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**Personnel motivation in knowledge transfer offices:
The role of university-level and organizational-level antecedents**

Abstract

Knowledge transfer offices (KTOs) have become key actors in economic growth, innovation, and social and technological progress. Accordingly, scholars have dedicated increasing attention to KTOs' activities and performance. Surprisingly, these topics have mainly been addressed at the macro level through environmental and institutional variables, while scant attention has been given to the effect of micro- and behavioral dynamics on KTO outcomes. By considering four Italian KTOs, our paper aims to better understand the motivational aspects of KTO employees—and particularly the antecedents of such motivation. Focusing on self-determination theory (SDT), we link the three basic needs (relatedness, competence and autonomy) that explain KTO employees' intrinsic motivation to specific university-level and organizational-level antecedents. With regard to the former, we show that university government plays a key role in satisfying the need for autonomy among KTO personnel, while KTO organizational antecedents are more important in addressing the needs for competence and relatedness.

Keywords: technology transfer, self-determination theory, intrinsic motivation, psychological needs, KTOs

INTRODUCTION

More than 40 years after the introduction of the Bay-Dole act in the US, many scholars around the world have examined knowledge transfer offices (KTOs) as intermediaries between producers of knowledge and inventions (i.e., university scientists) and the actors who can commercialize those outputs (i.e., firms, entrepreneurs, and venture capitalists). KTOs can help sustain economic and technological growth by improving university-industry relations (Chau, Gilman & Serbanica, 2017; Villani, Rasmussen & Grimaldi, 2017), as well as commercializing academic research toward possible market innovation through out-licensing of university patents and/or spin-off creation (Brescia, Colombo & Landoni, 2016; Zhou & Tang, 2020).

KTOs have been analyzed with respect to their characteristics, their actions, their activities and how they influence the effectiveness of the process through which knowledge originated by public bodies is then transferred to the marketplace (Siegel, Waldman & Link, 2003). Siegel et al. (2003) explored the productivity of 113 KTOs and highlighted the fact that environmental and institutional factors explain most of the variation in KTO efficiency. Other studies have pointed out the importance of KTOs increasing their effectiveness by bolstering their reputation and legitimacy (O’Kane et al., 2015). All in all, we find that the existing literature has paid attention to different factors, but mostly focused on macro-level dynamics (i.e., institutional and organizational) (e.g., Battaglia, Landoni & Rizzitelli, 2017; Zhou & Tang, 2020); meanwhile, limited attention has been paid to micro-process and micro-organizational factors that can have a huge effect on performance outcomes. Intrinsic motivation is one such factor that has not been sufficiently explored.

This is somewhat surprising, given the relevance of intrinsic motivation to work performance (Brief & Aldag, 1977; Cerasoli, Nicklin & Ford, 2014; Grant, 2008; Hackman &

Oldham, 1976; Menges et al., 2017; Piccolo & Colquitt, 2006; Shin & Grant, 2019). Intrinsic motivation makes effort less daunting, thus leading employees to work harder, smarter, longer, and more productively (Gagne & Deci, 2005; Menges et al., 2017). If employees are not motivated to fulfill their tasks and achieve their goals, the organization cannot attain success (Barney, 1991; Dobre, 2013). If intrinsic motivation is low, even the most talented employee will not deliver. In other words, an energized and highly motivated employee can reach good performance despite some knowledge gaps (Landy & Conte, 2016). Thus, despite the importance of macro-level aspects to KTOs' performance (one reason why the extant literature has extensively studied them), there is still a need to understand the micro-level mechanisms (i.e., motivation) that also shape KTOs' effectiveness and outcomes.

Intrinsic motivation is a fundamental component of any credible model of human performance (Gagnè & Deci, 2005; Shin & Grant, 2019). It is defined as “the doing of an activity for its inherent satisfactions rather than for some separable consequence” (Ryan & Deci, 2000, p. 56). Despite the importance of intrinsic motivation in work settings, many jobs are not designed to enable intrinsic motivation (Shin & Grant, 2019). In some work settings, individuals must act in the presence of challenging conditions (e.g., having little discretion in tasks, decisions, work methods, and schedules) (Morgeson & Humphrey, 2006; Humphrey, Nahrgang & Morgeson, 2007) that can undermine the arousal, magnitude, direction and maintenance of effort in their job. This is pretty much the case of KTOs, most of which are characterized by the presence of different institutional logics, low routinization, and fast-changing external dynamics—and at the same time, a high dependency on internal rules and regulations. While motivation has been a prominent area of interest in organizational behavioral research, and continues to be one of the most frequently discussed topics in the field of psychology (Rousseau, 1997), scant attention has

been given to understanding the intrinsic motivations of KTO personnel. Nonetheless, these individuals operate in very complex work settings that constantly strive to balance different and diverging factors in their daily job activities (Balven et al., 2018), which may put at risk their intrinsic motivation. Besides being peculiar organizational settings, KTOs play a key role in making universities more public engaged, more socially involved, and more impactful in their contribution to the ecosystem. Accordingly, it turns to be of utmost importance to better understand how employees' motivation can be enhanced to make KTO more effective and successful.

Moving from these premises, this paper aims to answer the following research question: *How do contextual factors enable KTOs' employees to reach intrinsic motivation, in a work context where satisfaction may be threatened?*

To address this question, we conducted a multiple comparative case study of four KTOs in Italy (Eisenhardt, 1989; Eisenhardt & Graebner, 2007). The selected KTOs are comparable in terms of their main characteristics and activities, located as they are in regions of Northern Italy that display similar economic characteristics and technological development (Istat, 2020). Three of them have been doing very well over the last ten years; a fourth has exhibited weaker performance. Comparing them should offer insights into how KTO employees achieve intrinsic motivation—and more importantly, what antecedent conditions, and at what different levels, enable the satisfaction of such motivation. We believe this is a very important gap to fill, as it allows not only to understand how to get employees motivated towards their job, but also to understand how organizational and university-level processes and activities can be defined and organized to achieve better and more effective outcomes through (intrinsically) motivated employees.

To shed light on this issue, we build on self-determination theory (SDT) (Gagné & Deci, 2005), and particularly the basic psychological needs for competence, autonomy and relatedness, which play a critical role in explaining individual intrinsic motivation at work.

Our findings contribute to the growing area of technology transfer by adopting a micro-level perspective for explaining KTO performance. More generally, we shed light on micro-organizational factors that support intrinsic motivation and, in turn, allow for more effective technology transfer and knowledge share processes. Here we understand KTOs as organizational units within public entities that are characterized by constraints, procedural rigidity, protocols, and regulations, and which are involved in non-routinized, complex tasks that require a strong commitment in addition to appropriate skills and competencies (Fitzgerald & Cunningham, 2016; Bright, 2008). Indeed, KTO employees' arduous tasks include: managing tensions between academic and market logics; balancing academic versus managerial goals; interacting with different stakeholders (scientists, university managers, companies, VCs and other financial institutions); and managing different internal priorities (requests from different departments and structures). We believe that our study provides an original contribution with regard to the drivers of intrinsic motivation that KTO personnel face every day and with limited incentives. While KTOs are unique/peculiar compared to other units/offices within research organizations, our findings may still be applicable to other organizational contexts that face similar dynamics and complexities. From a theoretical point of view, we also generally contribute to SDT by corroborating the importance of contextual factors for intrinsic motivation. In particular, we shed light on the specific antecedent factors that support KTO employees' intrinsic motivation at the university and organizational level.

From a managerial point of view, understanding the link between needs satisfaction and

university-level antecedents will help different stakeholders shape the university context in a way that simultaneously a) supports successful knowledge and technology transfer and b) enhances employee motivation. The paper also contains managerial implications for KTO managers who feel an increasing pressure to deliver results, given the availability of knowledge transfer objectives and performance indicators in many universities' strategic plans. At a minimum, they should be aware that intrinsic motivation is a powerful driver for KTO performance, beyond macro-level factors.

This paper also features policy implications. To the extent that countries and governments are investing in technology transfer and knowledge sharing to spur economic, social, technological, and environmental impact, it is important to create legal frameworks that legitimate the role of KTO professionals and support their motivation. While this paper finds that intrinsic motivation is a key determinant of performance, it would be appropriate to also account for extrinsic factors, such as remuneration based on meeting challenging results.

THEORETICAL BACKGROUND

Knowledge can move through different channels (not all of which generate economic impact), such as publications, graduating students entering the workforce, scholarly relationships with industry, and formal licensing of intellectual property to third parties such as start-up companies. Examples of knowledge transfer and sharing can be found across virtually every scientific and industrial area, such as pharmaceuticals and medical devices, agriculture, aerospace, environmental improvements. Many of the products and technological advances we take for granted in our everyday lives came from university research before being transferred to the marketplace through knowledge transfer processes. University KTOs are the key players in these knowledge-sharing processes, as they oversee the commercial valorization of research results

and knowledge flows that generate economic impact.

University KTOs

The research on university KTOs has grown quickly due to their relevance in making academic knowledge more useful and exploitable within society (Siegel et al., 2003). Most scientific inquiry has focused on the practices that KTOs adopt and how they impact performance (Siegel et al., 2003), specifically in relation to knowledge commercialization (Belitski, Aginskaja & Marozau, 2019), intellectual property rights (Siegel, Veugelers & Wright, 2007), spin-off creation and academic entrepreneurship (Grimaldi et al., 2011), and the role of KTOs as boundary spanners (O'Kane et al., 2020; Villani et al., 2017). In this respect, much attention has been paid to the generation of 'measurable outcomes', which include patents, licences and spinoffs (Giuri et al., 2020; Siegel et al., 2003). A few studies, meanwhile, have focused on the organizational practices and strategies adopted by KTOs (e.g., Giuri et al., 2019; Siegel et al., 2003). However, very little research has been devoted to better understanding the peculiar characteristics that make university KTOs a unique organizational setting (Good et al., 2019), nor to the micro-level processes through which organizational practices translate into individual behavior. In their conceptual paper featuring qualitative interviews with KTOs employees, Balven and colleagues (2018) identified motivation as a critical, yet overlooked micro-process that affects academic entrepreneurship. More attention on this and other micro-level processes would facilitate a better understanding of the effectiveness of technology transfer activities. To that end, we need to first establish a broader picture of KTOs' operational context.

Characteristics of University KTOs

University KTOs are integrated into the university structure; therefore, in most cases, they are subject to public regulations. Internal university regulations are very important for academic

entrepreneurship and spinoff creation; indeed, they represent an important mechanism for fostering or hindering knowledge transfer activities (Muscio, Quaglione & Ramaciotti, 2016). In this respect, Alexander et al. (2020) emphasized that the practical management of knowledge transfer by KTOs is often hampered by the procedural rigidity of protocols and regulations. Indeed, bureaucracy and inflexible rules are two pillars that usually characterize the functioning of university KTOs (Alexander et al., 2020; Siegel et al., 2003).

