Development and implementation of an approach for promoting technology transfer in agri-food

Introduction

Since people started switching from scavenging for food to producing it, agriculture has always incorporated innovation. However, formal commercial and governmental systems of study and development of innovations did not become widespread until the 20th century (Kalaitzandonakes et al., 2018). However, innovation continues to be a challenge for the Agri-Food Industry, concerning the main economic, social and demographic issues and ensuring the competitiveness of most companies through identifying opportunities that follow policies and European Union regulations. The need to enter new markets and increasingly knowledgeable and demanding consumers have led companies in the sector to invest in R&D and innovation, resorting to Higher Education Institutions (HEI) as a source of technology and knowledge (FAO, 2018). However, the methodologies that need to be used to approach stakeholders and promote technology differ from the other sectors, emphasizing events and a close relationship between researchers and the business community. On the other hand, the validation of technologies, namely in the productive component, is much more time-consuming and must comply with a set of specificities that are very different from those of other sectors (FAO, 2018).

The economics literature highlights two mechanisms by which information becomes a driver of company competitiveness and transformation. Creating new knowledge is the initial step in developing innovative, commercially feasible solutions. The second is disseminating current knowledge via various formal and informal means (Kastelli et al., 2018). Interaction between people or other entities (groups, organisations) is essential for articulating and amplifying knowledge. It can also quicken the pace of innovation by enabling rivals to build on the achievements of earlier innovators rather than obstructing their development (Nonaka, 1994).

Given such obstacles, and with an eye on the importance of technology transfer, the question we investigate in this paper is what universities can do to strengthen knowledge transfer from academia to industry, specifically in agri-food. This study's objective is to present a methodological approach capable of promoting the valorization of knowledge and technology developed in academia to stimulate their transfer to the industry and to promote UIC. The proposed approach is based on developing and implementing a program designed to support academic researchers in approaching the industry and transferring knowledge and technology to the industry. The proposed approach is focused on the specificities of the agri-food sector. These specificities are acknowledged in the literature, but there is a lack of research on how to address them.

Literature Review

Technology transfer is complex and involves many intricately related components, including tacit and implicit knowledge and technology (Calcagnini & Favaretto, 2016). Universities may encourage faculty, support technology transfer, assist in university-industry collaboration, or participate in regional and local economic development initiatives to foster innovation and entrepreneurship activities (Carayannis, Grigoroudis, et al., 2018). In this context, universities integrate national (and regional) innovation systems also by implementing processes linking knowledge application, knowledge use, and knowledge diffusion from university to industry (Carayannis et al., 2015; Carayannis & Campbell, 2010), contributing to the entrepreneurial university (Etzkowitz et al., 2000).

Although knowledge and technology transfer from university to the industry is common in many sectors, such as computer technology and life sciences, agriculture is typically not very strong. Even though there are examples of effective technology transfer in agriculture, these instances are not the norm (Hoenen et al., 2018). However, results show that the returns on investments in agri-food R&D are considerable (Alfranca & Huffman, 2001; Fuglie & Toole, 2014) and that both developed and, perhaps more significantly, developing economies gain from these efforts. The difficulties in technology transfer in agri-food are caused mainly by characteristics of the sector itself (Hoenen et al., 2018). Technology transfer procedures in agri-food are complex by the open innovation character of the sector, which has fewer absorption capacities than other economically active sectors due to the nature of its businesses (Carayannis, Rozakis, et al., 2018).

TT Approach

Technology Transfer, as a model, involves key elements, processes, behaviours, and social factors. Modern adoption paradigms are based mainly on the Diffusion of Innovation Theory, developed by E.M. Rogers in 1962. Rogers said that the spread of a new idea is influenced by communication channels, besides innovation itself, time, and a social system (Everett M. Rogers, 1983). Rogers stated that "diffusion is the process by which an innovation is communicated through certain channels over time among the members of a social system" (Everett M. Rogers, 1983, pp.5). On the other hand, communication is "a process in which participants create and share information with one another in order to reach a mutual understanding" (Everett M. Rogers, 1983, pp.5).

