



Mapping the Technology Transfer Offices in Greece: Initial Outcomes Concerning Medical and Health Technologies and Next Steps

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Abstract

While the academic debate on how to transfer technology from universities and research centres to the society is not absent in Greece, yet the study of the institutions mediating in this process is not that advanced. Here, we present the results from our first survey on the Technology Transfer Offices of 12 major Greek universities and research centres. We analyse their structure, regulations and classification of services, and report on their industrial (patents, trademarks, etc.) and intellectual (copyright, digital content, etc.) property outputs. Furthermore, we explore potential patterns of collaboration. With a few notable exceptions in a limited number of aspects that formulate the everyday workings and performance indicators of the examined TTOs, findings indicate an underdeveloped ecosystem with significant room for improvement. The research presented here is part of a broader project, which aims to map the entire ecosystem of the Greek higher education institutions and research centres.

Keywords Technology transfer offices · Greece · Survey · Universities · Research centres

Introduction

The exploitation of knowledge produced at universities and research centres has been recognized as central in the context of pursuing economic prosperity. Worldwide, many higher education institutions, which are key hosts of research talent and producers of new knowledge have been trying to make them available to interested parties, including actors from the private sector and the business world (Audretsch et al., 2012; Guerrero & Urbano, 2012). The effort to exploit the knowledge that they produce has been conceptually defined as their ‘third mission’ (Dill, 2014;

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Etzkowitz et al., 2000; Holgersson & Aaboén, 2019), with teaching and research being their first and second one respectively. In order to facilitate the transformation of scientific and technological knowledge into profit-making ideas, many universities and research centres set up initiatives that help students and researchers mature their ideas, bring them closer to valorization and obtain entrepreneurial skills (Audretsch & Keilbach, 2004; Hockaday, 2020).

Enabling this third mission requires a whole range of scientific fields and professional backgrounds. The inherent complexity of the issues involved in the exploitation of scientific and technological outputs has led to the emergence of intermediary organisations, such as the technology transfer offices (TTOs). These organisations help transcend the cognitive, financial and technical limits of the institutions involved (from universities and research centres to businesses) while safeguarding the interests of the producers of the research (Audretsch & Keilbach, 2004; Friedman & Silberman, 2003; Grimaldi et al., 2011).

In this paper, we wish to explore the performance of such intermediary organisations in the case of Greece. That is, herein we undertook the objective of mapping such organisations and their characteristics as well as offering a record of their performance. As such, this paper aims at addressing the problem of shedding light to the operations, characteristics and to a select list of performance indicators of these offices — a feature that according to all relevant information has not been undertaken before. In parallel, these findings and the overall status of these domestic organisations are contextualised within the current theoretical discussions on knowledge valorization.

Contribution of the Paper

Organisations enabling knowledge valorization are important towards achieving a knowledge-based economy. This paper contributes in this discussion in the following manner. Firstly, by mapping and exploring the performance of Greek TTOs. Given that such information did not exist, a nationwide survey had to be conducted. In this paper, we present and analyse the results of this survey. Accordingly, we aspire to contribute in both the relevant global and domestic discussion in the following manners. Firstly, by providing the first metrics concerning Greek TTOs. This would result in obtaining an understanding of the major strengths and deficiencies of the domestic technology transfer system and fill another part of the wider RDI system of the country (e.g. Sachini et al., 2021; Sachini, Karampekios et al., 2020; Sachini, Malliou et al., 2020; Sachini, Sioumalas-Christodoulou et al., 2020). Providing evidence for an evidence-based policy making process is a further benefit from this. In view of the subsequent policy measures (see below on funding actions targeted on Greek TTOs), optimization steps can be undertaken based on these and other relevant findings, indicating a positive feedback loop.

On an academic footing, this paper contributes in the following manners. Firstly, by shedding light to a so far underexplored country case analysis. Following up a 2000 case study indicating the role of public procurement as a means of technology transfer in digital communication (Caloghirou et al., 2000), the country's technology

transfer tactics and ‘mechanics’ (or, the lack thereof) have gone unattended. This study offers a much more recent and holistic country case view. Significantly, it does so by making use of internationally established relevant metrics. As such, it opens up the way for future cross-country comparability.

This relates to a second contribution — current theoretical debates on knowledge spillovers, such as knowledge filters as well as the entrepreneurial-like mind-set that is expected of researchers to develop. Aiming at valorizing science and technology outputs and/or ‘by-products’ (Qiao et al., 2019), understanding domestic TTO’s strengths and weaknesses provides a guide for ‘unearthing’ hidden assets and/or the increase of the creation rate of new assets.

Structure of Paper

The structure of the paper is as follows. Firstly, we explore a range of theoretical aspects relevant to the objective of having intermediary organisations enabling technology commercialisation within tertiary institutions. We conducted the literature review having in mind the issue of addressing of their performance measurement. Also, given that this paper focuses on the Greek case, the domestic history of exploitation of scientific knowledge is also addressed.

Methodological issues, including questionnaire structure, IT infrastructure and population follow suit. Next comes the section of the empirical findings, which is divided into six parts. The concluding part, discusses the findings and the limitations of the study, contextualises the results within the current theoretical frames, explores potential avenues of further research and offers policy recommendations.

Literature Review

Historical Lineage

Turning scientific knowledge into technological and business products is a quite complex and risky process. A number of technical and societal factors are involved into this valorization process. Achieving technical proficiency, calculating the economic impact, setting the most appropriate intellectual property management plan and establishing synergies with outside partners are some steps involved in this process (Kirby et al., 2011; Macho-Stadler et al., 2007; Mazzucato, 2016). In addition, researchers and research institutes, large companies and SMEs, start-ups and spin-offs, government agencies, policy makers, students and citizens constitute the actors participating in this process.

The issue of researchers, that is the individuals most responsible for knowledge creation and its transformation into science and technology outputs, being turned into entrepreneurs has received a lot of attention. What is quite clear is that for a successful transformation to take hold a number of social and organisational parameters need to be aligned. Göktepe-Hulten and Mahagaonkar speak of researchers ‘not willing or in need to abandon the norms of science even when they are involved in

commercialization activities' (2010). Also, Casati and Genet (2014) and Mangematin et al. (2014) identified specific traits such as the ability to assume multiple (and even conflictual) roles and deal with multiple sources of pressure and tension to be directly responsible for successfully transforming researchers into entrepreneurs. The lack of these traits taken in tandem with characteristics such as being a young/inexperienced researcher, be part of department(s) with limited technology transfer experience and/or having scarce organizational support (Greven et al., 2020 cited in Giones et al., 2021) points to a decreased probability of a researcher turning into a successful entrepreneur.

Importantly, researchers and research outputs alone are not sufficient for the successful transfer of knowledge and technology. This is due to the lack of linearity between the individual stages: basic research, applied research, technological development, innovation. That is, it is neither automatic nor a logical consequence that a research output will find its way to economic exploitation (Mowery et al., 2001). Recognizing this, intermediate services and structures have been developed to bridge the intermittent gaps and crevices. These services and structures fall under the wider technology transfer mechanism(s) that seek to promote the transfer and/or exchange of technology with industry, state and local governments, academia and other public and/or private agencies. To accomplish its mission, these mechanisms promote research and partnerships as well as evaluate, protect, market, license, monitor and manage inventions and other intellectual property assets produced/created within the institutional boundaries of a given organisation. Significantly, these structures possess adequate and special knowledge, are staffed with personnel with appropriate skills and understanding of various specific scientific and technological fields, and are guided by an approach that feeds research results into the economy. Such skills are related to, e.g. the ability to attract and convince high-risk venture capital, managing industrial and intellectual property, legal coverage, preparing technical and economic development plans, networking, etc. (Cunningham et al., 2020). On a wider context, the intermediary mechanisms have been developed as a way of maximising the potential benefits for the institution (Lafuente & Berbegal-Mirabent, 2017).

The 1980 U.S. passage of the Stevenson-Wydler Act on Technological Innovation and the Bayh-Dole Act of the same year marked a milestone in the effort to boost the economy through the marketing of research-derived patents. These laws provided universities ownership of patents that had emerged from federally funded research in exchange for the commitment of the universities to attempt to commercialise them. This gave birth to the 'formalised linear model of technology transfer' as Bradley et al. (2013) called it, indicating other, informal tech transfer pathways (see, Hayter et al., 2020; Schaeffer et al., 2020). The main point here is that the valorization of science and technology outputs has increasingly been seen as part and parcel of a sustainable development model where knowledge spill overs through its scientific and technological 'by-products' are considered as growth enablers (Qiao et al., 2019). Incentivizing the exploitation of such spill overs either through the 'unearthing' of hidden assets and/or the increase of the creation rate of new assets has been the guiding. Indeed, following Mueller's (2006) argument, these intermediary organisations can help penetrate the knowledge filter that limits the total conversion of knowledge into new products, processes, and organizations (Acs et al.,

2005). Rapid transformation of tacit to tangible knowledge, informal practices, including communication and a more customized and personalized approach that best caters (and) for the researcher's interests may account for this.

