SETTING UP A TECHNOLOGY COMMERCIALIZATION OFFICE AT A NON-ENTREPRENEURIAL UNIVERSITY: AN INSIDER'S LOOK AT PRACTICES AND CULTURE

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Introduction

The introduction of the entrepreneurial university and the accompanying drive for science to acquire commercial relevance has created tensions (Slaughter and Leslie, 1997; Slaughter and Rhoades, 2000; Ferne, 1995; Bennich-Bjorkman, 1997). One reason is that faculty scientists are nowadays expected to think as entrepreneurs (Lockett and Wright, 2005), and many feel uneasy with both their participation in the commercialization process and the role of University Technology Commercialization Offices (TCO) (Martinelli *et al*., 2008, Louis *et al*., 1989). Considering that the main resource for the creation of entrepreneurial universities is human capital (Guerrero and Urbano, 2012), the way faculty scientists view their role and their respective goodwill toward entrepreneurship and the TCO, must be considered when building an entrepreneurial environment (Krueger *et al*., 2000). Looking into faculty's perceptions is important because they encompass attitudes and values shaping informal rules of interaction in organisations (North, 1990; Vanaelst *et al*., 2006).

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The few studies analysing entrepreneurship among faculty scientists indicate that scientists have raised concerns about the role of markets in influencing academic freedom (Baldini, 2008; Davis *et al*., 2011), especially in terms of autonomy in self-selecting a research agenda and the respective method of dissemination (Jacobsen *et al*., 2001, Davis *et al*., 2011). Their concerns relate to the ways the pressure to patent can skew research priorities at the expense of fundamental research, and shift the attention of faculty away from activities best suited to their skills (Nelson, 2001), forcing universities to behave more like firms. Others fear that university patenting may restrict communication with colleagues (Blumenthal *et al*., 1996; Martinelli, *et al*., 2008), increase secrecy (Blumenthal *et al*., 1986), the withholding of data (Campbell *et al*., 2000), and inevitably limit the dissemination of knowledge (Calderini and Franzoni, 2004; Lee, 2000). This article builds on these insights and offers qualitative evidence about a related category of reasons for the hostile attitude towards commercialization of academic research: lack of a common mindset between TCO's and research faculty.

It frequently escapes attention that the prerequisite for arranging a commercial deal is the existence of shared understandings and orientation towards common goals between the TCO, faculty and industry, so that a TCO assesses potential opportunities and sets up well defined legal relationships between the university and a commercial firm (Kaghan and Lounsbury, 2006). These shared understandings play an important role since faculty scientists are effectively gate keepers that control the informal flow of knowledge that is indispensable to the translation of academic research to products with commercial value (Agrawal and Henderson, 2002; Agrawal, 2006; Thursby *et al*., 2001; Thursby and Thursby, 2002). It follows that faculty's views of the merits of commercialisation and their role in the process can hinder or even sabotage technology transfer. Dispersing myths and addressing suspicion and deep misunderstandings held by communities of practice, such as the community of faculty researchers, is of paramount importance in order to develop a sense of comfort and build trust among faculty and the TCO.

This is particularly true for non-entrepreneurial universities. Lack of shared understandings can make the job of the TCO arduous; equally, not addressing the cultural and moral aspects of technology transfer reproduces suspicion and mistrust. In support of this proposition, the paper presents qualitative evidence from a two year attempt (2013-2015) to instigate entrepreneurship to a non-entrepreneurial university, the Agricultural University of Athens (AUA), whose faculty fully lacked experience in commercialization. Throughout this period K. Sideri was the intellectual property (IP) advisor of the purposefully created TCO at

AUA. The data is based on notes kept by the IP advisor from the meetings with research teams, as they provided invaluable insight into perceptions and ways of thinking about the commercialization project. In total there were around 30 such meetings. Further notes emerged from informal discussions with management and others involved in the commercialization program.

Observant participation provided the opportunity to see beyond what Erving Goffman refers to as 'front stage' behavior, the social front that interviewees present to outsiders, and gain access to elements comprising 'back stage' behavior of a community of practice (Goffman, 1990). At the same time, being an IP advisor meant that there was a clear division of labor (i.e. the IP advisor was not one of them [research teams], but at the same time the IP advisor was not an outsider), the problem of 'going native,' becoming too involved in the community under study and losing objectivity, was avoided.