Moreover, university KTOs represent pluralistic contexts characterized by competing strategic demands and divergent stakeholder goals (O’Kane et al., 2015). O’Kane et al. (2015) reported that KTOs have two principal stakeholders within the university (i.e., academics and administrative staff) that are often characterized by non-overlapping objectives. Similarly, Siegel et al. (2004) explained that KTOs are populated by different actors: university scientists, university technology managers and administrators, and firms and other third parties. Additionally, KTOs often interact with external actors, including business incubators and financing institutions, e.g., business angels and venture capitalists who are interested in scouting promising entrepreneurial ideas and technologies for commercial exploitation. These external actors (that KTO personnel interact with) are additional stakeholders in their eyes, with their own agendas and objectives. Matching these external needs with internal requirements in order to accomplish their institutional mission can be very challenging. Finally, many KTOs have become increasingly active in supporting student entrepreneurship. They bring together students from a variety of disciplines to generate innovative solutions sought by external stakeholders (e.g., hackathons, challenge-based events, business plan competitions), which makes KTOs even more multifaceted. Accordingly, KTO employees must balance their economic and academic priorities amidst overlapping boundaries. In the face of competing institutional logics—in the

form of different interests, goals, cultural backgrounds and behaviors (Pache & Santos, 2013)—KTOs are typically subject to conflict and uncertainty.

The extant literature (e.g., Howells, 2006; Villani et al., 2017) has extensively documented how university KTOs serve as external boundary spanners that bridge the different logics of the “suppliers” of research results (i.e., academic scientists and the community of academic researchers at large) and the potential “customers” (i.e., firms, entrepreneurs, venture capitalists and other actors and institutional players in the local, national, and international ecosystems). However, less attention has been given to their internal boundary-spanning activities (Huyghe et al., 2014). Indeed, university KTOs have the complex task of interacting with different university departments and faculties involved in the commercialization of academic research (Markman, Gianiodis & Phan, 2008). In other words, KTO employees face the challenge of managing cross-organizational and cross-departmental relationships, in addition to dealing with more practical technology transfer issues (Huyghe et al., 2014; O’Kane et al., 2015). They must engage in internal boundary-spanning among university governance, administrators, technicians, department heads, school coordinators, researchers, and students, which makes their jobs highly interrelated with many other internal university structures. Therefore, university KTOs are a central organization within a broader organization, and their employees must be able to engage many different units.

Another characteristic of university KTOs is that they are part of a wider technology transfer ecosystem that includes incubators, science parks, enterprises, regional agencies, institutions and other universities (Belitski et al., 2019; Good et al., 2019). These actors are part of dynamic external networks whose evolution is likely to influence KTOs’ activities and organization. Beyond these local context dynamics, normative evolution at the regional and

national levels (e.g., laws in support of new venture creation, spinoff capitalization, financial incentives for companies investing in R&D, grants and other subsidies in favor of the valorization of research results) must also be taken into account. As a result, university KTOs must grapple with the fast-changing dynamics of the broader ecosystem. In short, KTOs both influence and are influenced by uncertain and ever-changing external environments in terms of regulations, funding schemes, laws, support mechanisms, and regional and national programs.

Key contingencies of university KTOs effectiveness

Scholars recognize that the needs for autonomy, competence and relatedness are psychological in nature and are essential for nurturing intrinsic motivation (Ryan & Deci, 2000). However, the unique work context of KTOs can threaten such needs because (a) public regulations and bureaucracy might suppress employees' autonomy; (b) the complexity of boundary-spanning activities (both internal and external) might interact with low skill variety to undermine the sense of competence; and (c) the dimensions of the ecosystem might lead to a huge number of relationships that are too weak and scattered to provide a true sense of relatedness. In this scenario, how can people achieve daily intrinsic motivation for the job?

Scholars generally recognize that employee intrinsic motivation significantly influences performance in most organizations (Brief & Aldag, 1977; Cerasoli, Nicklin & Ford, 2014; Dobre, 2013; Grant, 2008; Hackman & Oldham, 1976; Menges et al., 2017; Piccolo & Colquitt, 2006; Shin & Grant, 2019). However, the issue has never been explored in university KTOs. Although university KTOs may be seen as 'standard' public-sector organizations, they are increasingly forced to adopt a business-oriented approach in order to improve their productivity and efficiency. Accordingly, performance outputs have become the key measure for comparing KTOs' effectiveness. Many studies have addressed different factors that affect university KTOs'

performance at a macro-level (i.e., organizational and contextual) (Balven et al., 2018; Belitski et al., 2019; Miller, McAdam & McAdam, 2018), including entrepreneurial ecosystems (Al-Tabbaa & Ankrah, 2016; Audretsch, 2014; Villani & Lechner, 2021; Perkmann & Walsh, 2010), organizational structure and business models (Baglieri, Baldi & Tucci, 2020; Bercovitz et al., 2001; O'Shea et al., 2005; Siegel et al., 2007), patenting, licensing and spin-off creation capability (Rasmussen & Wright, 2015; Wright, 2007), and geographical and cognitive proximity to academia and industry (Bercovitz & Feldman, 2006; Villani et al., 2017). By contrast, research has remained silent on the relationship between intrinsic motivation and performance in KTOs.

Role and impact of intrinsic motivation in university KTOs

Intrinsic motivation is pivotal to the productivity, profitability and sustainability of every organization (Barney, 1991; Balven et al., 2018; Cerasoli et al., 2014; Menges et al., 2017; Shin & Grant, 2019). Shin and Grant (2019) consider motivation to be a powerful tool that reinforces behavior and triggers the tendency to persist. Others (Cerasoli et al., 2014; Grant, 2008) regard motivation as a foundational driver of performance. Indeed, the level of organizational performance mainly flows from employees' actual skills and level of motivation (Barney, 1991). However, whether a gap in skills may be closed through learning new knowledge, a lack of motivation is much more complex to be filled.

Self-determination theory (SDT) is the dominant theory of intrinsic motivation (Cerasoli et al., 2014; Ryan & Deci, 2000) due to its capacity to predict human behavior in multiple contexts (González-Cutre et al., 2016; Ryan & Deci, 2000). It features prominently in psychology, but has also received empirical validation in domains ranging from education, healthcare, and sports to the fields of work motivation and management (Deci et al., 2017). SDT

rests on two key concepts: First, SDT identifies three basic psychological needs that must be satisfied to achieve intrinsic motivation (Gagné & Deci, 2005; Ryan & Deci, 2000). The *need for autonomy* (Ryan & Deci, 2000) represents individuals' inherent desire to experience a general sense of choice and volition. In particular, it refers to the sense of authorship of one's actions and the feeling of being psychologically free. The need for autonomy is frustrated when employees cannot stand behind their actions or feel they must act against their will (Olafsen et al., 2017; Ryan & Deci, 2000). The *need for competence* reflects individuals' inclination to influence the environment and obtain desired outcomes (Ryan & Deci, 2000). Competence frustration occurs when employees feel that they are ineffective and cannot achieve desirable end-states in their work (Gillet et al., 2012). Finally, the *need for relatedness* (Baumeister & Leary, 1995) refers to individuals' inherent propensity to feel connected to and be cared for by others as a member of a group. This need is frustrated when employees do not feel a sense of communion and lack the experience of having close and intimate relationships with other people (Ryan & Deci, 2000).

Research from various life domains has shown that satisfying these three basic needs is positively associated with intrinsic (i.e., autonomous) motivation and work outcomes (e.g., Gillet et al., 2012; González-Cutre et al., 2016). By contrast, thwarted satisfaction of those needs undermines motivation and has maladaptive consequences. For example, Gillet et al. (2012) revealed that satisfaction (vs. frustration) of the three needs led to greater (vs. lower) well-being in organizational contexts. De Cooman et al. (2013) found that employees who felt greater need satisfaction on the job also displayed greater intrinsic motivation and effort expenditure. Similarly, in their meta-analysis, Van den Broeck et al. (2016) showed that each basic need had a significant positive relationship with introjected, intrinsic motivation. Thus, the satisfaction of autonomy, competence, and relatedness provides the basis for intrinsic motivation and is

conducive to optimal functioning and wellness among employees, which poses obvious benefits for the organization (Olafsen et al., 2017). Since various studies have confirmed that the presence of intrinsic motivation—or at least, the satisfaction of the associated basic needs—can predict positive work-related outcomes, we consider it necessary to explore the antecedents of motivation in order to understand how to promote wellness and high-quality performance in organizations. Accordingly, we turn to the second key aspect addressed by SDT, which relate to the importance of contextual characteristics.

SDT emphasizes the importance of contextual factors that hinder or undermine self-motivation, social functioning, and personal well-being (Gagné & Deci, 2005; Ryan & Deci, 2000). The research has consistently found that social contexts such as workplaces that support the satisfaction of the abovementioned needs can facilitate intrinsic motivation, psychological and physical wellness, and enhanced performance (Deci & Ryan, 2000; Deci et al., 2017). A social environment that affords competence but fails to nurture relatedness is expected to result in some impoverishment of wellbeing. Worse yet, work contexts that engender conflicts between basic needs establish the conditions for alienation and psychopathology (Ryan, 1995). For example, Hon (2012) found that hotel employees are more autonomously motivated and creative when they perceive their managers to be supportive of autonomy, and their co-workers to be supportive of relatedness. Consequently, intrinsic motivation and creativity decrease dramatically in the case of pressure and coercion. Similarly, Williams et al. (2014) showed that managers' support for employees' basic psychological needs prompted more intrinsic motivation, as well as fewer psychosomatic symptoms and less emotional exhaustion, turnover intentions, and absenteeism (Deci et al., 2017).

By joining these two key aspects, SDT provides a useful lens for examining the multifaceted nature of human motivation and its relationship with social values and norms. SDT treats intrinsic motivation as the outcome of the interaction between contextual factors and individuals' psychological needs. Accordingly, organizations that obtain better outcomes are those where employees feel supported in their autonomy, competence, and relatedness and are therefore self-motivated (Gagné & Deci, 2005; Ryan & Deci, 2000). This should also be true for university KTOs, despite common perceptions of KTO employees being extrinsically motivated (Balven et al., 2018). In sum, SDT represents an interesting lens because it allows going beyond the more traditional, economic, extrinsic incentives usually analyzed in association with job characteristics, by enabling to understand the challenging, interesting, and internally rewarding part – without the prospect of any external reward – of job activities.