Originally developed in the USA, this approach set the benchmark for other developed countries globally (e.g. Flanagan, 2017; Geuna & Rossi, 2011; Mowery & Sampat, 2004; Poyago-Theotoky et al., 2002; Sellenthin, 2009; So et al., 2008). The same applies at the European level. The quest for a development model that capitalized upon European RDI-relevant strengths and builds upon regional scientific, technological and industrial characteristics has put higher education institutions and technology transfer mechanisms at centre stage (European Commission, 2009, 2020; Finne et al., 2011). As a result, these enabling structures and mechanisms have been regularly monitored in order to appreciate and optimize their performance, where applicable.

The operation and performance of TTOs have a dimension that is strongly associated to metrics (Souder et al., 1990). Managing these offices essentially entails monitoring several parameters, such as the number of patents, the number of licences granted, the creation of spin-offs, etc. Indeed, given the growing interest in technology transfer, the measured dimensions are expanding.

To monitor the performance of TTOs, incubators, accelerators, performance between national and international research programmes, type and branches of local business, networks including support structures, and continuing vocational training are being probed (Campbell et al., 2020; Jensen et al., 2009). Additional indicators are employed to examine the efficiency of the technology transfer process. Such indicators are the time elapsed between the date a licence was requested and the licence execution date (NIST, 2011), the patent applications' ratio for all known inventions and the ratio of the transfer rate of new patents to the total number of patents submitted for evaluation (Choudry & Ponzio, 2019; National Academies of Sciences, Engineering, & Medicine, 2017).

The above indices are measured through regular surveys and related metrics. Of those, two are the longest-running ones. The first is the annual survey of the American Association of University Technology Managers. This collects data from TTOs in the USA and Canada. The second is the annual Higher Education Business and Community Interaction Survey, conducted by the United Kingdom Research and Innovation (UKRI), which collects data from all UK universities.

On the European Union level, the Technology Transfer Offices Circle operated by the European Commission's Joint Research Centre (JRC) is a network set up to bring together Europe's largest public research organisations in order to exchange good practices, knowledge and experience, and to take joint action for a common approach, creating international standards on the subject. In 2018, the EU set up the Technology Transfer Skills Centre with the aim of providing specialised services for the various General-Directorates, regional and local authorities and relevant stakeholders. The Centre collaborates with the Association for European Science and Technology Transfer (ASTP — formerly ASTP-Proton) to establish methodologies for technology transfer measurement (Campbell et al., 2020). Finally, in 2018, the Alliance of Technology Transfer Professionals (ATTP) was established as an organisation bringing together major technology transfer associations such as ASTP, AUTM, KCA, PraxisUnico, SARIMA, SNITTS, TechnologieAllianz, UNITT, USIMP.

The Greek Case

The issue of commercialisation of scientific knowledge is not unknown in the Greek public debate. Greek legislation was one of the first in the world to address technology transfer issues. It was only 5 years after the introduction of the Bayh-Dole act that the Greek legislation acknowledged the importance of the exploitation and transfer of scientific knowledge. This was done to enable the ‘short-term or long-term service of the development programme of the country’ (see Law 1514/1985, especially see Article 3 and Law 1733/1987 wherein technology transfer was explicitly part of the official title of the law, and, also, Law 1514/1985, Article 2). Despite this early and subsequent legislation (see Hellenic Republic, 1988), the commercial exploitation of scientific knowledge and, in general, the framework for defining the connection with the private sector has not been a success.

The issue of collaboration between the public and private sector has been a long-standing weakness of the national RDI system. For all its strengths¹ pointing to a strong science-level ecosystem, there are a number of indicators that point to an asymmetry, indeed a weaker technology- and/or entrepreneurial-based aspect of the same ecosystem. For example, analysis of the indicator that reflects the level of achieved connection between the public and private sector, that is co-publications per million population, indicates that the country significantly lags the European median.² Equally, until the setting up of the *Elevate Greece* platform,³ science-based entrepreneurship, including university spin-offs, were unable to obtain visibility nor to lure funds. On the latter, during 2021–2022, this trend has been reversed. Indeed, the deployed capital has been steadily increasing coupled with a record number of follow-on investments (Startups in Greece, 2022).

Balancing out this asymmetry, however, has been a quite recent phenomenon. A combination of domestic and European initiatives on entrepreneurship coupled with the need to reboot the economy on a firm, tech-based footing has provided the framework conditions accounting for this emphasis. This pendulum-like movement towards more and better evidence, though, has to break parts with a systemic lack of data. A most explicit case is the case of numerical and statistical recording of technology transfer(s). While one can assume that cases of such transfer have/had taken place, these transfers, however, have gone unreported and under the radar. A major driver in undertaking this research, thus, has been the need to shed light on the actual performance.

¹ Greek science stands as a competitive research ecosystem. This is attested, for example, by a number of indicators such as systemic over-performance in competitive European collaborative projects (Horizon, 2021), an increasingly good bibliometric performance (Sachini, Malliou et al., 2020). In addition, Greek highly educated individuals (Sachini, Karampekios et al., 2020) occupy a disproportionately high number of academic and research positions in US' IVY league universities (Yuret, 2017). For an empirical discussion on how research and development expenditure impacts innovation, see Voutsinas et al., 2018.

² With a European average of 100, Greece scores 29.1 (2011), 30.6 (2012), 33.7 (2013), 35.2 (2014), 37.1 (2015), 36.6 (2016), 39.0 (2017), 42.3 (2018) in this dimension (EIS, 2020, database xl., sheet '3.2.2', line 13).

³ <https://elevategreece.gov.gr/>

Indeed, in the aftermath of the decade-long economic crisis and the need to reposition national development models on knowledge, the issue is being viewed with renewed emphasis by policy makers and academics alike. A range of actions have been initiated — both at the public and private domain. The National Council for Research, Technology and Innovation has recently established the sectoral scientific council on technology transfer and intellectual property (ESETEK, 2021). Comprising of both academics and business people, it seeks to offer policy advice on how to curb the obstacles for technology commercialisation. To inform policy action and familiarize academics on the subject, Uni.Fund (a VC fund) and the Onassis Foundation have been regularly organizing dedicated webinars/seminars on technology transfer with a hands-on approach for researchers and university personnel to educate them on various aspects of the practice (Onassis Foundation, 2021).

Moreover, valorisation of science and technology outcomes and the importance of mediation mechanisms have become part and parcel of large-scale public funding intervention schemes such as regional innovation strategy (2021–2017), the National Development Reference Framework as well as the Strategic Plan for the Recovery Fund (2020: 90, 94, 110). Indeed, in 2022 two major public funding actions were initiated that aim to assist universities and research centres to set up and operate technology transfer units (‘structures’) (GSRI, 2021). Mostly focusing on establishing institutional regulations and policies on patent examination, firm collaboration, the potential recipients included the totality of these institutions. Significantly, some institutions rather than setting up these structures alone, chose to join forces and establish collective technology transfer units.⁴ Banking on creating economies of scale and tapping into collaborative know-how on, e.g. IPR arrangements, validation mechanisms, etc. stood as the most prudent manner in relation to operating these structures.

While this range of policy and funding actions ‘echoes’ a horizontal approach to incentivize the ecosystem towards the direction of technology valorization, it also builds upon a well-known capacity of the domestic ecosystem. Indeed, Greece is a European country with significant research and scientific capability (see Sachini, Karampekios et al., 2020; Sachini, Malliou et al., 2020; Yuret, 2017). Enabling commercial exploitation of scientific knowledge can be aided by the dynamic participation of Greek institutions in European competitive programmes. Therein, Greek organisations achieve high success rates — 13.70% as opposed to 12.05% EU average (Horizon, 2021 — 14.05.2021). As EU projects are a major source of R&D funding, one can assume that the latter’s emphasis on the commercial use of research has made Greek organisations aware of the need for technology commercialisation — creating a positive ‘dependence’ of domestic organisations on European priorities.

⁴ Examples of this collaborative action include initiatives named as ‘Science Agora’ and ‘Spiral’ between leading Greek universities and research centres.

Methodology

As already indicated, this research aimed at bringing to light the practices and performance of the Greek TTOs. Given that it was the first time that this kind of study was conducted in Greece, we had to address several issues. The identification of the TTOs within each institution is such an issue. In countries with developed technology transfer mechanisms, the relevant administrative divisions have been long identified — in our case, this was not the case.

To do so we resorted to a top-down, two-phase approach. Firstly, the point of contact for receiving the questionnaire had to be identified. This had to be a high-ranking administratively elected person (the Vice Rector for Financial Services and the President of the Research Centre) ensuring legitimacy and institutional coverage. To obtain an overall picture of the TTOs, it was necessary to identify the structures, map the services and the officials/technology officers with whom we should communicate with. In addition, the existence and the maturity of the relevant regulations as the main institutional documents guiding the operations of TTOs were requested of him/her during this phase (see Fig. 1 — Phase A).