An important aspect of the role of IP advisor at AUA involved the dispersion of myth and aversion of suspicion between faculty and the TCO. To this effect, a lot of time was spent educating individual faculty scientists on commercialization related issues. There was good reason for that, and as the article will argue in detail, it proved of importance to the young TCO's attempt to establish itself.

For example, since faculty had no experience in commercialization, it was important to build trust by explaining what the university's social mission is and if this mission conflicts with the university's commercialization role. In short, concerns relating to how markets may affect academic freedom needed to be addressed (Davis *et al*., 2011). Yet, building trust was not enough. It became necessary to simultaneously train faculty in understanding market issues and procedures that many take for granted e.g. why, when (and if) we need patents in order to commercialize faculty inventions.

The need for education is not unique to AUA. In order to allow academics to strengthen their entrepreneurial skills and capabilities (and gain a better understanding of the needs of enterprises and industrial organizations) entrepreneurial universities offer related education and exchange programs, and adopt collaboration strategies between university and industry (Lee and Win, 2004; Guerrero *et al*., 2014). These initiatives constitute a valuable mechanism in promoting entrepreneurship because they help improve faculty skills, attributes, abilities, behaviour and knowledge (Kirby, 2005). The need for training was recognised from the beginning by the TCO at AUA, which organised an extensive educational program that allowed faculty to learn about commercialization and interact with experts and practitioners.

However, the seminar approach of this program was not suited to its purpose, because most faculty scientists lacked even an elementary understanding of the role of markets and market instruments like patents in the commercialization process. When scientists lack an understanding of the way markets operate they are likely to be unable to assess the commercial relevance or value of their IP (Vohora *et al*., 2004) and therefore less likely to engage in technology transfer. For example, at AUA even mundane tasks like drafting the invention disclosure forms (IDF) (which enable the TCO to see what can be protected by IP rights and eventually identify commercialization partners) were arduous for faculty and plagued with "noise" that hindered a thorough assessment of the disclosed technologies. As a consequence, it was important to explain the fundamentals of patentability, how markets work, and even coach them in strategy by offering pointers about when to patent and when not to.

Overall, the active involvement of AUA faculty in the patenting process (that is often taken for granted) had to be gradually developed through educational initiatives. The difficulty understanding the issues involved in commercialization is no doubt the result of both lack of experience and the absence of a vibrant economic and industrial environment with relative skills and expertise in the periphery of the AUA. After all, as Martin (2012) argues a university is the product of its surrounding economic and industrial environment, which in this case was agnostic about technology transfer.

It comes as no surprise that the research teams involved in commercialization, when asked to assess the work of the TCO, praised it. This is of importance because most TCOs are not immediately successful in generating income for the university (Swamidass and Vulasa, 2009; Bulut and Moschini, 2009; Heisey and Adelman, 2011), therefore for a young TCO the only hope of survival rests in the support it gets from faculty.

Building a TCO at AUA

In Greece, public research institutions and universities are insulated from commercial considerations. This is indicated in the extremely low number of patents and quite low industry financed public R&D (OECD, 2014). Even though the national strategic plan for development of research, technology and innovation (2007-13) sought to reverse this trend and encouraged the development of TCOs in universities, in practice university technology transfer and commercialization is still at its infancy. Against this backdrop, the creation of a TCO at AUA was conceived from the start as an experiment on how to jumpstart

entrepreneurship in an economic and industrial environment that lucks all experience and infrastructure relating to technology commercialization in general. Accordingly, the TCO at AUA was established in 2013 after the research team behind the initiative was awarded the grant "Innovation and Entrepreneurship – Valorization of Research by the Agricultural University of Athens." (Reference No: 464052) from the Municipality of Athens, in order to try and create a TCO for a two year period.

The young TCO employed a staff of four (two women and two men). Following a long established tradition in TCOs the head of the TCO was not a lawyer. The head of the TCO was an academic with no prior experience in commercialization who underwent a thorough training from external experts and consultants.

In the two-year period of operation the disclosure rate at AUA was impressive. The TCO, managed to attract 42 disclosures out of 176 faculty members. To put these numbers into perspective, Thursby and Thursby (2007), in their study of disclosures at six US universities over 17 years, find that on average 7.1% of faculty members disclosed per year, and 80% of faculty either never disclosed or disclosed only once in the seventeen year period.