METHODS

When investigating overlooked phenomena with an explorative research question, a qualitative approach is warranted (Yin, 2003). Multiple case study is a suitable analytical approach for analyzing complex social phenomena in a real-life context (Yin, 2003). This research design is particularly recommended when the study's objective is to build new theory (Eisenhardt, 1989; Eisenhardt & Graebner, 2007). Relative to the single-case approach, multiple cases allow for more powerful conclusions by integrating diverse data sources into a replication logic (Yin, 2003). In our study, we conducted an in-depth comparative case study (Eisenhardt, 1989; Yin, 2013) of four university KTOs in Italy, with the aim of better describing the KTOs' motivational aspects—and particularly, the university-level antecedents of that motivation across KTOs (Eisenhardt, 1989). Following our research question, our study's unit of analysis is the contextual factors (i.e., at the KTO and university level) that represent the antecedents of KTO employees' motivation. The level

of analysis, meanwhile, is the individual: namely, KTO employees and managers. This comparative case study is ideal because the institutions were created under the same legal framework and around the same time. Whereas KTO1, KTO2 and KTO3 are considered among the ten most-successful KTOs in Italy in terms of outcomes, KTO4 is considered a less successful one (NETVAL, 2018). We added KTO4 as a contrasting case to validate our results. The following sections provide more details about the analysis of our cases. Thus, a qualitative approach is very much appropriate here – in the presence of a “how” question – where the objective is not to examine the effect of an already known variable on a defined outcome, but to figure out and understand more in depth the way some contextual factors function to fulfill the three psychological needs and, therefore, support intrinsic motivation.

Research setting and cases selection

In university KTOs, there are manifold knowledge and technology transfer channels that range from informal (such as networking activities) to formal (such as licensing) (OECD, 2013). In addition, formal channels can be divided into non-commercial channels (such as publications) and commercial channels (such as spinoff creation or contract research). University KTOs mostly deal with commercial technology transfer channels, but they also offer a great variety of support activities for researchers and students. The most important activities of our KTOs are as follows: patenting, licensing, spin-off establishment, implementation of ready-for-commerce services/products, and consulting activities. The four KTOs all engage in the same activities, even if their structures vary considerably. In Table 1, we summarize the key characteristics of the four university KTOs included in our study, while Figure 1 graphically represents their structure.

Insert Table 1 about here

Insert Figure 1 about here

Given our research interest, we selected the university KTOs based on theoretical sampling (Eisenhardt, 1989; Glaser & Strauss, 1967). Since previous literature has demonstrated a direct positive relationship between intrinsic motivation and organizational performance (Cerasoli et al., 2014; Grant, 2008; Menges et al., 2017; Shin & Grant, 2019), we followed a literal replication strategy by selecting three very successful KTOs (i.e., KTO1, KTO2 and KTO3). Indeed, their high performance predicted very motivated employees; we therefore expected similar results in terms of the university-level antecedents of intrinsic motivation. Accordingly, they represent the KTOs that ground our model. However, in order to improve and validate our theory, as well as bolster the reliability and generalizability of our results, we followed a theoretical replication strategy by selecting a fourth KTO (i.e., KTO4). We wanted a case that would predict contrasting results in terms of the university-level antecedents of intrinsic motivation (Eisenhardt, 1989). Accordingly, we sought low-motivation employees by including a less successful KTO.

The KTOs' success was measured in terms of the dimensions of technology transfer in Italy, such as the number of inventions, number of patents and licensing contracts, and number of spinoffs normalized by the number of KTO personnel (NETVAL, 2018). While KTO1, KTO2 and KTO3 were among the top ten university KTOs out of 69 examined (NETVAL, 2018), KTO4 was at the bottom end of the ranking due to a reduction in resources and staff, poor performance in technology transfer outcomes, and shifts in management positions.

As a second criterion, we decided to focus on large- and middle-sized KTOs with at least five employees (i.e., 5.6 is the average number of people employed in Italian KTOs) to ensure that there would be enough variety among employees' perspectives. However, we introduced some

degree of variance in our selection criteria by including KTOs with one, two and three sub-units, with public and private legal forms, and different team sizes.

Since our main objective is to understand how contextual factors support intrinsic motivation in KTOs, we sought to avoid contextual biases. Indeed, the nature of knowledge transfer activities may differ greatly across regions and university quality (Minguillo & Thelwall, 2015). On one hand, the four KTOs are affiliated with four universities that are among the 20-most research-intensive universities in Italy (Times Higher Education World University Rankings 2021, category “research”). On the other hand, the four regions are comparable in terms of many relevant aspects, such as the number of people working on R&D, the size of enterprises, the sector of activities, the amount of R&D expense in relation to PIL, and the number of innovative enterprises. We report the main organizational characteristics of each KTO below.

At KTO 1, knowledge transfer activities are organized within a university department that is responsible for third mission activities and communications more in general. The whole department has twelve units and three of them (the “core units”) are in charge of patenting, licensing and spin-off related tasks. The “IP protection” unit consists of six people whose mission is to promote and implement the protection of research results, including technical-legal analysis and contractual services. Closely connected with this unit is the “IP enhancement” unit, which also has a staff of six people who pursue implying IP valorization strategies and agreements with researchers and companies. Finally, the largest unit (nine people) is the “spin-off and start-up” unit, which strives to proactively create and develop new businesses based on the work of researchers and skilled students. This team coordinates calls for spin-off ideas and new company creations, as well as manages a makerspace.

At University 2, the KTO unit is part of the department for research relations with companies. The KTO focuses on IP protection and spin-off support, but also includes a departmental unit that oversees the establishment and maintenance of industry relations and related services. This second unit was originally founded as an Ltd. Company and transformed into a university foundation in 2019. With approximately 20 persons between them, the two units strive to “[... take] part to the scientific excellence of [university 2] by involving professors, researchers, students, companies and public institutions in technology transfer activities and postgraduate education aimed at the social and economic development” (strategy document). Holistically, these units focus on valorizing IP, establishing contract research, and organizing networking opportunities. Because of the units’ close alignment, we treated them as the singular KTO 2.

At University 3, the third mission is defined by the department for “innovation ecosystem and enhancement of research placement”, which also includes the KTO. Since the early 2000s, the KTO unit of University 3 has sought to create economic and societal value by translating scientific discoveries into patents and spin-off creations (e.g., fostering an entrepreneurial mindset, business modeling, finding funding, etc.), as well as networking with companies. KTO 3 is organized as a single group and is formally led by the general director of the university.

Finally, University 4 established a department called “Internationalization, research and third mission area”, which is responsible for processes related to international student mobility, (international) cooperation and research initiatives, and promotion and enhancement of scientific research results via spin-offs, patents, contract research and trainings. Therefore, the KTO represents a specific unit (“Research enhancement and technology transfer sector”) of that

department. Its primary services revolve around the commercialization and legal protection of knowledge and technologies.

Data collection

For the data collection, we followed common recommendations for case study analysis (e.g., Eisenhardt, 1989; Yin, 2013) by combining preliminary unstructured interviews, formal semi-structured interviews, archival documents (including university reports and regulations), strategy documents, KTO brochures, web-based resources (such as KTO websites and LinkedIn person and unit profiles), and informal talks (see Table 2). We employed a ‘snowball technique’ to identify our informants. We had a preliminary discussion with the president of the NETVAL, a network that represents nearly all the Italian universities and public research centers that commercially exploit their research results. With his deep understanding of knowledge transfer in Italy, he helped us identify the managers who would be the most knowledgeable about and involved in the KTOs’ internal processes and dynamics. We conducted the first set of interviews with those individuals, and then asked each of them to suggest other people who could provide relevant information. These semi-structured interviews lasted between 46 and 97 minutes (69 minutes on average) and followed an interview protocol that evolved throughout the data collection process (Strauss & Corbin, 1998). The interview protocol was organized in sections: five for KTO managers and four for KTO employees. The first section included questions about the individual situation, including the reasons for joining the KTO alongside their experiences and (current and future) expectations. The second and third sections were about the KTO and the university’s contextual characteristics, the relationship between them, and their ability to fulfill individual psychological needs (i.e., autonomy, competence and relatedness). The last section for employees was about the perceived influence of their own motivation on clients’ (i.e., researchers and

industrial partners) behaviors. In the case of the managers, the additional fifth section concerned the opportunities and struggles in fulfilling employees' psychological needs and finding ways to motivate them. We recorded and transcribed thirteen interviews; the remaining six were documented in the form of a detailed protocol. In the analysis, we used codes to preserve the anonymity of the organizations and individuals.

Insert Table 2 about here

Data analysis

Given the limited empirical research on the micro-level aspects of university KTOs—and more specifically, the impact of organizational and university-level antecedents on KTO employees' intrinsic motivation—we adopted an inductive approach aimed at developing theory (Eisenhardt, 1989). Our analytic approach followed common practice in qualitative research (e.g., Gioia, Corley & Hamilton, 2013). Through an iterative procedure, we inductively coded interviews and documents with the aim of identifying important relationships between existing literature, data and emerging themes.

The data analysis included two different steps: (a) a comparative analysis of the successful cases (i.e., KTO1, KTO2 and KTO3) based on literal replication, and (b) a comparative analysis of the successful cases with the less successful one (i.e., KTO4) based on theoretical replication. Whereas step (a) represented the core analysis of our study, aimed at identifying similarities among cases to address our research question, step (b) was added as additional evidence to corroborate our results and improve their rigor and consistency. In this sense, step (a) involved two different phases: (1) checking that the direct positive relationship between performance and intrinsic motivation was observed in our cases, and (2) identifying university-level antecedents of KTO employees' intrinsic motivation. Whereas phase one was

just intended to confirm the direct relationship between intrinsic motivation and performance already observed and discussed by previous literature (e.g., Cerasoli et al., 2014; Menges et al., 2017), phase two represents the core part of the findings and it is focused on the identification of common contextual factors in KTO1, KTO2 and KTO3. The two different phases followed common rules, but in the first phase we adopted a priori specification of the three psychological needs identified by SDT.

We treated all interview transcripts and archival documents separately according to their associated case (within-case analysis) and then proceeded to analyze cross case patterns (Eisenhardt, 1989; Yin, 2003). We performed an opened coding for each case, whereby we aimed to find recurrent topics using simple guiding research questions. As our analysis progressed, we became increasingly familiar with the contexts and specifically refined the codes to better distinguish antecedents at different levels (i.e., university and organizational), which led us to a set of first-order codes for each guiding question (Gioia et al., 2013). This phase was extremely useful for exploring emerging patterns in the collected data (Strauss & Corbin, 1998) and identifying in vivo codes or terms that adequately captured the meaning behind the informants' experience (e.g., 'creation of a technology-transfer-related university brand', 'creation of a matrix structure in the department', 'team management by shared public value to deal with the diversity').

We then proceeded with axial coding (Strauss & Corbin, 1998), with the objective of giving the same codes to perceptions, acts or occurrences that shared common characteristics. At this stage, our aim was to theorize the in vivo codes as higher-order themes by identifying the initial relationships among them (e.g., 'Managing based on a public-good ideology', 'Providing clear and challenging goals', 'Enhancing overall knowledge-transfer perception', 'Being inspired by

knowledge-transfer challenges’). We continued with this process until additional analyses did not provide further insights in terms of new categories or the relationships between the existing categories. In other words, we proceeded until we reached data saturation.