Having received the contact details of the TTO officials, the second phase began (see Fig. 1 — Phase B). Unsurprisingly, there was no case of an institution where only one responsible person per institution was identified — on the contrary, multiple persons were named. Since many executives per institution were involved, it was important to ensure that the answers to the questionnaire considered all the data and echoed the agreement of all involved. This was ensured as follows: after the data were submitted, we returned with an exploratory question to all the officials per institution as to whether the submitted data were representative of the institution as a whole. With an affirmative answer to this question, the submission was considered complete for the specific institution. Research commenced on 20/11/2019 and was completed by May 2020.

It is to be noted that most of the authors of this study are employed in the Greek National Documentation Centre (EKT). EKT is the National Authority of the Hellenic Statistical System for the production of European statistics on Research, Development and Innovation. In this capacity, EKT has acquired great experience in conducting statistical surveys.⁵ We had to capitalize on this experience to establish the research design, develop the questionnaire that was utilized in the aforementioned Phases A and B, just as we relied on EKT's infrastructure for the collection and processing of responses.

Questionnaire Structure

A combination of structured questions that presented a range of closed answers was selected as the preferred means of questionnaire format. However, given that this

⁵ In parallel to this statistical activity, a number of research papers shed light to the domestic innovation system. See (among others) Sachini, Karampekios et al., 2020; Sachini, Malliou et al., 2020; Sachini, Sioumalas-Christodoulou et al., 2020; Labrianidis et al., 2021; Karampekios & Sachini 2021).

a

Questionnaire. Main points

- Administrative structure
- Regulations

**A**

Collection. Population

High ranking
administrative individual

- Tech transfer services, type
- Tech transfer services, number per employee category
- Tech transfer services, per Field of Science
- Tech transfer services, number of outputs
- Network
- Personal opinion on e.g. links to wider economy, technical adequacy

**B**

TTO officer(s)/executive(s)

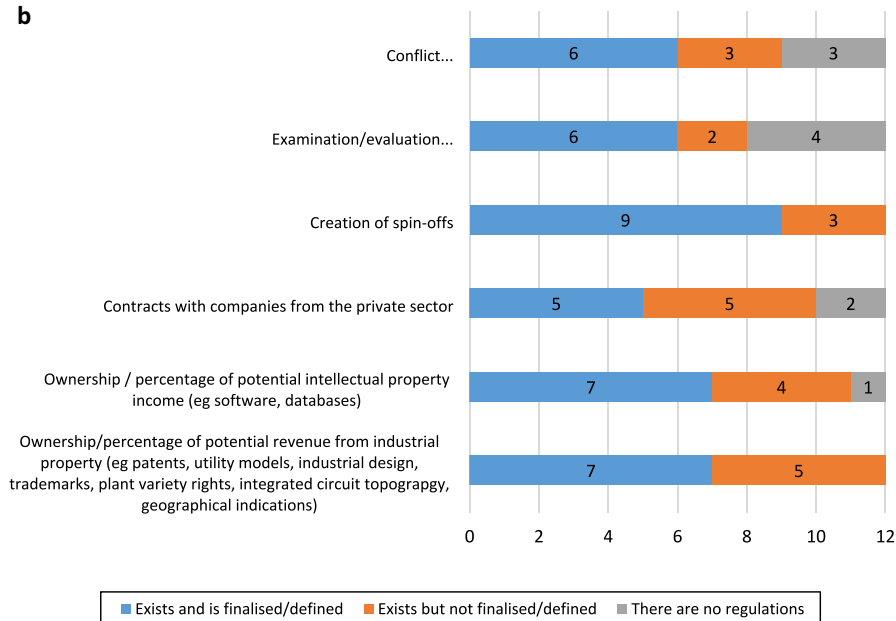
b

Fig. 1 **a** Main points of questionnaire posed in Phases A and B of collection. **b** Does your organisation have established institutional regulations and policies on the following? [presented numbers refer to the 12 institutions probed]

was the first time such a survey was undertaken and a lot would have to be explained in a more open language, each question contained an ‘open’ answer for the respondents to be able to express their opinions freely.

The first section of the questionnaire (utilized in Phase A — see above) sought to record the related administrative structure within the institution and it contained questions about the existence of technology commercialisation regulations. This was addressed towards high-ranking administratively elected personnel of each institution.

Subsequent sections of the questionnaire (that were sent out after Phase A had been completed towards the personnel identified in the same phase) sought to identify the categories of services offered per stage of determining the potential of an idea. Also, the questionnaire had a strong quantitative aspect, in as much sought to record a number of performance metrics, specifically, the number of services per staff category and the scientific fields in which the institution operates in terms of technology transfer services. Concerning performance (outputs), we sought to record the performance for industrial (patents, etc.) and intellectual property (copyrights, etc.) outputs. In regards to the former, questions about utility model certificates, trademarks, geographical indications, plant variety rights, etc. were included. These were included because they have been identified as important in technological low and medium countries (Abbate et al., 2020; Castaldi et al., 2020; Graham, 2008; Mamede et al., 2014; Millot, 2009).

The third part addressed issues relating to outreach and connectivity with other organisations and the wider economy. In addition, the views of the technology officers on issues such as the networking with enterprises, technical and cognitive competence and support provided were monitored.

Lastly, the questionnaire explored the degree of agreement of the officers in a series of proposals for the improvement of the offered technology transfer services.

Questionnaire Processing and Analysis, IT Infrastructure

The open system of statistical surveys and submission of questionnaires, LimeSurvey (version 3.17.5), was used to design and submit the questionnaire. The questionnaire included closed-ended questions requiring the noting of a numerical index, affirmation or denial. Open-ended questions were posed concerning the recording of contact details (name, telephone and email) and the naming of the administrative structures within each institution.

Data collection was imported from LimeSurvey into the SPSS statistical package. As a first step of the conducted analysis, we examined the coherence and completeness of the data. For example, we looked for incomplete answers, outliers, missing values, data lost due to information systems incompatibility (data wrangling). To correct these, we returned to the respondents and asked for clarifications. Data wrangling issues concerned the homogenisation of specific administrative structures. These structures while named differently per institution concerned the same subject. For example, responses such as ‘legal advisor’ or ‘legal department’ were consolidated into a ‘Legal Support Office’. Lastly, we produced descriptive statistics with relevant tables and graphs.

Population and Reference Period

Universities and research centres with an exhibited capacity in the scientific fields of Medicine and Health Sciences were included in our sample. To locate these universities, a multi-pronged approach was followed. Firstly, we identified institutions that exhibited a long-term involvement in competitive EU health research projects. Secondly, we included institutions with Schools and Departments of Medicine, Biology and in one case the School of Molecular Biology and Genetics. In addition, two Universities with a declared orientation in agriculture were selected. This was due to their Schools and Departments being particularly active in the field of biotechnology and human nutrition. The geographical scope of our sample was nationwide and the oldest and most renowned institutions in the country were selected.

A possible limitation of our sample selection (referring to sample representation — presented in detail in the concluding section of this paper) was offset due to the high bureaucratic costs that were required to engage all the institutions of the country in the context of this first mapping attempt. Furthermore, this approach allowed us to determine the dimensions of the domestic technology transfer system and identify the interlocutors, their characteristics, etc. as well as to make marginal adjustments where required.

Realising that the system was not fully prepared to list all the requested data, the answers to some questions were not obligatory, while the reference period was ‘the last three years’ instead of the immediately preceding calendar year. A parallel objective (to obtain a first mapping of the actual performance) was to activate the system. Thus, we opted against adopting a strict statistical approach to annual recording, which risked undercutting individual performance. To the extent that the aim is to initialize the periodicity of this research, the working hypothesis is that the competent bodies and services will be better prepared for forthcoming data collection surveys.

On a general note, all data herein are presented anonymously to ensure statistical confidentiality. In the very few cases where the submitted data potentially allowed the identification of the institutions, further anonymization was carried out. The following table (Table 1) presents the institutions that constitute the target population of the research. Fifteen (15) institutions were selected. Of those, nine (9) were Universities and six (6) were Research Centres. It should be noted that of the fifteen (15) institutions, three (3) did not submit data.

Recognising that the identified institutions are engaged not only in activities relative to the field of Medicine and Health Sciences but are organisations with enriched scientific and technological activity in other scientific fields as well, the survey aimed at capturing their performance in those fields, also. To this end, the questions concerning the recording of industrial and intellectual property outputs included separate response fields for those other scientific fields. In addition, it was requested that the scientific fields in which ‘mainly, (each) Institute operates in terms of technology transfer services’ should be identified. That is, the questionnaire sought to obtain an all-round picture and the interdisciplinary dynamics of the TTOs at hand.