Considering that innovation plays a limited role in the agri-food system (Knudson *et al*., 2004), this big turnout may in part be attributed to enthusiasm about something novel that can benefit society while valorizing existing research. However, it was equally evident that faculty scientists lacked an understanding of what had commercial potential and what kind of commercial potential. As a result, many faculty scientists disclosed what they thought to be good ideas with potential for scientific publications. Moreover, it soon became evident that sustaining the initial enthusiasm would require a lot of work on the part of the TCO. The following section will look into this last point in more detail.

TCOs, Culture and Social Interaction

The IP advisor was assigned six research teams with promising technologies. Working with them involved face to face interaction, frequently using skype. The purpose of these meetings was to discuss the details of each team's technology, so as to decide if and how they can be protected. These discussions did not only aim at eliciting information to formulate correct legal advice. They also had a strong educational component. In fact, the two roles (legal advice and educational) interlaced: Interactive meetings with research teams had an educational component in the sense of answering questions relating to patenting and other protection methods and discussing the teams' present and future research to see what

can be protected by legal rights. Perhaps more importantly for the long term goals of the commercialization program of the university, meetings with the research teams proved invaluable in addressing hidden suspicion about the role of the University and the TCO, and the reasons for commercializing university technology.

The educational component makes more sense if we see the work of TCO managers as also involving the fostering of a proper work environment (in cultural and technical terms) in which the signing of a technology transfer contract can be jointly performed by university and industry employees with a minimal account of friction. This is a process that requires the successful meeting of minds between the TCO, researchers and industry bearing in mind that a technology transfer contract has both a legal aspect, the definition of legal rights and permissions, and a moral aspect, the translation of a technology into a useful application (Kaghan and Lounsbury, 2004).

This meeting of minds is not straightforward considering that most faculty disclosures involve embryonic prototypes of inventions (Thursby and Thursby, 2004; Thursby *et al.*, 2001), which frequently need active faculty involvement in their development (Agrawal and Henderson, 2002; Agrawal, 2006; Thursby *et al*., 2001; Thursby and Thursby, 2002). In a sense faculty scientists are effectively gate keepers that control the informal flow of knowledge that is needed for commercialization. At AUA the need for building a collective mind was imperative. The young TCO was established in an academic environment that was research active but lacked entrepreneurial spirit, hence the importance of building trust towards the TCO's activities. Although there was a big turnout of researchers who disclosed their technologies to the TCO when it began operating, the reason may be that researchers perceived the process as a challenge to contribute a discovery with social and commercial value. However, the TCO management believed that the continued success of the TCO was dependent upon persuading faculty about the compatibility between academic and commercial endeavors and the ensuing benefits of having a TCO in place.[2]

To achieve this goal, from the beginning, the TCO actively tried to educate the AUA's administration and faculty. It did so by inviting two international acclaimed external experts who presented a set of seminars that fully outlined all aspects of University technology commercialization. Throughout these seminars poor attendance was notable. This accords with findings that show that successful technology transfer and commercialization require a particular cultural atmosphere of entrepreneurship (Gold, 2012). It is face to face

[2] This emerged from various discussions with the management. Also see Owen-Smith and Powell (2001).

interaction with individual research teams that proved invaluable in this respect, as they provided the opportunity to explain the moral and legal component of a technology transfer contract.

The Six Research Teams

As mentioned earlier, the IP advisor was assigned six teams with promising technologies. These six teams are the focus groups of the present study. It is useful to group the six teams in two major groups with similar characteristics. Two teams had already commercialized their technologies in the past: One team had signed a material transfer agreement with a private company (through the University) and the leader of the second team was in the process of obtaining a European Patent Office (EPO) patent for research outside the University. These two teams were more advanced in comparison to the rest of the teams (four in number), which were just beginning to entertain the idea of commercialization. The two 'advanced' teams we label them 'group A' and the four 'beginner' teams we label them 'group B'. This classification is important: There are major differences in the ways groups A and B responded to the commercialization program of the AUA.

Generally, group B not only had a poor understanding of what can be commercialized and how, but also what the reasons for disclosing their research are, what the role of the TCO and the University is, and what their role as researchers in the process of commercialization is. In short, they had a very fuzzy idea about both the reasons why we are doing this commercialization project and the ways we can commercialize technologies and ideas. Group A were entrepreneurial and more conscious of their roles as researchers and inventors but lacked understanding of the legal aspects.