Finally, we considered the data and the current literature in tandem until significant theoretical relationships among the first-order codes resulted in more abstract second-order themes. In particular, according to phase (1), we finally observed the satisfaction of the three psychological needs treated by SDT, which led to the following second-order codes: *expression of the need for relatedness*, *expression of the need for autonomy*, and *expression of the need for competence*. For the university-level antecedents, we uncovered a distinction between university and organizational antecedents that affected the fulfillment of these needs, leading us to the following second-order codes: *strategic plan*, *structural set-up for hybrid demands*, and *scientific support* for university-level antecedents, and *hybrid team management*, *goal setting* and *skill maintenance* for organizational-level antecedents. Tables 3, 4 and 5 present the structure of our data, including the first- and second-order codes for motives and for university-level and organizational-level antecedents, respectively.

Insert Tables 3, 4, 5 about here

One risk of the inductive approach is that the authors might lose their higher-level perspective because they identify too much with their subjects. For this reason, we decided to split the research team. Hence, two authors analyzed the cases, while a third author adopted the outsider’s (or “devil’s advocate”) perspective in order to ascertain the accuracy of the theory produced (Eisenhardt, 1989; Gioia et al., 2013). This step was very important for assessing the internal validity of our theory.

After building our theory from the comparative analysis of KTO1, KTO2 and KTO3, we initiated step (b) with KTO4, which followed the same data analysis process explained above. Since we chose this unsuccessful case based on theoretical replication, we expected to confirm our theory by finding contrasting evidence to our model. The analysis of KTO4 again confirmed the positive and direct relationship between performance and intrinsic motivation (i.e., employees in KTO4 were characterized by high levels of demotivation), while confirming the absence of the organizational-level and university-level antecedents identified in step (a). Examples of first-order codes that were missing—and therefore threatened need satisfaction in KTO4—were: *adopting entrepreneurial behaviors, enhancing the overall knowledge-transfer perception, opening up to external relations, taking advantage of rich relational opportunities, supporting an entrepreneurial team spirit, specialization of organizational units and supporting scientifically KTO activities.*

FINDINGS

The findings section is divided into three main parts. First, we wanted to ensure that our three cases truly reflected the direct positive relationship between performance and intrinsic motivation uncovered by previous literature (Cerasoli et al., 2014; Grant, 2008; Menges et al., 2017; Shin & Grant, 2019). In other words, we wanted to confirm that we were actually dealing with highly motivated employees (i.e., able to fulfill the three basic psychological needs), which was necessary for addressing our research question. In the second part of our findings, we identify the similarities among the three successful cases and define the antecedent contextual factors that satisfy the needs underlying KTO employees' motivation. Finally, we present the results from the comparative analysis between the three cases and KTO4, which represents the low-performing case. This section is intended to corroborate our model by providing contrasting

evidence from low-motivation employees (i.e., from a low-performing KTO).

Part I – Intrinsic motivation of KTOs’ employees

Speaking with the employees of our three high-performance KTOs, we observed that they were generally very satisfied with their current job, as expressed by statements such as, “[*what*] I do is close to my ideal job, actually” (interview #13, KTO 2), “I’d say it satisfies me, it’s certainly a job that fascinates me, it satisfies me” (interview #7, KTO 1), or “So, I think this is the perfect job for me” (interview #2, KTO 2). We discovered that most of these KTOs’ employees and managers – who lack extrinsic incentives, especially financial ones – are instead motivated by rewards that foster intrinsic motivation. Note the following salient statements of two interviewees:

“The people are not here for the money. [...] Not that the money is rewarding – you don’t get rich here, but everyone feels that you can influence the path [...]” (interview #12, KTO 2).

“Not so much because this is very small amount of money. So, it is not so interesting. I would prefer to have the possibility to do more specialization courses or education in this sector, which is paid by the university as an incentive” (interview #5, KTO 2).

While the employees of these three KTOs displayed highly motivated behavior, we wanted to also show how they are able to fulfill the three specific needs – autonomy, competence and relatedness – that underlie intrinsic motivation. In the following sections, we will detail the patterns that materialized across the three KTOs.

Fulfillment of the need for relatedness

The need for relatedness describes the desire to connect with others and build meaningful relationships. Thus, people often show affection toward individuals or groups who help satisfy this need (Deci & Ryan, 2004). In addition, they feel comfortable in dependent relationships and are more likely to show prosocial behaviors (Reeve, 2014). Among our three KTOs, we found

three first-order codes that illuminate how KTOs' employees can satisfy their need for relatedness: *teaming up beyond work duties*, *opening up to external relationships*, and *sense of contributing to the public good*.

For *teaming up beyond work duties*, we found that the employees of all KTOs appreciated the connection they made with the internal team, which included their colleagues and superiors. In particular, they emphasized colleagues who shared their motivational attitude. One of them reported the following:

"I like the fact that I am involved with a good team. And it's like this because I have very motivated, young, colleagues" (interview #3, KTO 2).

The superior's role is often described as inspirational and especially motivating, particularly if it is combined with trusting relationships:

"What I like the most is that I have the trust of [name of superior] who is my boss and also I think of [name of department head] who is [name of superior] boss [...]. They listen to me a lot, and this is very important for me" (interview #4, KTO 1).

These aspects make it possible to establish relationships that go beyond issues that are strictly related to the job and extend to leisure activities. An employee in KTO3 stated the following:

"We meet quite regularly after working hours for a drink or during the weekend for pizza [...] you know, this is very important to increase cohesion at work and build a team spirit that is based on real collaboration and synergy" (interview #10, KTO 3).

Furthermore, we found that KTO managers and employees make use of a wide range of actors to experience social connections far beyond the core KTO team (*opening up to external relationships*). This is partly due to the inherent job description as connectors or translators of the scientific and industry culture. Thus, they build relationships with researchers and students as well as company employees, as noted by one employee in KTO 1:

“I’m very glad to spend time and interact with very intelligent and interesting people. [...] You can be a sort of bridge to different cultures. The academic and the industrial cultures. [...] I like the social relationships that you can build thanks to this job because I interact a lot with the research but also a lot with companies so with different subjects, actors and stakeholders of the industrial world. I think this a sort of privilege, and I like to be part of the relationships” (interview #8, KTO 1).

KTO employees actually identify with the associations and communities of knowledge transfer at the national and European levels depending on the KTO’s specific target groups and networks (e.g., as indicated by memberships in different associations and networks – such as Netval and ASTP Proton - A World of Knowledge Transfer – in the curricula vitae and LinkedIn profiles of our interviewees). The employees highlighted the opportunity to build relations in European projects. An important community mentioned by all KTOs is the Italian KTO network (NETVAL). As one of them said,

“Our job involves the same things. We... I feel like I am part of a team, a big team, and I feel well in this team. [...] There is a sort of big team, big Italian team [NETVAL]” (interview #2, KTO 2).

Third, we found a *sense of contributing to the public good*. The employees across all three KTOs reported that they enjoyed helping *“professors and post-docs [to find] a way out of a golden cage”* (interview #12, KTO 2). Employees find motivation by serving the university and the local economy, as well as the potential customers of the products developed from the licenced technologies. What stands out is many employees’ high identification with the university and their desire to actively be a part of it. One employee stated the following:

“I’m a big fan of this university and was really happy to contribute and work for the university” (interview #8, KTO 1).

In many cases, employees reported that they studied at the university. Some even reported that they held a bachelor’s, master’s and PhD degree from the university, and they intentionally wanted to keep as many contacts as possible from the university. Hence, we argue

that taking an active part in the public good fulfills the need for relatedness and is thus part of intrinsic motivation. In sum, we observe that creating bonds within and beyond the KTO team, in tandem with serving the public good, supports the need for relatedness.

Fulfillment of the need for autonomy

People perceive a sense of autonomy when they feel that they are in charge of the activities in their lives (Legault, 2016). Autonomous individuals act willingly (a sense of volition) according to their beliefs (perceived locus of causality) and are able to make decisions among desired alternatives (perceived choice) (Reeve, 2014). KTO managers and employees expressed their need for autonomy by *adopting entrepreneurial behaviors*. The managers reported that they were highly motivated by the opportunity to shape their organization and their own initiatives. Many of the KTO managers were senior figures who played key roles in defining the organizational processes and activities. One manager reported the following:

“So, it [the foundation of the unit] was kind of really a startup dealing with innovation, dealing with new things. And feeling that the project was mine because we were, really, three, four people. So, we could shape it as we liked it” (interview #14, KTO 2).

Similarly, the employees in all KTOs reported a sense of freedom in choosing activities and topics according to their interests and competences. They expressed feeling self-directed since they could draw on their own interests when forming new initiatives. Knowledge transfer is not based on routines per se; however, the people working in KTOs highly valued the opportunity to set their own goals and be recognized for their individual impact. In particular, an employee of KTO3 commented in the following way:

“It’s now many years that I have worked in this context, and one of the characteristics that I like most is that of being part of a team but, at the same time, having enough freedom to set the direction and have an impact on final goals. I mean [...] there is a path that we share, but then it’s up to me to come up with new proposals, ideas, etcetera. You know, you can reach the goal anyway,

but how you reach it makes a huge difference... that's your impact!" (interview #9, KTO 3).

The importance of entrepreneurial behavior for KTO employees also appeared in situations where the unit was facing a shortage of human resources. In such cases, employees mostly felt driven by the pressure to accomplish specific tasks rather than inject creativity into their job. Nonetheless, individuals still distinctively valued the ability to see and influence the overall organizational process. In other words, they focused on the consequences of their work. One manager stated the following:

"I think that the technology transfer is a good opportunity to see the effects of the research and of the education inside society, [...] you're quite lucky to see the last step of the research and of the education within that society as well as the market and the company enterprises" (interview #6, KTO 1).

It follows that the entrepreneurial attitude expresses the need for autonomy.

Fulfillment of the need for competence

The need for competence refers to the desire for feelings of mastery and the innate tendency to employ one's full potential (Deci & Ryan, 2000; Legault, 2017). People strive for "just-manageable" challenges in relation to their talent and skills that are neither too simple nor too complex (Legault, 2017). We found two first-order codes related to how the KTO employees satisfy their need for competence: *being inspired by knowledge-transfer challenges* and *maintaining updated expertise*. The first code is driven by employees' fascination with the variety of challenges implied by knowledge transfer, which lead to rich learning opportunities. Across all three KTOs, this aspect mainly involves the pleasure of dealing with demanding problems that require a certain degree of obstinacy in order to find solutions that can satisfy most parties. This is what has been described as "*the capability of doing common things uncommonly well*" (interview #10, KTO 3). One employee described the high individuality of each case as

exciting and challenging:

“I would say that I do like a lot the variety of content, that is a good opportunity to learn and to put yourself in at every time in a sort of challenge, and it challenges you every time” (interview #6, KTO 1).