Table 1 Research population (universities and research centres)

Universities	Departments, schools, faculties	Research centres
Artistotle University of Thessaloniki	School of Medicine School of Biology	Centre for Research and Technology, Hellas
Democritian University of Thrace	Department of Medicine Department of Molecular Biology and Genetics	Biomedical Science s research Centre 'Alexander Fleming'
University of Athens	Department of Medicine Faculty of Biology	Biomedical Research Foundation, Academy of Athens
University of Thessaly	Faculty of Medicine	Foundation for Research and Technology, Hellas
University of Ioannina	Faculty of Medicine	
University of Crete	Department of Biology School of Medicine	
University of Patras	Department of Biology School of Medicine	National Hellenic Research Foundation
Harokopio University	Department of Nutrition and Dietetics	National Centre for Scientific Research 'Demokritos'
Agricultural University of Athens	Department of Biotechnology Department of Food Science and Human Nutrition	

Findings

This section is divided into six parts symmetrical to the respective questionnaire structure. Part 1 displays the overall TTO structure, regulations and services. Part 2 provides the results with regard to the operational, pre-competitive and exploratory related services. Part 3 presents the performance in terms of industrial property, while Part 4 examines the intellectual property output. Part 5 explores the performance of the institutions in relation to networking and co-operation with other organisations. Part 6 reflects views of the institutions' executives (stating the level of their agreement/disagreement) on subjects related to the TTO and the wider economy, technical and knowledge adequacy as well as institutional support.

Structure, Regulations and Services (Part 1)

Table 2 presents the administrative structure of the TTOs. The results pertain to each institution in a series of sub-functions such as the management of research projects, the provision of technical services, legal support, the negotiation of investment agreements, the implementation of technological control and lifelong learning.

A direct conclusion is that there is no homogeneity in terms of lexical formulation of the administrative structures active in the individual functions between the institutions. Outreach and international relations offices, the property development company as well as the office of the president were designated as playing a TTO-related role. The role of Special Account for Research Grants (ELKE) is crucial because they offer administrative services with broad responsibilities due to their jurisdiction as a gateway for and management of (European) resources. In all probability, ELKE was chosen for a variety of reasons: because of its financial role; because of its technical expertise; because technology commercialisation not being a main activity of the institute had to be placed within existing institutional frame that bears affiliation on the grounds of, e.g. funds.

The examination of the existence of statutory institutional policies on issues such as the ownership/participation rate of the institutions in the potential revenue that may result from the exploitation of industrial property, conflict of interest and incompatibility, etc. took place. Understanding the administrative structure and institutional set-up on these issues is a key element in determining, framing and understanding their metric performance (Hartung, 1951). Conversely, ignorance of the existence or non-established rules as the basis of the service as well as the performance itself have a negative effect on the overall enhancement of the technology transfer process as the actors involved do not know the rules of the game (North, 1990: 3; Baumol, 1990). Figure 1B presents the answers to the question of whether institutional regulations and policies for individual subject fields with regard to the functioning of TTOs exist and if so to what degree. In most cases, institutions have finalised their regulations and policies or are in the process of doing so. Two cases in point are the creation of spin-offs and percentile distribution of potential revenues. Oppositely, 4 institutions do not have policies regulating the examination of patents.

Table 2 Technology Transfer Offices. Current institutional structure

	Inst. 1	Inst. 2	Inst. 3	Inst. 4	Inst. 5	Inst. 6	Inst. 7	Inst. 8	Inst. 9	Inst. 10	Inst. 11	Inst. 12
Management of research programmes	Administrative service	Special Account for Research Grants [ELKE]	1) Project Monitoring Department, 2) Financial Management Department, 3) Research Planning & Support Department	Programming Office	Office of administrative & financial services	ELKE	1) ELKE, 2) Department of project management	ELKE	ELKE	Department of Project Planning & Management	Department of project support	ELKE
Management of research contracts concluded with private companies	Administrative service	Innovation and operational support office	1) Legal Support Department, 2) Technology Transfer Office, 3) Financial Management Department	Technology Transfer Office	Office of administrative & financial services	ELKE	1) ELKE, 2) Department of project management	ELKE	ELKE	Department of Project Planning & Management	Department of project support	ELKE
Intellectual and Industrial Property Management	Legal support office	Innovation and operational support office	1) Technology Transfer Office, 2) Legal support office	Technology Transfer Office	Outreach unit	ELKE	1) ELKE, 2) Department of certification of precedures, supplies, goods & other services	ELKE	ELKE	1) Office for the exploitation of results, 2) Technology Transfer, 3) Outreach unit	Research and entrepreneurship centre	ELKE

Table 2 (continued)

	Inst. 1	Inst. 2	Inst. 3	Inst. 4	Inst. 5	Inst. 6	Inst. 7	Inst. 8	Inst. 9	Inst. 10	Inst. 11	Inst. 12
Management of licensing activities	Legal support office	Innovation and operational support office	1) Technology Transfer Office, 2) Legal support office	Technology Transfer Office	Outreach Unit		1) ELKE, 2) Department of certification of procedures, supplies, goods & other services	ELKE	ELKE	Property development and management company	Research and entrepreneurship centre	ELKE
Management of research and consultancy services contracts		Innovation and operational support office	1) Technology Transfer Office, 2) Legal support office	Technology Transfer Office	Office of administrative & financial services	ELKE		ELKE	ELKE	1) Office for the exploitation of results, 2) Technology Transfer, 3) Outreach unit	Department of project support	ELKE
Provision of technical services		Office of technological applications	1) Laboratories, 2) research teams, 3) Interdisciplinary Research Centre		Office of support services				Technical services office	ELKE		
Support for the creation of spin-off companies	1) Organisation for technology transfer 2) Legal support office	Innovation and operational support office	1) Technology Transfer Office, 2) Legal support office	Technology Transfer Office	Outreach unit	Property & Development Company	1) ELKE, 2) Department of certification of procedures, supplies, goods & other services	Investment committee		1) Technology Transfer Officer, 2) Outreach unit	1) Department of project support, 2) Research and entrepreneurship centre	ELKE

Table 2 (continued)

	Inst. 1	Inst. 2	Inst. 3	Inst. 4	Inst. 5	Inst. 6	Inst. 7	Inst. 8	Inst. 9	Inst. 10	Inst. 11	Inst. 12
Legal support (eg drafting contracts, setting up a company, support in applying for a patent, etc.)	Legal support office	Innovation and operational support office	1) Technology Transfer Office, 2) Legal support office	Legal support office	Legal support office	Legal support office	1) ELKE, 2) Department of certification of procedures, goods & other services	Legal support office		1) Technology Transfer office, 3) Outreach unit	Department of project support	ELKE
Supervision of research parks, incubators	Company for the management and development of the science and technology park	Innovation and operational support office	Technology Transfer Office		Office of administration & financial services					Innovation and Entrepreneurship Unit	Research and entrepreneurship centre	
Negotiating/Concluding investment agreements	Organisation for technology transfer	Innovation and operational support office	1) Technology Transfer Office, 2) Legal Support Office	President's Office	1) Office of administrative & financial services, 2) Outreach unit					Property development and management company	1) Department of project support, 2) Research and entrepreneurship centre	ELKE
Support and promotion of internationalisation/outreach activities	Organisation for technology transfer	Innovation and operational support office	1) Technology Transfer Office, 2) Research Planning & Support Department	President's Office	Outreach unit	Department of international public relations	1) ELKE, 2) Department of Innovation, Research & Entrepreneurship			1) Technology Transfer office, 2) Outreach unit	Department of project support	ELKE

Table 2 (continued)

	Inst. 1	Inst. 2	Inst. 3	Inst. 4	Inst. 5	Inst. 6	Inst. 7	Inst. 8	Inst. 9	Inst. 10	Inst. 11	Inst. 12
Implementa- tion of networking actions eg business missions, bilateral meetings etc	Organisa- tion for technology transfer	Innova- tion and operational support office	1) Technology Transfer Office, 2) Research Planning & Support Department	President's Office	Outreach unit	Employment & Career Centre	1) ELKE, 2) Depart- ment of Innovation, Research & Entrepre- neurship			1) Technology Transfer office, 2) Outreach unit	Research and entrepre- neurship centre	
Implementa- tion of technology audit (e.g. identifica- tion of the strong technologi- cal areas of the institu- tion's teams/ depart- ments, investiga- tion of technologi- cal maturity or ideas that need protec- tion)	Organisa- tion for technology transfer	Innova- tion and operational support office	Technology Transfer Office	Technology Transfer Office	Outreach unit					Innovation and Entre- preneurship Unit	Research and entrepre- neurship centre	

Table 2 (continued)