Let us give a first flavor of the main observations, which will be discussed in more detail in the following sections: Two of the four teams in group B were overly skeptical and unwilling to cooperate initially. One researcher in group B asked: '*How does this violate my integrity as a scientist?*' The culture of entrepreneurship is viewed by some academics as posing a threat to the integrity of the university, the norms of pure science and their role as independent critics of society (Etzkowitz *et al*., 2000). Another research team in group B begun not being at ease with the commercialization project when they thought it was taking time from their research, and it is for this reason that they initially viewed meetings with the IP advisor as nuisance. All the teams in group B had a poor understanding of the dividing line between basic research and what can be commercialized. One researcher stated: '*I do what I*

always do in the lab, why should I start thinking in a different way?' Moreover, they had no understanding of how commercial research may violate the rights of third parties or what is protected by a patent.

During the evaluation stage of the TCO all the teams in group B acknowledged that meetings were useful and an important exercise[3] and that having an entrepreneurial mind need not be incompatible with being research oriented. At the same time, there are some things that we are allowed to do in research but not when we compete with others in markets. The friction and symbiotic relationship between the two worlds, entrepreneurial and academic, was a recurring theme in all discussions, but especially prominent in discussions with group B.

With regard to group A, one research team had signed a material transfer agreement, and to this effect it was given solid advice by the AUA's legal advisor[4] before the beginning of the two year commercialization program. The other team in group A did not have access to specialized IP advice before the beginning of the program. For this reason, although they were entrepreneurially inclined and had even drafted themselves a patent application to the EPO and the Greek Patent Office, they still had a very poor understanding of legal and practical issues. It is not surprising that when asked to evaluate the program this team said that the service they valued the most was IP advice and training.

This group even disclosed to the IP advisor the technologies they had tried to commercialize while bypassing the university, because they needed advice. Since all this technology was developed prior to the formation of the TCO, it seems that AUA faced minimal TCO bypassing (Markman *et al*., 2005, 2008). This is good news because diminishing such opportunism is hard (Panagopoulos and Carayannis, 2013), to the detriment of university licensing revenue (Markman *et al*., 2008; Thursby *et al*., 2009). However, it follows that one of the reasons they would not bypass the TCO was that they needed solid legal advice and strategic analysis which was very expensive outside the TCO in Greece, and for this reason they thought that the TCO was offering very useful services.

[3]Evaluation of the TCO was performed when the 2 year program ended by an independent academic from a UK University.
[4] The legal advisor of the University is a civil servant who gives general legal advice on university matters. They have no IP law specialization.

Dispersing Myths and Suspicion - the social mission of Universities and commerce

Most of the discussions begun with explaining the special role of Universities. It was important to explain to them that, indeed, concerns about compromising the public aspects of academic research led policy makers to insulate universities from commercial considerations in the USA and Europe in the past. This changed in the USA in 1980 with the Bayh-Dole Act (Siegel and Wright, 2015), which passed to facilitate commercialization of university inventions, and Europe slowly followed these developments. However, the rationale behind this policy change was not to allow universities to make money. This completely misunderstands the role of universities and their mission, but it is true that many universities do not have a clear statement on the issue (Lemley, 2007). The prevailing view in academic circles and funders is that universities are publicly funded institutions and the commercialization of university technology aims at bringing a useful product to the market quickly. It is in this spirit that TCO's are set up to assist in the translation of university research and license IP rights held by the university.

Our conversations then focused on the reasons why IP rights are considered to be important to attract private investment, without neglecting to consider the thorny question of patentability of university inventions in various fields of research.[5] However, having a general seminar on these issues fails to convey the complexity of the question of IP rights on university research. There is little evidence that increased university patenting and licensing has facilitated technology transfer (Sampat, 2002; Mowery *et al*., 2001) and at the same time, there is no systematic evidence that the growth of IP rights on academic research is affecting academic research in a negative way (Aghion *et al*., 2008; Williams, 2010). Much depends on the field of patenting, on the breadth of the claims of the patent, and on the problem of patenting too early, as university patenting has moved upstream into the realm of science, and University TCO's should make responsible decisions focusing on the particularities of each technology to assess if, how, and when we should protect it by individual rights. In terms of dispersing myths and suspicion and for the purposes of training it was important to discuss these aspects of social responsibility and what it means in the context of IP rights held by universities.