Being inspired by knowledge-transfer challenges is also explained by the pure interest in deepening one’s expertise on knowledge and technology transfer topics. The individual need for learning opportunities goes beyond the classic training sessions to include training experiences at the international level and the possibility of pursuing more research-driven training options (e.g., conducting a doctoral thesis on technology transfer) that allow for a richer knowledge base. This is exemplified in the following statement:

“[...] I learn from European colleagues and see how it works in other context, and my boss is really supportive so that for me is a reward that I have the opportunity to learn, to take on new challenges that are still related to tech. transfer” (interview #1, KTO 1).

The second code – *maintaining updated expertise* – is better explained by employees’ desire to remain constantly aware of different partners’ daily activities. Although each employee strives to be a specialist in a specific domain, they still gain a sense of affection for the different topics they encounter through their work. Thus, the engineer may become enamoured with the technologies developed by the scientists and seek to protect and/or licence them in the best way possible (e.g., *“I’m involved in projects that will make me smart”* (interview #3, KTO 2)); the lawyer may be more generally enthusiastic about all the legal aspects related to patenting, licensing and collaboration (e.g., *“I like all the legal aspects of this office because my job is really dealing with contracts all the time, and I am a legal so I like contracts”* (interview #5, KTO 2)); and the business person may appreciate opportunities to focus on innovation and networking (e.g., *“I am very interested in innovation and design thinking and want to learn more about that”* (interview #12, KTO 2)). To conclude, employees who are *inspired by knowledge-*

transfer challenges and *maintain updated expertise* express the need for competence.

Part II – University-level antecedents of psychological needs fulfillment

Having discussed how KTO personnel satisfy the three basic needs to reach intrinsic motivation, we now turn to the antecedents – university-level and organizational-level (KTO) – that enable the fulfillment of those needs. In the next two subsections, we will consider the specific antecedents and use our three cases to describe how university government (university-level antecedents) and KTO managers (organizational-level antecedents) can create conditions that satisfy employees' basic needs and foster intrinsic motivation. Beyond identifying the different antecedents, we also explain the relationship between specific antecedents and their satisfied need.

University-level antecedents

The university-level antecedents address the three basic needs on a rather abstract level that predominantly encompasses structural aspects. These include three different dimensions that represent our second-order codes: *strategic plan*, *structural set-up for hybrid demands*, and *scientific support*. Each of these dimensions works to address one or more of the psychological needs through specific mechanisms (i.e., our first-order codes) that we present in the following sections (see also Table 4).

Strategic plan to fulfill the need for relatedness

The first university-level antecedent includes two main actions: *contributing to social and economic development* and *enhancing the overall perception of knowledge-transfer*. The university's strategic formulation of the third mission establishes not only the objectives, but also the quantity and nature of the resources that will be allocated for knowledge and technology transfer. It is important that the strategic plan outlines the contribution of knowledge transfer

activities to the region's social and economic development (i.e., *contributing to social and economic development*). As an example, University 3 addresses the notion of contributing to the public good and establishing external relationships in the following way:

"[...] the transfer and exploitation of knowledge in the context of the economic and cultural development of the territories has to be in compliance with the principles of environmental and social sustainability [...] In doing that, we have to pay careful attention to regional needs, while establishing close relations with public and private institutions" (strategy of University 3).

As another example, the strategic plan of University 2 clearly states that the KTO must be a participant in at least ten European projects per year that involve public entities and ventures. On this point, one employee said:

"[...] the activities we deal with need to have a clear impact on our territory, at least! We have to go continuously outside looking for collaboration and new relationships that could turn to potential projects. We have to sell our job and speak, speak, and speak with ne people [...] That's a big challenge but the best opportunity we have to enlarge our network" (interview #12, KTO 2).

In setting a strategic direction, the university also needs to *enhance overall knowledge-transfer perception* among researchers, students and external parties. One informant stated the following:

"I think that if governance focuses on technology transfer as an item that is important for the organization itself, for example, the KTO performs a value that could be understood both by the researchers and by us [...] that facilitates us to work with researchers and students as well, [...] that allows the creation of a culture about technology transfer and [provides a] direction where to move" (interview #6, KTO 1).

The university government can enhance this perception by establishing a technology-transfer-related university "brand" and bolstering its reputation among researchers. For this purpose, University 1 created a technology transfer network – an internal scientist network – that serves as an open community for entrepreneurship. Here, researchers with technology transfer experience can exchange their ideas, challenges, and suggestions, which helps to spread a

technology transfer image from within. First, this process helps to create contacts and relationships among people who were previously unconnected; second, it stimulates curiosity in people with less experience and pushes them to connect with colleagues who have the information they need. KTOs can leverage these networks to communicate their services, promote success stories, advertise events, and generally broaden public awareness about knowledge transfer issues. By fostering a positive perception of technology transfer, the university directly addresses the need for relatedness in three main ways. First, by showing appreciation for KTO employees, it enhances their loyalty to the university and cultivates their desire to contribute to the public good. Second, the different activities undertaken help to widen the network around knowledge transfer activities (i.e., to include external academics, experts). Third, the diffusion of a positive perception of technology transfer helps KTO employees bond with researchers and thereby address the need for relatedness. In short, the definition of a clear and specific strategic plan can help fulfill the need for relatedness.

Structural set-up for hybrid demands to fulfill the need for autonomy

The *structural set-up for hybrid demands* includes three specific aspects: *specialization of organizational units, grounding on unconventional public-body regulations, and establishing direct contact with KTO management.*

KTOs typically operate through a ‘matrix structure’ that defines the specialized legal form of their unit(s). The matrix structure unfolds along two dimensions: a) the technology transfer area (e.g., intellectual property (IP) office, licence/valorization unit, spin-off unit, incubator) and b) the scientific field or industry sector. In addition, separation according to target groups is possible, e.g., students and researchers. At University 1, for example, the KTO has a matrix structure with three internal units: IP protection, IP valorization, and spin-off. Thus,

within each unit, employees specialize in different scientific fields such as the ‘bioeconomy’. In this way, different units oversee different topics and initiate their associated activities and processes. For example, employees within the IP protection unit can exchange legal issues within the unit, but discuss field issues across units. This type of structure optimizes the allocation of topics and tasks while reducing the risk of being overburdened by deadlines, which then enhances employees’ autonomy. In this way, the matrix structure also indirectly affects the need for competence by allowing employees to deepen their understanding of certain issues and apply their core competencies to certain tasks. In legal terms, the versatility of the matrix structure allows units to be designed in a way that maximizes their functioning. For instance, the spinoff and valorization units usually benefit from having external ownership, which facilitates better and faster interactions with external parties (e.g., start-ups, institutions, companies). We found that all three KTOs were affiliated with an external start-up incubator. Moreover, semiprivate ownership allows those units to find a better fit with their main stakeholders and act in a more autonomous way compared to standard public bodies. For example, University 2 established the valorization unit as a university foundation and tasked its nearly 20 employees with “*[... taking] part in the scientific excellence of [University 2] by involving professors, researchers, students, companies and public institutions in technology transfer activities and postgraduate education aimed at social and economic development*” (mission of the foundation in KTO 2). Thanks to the unit’s greater procedural autonomy, the managers of KTO 2 have more control over recruiting and the definition of incentive systems. By contrast, universities’ normal recruitment process generally involves strict rules that downplay the importance of a person-job fit. This specialization also has important implications for the allocation of tangible resources (e.g., money). KTOs with more resources had more capacity to develop services in an independent

way (satisfying the need for autonomy), and more opportunity to learn from trial and error (indirectly satisfying the need for competence).

The other university-level antecedent, i.e., *grounding on unconventional public-body regulations*, relates to two main factors: (a) internal and external recruitment processes and (b) the adaptation of bureaucratic procedures. With respect to the first issue, one interviewee stated the following:

“[...] years ago, we had a sort of reorganization of our central administration, and so I was just taken and put in this new office. [...] Things have changed a lot in the last years, and we now have a strong influence on those decisions” (interview #5, KTO 2).

The need for autonomy also relates to the second factor, which refers to the need to overcome bureaucratic hurdles (i.e., ‘red tape’). As one interviewee put it:

“[...] we had to ask all the time for permission because there is a lot of political influence in our work. I mean, I had to ask for permission to send an e-mail. It was impossible to work like this. [...] of course, we work within an organization that has specific functioning rules, but as far as we operate within them, we need to have freedom. After a strong battle, we are now there” (interview #4, KTO 1).

Regarding the last antecedent of autonomy (i.e., *establishing direct contact with KTO management*), we found that KTO employees highlighted the importance of having trustful relationships with the head of the KTO and more generally with the university government. A manager of one KTO unit stated the following:

“I can also tell you that when we ask for something, they [the university government] do listen to us” (interview #3, KTO 2).

Having a direct tie with the university level enables a continuous and iterative discussion about the KTO’s objectives and services. To enable strong ties, all universities ensured that the KTO was under a unit directly led by the university government. Yet, in University 1, for example, the head of the department that includes the KTO is also responsible for nine other

units. Strong ties and iterative communication allow KTO managers to obtain quick feedback regarding their own ideas, as well as discuss potential structural changes for improving KTO operation. Accordingly, KTO managers have a higher perceived locus of causality, which is essential for autonomy. While this aspect has a direct impact on KTO employees' degree of autonomy, it also indirectly satisfies the need for relatedness by allowing KTO managers to build meaningful, reciprocal relationships with the university government. In short, the presence of strong, direct ties between university governance and KTO management is beneficial for satisfying both the need for autonomy and, indirectly, the need for relatedness.

Scientific support to fulfill the need for competence

The last university-level antecedent we found is *scientifically supporting KTO activities*, which is extremely important to fulfilling the need for competence. University 1, for example, founded an internal technology transfer network that includes all academics whose research focuses on technology transfer and innovation issues, alongside other relevant stakeholders in that domain (e.g., consultants, entrepreneurs). This allows KTO managers and employees, academics, and other interested parties to jointly discuss knowledge-transfer ideas and topics, and thereby become more informed on various topics. Whereas stakeholders who are external to the KTO may obtain a better perception of the KTO's needs and processes, KTO employees can implement the latest scientific insights and acquire additional competences in order to better support academics. For instance, KTO3 organized some hackathons dealing with emerging entrepreneurial and societal issues (i.e., the impact of COVID on firms' innovation processes; the impact of new technological solutions on elderly people in the Covid era) where the objective was to find solutions that involved transferring knowledge between external experts and academics. These initiatives represented a great opportunity for KTO employees to improve their knowledge of scientific domains and new

methodological approaches. In short, having the scientific support encourages KTO employees to maintain and update their expertise, and thereby satisfies their need for competence.