	Inst. 1	Inst. 2	Inst. 3	Inst. 4	Inst. 5	Inst. 6	Inst. 7	Inst. 8	Inst. 9	Inst. 10	Inst. 11	Inst. 12
Support in the implementation of regional and/or national, and/or international programmes	Organisation for technology transfer	Innovation and operational support office	Research Planning & Support Department	Programming Office	Office of administrative & financial services	ELKE	1) ELKE, 2) Department of Project Management	ELKE		Department of Project Planning & Management	Project support department	ELKE
Provision of lifelong learning services in cutting-edge cognitive subjects that attract business interest (continuous professional development)		Education office	1) Training and lifelong learning centre, 2) Technology Transfer Office			Training and lifelong learning centre	1) ELKE, 2) Department of Innovation, Research & Entrepreneurship	Training and lifelong learning centre		Training and lifelong learning centre	Training and lifelong learning centre	ELKE

Note on Table 2: This question allowed open answers (precisely because there was no picture of the existing administrative structure). Therefore, the answers had to be processed before presentation. This was done with the utmost care and we avoided lexical adjustments for the sake of homogenisation. The purpose, it is reiterated, is to record the existing administrative ‘wealth’. Indicatively, the administrative structures that provide lifelong learning services are presented as named, e.g. ‘training centre and lifelong learning’, ‘training office’. Exceptions were legal aid offices that were named in different ways, e.g. legal service, legal advisor but, supposedly, offer the same legal services

The following 3 figures (Figs. 2, 3, 4) present the findings on the technology transfer services provided by institutions. The services were categorised in view of the different stages of technological maturity. The stages range from the identification of economically viable ideas, the search for collaborations for the exploitation of these ideas and technologies to the individual real services offered for the exploitation of the innovative technology.

In the case of investigating the potential economic viability of the proposed idea and/or technology, 10 institutions encourage their scientists to describe their idea in a manner that focuses on its commercial use. Also, 8 institutions offer evaluation services in relation to the commercial potential of the proposed idea on the basis of technical, legal and financial aspects. Contrasting, only 4 institutions make use of techniques that identify cutting edge research and technology (Fig. 2).

In terms of seeking partnerships and offering individual services, most institutions (9) offer services such as seminars, workshops and conferences as means to enable contact between institutions and companies. This is followed by organising thematic workshops and exhibitions to highlight specialised ideas (8 institutions). Only half (6) of institutions, though, execute regular visits to companies and even less to other research centres as a method for exploring the potential exploitation of new ideas and technologies (Fig. 3).

At the economic exploitation stage, 10 institutions support their personnel in creating spin-offs. Equally, the majority (7 institutions) support further idea maturation, access to market processes such as market analysis and legal advice, as well as provide information on tax systems, fees, etc. Oppositely, only 2 institutions offer technical and deep advice for further adapting the offered technologies in view of customized industrial needs and realities (Fig. 4).

Figure 5 presents the number of technology transfer services provided per category of research staff (teaching staff, other research staff such as researchers, fellows, PhD candidates) as well as technical and administrative staff and students. Most institutions report that they indeed offer tech transfer services to all the population groups. However, most have offered these services to population groups of up to 10 people, while it is only 1 or 2 institutions that have managed to offer such services to a large enough population (> 300).

Operational, Pre-competitive and Exploratory Related Services (Part 2)

The following Fig. 6(a) and (b) report the numerical recording of the performance of technology transfer offices by category of results in the last 3 years: among others, the analysis of the potential of commercial development, the analysis of the ability to enter new markets and the number of spin-offs and start-ups.

Concerning spin-offs, 8 institutions have set up cumulatively 42 of them, while 5 institutions have set up 37 start-ups. Also, 5 institutions have proceeded to 138 analyses of the idea commercialisation potential (Fig. 6a).

Performance in the field of Medicine and Health Sciences is significantly lower. Specifically, 7 institutions have founded 11 spin-offs and 1 institution has set up 1 start-up. Also, 3 institutions have proceeded to 14 analyses of the idea commercialisation process (Fig. 6b).

Industrial Property (Part 3)

The performance in a number of industrial property subcategories, such as patents, model certificates, trademarks, geographical indications, etc. in the last 3 years are presented. In terms of findings related to industrial property and in terms of performance in scientific fields other than the field of Medicine and Health Sciences, the following results were recorded: 8 institutions reported the filing of 56 patents, while 7 of them have a total score of 79 published patents. With the exception of patents, almost no institution records any performance in any other subcategory of industrial property. That is, the utility model certificate, industrial design, trademark, plant variety rights, integrated circuit topography, geographical indications (Fig. 7a).

Performance with regard to the field of Medicine and Health Sciences is lower. Specifically, 6 institutions have filed applications for 20 patents and 3 institutions report the total number of published patents to be 14. In all other categories of industrial property, the performance of all institutions is zero (Fig. 7b).

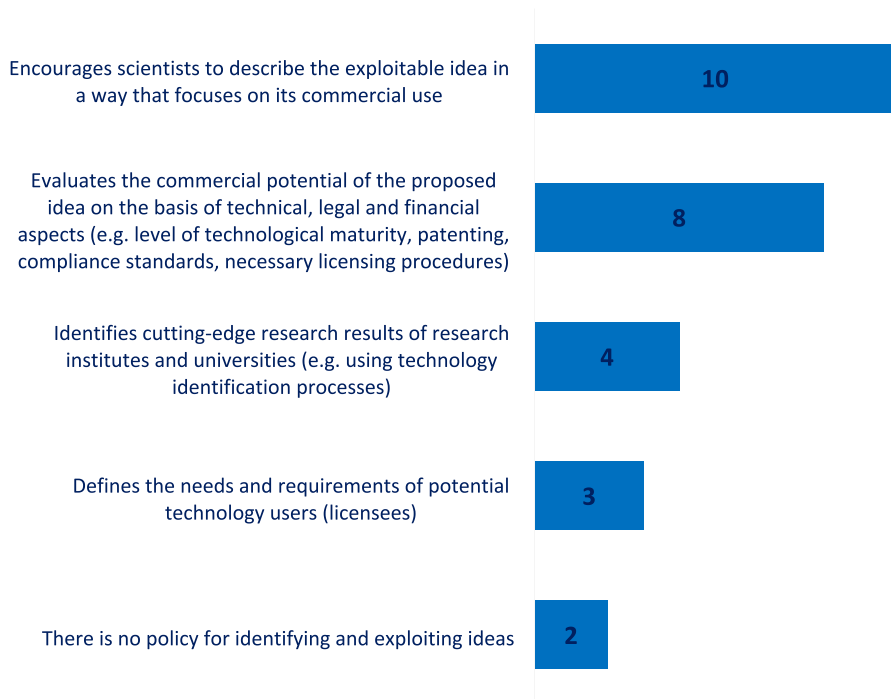


Fig. 2 Which of the following services does your institution offer in terms of identifying economically viable ideas? [presented numbers refer to the 12 institutions probed; multiple choices allowed]



Fig. 3 Which of the following services does your institution offer in terms of collaboration that could result to the exploitation of proposed new ideas and technologies? [presented numbers refer to the 12 institutions probed; multiple choices allowed]

Intellectual Property (Part 4)

This section pertains to copyright and records individual performance on copyrights, digital content, original databases, etc. in the last 3 years. Regarding the findings related to intellectual property and in terms of performance in all scientific fields except the field of Medicine and Health Sciences, the following results are recorded. 1 institution reports one (1) case of intellectual property that is granted to a third party with a licence. In all other cases, the performance of all institutions is zero (Fig. 8a). The situation in the field of Medicine and Health Sciences is similar. Except for 10 copyright cases which were granted under licences by 1 institution, in all other copyright cases the performance of every other institution is zero (Fig. 8b).



Fig. 4 Which of the following services does your institution offer during the economic development phase of an (innovative) idea/technology? [presented numbers refer to the 12 institutions probed; multiple choices allowed]

Networking and Co-operation (Part 5)

The performance of the institutions' TTOs in relation to networking and co-operation with other organisations in the last 3 years is presented in Fig. 9. Recognising that technology transfer is a dynamic and reciprocal practice that

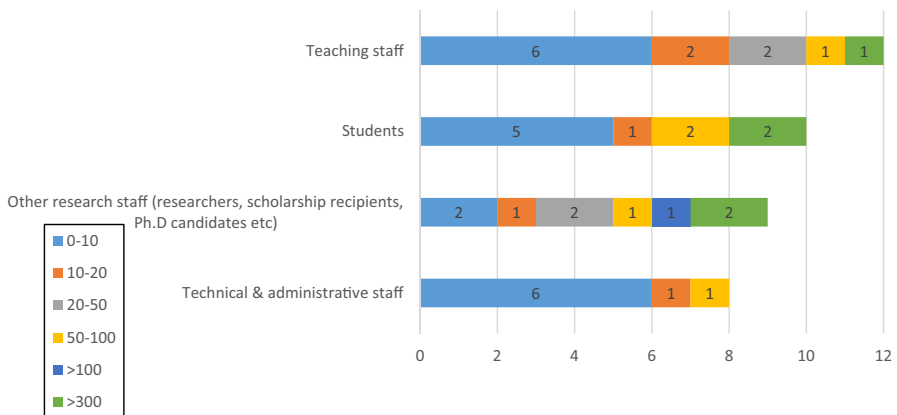


Fig. 5 Please report the number of Technology Transfer services provided to the following population categories in the last 3 years. [presented numbers refer to the 12 institutions probed; numeric range was selected]

