Programların başlamasından 2016 yılı sonuna kadar 210 yüksek lisans ve 17 doktora olmak üzere toplam 227 mezun bulunmaktadır. TEKPOL mezunlarının ana özellikleri ankete verdikleri yanıtlara dayanmaktadır. Temel göstergeler aşağıdaki tabloda yer almaktadır:

		MSc	PhD	Total
Cinsiyet (tüm mezunlar)	Kadın	91	7	98
	Erkek	119	10	129
Uyruk (tüm mezunlar)	Türk	208	17	225
	Türk olmayan	2	0	2
Cinsiyet*	Kadın	42	7	49
	Erkek	54	10	64
Yaş*	20-29	5	0	5
	30-39	61	8	69
	40-49	29	7	36
	50-59	1	2	3
İstihdam durumu*	Tam zamanlı çalışan	85	15	100
	Yarı zamanlı çalışan	2	1	3
	İşsiz	9	1	10
İşyeri lokasyonu*	Ankara	72	11	83
	İstanbul	13	3	16
	İzmir	2	1	3
	Türkiye'deki diğer şehirler	2	1	3
	ABD	2	0	2
	Avrupa	5	1	6
Lisans derecesi*	Mühendislik	41	7	48
	İktisadi ve idari bilimler	39	9	48
	Sosyal ve uygulamalı bilimler	6	1	7
	Temel bilimler	4	0	4
	Mimarlık	3	0	3
	İstatistik	2	0	2
	Tıp bilimleri	1	0	1

*Bu veriler ankete yanıt veren 96 yüksek lisans ve 17 doktora mezununa aittir.

ODTÜ yönetiminden elde edilen kayıt verisi; öğrenci sayıları, yıl bazında farklı öğretim görevlileri tarafından verilen ders sayıları ve TEKPOL öğretim kadrosunun akademik geçmişleri gibi göstergelere dair ham veri içermektedir. Söz konusu kayıt verisi analiz edilerek incelenen göstergeler şu şekilde sıralanabilir:

- TEKPOL programlarına kayıtlı öğrenci sayıları
- TEKPOL programlarında kişi ve ders çeşitliliği
- TEKPOL programlarında bölüm çeşitliliği
- TEKPOL programları kapsamındaki tezlerin alan çeşitliliği
- TEKPOL programları kapsamındaki derslerin alan çeşitliliği
- Öğretim görevlisi ve danışmanlar içinde TEKPOL oranı

Uygulanan anket, TEKPOL mezunlarının cinsiyet, yaş, TEKPOL'e başlama/bitiş tarihleri gibi genel profil soruları içermektedir. Sorulara verilen yanıtlar ilgili şekil ve tablolara yansıtılarak daha iyi anlaşılması amaçlanmıştır. Aynı göstergeler için yüksek lisans ve doktora mezunları için ayrı analizler yapılmış ve ilgili şekil ile tablolar da çoğu durumda yine her iki grup için ayrı ayrı düzenlenmiştir. Sadece bazı durumlarda daha anlamlı olması açısından yüksek lisans ve doktora mezunlarının yanıtlarının hepsi birlikte analiz edilerek yansıtılmıştır.

Ankete verilen yanıtlardan ortaya çıkarılan bulgular 5 ana alanda kategorize edilmektedir: program, tez konuları, istihdam, akademik çalışmalar ve etki. Bu alanlar altında ele alınan konular şu şekildedir:

- TEKPOL programlarını bitirme süresi
- TEKPOL programlarının nereden öğrenildiği
- TEKPOL programlarından ana beklentiler
- TEKPOL programlarından memnuniyet
- Çalışanların sektörel iş dağılımı
- Çalışanların titrleri
- Mevcut işe ilave işler
- Mevcut işte geçirilen süre

- Geçmiş iş deneyimi
- Geçmiş iş sayısı
- Akademik çalışma alanları
- Yayınlar
- Kariyere etki zamanlaması
- Kariyere etki türleri

Bu tezde, TEKPOL mezunlarının TEKPOL ile ilişkilerine devam edip etmediği de incelenmektedir. TEKPOL ile ilişkisi devam eden mezunlar için bu ilişkiler kategorize edilerek mezuniyet sonrası sosyal ve bilimsel ilişkileri ile iş birlikleri araştırılmaktadır.