Organizational (KTO) antecedents

Beyond the university-level antecedents, which mainly focus on the structural and strategic aspects, we also found some university-level organizational (KTO) antecedents that essentially deal with managerial issues (see Table 5). In particular, *hybrid team management* supports the need for relatedness, *goal setting* supports the need for autonomy and competence, and *skill maintenance* supports the need for competence.

Hybrid team management to fulfill the need for relatedness

As hybrid organizations engaging with academic researchers and industrial partners, KTOs must find the best strategies to help those stakeholders work together effectively. This proved to be an important aspect for most of the interviewees, who explicitly said that their job within a public university is indeed very different from other public-organization jobs, specifically in terms of the opportunity to make contact and interact with many people, even those belonging to different sectors. Accordingly, one important antecedent – of the need for relatedness – proved to be the ability of KTO managers to *take advantage of rich relational opportunities*. This specific antecedent seems to be inherent to KTO employees' job, but it still must be properly stimulated. One strategy that the KTO managers used to reach that objective was to actively support employees in establishing new relationships with different actors, even across the core target group of researchers and companies. For example, managers in KTO 1 and 3 assigned employees to European and international projects, while one manager in KTO 1 additionally provided memberships in inter/national networks (such as ASTP – A World of Knowledge Transfer). One manager stated the following:

“So, because I think that we literally need to build communications, maybe even stronger communications between each other [the KTOs in Italy], as they try to help each other. So, in order to exchange the best practice in order to grow [...]” (interview #3, KTO 2).

A second strategy was to reinforce existing relationships with the KTOs’ main stakeholders (i.e., researchers and ventures). In this respect, there is strategic value in involving local industry and becoming more familiar with sectoral peculiarities so as to establish the right connections between academics and enterprises. With this objective in mind, the managers of all KTOs organized periodical events: follow-up meetings on technology transfer matters, as well as more general initiatives where students were also involved (e.g., with job interviews). The format of these events was increasingly appreciated within the university: Some departments in University 1 even organized the yearly department meeting – with approximately two hundred researchers, companies, and other institutions – around the topic of the ‘third mission’. The many related sessions not only increased participants’ awareness of knowledge transfer, but also allowed them to build strong relationships with one another. In sum, addressing the motive to open-up to external relations satisfies the need for relatedness.

The second organizational antecedent we found is *managing by a public-good ideology*. Our interviews showed that the climate within the KTO is fundamental to cultivating shared values among employees. One manager stated the following:

“What instruments do we have? I would say the main is the climate; being able to create a good climate inside the office” (interview #6, KTO 1).

The KTO employees reported that they highly appreciated the alignment of their activities with public values. Thus, KTO managers had to manage the team by fostering shared public values that aligned with organizational strategy (e.g., serving the local economy; fostering sustainable and social spin-off creation). This was considered an important skill among the KTO

managers because it allowed them to create common ideals that fostered affection and prosocial behavior among colleagues. Some informants even used the word ‘family’ to describe their team. In KTO 1, the management of the public-good ideology was also observable in decision-making at the organizational level, as one informant summarized:

“I would exchange a higher level of royalty when I can get a higher impact from a contract” (interview #8, KTO 1).

To conclude, managing by public values addresses the need for relatedness in terms of two previously discussed motives: the affection for colleagues beyond work duties and the sense of contributing to the public good.

Finally, we found *supporting an entrepreneurial team spirit* to be an important antecedent for employees’ needs satisfaction. By entrepreneurial spirit, we refer to a managerial attitude that supports flexible and creative methods and iterative learning. To build an effective organizational system such as this, it was absolutely essential to invest in trusting relationships between managers and employees. Accordingly, KTO managers seeking to transform KTOs into more entrepreneurial organizations should incorporate practices such as periodic brainstorming activities and focus groups on specific issues. This commitment to practices intended to foster greater freedom of expression and a more creative mindset was absolutely fundamental in the core three KTOs for enhancing team cohesiveness. In that regard, one interviewee in KTO 3 reported the following:

“I’m a social animal, and when I started this job, I was quite terrified of the idea of sticking to the boring routine and demotivating rules of a public organization. Surprisingly, I found an enlightened person [the manager] who has been able to create a stimulating and close team thanks to her business approach and practices” (interview #11, KTO 3).

Goal setting to fulfill the need for autonomy and competence

Providing clear and challenging goals is an organizational antecedent that satisfies both the need

for autonomy and competence. In particular, the definition of clear and challenging goals represents a fundamental managerial step to fostering employees' motivation in their own work. In this respect, we found that our KTOs' managerial practices involved helping their employees set their own optimal goals and providing the proper stimuli to build a constructive and stimulating work environment. Managers at all three KTOs supported their employees in translating the university's abstract strategic objectives into individual-level objectives. These individual-level objectives prevented confusion and frustration. An employee in KTO 3 reported the following:

"It is really important to be clear about the outcomes expected of our activities [...], I mean, they have to be clearly stated and requested. I always say to my boss that I prefer to be scolded for my failures – but knowing in advance what she expects from me – instead of being commended for something that I reach by chance [...]. It is important to properly value my skills but also to be autonomous in setting the direction, without asking every time: is this okay, is this what you expected or not?" (interview #9, KTO 3).

Similarly, when we asked the employees at KTO2 if they had precise technology-transfer-related goals, the answers were as follows:

"I would like to be a specialist on the kind of process called design thinking" (interview #12, KTO 2) or

"Yes, of course. I am more focused on the first part of the innovation process, let's say the funnel in the first part, [...] and also particular activities in order to arrive at a prototype" (interview #4, KTO 1).

Hence, establishing the frame and aligning individual goal development with the KTO's overall objectives is an important managerial strategy or enabling and enhancing employees' autonomy and competence. This kind of objective gives employees the freedom to adopt an entrepreneurial behavior and better co-develop own objectives. At the same time, it enables employees to set objectives that expand their expertise. In short, KTO managers that adopt a goal-setting approach can support employees' intrinsic motivation.

Skill maintenance to fulfill the need for competence

The last organizational antecedent that we observed encompasses two organizational activities: *relying on a system based on feedback and taking advantage of multiple learning opportunities*. Both are considered important in fulfilling the need for competence by preserving employees' skills. The first aspect refers to the managerial ability to provide periodic feedback to employees on their activities. This allows employees to implement a trial-and-error learning process that reinforces individual competence on specific tasks. The feedback comes from the managers, but can even come from the task itself in terms of successful or unsuccessful results on knowledge transfer activities between academics and entrepreneurs. In KTO1, the manager of the IP protection unit used periodic group meetings to report on the processes and strategies used in successful licensing contracts, with the objective of sharing best practices with all the employees and, in that way, increasing their knowledge on the topic.

The second organizational antecedent refers to the promotion of international experience, research opportunities, and the diversification of project portfolios. These efforts inspire new knowledge-transfer channels that nurture the motive to work. Additionally, as with any learning opportunity, the purpose is to enhance employees' skills and abilities on specific topics. This is a great incentive, as stated by one manager:

“We cannot pay people more, but we can offer them opportunities in terms of training if they are interested in growing their competences. This is something that I usually offer and support in order to always keep employees updated on the most recent procedures; you know, our sector changes very quickly” (interview #1, KTO 1).

One employee even had the opportunity to combine the job at the KTO with a PhD in technology transfer. In summary, KTO managers can satisfy employees' need for competence by offering them continuous feedback and rich learning opportunities.

Part III – Comparative analysis with KTO4

Compared to KTO1, KTO2 and KTO3, the interviews with the employees of KTO4 illuminated a sense of frustration and weak motivation. For instance, several employees reported that they continued with the job due to extrinsic motives (i.e., they were rather close to retirement or personally preferred the job security offered by a public organization). Compounding matters, KTO4 had experienced a high job-turnover rate in the preceding five years, and the resulting struggles affected employees' needs satisfaction. The main challenges have been: 1) some changes in the university government; 2) cuts to the KTO's financial resources, which has reduced the number of KTO employees and diminished the KTO's standing in the community; and 3) the lack of an explicit "third mission" strategy from the university government. By comparing KTO1, KTO2 and KTO3 with KTO4, we were able to better understand the relationship between basic needs satisfaction (i.e., intrinsic motivation) and university-level antecedents of that satisfaction. More specifically, we were able to see what happens to intrinsic motivation if certain antecedents are missing. Notably, the analysis of KTO4 did not reveal any new antecedents.

Needs fulfillment threatened in KTO4

Employees in KTO4 reported that they enjoy maintaining the existing relationships (i.e., internal and external), but they did not have time to establish new relationships. The manager of the KTO explicitly said that she "*would like to invest in new projects with new ventures and start-ups [...] and I would also love to invest my time in getting in touch with new people that might be interested in knowing what we do. Instead, I'm always closed in my office dealing with those repetitive and routinary tasks that we have to carry out*" (interview #18, KTO4). It was evident that the employees of KTO4 faced restrictions regarding the need for relatedness.

Likewise, KTO4 employees did not claim to have the autonomy to create and implement initiatives according to their own ideas. Indeed, due to the lack of human and financial resources, they had to focus on the legal and administrative sides of knowledge transfer activities, and could not pursue more exciting activities. Given their meager opportunities for adopting entrepreneurial behaviors, KTO4 employees were threatened with a diminished need for autonomy.

Finally, the interviewees made clear that the university government perceived the KTO like any other administrative office. However, “*a different role should be recognized to our office, because it is not like dealing with pay slips [...] Things here are changing very fast, if we lack appropriate and updated skills and knowledge, does not make any sense to even say that we are doing knowledge transfer*” (interview #16, KTO4). Without the opportunity to expand their skills and knowledge, the KTO4 employees experienced a threat to their need for competence.

KTO4: evidence on university-level antecedents

Having reaffirmed the positive relationship between performance and intrinsic motivation (i.e., that poor performance is related to low-motivation employees), we now compare the university-level antecedents found in the analysis of KTO1, KTO2 and KTO3 with evidence from KTO4.

Whereas the first three KTOs invested considerable effort in defining a strategic plan for knowledge transfer activities, KTO4 did not. The reduction of the KTO’s size—in terms of both available budget and number of employees—signalled the KTO’s marginal role within the university. Without this legitimacy, the employees could not easily build stable relationships with researchers and establish the relevance of knowledge transfer. The external image also suffered because KTO employees lacked the time and resources to advertise the university’s knowledge and develop industry relationships. As a consequence, the unit could not invest in activities that would support the region’s social and economic development, and thus avoided even participating

in such projects. In short, the evidence from KTO4 affirms the relationship between having a strategic plan (for both internal and external knowledge-transfer) and satisfying the need for relatedness.

Similarly, KTO4 did not exhibit the *structural set-up for hybrid demands* that characterized the other three KTOs. More specifically, the functioning of KTO4 more closely aligned with a traditional administrative office within a public-sector organization (i.e., based on fixed and strict rules and processes). University 4 did not create workarounds for the KTO unit in order to grant it greater flexibility and autonomy in organizational activities. In addition, the manager of the office said:

“With respect to most KTOs, we do not have an external spin-off unit, and neither a division of the KTOs in sub-units specialized in different matters. All of us deal with every kind of knowledge transfer issue” (interview #18, KTO4).