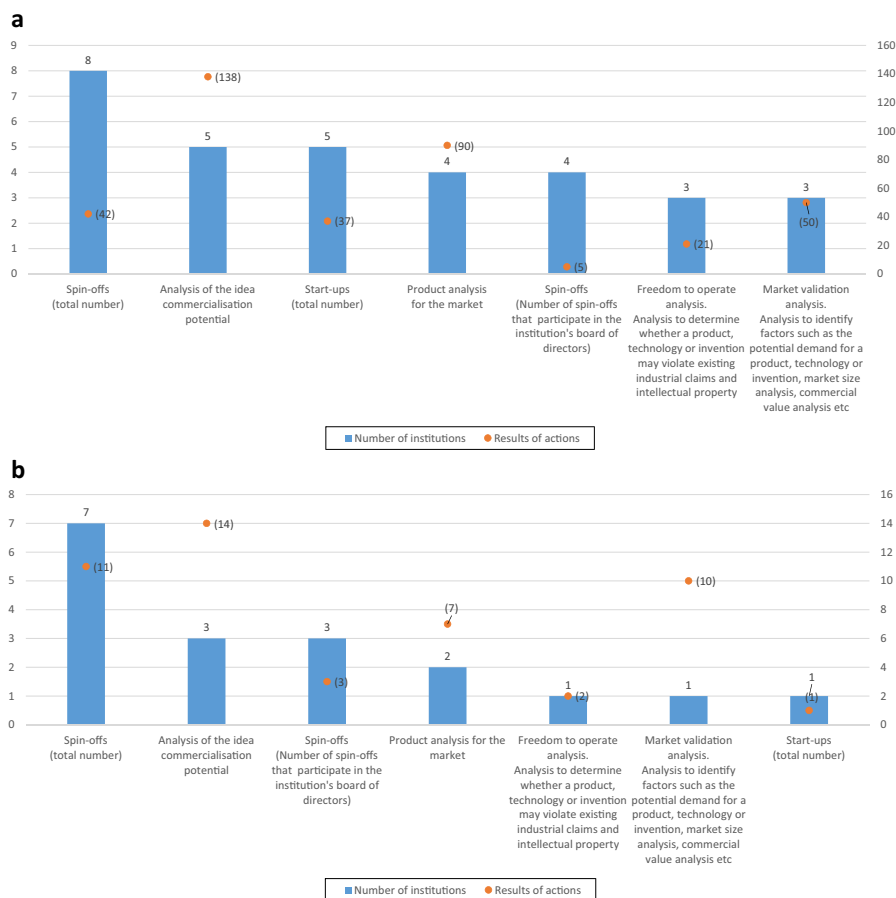


Fig. 6 **a** Please list the Technology Transfer results achieved in the last three years. [concerns every scientific field], [presented column numbers refer to the 12 institutions probed; scatter number refers to the cumulative number in each case]. **b** Please list the Technology Transfer results achieved in the last three years. [concerns the scientific field of Medical and Health Sciences], [presented column numbers refer to the 12 institutions probed; scatter number refers to the cumulative number in each case]

requires the establishment of links and networks between the institution and other organisations, the institutions were asked to record the number of collaborations that have been signed with a number of categories of institutions, inside and outside the country, both public and private. In addition, they included domestic and international research institutes/centres, regions and municipalities, the public sector and enterprises.

The most common type of collaboration is with companies. Specifically, 10 institutions report that they have/are collaborating with 1635 companies. The same number of institutions reported 350 collaborations with research centres. Significantly, 8 institutions indicate that they collaborated with 573 foreign research centres. Finally, 1 institution stated that it has signed memoranda of understanding with financial institutions, yet no additional data were provided.

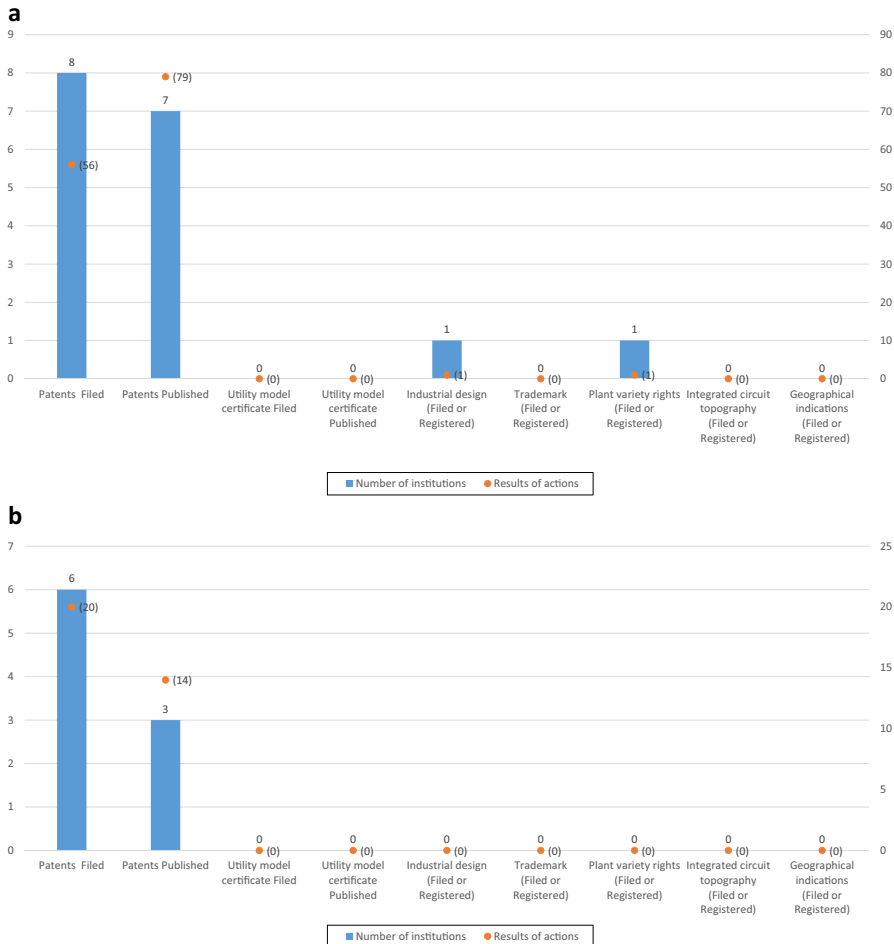


Fig. 7 a Industrial Property. Please list the results of the Technology Transfer-related actions achieved in the last three years. [concerns every scientific field], [presented column numbers refer to the 12 institutions probed; scatter number refers to the cumulative number in each case]. **7b** Industrial Property. Please list the results of the Technology Transfer-related actions achieved in the last three years. [concerns the scientific field of Medical and Health Sciences], [presented column numbers refer to the 12 institutions probed; scatter number refers to the cumulative number in each case]

Links to the Wider Economy (Part 6)

Figures 10 and 11 contain information with regard to TTOs' links with the wider economy, technical and knowledge adequacy as well as support provided by the institutions. In addition, certain considerations of TTO functionality improvement are suggested.

As such, Fig. 10 presents the degree of agreement or disagreement on a number of findings concerning the connection of technology transfer offices with the wider economy. Regarding the viewpoint that enterprises often turn to Greek

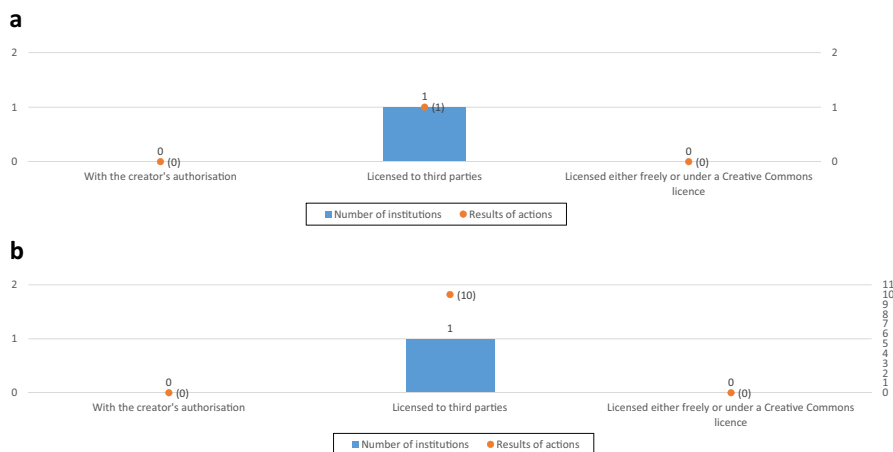


Fig. 8 **a** Intellectual Property (copyright for artistic creations, digital and other content, source code, original databases). Please list the results of the Technology Transfer-related actions achieved in the past three years. [concerns every scientific field], [presented column numbers refer to the 12 institutions probed; scatter number refers to the cumulative number in each case]. **b** Intellectual Property (on copyright for artistic creations, digital and other content, source code, original databases). Please list the results of the Technology Transfer-related actions achieved in the past three years. [concerns the scientific field of Medical and Health Sciences], [presented column numbers refer to the 12 institutions probed; scatter number refers to the cumulative number in each case]

universities and research centres looking for new technologies, only 3 institutions (completely) agree. The rest are either neutral or disagree.