Ağ analizi için Graphcommons yazılımı tercih edilmiştir. Anketten elde edilen veriye dayalı olarak 3 farklı analiz yapılmıştır: Sosyal, bilimsel, sosyal-bilimsel (toplu).

Yapılan ağ analizi sonucu ortaya çıkan temel göstergeler şu şekildedir:

	Sosyal ağ	Bilimsel ağ
1) MSc (n=96)		
Ortalama bağlantı sayısı	3.35	1.07
Sıfır bağlantı sayısı	40	72
2) PhD (n=17)		
Ortalama bağlantı sayısı	2.41	1.59
Sıfır bağlantı sayısı	6	5

Ankette mezunlara görüş ve önerilerini açıkça paylaşabilecekleri bir soru da yöneltilmiştir. Bu soruya, ankete dolduran 113 mezundan 107 tanesi yanıt vermiştir.

Soruya verilen cevaplara dayalı olarak mezunların önerileri 5 temel kategori altında derlenmiştir:

- TEKPOL'ün görünürlüğünün arttırılması
- TEKPOL programlarının ve müfredatının zenginleştirilmesi
- İletişimin iyileştirilmesi
- Kurumsal kapasitenin geliştirilmesi

Bu tez ana olarak TEKPOL programlarının Türkiye'de bilim, teknoloji ve inovasyon ortamına nasıl bir katma değer sağladığını araştırmakta olup bunun yanında disiplinlerarasılık, TEKPOL mezunu olmanın etkileri ve mezunların mezuniyet sonrası ilişkilerine yoğunlaşmaktadır.

Tüm bulgulara dayalı olarak TEKPOL için bazı ana öneriler paylaşılabilir. Türkiye'nin bilim, teknoloji ve inovasyon tarihinde benzersiz bir yere sahip olan TEKPOL'ün görünürlüğünün arttırılması için kısa vadede birtakım tedbirler içerecek bir plan geliştirilebilir. İkinci olarak da TEKPOL'ün disiplinlerarası yaklaşımının geliştirilmesi hedeflenebilir. Bu konuda tüm inisiyatif TEKPOL'ün elinde olmamakla beraber orta vadede farklı akademik geçmişe sahip misafir öğretim üyeleri ve ortak-danışmanların istihdam edilmesi bu konuda atılabilecek adımlar olarak düşünülebilir. Son olarak da TEKPOL'ün uzun vadede insan kaynakları ve mali yetkinlikler açısından kurumsal kapasitesinin geliştirilmesi planlanabilir. Bu konuda atılacak adımlar aynı zamanda TEKPOL'ün bilim, teknoloji ve inovasyon politikaları alanında bir düşünce kuruluşu (think tank) olarak faaliyet gösterebilmesine de destek olacaktır.

Tüm bunların yanında, bu tezin bazı kısıtları olduğunu da vurgulamak gerekmektedir. İlk olarak bu çalışma tek bir disiplinlerarası programa dayalı olarak yapıldığından farklı

disiplinlerarası programlara genelleştirilmesi için yeterli olup olmadığı tartışmaya açıktır. Bir diğer kısıt da uygulanan metodoloji ile ilgilidir. Uygulanan anket ile pek çok konuda cevap alınmış, ancak sonuçlar bu cevapların arkasındaki mekanizmalara dair ayrıntılı bilgi içermemektedir. Bu nedenle lisansüstü program değerlendirmesi alanında gelecekte yapılacak çalışmaların nicel ve nitel teknikleri harmanlayarak yapılması önerilmektedir.