KTO4 consists of a single unit without specializations. Hence, KTO4’s employees must supervise the legal and commercial issues across all disciplines. Employees are therefore driven by tasks and feel little autonomy. In addition, the KTO manager struggled to build a direct relationship with university governance due to continuous personnel changes and a general lack of awareness about knowledge transfer issues on the governance side. These issues serve to marginalize the KTO’s role within the university (thereby threatening the need for relatedness), as well as reduce the amount of support for implementing new ideas and solutions (thereby threatening the need for autonomy). As one employee reported:

“Sometimes it is convenient to remain in the shade [...] Very often, it happens that we do not see anyone knocking to our door for days, anyone is really interested in what we do. On the positive side, anyone asks you doing more than what we always do, more or less always in the same way since years” (interview #17, KTO4).

In sum, these findings confirm that a structural set-up is crucial to satisfying KTO employees' need for autonomy.

KTO4: evidence on organizational antecedents

Turning now to the organizational antecedents, we found that KTO4 lacked all the mechanisms put in place by the other three KTOs. Employees in KTO4 lacked the time and opportunity to build new relationships, forcing them to rely exclusively on researchers' personal networks to reach external partners for potential projects. Further, KTO4 lacked a strategy for appealing to different target groups, and thus could not provide the rich relational opportunities that are important for satisfying employees' need for relatedness. Moreover, the KTO manager reported that she was unable to implement and support an entrepreneurial spirit in her office, since the unit's vast amount of administrative and legal tasks consumed most of the employees' time. This factor also impeded employees' ability to satisfy their need for relatedness.

The same was true for efforts to fulfill the need for autonomy. University 4 delineated goals for all administrative units, including the KTO, but the goals were mainly outcome-related and did not offer much operational freedom.

Finally, the employees in KTO4 were not able to extend their skills and take advantage of learning opportunities to improve their expertise and update their knowledge on fast-changing topics. The manager even stated that although the KTO won a European project, they had to refuse it because no employees had the time to work on the project. This experience caused frustration internally and hindered the satisfaction of the need for competence.

Final model

Ultimately, we found that university governments and managers in KTOs employ different actions to satisfy KTO employees' psychological needs. Figure 2 provides a visual representation of the university-level and organizational-level antecedents for basic needs satisfaction in KTOs.

Insert Figure 2 about here

On the university side, university governance primarily establishes the strategic (and structural) context for needs satisfaction; on the organizational side, KTO managers can adopt diverse managerial strategies to fulfill employees' basic needs. By establishing the strategic context, universities can actively steer the direction of technology transfer activities and foster the perception of technology transfer among researchers, KTO personnel and other external stakeholders. Although university-level practices affect the satisfaction of all three psychological needs, they seem to be particularly impactful on the need for autonomy. Indeed, without a proper organizational structure and appropriate rules, KTOs risk operating under the same conditions as other public organizations, which usually do not provide the necessary autonomy in relation to decision-making or recruiting. However, KTOs are not well tailored for standard public procedures due to having to accommodate competing interests (i.e., university and industry) through streamlined processes. Accordingly, university-level arrangements that account for that risk (e.g., *grounding on unconventional public-body regulations* and *specialization of organizational units*, which involve structural diversity in terms of a matrix structure and different legal forms for different units) allow KTOs to operate at full speed without sacrificing their autonomy.

While the need for autonomy can be formally addressed at the strategic and structural level, the needs for relatedness and competence are better addressed by managerial practices that

are defined and adopted within the KTO itself. In particular, KTO employees work with various actors who follow different logics. On the one hand, this aspect may represent a rich relational opportunity; on the other hand, it may foster the perception that different stakeholders are behaving unfairly. Accordingly, KTOs benefit from a managerial approach that capitalizes on hybrid skills. For instance, managerial strategies that foster constant learning – both within and outside the KTO – are recognized as a successful way to continually update employees' skills and thereby satisfy the need for competence. Therefore, it is important that managers have the ability to jointly address relational and competence issues.

DISCUSSION AND CONCLUSIONS

Theoretical contributions

This study sheds light on how employees' motivation can be supported in KTOs. More specifically, we identify the specific university- and organizational-level factors that allow the satisfaction of the three psychological needs at the heart of intrinsic motivation. More than that, we find that whereas organizational-level antecedents (i.e., *hybrid team management*, *goal setting*, and *skill maintenance*) are more important to satisfy the needs for relatedness and competence, the university-level antecedents (i.e., *strategic plan*, *structural set-up for hybrid demands*, and *scientific support*) are key for fulfilling the need for autonomy. Thus, we show that – in addition to macro-level aspects (e.g., for example look at Rasmussen & Wright, 2015) – also micro-level dimensions (i.e., intrinsic motivation) are important to allow for more effective technology transfer and knowledge share processes.

In doing so, our study offers some theoretical contributions, as well as some managerial and policy implications. First, we shed light on the overlooked relationship between intrinsic motivation and performance in KTOs. This study addresses this gap by closely considering the

organizational behavior dynamics within KTOs, with a specific emphasis on KTO personnel's intrinsic motivation. With their experience, networks, and abilities, KTO employees represent the heart of knowledge transfer at public universities and research institutions. Indeed, the quality and engagement of such employees will strongly determine whether frontier knowledge and research results are successfully translated into commercial ventures. In this sense, understanding these individuals' intrinsic motivation is critical to bolstering KTOs' contribution to economic, technological, social, cultural and environmental outcomes.

Second, we contribute to the stream of literature concerned with the performance of organizational units within public entities that are characterized by constraints, procedural rigidity, regulations and an absence of incentives, and yet face complex tasks that include managing the tensions between different logics (academic versus market), goals (academic versus managerial), stakeholders (e.g., scientists, university managers, and companies), and internal priorities (e.g., requests from different departments and structures). The tensions and complexities that define bridging institutions like KTOs can dampen individual motivation, especially when coupled with a lack of incentives and a demand for procedural transparency and equity. These settings are not typically designed to fulfill employees' psychological needs and thereby generate intrinsic motivation; thus, there is great value in understanding the antecedents of employees' motivation and uncovering ways to maintain and bolster it.

Third, in line with SDT, we confirmed the importance of contextual factors for intrinsic motivation. SDT is specifically framed in terms of environmental factors that facilitate or undermine intrinsic motivation. This language reflects the assumption that intrinsic motivation arises when individuals experience conditions that galvanize its expression (Ryan & Deci, 2000). Accordingly, we provide evidence on the specific contextual antecedents that catalyze

employees' intrinsic motivation in KTOs. Specifically, we show that the need for autonomy is mainly supported by university-level factors in KTOs, while the needs for competence and relatedness are satisfied by organizational practices and mechanisms.

Given the fact that our insights highlight the establishment of specific organizational conditions that enhance employees' intrinsic motivation and eventually performance, future research could use the literature on contextual ambidexterity (Gibson & Birkinshaw, 2004) to further investigate the topic.

Managerial implications

Our findings also have implications for effective KTO management. KTO employees face an inherent level of complexity due to bridging different cultures and managing tensions within public organizations. Concurrently, they must comply with public organizational norms, rules, and restrictions, which can conflict with the fulfillment of psychological needs. However, employees' intrinsic motivation is a crucial determinant of their behavior, and by extension, the KTO's performance—and thus, uncovering ways to support said motivation has apparent value.

In many public organizations, employees are not selected for a specific task within a specific unit in the organization, as they are in the private sector. Selection procedures in the public domain are often subject to public regulations and financial restrictions, with the goal of identifying candidates with administrative and management competencies that are applicable regardless of the assigned tasks (which can vary over the years). When selecting newcomers within public organizations – and specifically within KTOs – it is important to consider employees' motivational profile and ensure that it properly suits their needs, the work context, and the accompanying tasks. Further, we are aware that many public organizations rotate managers in order to expose them to different domains and encourage more transversal views of

processes that span the entire organization. However, in some settings like KTOs—where employees' prior knowledge, expertise and relations are important for achieving results whose benefits may only materialize in the long-run—managers should pay close attention to the contextual factors that can satisfy the needs that underlie motivation.

Beyond the issue of 'fit creation', there is also the often-neglected issue of skill 'maintenance'. On this point, organizations should strive to ensure that their employees are routinely 'in-flow' (Nakamura & Csikszentmihalyi, 2014): that their individual skills and competencies match the challenge level of the assigned tasks, and thereby satisfy the need for competence. This 'in-flow' state may vary over time due to different factors: employee growth and competence evolution; changes in university governance that reflect new policies, visions, challenges and objectives; and changes in the KTO management structure. In light of such changes, KTO managers need to continuously re-evaluate and realign human capital to achieve better performance. On the learning and growing side, for example, employees should have access to external sources of knowledge, stimuli and inspiration (mobility, masters, workshops). Similarly, KTO employees should have the opportunity to engage in discussions and receive feedback in order to better perceive the bigger picture. Having the space to learn from errors and incorporate feedback is crucial to satisfying the need for competence.

Policy implications

Finally, our study features several policy-level implications. While our results underscore the importance of intrinsic motivation for KTOs' personnel performance, they do not suggest that extrinsic motivational factors are irrelevant. From a policy perspective, countries and governments that are investing in technology transfer and knowledge sharing should create legal frameworks that facilitate both intrinsic and extrinsic motivation—an example of the latter being

remuneration that varies based on meeting challenging results.

Limitations

Our study offers a useful first step toward exploring motivational aspects in KTOs. However, it is also subject to limitations that we hope other researchers can take as a starting point for future inquiry. Since our research is a first, exploratory research on motivation of KTOs' employees, we welcome future studies that extend or refine our framework with other possible antecedent conditions.