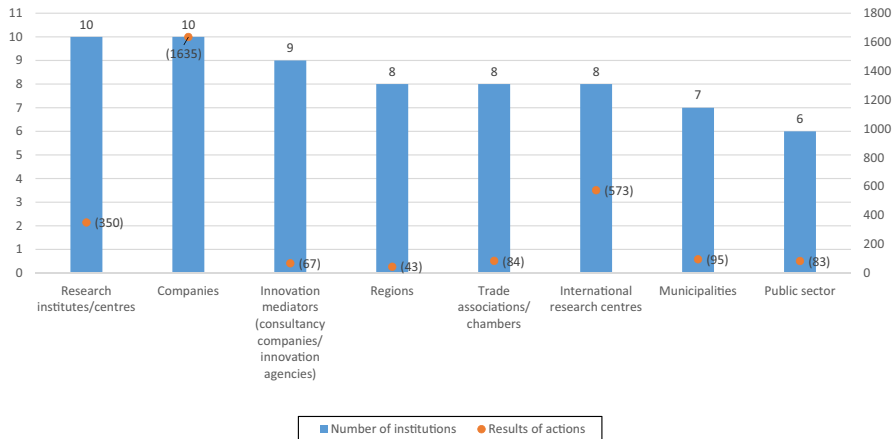
Only 1 institution agrees with the viewpoint that enterprises are aware of the procedures required to submit proposals for co-operation with Greek universities and research centres. The rest are either neutral or disagree.

Oppositely, answers point to an affirmative opinion in terms of whether Greek universities and research centres have the technological ability to offer enterprises new technological solutions. Here, only 1 institution takes a stance against this assertion. One more is neutral. The other institutions fully agree/agree with the above statement.

Similar answers are also given to the question of whether the services offered by Enterprise Europe Network (EEN) contribute to the strengthening of outreach, the development and strengthening of international ties and collaborations of institutions. Three institutions have a neutral view (neither agree nor disagree). The other institutions (completely) agree with the above.

The following figure (Fig. 11) examines the views of the executives of the institutions regarding the degree of agreement or disagreement in relation to aspects such as the existing technical and knowledge competence and the support provided by the institutions.

Concerning the assertion that institutions adequately fund technology transfer activities, only 5 institutions agree. The same number of institutions strongly disagrees/disagrees. Concerning whether institutions have the necessary commercial capacity to effectively manage the technology transfer process, 5 institutions report



Note: one institution answered the signing of MoUs with financial institutions.

Fig. 9 Please report the number of collaborations concluded with the following categories of external bodies in the last three years? [presented column numbers refer to the 12 institutions probed; scatter number refers to the cumulative number in each case] Note: one institution answered the signing of MoUs with financial institutions.

that they (completely) agree with this opinion, 4 institutions disagree while 3 institutions are neutral.

The majority of affirmative responses (simple and complete agreement) were recorded concerning the assertion(s) that the institutions (a) have the necessary legal capacity to effectively manage the technology transfer process, (b) have a clearly defined framework for calculating the participation rates and (c) have made tech transfer as an integral part of its strategy.

Discussion

Given Greece's orientation towards knowledge economy and knowledge valorization being placed center-stage during recent years — and especially after the decade-long economic crisis — an empirical analysis of a crucial aspect of this valorization process had been lacking. Technology Transfer Offices, their performance and a contextual placement within current theoretical approaches have been the prime objective of this paper.

According to the data collected, there is disparity between universities and research centres in terms of the relevant administrative structures providing technology transfer services. In terms of institutional regulations and operational policies, a variety in both the existence per se but also the degree of conceptual and definitional depth is reported. In most cases, institutions indicated that they have finalised or are in the process of finalising their regulations and policies.

In relation to the provision of individual services on the various stages of the continuum between idea creation and economic exploitation, the institutions reported a number

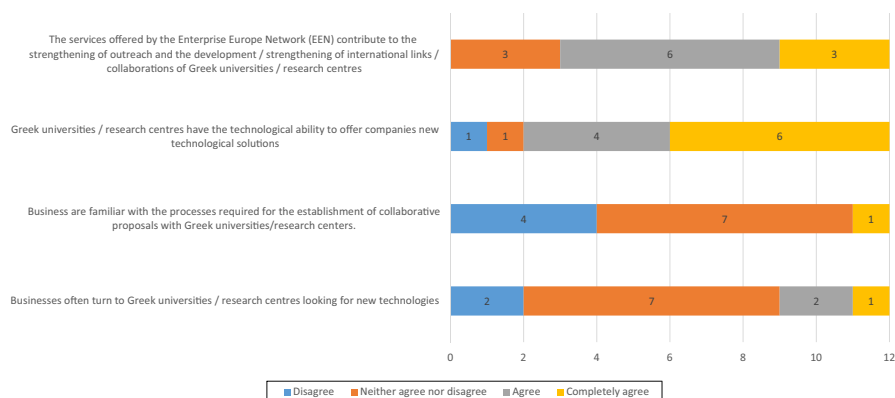


Fig. 10 Please indicate the extent to which you agree or disagree with each of the following statements. [presented numbers refer to the 12 institutions probed]

of such associated services. Of the 12 probed institutions, the majority affirmed its capability in providing such services. Yet, the aforementioned majority refers to a bordering half of the institutions — this indicates an important number of institutions that do not offer such services. Importantly, only a few institutions offer services such as defining the needs and requirements of the potential users/licensees and offering technical advice to support the implementation of new technologies or processes, i.e. services that require a deep, hands-on and potentially time-consuming approach.

The number of services provided for different categories of research and other personnel is numerically significant for only a few institutions. Most institutions report that they offer technology transfer services. However, these services have been mostly offered to population groups of up to 10 people.

In terms of industrial and intellectual property performance, most institutions reported low results. While both start-ups and spin-offs are reported therein, the sheer number of these instances is low. In addition, patents, both filed and published, have also been indicated by several institutions to be granted in their name, yet, these, again, are in very small numbers.

Regarding the networking with other bodies, domestically and internationally, institutions appear to be quite active having concluded collaborations with public bodies, companies as well as international research centres. Overall, with a few notable exceptions in a limited number of aspects that formulate the everyday workings and performance indicators of the examined TTOs, findings indicate an unstructured and underdeveloped ecosystem. Few institutions offer the close-to-full package in terms of tech transfer services and possess the relevant skills and dexterities. This finding, however, rather than offering a bleak image of the whole situation, can, assuming that it is conversed, provide a window of opportunity and significant room for improvement — especially if a global perspective is taken.

Adjacent is the assertion that newly found actions such as the establishment of a dedicated sectoral, scientific council on technology transfer and intellectual property by the National Council for Research, Technology and Innovation (ESETEK, 2021), the premium

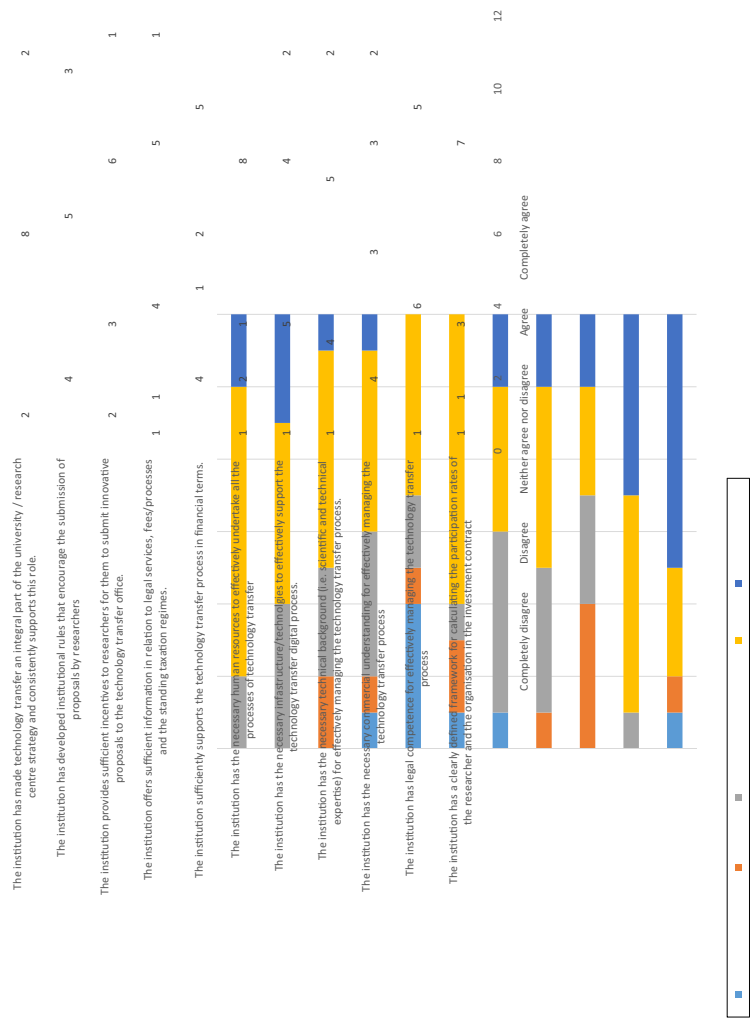


Fig. 11 Please indicate the extent to which you agree or disagree with each of the following statements regarding technical/knowledge competence as well as the support provided for the structure / structures within your institution that deals with the subject of technology transfer. [presented numbers refer to the 12 institutions probed]