It is useful to briefly refer to the characteristics of the technologies developed by the six groups. One research team in Group A had an apparatus using biotechnology to detect

[5] Such as DNA sequences and research tools.

chemicals in food, and another research team had biological material for use in the food industry. The research teams in Group B had a food recipe using edible films and having health benefits, a chemical for preserving dried plants, a method for measuring oil acidity, and a mobile veterinary unit. In the case of biological material (which was already commercially exploited by means of a material transfer agreement) there were legal and ethical issues pointing against IP rights, but the material was still tangible property of the University. The other technologies did not raise such issues. Yet, we discussed ways to think about socially responsible licensing such as including terms that require the licensee to meet certain performance obligations and to make financial payments to the University.[6]

Finally, the researchers wanted to know more about technology transfer offices and the differences with the model of technology transfer based on professor's privilege (Audretsch and Goktepe-Hulten, 2015), what the critique of TCOs is (Rai and Sampat, 2015) and what the tendencies are in the US and Europe (Valdivia, 2013).

Dispersing Myths and Suspicion – being an inventor and a scientist

An Invention Disclosure Form (IDF) is a written description of an invention or development submitted to the TCO. It is a confidential document marking the beginning of the commercialization process, enabling us to see what can be protected by IP rights and identify commercialization partners. Researchers are typically asked to disclose technologies that solve a technical problem or have commercial value, and TCOs advice researchers to avoid making presentations or publications of the disclosed invention. Faculty at AUA drafted Invention Disclosure Forms (IDF) enabling the TCO to see what can be protected by IP rights so as to eventually identify commercialization partners. However, these IDFs were plagued with 'noise' that hindered a thorough assessment of the disclosed technologies and a result, research teams did not describe their technology giving the details we needed so as to see if and how it can be protected. For this reason, the teams were given a separate form to fill up asking specific questions about how the technology works: *What parts or steps make up the invention, in its best form? What does each contribute to the invention? Which parts are new to this invention, which are old (conventional, used in the expected way)? In what way do the parts interact to make the invention work? Which part is essential to the invention*

[6] See the Association of University Technology Managers (AUTM) Nine Points to Consider in Licensing University Technology available at http://www.autm.net/AUTMMain/media/Advocacy/Documents/Points_to_Consider.pdf. Note that the intellectual property advisor was not involved in drafting contracts.

(if this part was changed or left out, would the invention still work). Can you describe equivalents, alternative uses, and limitations of the invention?

Answering these questions was not easy, but the teams in both group A and group B found it a useful exercise. They were being introduced to a way of thinking about patents and patenting that helped them understand basic but otherwise confusing '*legalese*', the formal and technical language contained in legal documents such as inventive step and other requirements of patentability. Indeed, in the end all but one team in group B were willing to get a patent. The teams which were told they could not apply for patent protection felt they were not good enough, as they considered patenting to be a metric of academic merit and prestige. It had to be demonstrated to them that a Nobel prize winner may not qualify for a patent, as the criteria of patentability are not fulfilled in the case of basic research with no applications identified yet or basic research that needs further development. Then again, a very simple idea developed into a useful application by a layperson may qualify for patent protection when it solves a long felt but unsolved need, there is failure of others to solve the technical problem, and the invention has unexpected results.[7]

Overall, the willingness of the research teams to cooperate with the TCO increased for both groups A and B when they realized that the commercial prospect need not take up a lot of their time due to the TCO doing the hard work, and need not be incompatible with their research plans or the research profile of the group.[8] In this respect, learning to read patent documents proved to be a particularly useful exercise. For example, one team in group B did an extensive patent search in the field of chemistry using the EPO's database under the guidance from the IP advisor. In fact they found a recent patent describing processes that they have tried in the lab but never thought of patenting. Although many legal scholars think that researchers see no value in reading patents, two teams in group B and one team on group A agreed that patents disclose information that is technically useful to researchers in the same way as a good literature review of scientific publications (Ouellette, 2012). In particular they thought that reading patents is useful because one can see how others have approached particular technical problems and helps identify trends, see what others have not tried, and avoid going down certain research avenues. In some cases, they found details about how to perform an experiment that were not described in academic publications. In short, the research teams were introduced to the idea that an inventor needs to be familiar with prior art and should not leave the relevant search solely to the TCO, an idea that proved to be received

[7] Haberman v. Jackel International Ltd [1999] FSR 683 (Great Britain).
[8] On this point also see Thursby and Thursby (2002).

positively. An important point that emerged in these discussions is that they all found patent claims to be overly broad and in many cases patents did not sufficiently describe the disclosed invention.