The Bozeman models share the same elemental distribution (Bozeman, 2000; Bozeman et al., 2015). The "message," which for the TT process is technology, scientific knowledge, or any research result, can be presented in a variety of ways ("transfer medium"), and the transfer process can be carried out by a variety of mechanisms. The adoption of technology and the comprehension of their major issues are essential for making technology

transfer successful. This is one of our approach's vectors – the technology communication in the TT process.
Another mechanism for Technology Transfer is university entrepreneurship. In contrast to the past, when universities passively licensed their innovations, many research universities are now actively looking for methods to channel proprietary technology to maximise rents and create new businesses (Markman et al., 2005; Rothaermel et al., 2007). The creation of spin-offs plays an essential role in this, as they allow to bring early-stage technology produced in institutions to market (Boh et al., 2016). The second vector of our approach is university entrepreneurship.

The approach proposed in this paper is based on the importance of the diffusion of technology and university entrepreneurship. Therefore, it consists of two vectors (Figure 1):

A. Communication and diffusion of technology to be transferred. It is materialised by A) the development of communication material for a set of technologies to be transferred and the dissemination of that material, and B) the promotion of such technologies using a combination of strategies;
B. Academic entrepreneurship. It is materialised by implementing a pre-acceleration program for students and researchers.

Both vectors were articulated with the regional innovation ecosystem. It is implemented by coordinating the TT activities with the innovation stakeholders and initiatives.

Figure 1. Vectors of the proposed TT approach.

Methodology

For testing the proposed approach, it has been applied to a specific case with the development of a technology transfer program in one academic

research centre that develops R&D+I and educational activities in the agri-food sector.

The case study methodology

The case study research methodology has the right qualities to fit the objectives of the defined work and to structure the research design, which seeks to explain interactions between various factors that manifest themselves in a developing real-world context, within a well-defined occurrence, in terms of both the organisational framework and the time frame, and with less control of the researcher (Yin, 1994, Miles and Huberman, 1994). The case study should include the many innovation process participants, consider different points of view, and enable data analysis from numerous angles (Tellis 1997). Investigating a current phenomenon in its actual environment of occurrence using an empirical approach is particularly intriguing when the distinctions between phenomenon and context are not immediately apparent. (Yin, 1994).

The case study was developed at The Research Center: CBQF – ESB-UCP (Porto-Portugal). It develops research in Agri-Food, Nutrition, Health and Environment.

A set of instruments were designed to collect data, interviews with key staff involved, observation and field notes from research project presentations, business project presentations, coordinating meetings, training sessions, coaching services, seminars and networking events. Relevant documentation was also collected as activity reports, management reports, evaluation reports, project portfolios, project proposals and business presentations.

Results and Discussion

Implementing the approach

The proposed approach was implemented through a project for the transfer and economic recovery of scientific and technological knowledge for the agri-food sector, based on R&D projects and respective outputs and curricula for advanced studies, promoted by two Portuguese universities – Universidade de Trás-os-Montes and Alto Douro (UTAD) and Universidade Católica Portuguesa no Porto – Escola Superior de Biotecnologia (UCP-ESB). The project included four actions aligned with the two vectors proposed : Content Creation and Dissemination of R&I, National Promotion of Technology Transfer, International promotion and participation in innovation and technology transfer networks, and Economic valorisation of knowledge through academic entrepreneurship

The project contributed to the sustainability of the technology transfer to the agri-food sector by promoting: the dynamism of the University-Company interface, which was self-promoted based on the results; the

consolidation and opening of national and international knowledge transfer channels that, once explored, are more viable to maintain; the establishment of practices of economic valorisation of knowledge, with the body of researchers, in areas that have a temporal relevance and are easier to institutionalise in the context of a research program and postgraduate studies and, also, by the structuring of know-how associated with the processes inherent to the pre-acceleration program that will be more easily reproduced in the future.

The approach that was followed contributed to the progress of the valorisation of three technologies, which ultimately will contribute to its transfer from university to industry.

Conclusion and Implications

The TT approach proved easy to implement and replicate among PhD students and researchers in biotechnology, food engineering, environment, and nutrition. It allowed participants to consolidate and develop skills and knowledge, complementing their training in management/ entrepreneurship/ marketing through the development of business and marketing plans for their products. It allowed innovation in the agri-food and environmental sector through the development of new products or optimisation of processes, also valuing the results of research/doctoral activities.

For future avenues of research, the proposed approach should be revised to include one more vector – the development of proofs-of-concept that will answer specific industry answers concerning each technology.

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