placed on technology valorization found within the national strategic documents and bottom-up relevant education activities allow for this optimistic view. The public funding actions aimed to assist universities and research centres to set up and operate technology transfer have been especially useful towards helping institutions establish institutional regulations and policies on patent examination, firm collaboration, etc. (GSRI, 2021). According to all indications, a follow-up funding action focusing on TTOs is planned to be launched end of 2023/start of 2024. This action will help deepen their operation by way of attracting specialised human capital that can cater for the particular needs and characteristics of each knowledge valorization case, thus leading to success stories.

Focusing on the theoretical debates, providing new empirical data on a country case stands as an achievement on its own, especially since Greece is a European country with significant research and scientific capability (see Sachini, Karsmpekios et al., 2020; Sachini, Malliou et al., 2020; Yuret, 2017). For all their inherent differences, this asymmetrical development between science creation and subsequent valorization can be found in Latin American countries (see Crespi & Dutrénit, 2014; Ísmodes, 2015; Fuquen & Escobar, 2018). Given this new evidence, potential cross-country comparisons can be made, while the measurement process as well the results of the follow-up rounds of this process can be considered to be important output indicators for relevant bibliographic analyses. Concerning the valorization of science and technology outputs as part of a sustainable development model where knowledge spill overs through its scientific and technological ‘by-products’ are considered as growth enablers (Qiao et al., 2019), understanding domestic TTO’s strengths and weaknesses provides a guide for ‘unearthing’ hidden assets and/or the increase of the creation rate of new assets. For all their limitations, such Greek intermediary organisations can help penetrate the knowledge filter that limits the total conversion of knowledge into new products, processes, and organizations (Acs et al., 2005).

Limitations

Concerning limitations, our sample focused on institutions active in the Medicine and Health sciences. This does not mean that we did not report on those institutions’ other-than-health performance. Dedicated questions were included in the questionnaire that aimed to explore this wider technology transfer activity. This may be true, yet institutions that are primarily focused in engineering and economic sciences were not included in our sample. While this may raise issues of sample representation, a list of the most renowned and old institutions was included in the survey. A second limitation concerns potential under-reporting by institutions. Something not quite explicitly identified in the bibliography, employed personnel of these institutions (professors, etc.) may under-report their patent activity since such activities (or, other entrepreneurial-related) may have been conducted under their private and not under their full-time employment capacity. A third limitation, as is always the case, is the issue of timely reporting. That is, a time lag between data collection and data reporting remains an open question.

Future Steps (Including Policy Recommendations)

Concerning further research, understanding the monetary valuation of these spin-offs and start-ups, the value of the patents as well as identifying the organisation to which it has been submitted, e.g. EPO, USPTO seems promising.

The number of partnerships that some institutions have entered into appears to be significant. The nature of partnerships is, in fact, multilevel as it includes private bodies, such as enterprises, and public bodies such as regional and municipal authorities. In addition, several collaborations have been concluded with international research centres. In relation to this, a follow-up step is to explore the nature of these collaborations. For example, identify individual features of this collaboration. The same should be done in relation to the local governance system. Especially, its municipal and regional sub-system, since technological solutions of the institutions could be adopted at the regional and municipal level in the context of public innovation procurement. In terms of partnerships with enterprises, it is certainly interesting to evaluate these results with an emphasis on requests for co-operation, the problems that enterprises may have encountered as well as potential gains for the institutions involved. The views of the officials that enterprises do not turn to the institutions when they look out for new technologies is a point worth examining. Why this is not the case is important to explore. Identification of the causes can enhance the sought-after interconnection between businesses and public institutions. Part of the same answer concerns public institutions making available detailed information about the procedures required for the submission of co-operation proposals.

In terms of scalability, the next step is to replicate the survey and include the entire population of Greek universities and research centres. This follow-up will include new variables in light of global trends (see Campbell et al., 2020; Jensen et al., 2009; Choudry & Ponzio, 2019) such as the role of the public sector through public innovation procurement initiatives (Link & Oliver, 2020: Chapter 13; Kattel & Mazzucato, 2018). Similarly, the recent finding that TTOs play an active role in stimulating universities' entrepreneurial capabilities through the provision of science and technology entrepreneurship education (Bolzani et al., 2021) is another potential addition. Also, issues of gender parity, inclusion and potential related disparities should be explored.

The issue of adequate funding for technology transfer activities needs to be addressed. Increasing regular funding for TTO structures is perhaps the most appropriate solution. While the issue of self-financing is still a long way ahead to be addressed, it is important to initiate this discussion. One can hope that the recent (and forthcoming) public funding actions on setting up technology transfer structures will be viewed in relation to ensuring long-term economic sustainability. While project-based funding is an inferior solution due to the cyclical nature of the relevant funding, co-operation with financial institutions should be considered and expanded in all cases where it has already been activated. Potential tensions that may arise, as this type of financing is more competitive and demanding since these institutions invest under the primary motive of profit and safe return or maximising investment, should be addressed on a case-by-case basis.

Concerning policy recommendations, staffing the individual institutions with appropriate personnel, the definition and updating of the institutional regulations and policies and

the funding from the regular/ordinary budget. Herein, the recent public funding actions aimed to assist universities and research centres to set up and operate technology transfer proved to be especially helpful in relation to helping institutions to establish institutional regulations and policies on patent examination, firm collaboration, etc. (GSRI, 2021). Populating these structures can also be based on the positive results on technology valorization by actions taken by the Italian Patent and Trademark Office (UIBM) aimed at increasing the number of employees in the domestic TTOs (Micozzi et al., 2021). These would act as tell-tale signs of the importance attached by both the institution and the state. Further, the administrative ‘alignment’ of the services involved can be achieved by examining the administrative responsibilities of the services and structures identified and redefining them in the context of inter-institutional complementarity and systemic consideration. On these fronts, the upcoming GSRI funding action would help establish a more ‘institutional’ approach to such matters and help attract specialised technology transfer professionals who can cater for the particular needs and characteristics of each knowledge valorization case.

The issue of upgrading the skills (upskilling and reskilling) of the personnel is important. As the human resources involved in this process must demonstrate skills in a variety of subject areas ranging from technological evaluation and assessment to negotiation, communication and persuasion, ways of systematically training existing staff and attracting new personnel should be explored.

In general, the above actions should consider the specifics of each institution, including its scientific direction and orientation, but also the links and needs it serves in relation to local economy, regional development structure and business composition. However, any corrective action taken should be part of a broader development strategy. On this, a highly visible Enterprise Greece platform coupled with increasing amounts of funds being place of start-ups and a focus on catering for industrial needs through, e.g. industrial doctorates present such promising avenues of a comprehensive development strategy. Moreover, it should be contextualised within medium-term, flagship spatial, regional and sectoral development programmes, such as smart specialisation for the next programming period (2021–2027) as well as the planned strategic interventions within the framework of the Development Plan for the Greek Economy. In other words, the optimisation of these institutional mechanisms should be pursued in relation to a number of extra-institutional features.

Conclusion

In this paper, we mapped and explored the performance of a select list of technology transfer offices in Greece. Analysis indicated a variety of characteristics as well as performing conditions. Balancing out the asymmetry between a significant and well-developed research and scientific capability with a less developed technological valorization process that can help exploit research results should be considered as an important policy target in the coming years, especially due to the recent and upcoming funding actions aimed at further enhancing this knowledge valorization process.

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Data Availability The sensitive nature of these data means that they are only available internally. For external researchers, ethical approval may be obtained via formal request and application to the National Documentation Centre (EKT) for a specific research project. Interested parties are advised to contact the corresponding author (nkarampekios@ekt.gr) to discuss the application.

Declarations

Ethics Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Consent to Participate Informed consent was obtained from all individual participants included in the study.

Conflict of Interest The authors declare no competing interests.

Disclaimer This study was initiated within the context of the EIT Health hub in Greece.

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