Non-obviousness and other confusing 'legalese'

One team in group A had already patented their research and we needed to see if we can get a follow-on patent. Even group A (both exceptional scientists and entrepreneurially minded) needed a lot of coaching to understand the criterion of non obviousness in patent law. Although they had experience with commercial dealings, they showed little understanding of legal aspects, which is of course unsurprising. As already mentioned, one research team had drafted a patent, but they did so without legal counseling and for this reason the patent was weak. In this respect, they found the TCO as the only way out of the conundrum, acknowledging that they are finally getting solid legal advice and training in thinking about inventiveness and the basics of patenting. To this effect, they were introduced to the EPO's way of thinking about non-obviousness, and were asked to prepare a list with similarities and differences with prior art, and identify the reasons why the step taken in solving a particular technical problem is non obvious to the person skilled in the art.

In group B there were two teams whose inventions consisted merely in the juxtaposition of known devices or processes. In both these cases, the inventions could not be protected by patents because the combination did not produce unexpected results.[9] The rationale behind this is that a 20 year state monopoly cannot protect combinations that are no greater than the sum of their parts (and therefore produce no unexpected results). The combination of known processes or devices may in fact require creativity, tacit knowledge and resource employment, and it certainly does not consist of mere copy pasting, yet lowering the threshold of patentability would impose an unnecessary constrain in the flow of knowledge in the public domain. In short, it was necessary to train the research teams in understanding the basics of both when to patent and when not to patent. Stressing the social responsibility of university researchers was balanced against training to increase the

[9] To illustrate non obviousness in combination inventions an example from the European Patent Office practice notes was used which the teams found very useful: Example 1: Machine for producing sausages consists of a known mincing machine and a known filling machine disposed side by side. *Requirement of non obviousness not satisfied*. Example 2: A mixture of medicines consists of a painkiller (analgesic) and a tranquillizer (sedative). It was found that through the addition of the tranquillizer, which intrinsically appeared to have no painkilling effect, the analgesic effect of the painkiller was intensified in a way which could not have been predicted from the known properties of the active substances. *Requirement of non obviousness satisfied*.

willingness to patent, reflecting the differences between the commercial world and the university.[10]

Two teams had drafted patent applications on their own without using the services of patent attorneys (one in group A and one in group B), but lacked basic understanding of patent law, for example they did not know that patents confer territorial rights (hence the importance of having a business plan), that from the date of application there are important deadlines to observe, and that the Greek Patent office functions more like a registration office. Moreover, they did not know that there are many strategic reasons for not applying for a patent, even if an invention fulfills the criteria of patentability, and had no understanding of costs, which is around 32.000 € for an EPO patent.

Conclusions

The Bayh Dole Act has opened the way to the entrepreneurial university (Grimaldi *et al*., 2011; Siegel and Wright, 2015). However, considering that entrepreneurial universities are still concentrated around the US and Western Europe, this paper offers qualitative evidence as to transaction costs that may limit the global appeal of such institutions (So *et al.*, 2008; Sampat, 2009; Mowery and Sampat, 2005).

The main finding is that, at AUA at least, faculty's views on the merits of commercialisation and their role in the process were instrumental in hindering or advancing the goal of technology transfer. In response, the TCO educated faculty scientists on the basics of commercialization and was called to address key troubling moral and cultural aspects of technology transfer. Education proved fundamental in addressing frictions deriving from the uneasy relationship between commerce and science, gain faculty's trust, and allow for a meeting of minds between faculty and the TCO. Only when a collective mind had been built did it become possible for the TCO to progress beyond disclosure and attempt to patent and license its technologies.

[10] The same concerns with regard to social responsibility and the public mission of university were raised in the context of trade secrets (information that is treated as a secret because it provides a person or entity with a competitive advantage). Although some aspects of the technologies of two teams in group B could be protected by trade secrets, generally universities avoid this route because it conflicts with their mission to freely publish and disseminate knowledge for the benefit of mankind.

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