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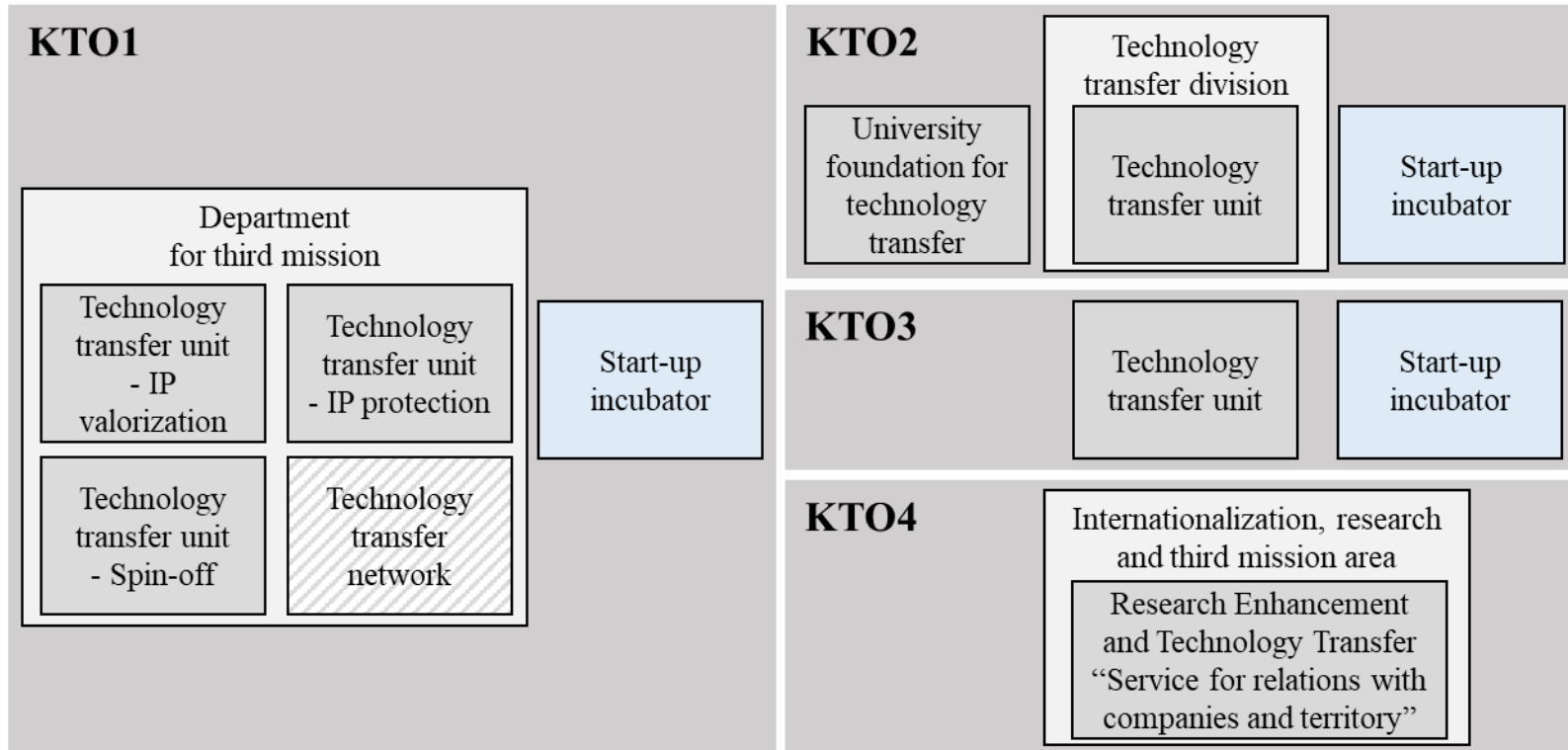
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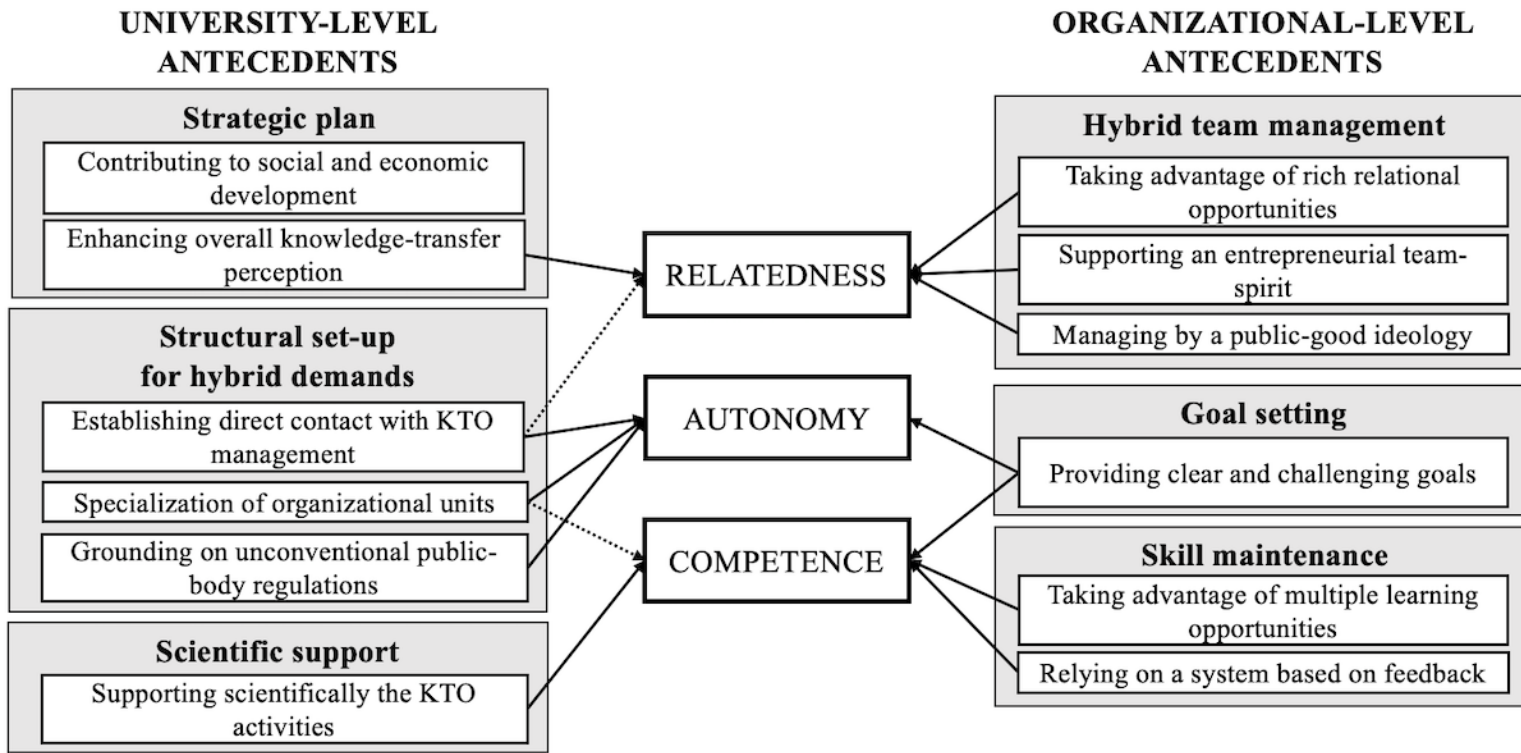
FIGURES AND TABLES

Figure 1. KTO units related to the case studies*



* Grey boxes represent KTO units under university control; grey hatched boxes illustrate internal networks; blue boxes with scattered frames represent KTO-like organizations without university control.

Figure 2. Model of KTO employees’ psychological needs satisfaction through university-level and organizational-level antecedents



*Dashed line represents indirect effect.

Tables

Table 1. Case studies

<i>Technology transfer characteristics</i>	<i>KTO1</i>	<i>KTO2</i>	<i>KTO3</i>	<i>KTO4</i>
Description of the third mission within the university's mission	"[...] the maintenance of dynamic relationships and exchanges with society as a whole and the world of work".	"[...] to become 'a reference point for the world of innovation, in all its forms, and applied research'".	"[...] dissemination of knowledge and culture as well as the transfer and exploitation of knowledge in the context of the economic and cultural development of the territories, in compliance with the principles of environmental and social sustainability [...]".	"It contributes to the social, economic and cultural development of the territory, promotes the enhancement of scientific research results, support for new businesses and innovative projects, lifelong learning and continuous training" [#]
No of internal KTO units	3 + 1 network	1 + 1 foundation	1	1
No of active patents	370+ (2018)	140+	100+ (2019)	97 (2021)
No of spin-offs	~32	~57	~27 (2019)	~ 45
Establishment of TT activities	2004	Early 2000	Early 2000	Early 2000
No of employees	~21	~28	~5	~5
<i>University characteristics</i>	<i>University1</i>	<i>University2</i>	<i>University3</i>	<i>University 4</i>
Institutional control	Public	Public	Public	Public
No of students	85,000+ (2018/19)	55,000+ (2017/18)	50,000+	32,000+
No of teaching and research staff	2700+	2,200+ (2017/18)	1,500+	1.250+
No of PhD students	1,400+	1.400+	700+	1,100+
No of research departments	32 (2018/19)	32	20	22
No of scientific documents*	130,000+	125,000+	85,000+	82,000+

Source: All numbers are based on the latest documents from the three universities and KTOs. This includes annual reports, strategy documents and official websites. All data are from 2020, except for the cases where the year is explicitly mentioned.; * The number is based on the Scopus database, last accessed on 1 October 2020.; #The university mission is not available. Therefore we added the self-description of the unit.

Table 2. Data sources

<i>Description</i>	<i>KTO1</i>	<i>KTO2</i>	<i>KTO3</i>	<i>KTO4</i>
<i>Interviews</i>	<i># of interviews (LinkedIn profiles)</i>	<i># of interviews (LinkedIn profiles)</i>	<i># of interviews (LinkedIn profiles)</i>	<i># of interviews (LinkedIn profiles)</i>
Managers	5 (2)	2 (1)	1 (0)	1 (0)
Employees	2 (1)	3 (2)	2 (0)	2 (0)
Total	7 (3)	5 (3)	3 (0)	3 (0)
<i>Archival materials</i>	<i>Approx. # of pages</i>	<i>Approx. # of pages</i>	<i>Approx. # of pages</i>	<i>Approx. # of pages</i>
University (strategy) reports	60	283	321	42
Patent and Spin-off regulations	9	28	19	22
Brochures and press releases	66	21	26	2
Other (charts, databases)	1	33	1	89
Total	136	365	367	155

Table 3. Representative quotes for the occurrence of basic needs

Representative quotes	#Nr./E M*/org.	Motives (first-order codes)	Need expression (second- order code)
<p>“And this is how I arrived at this big family on the tech transfer, because I think we can see the tech transfer as a family. [...] I like to move; I like to meet different people. So, I think this is the perfect job for me”.</p> <p>“I would say, feel most committed to students and also small companies”.</p>	<p>#2, E, KTO 2</p> <p>#12, E, KTO 2</p>	Opening-up to external relations	Expression of the need for relatedness
<p>“I think [name of advisor] is a very powerful person. I really admire her, so I have a personal need do accomplish something that is okay for her”.</p>	#4, E, KTO 1	Teaming-up beyond work duties	
<p>“When a researcher comes to me it is usually because he wants to create a spin-off company [...] and what I feel is that I can influence, I think I can improve his motivation, giving him or her all the skills, all the information to reach their goal”.</p>	#2, E, KTO 2	Sense of contributing to the public-good	
<p>“I’m basically in love. I’m in love with the university because I started at the [name of the university], I obtained my [name of degree] there”.</p>	#8, E, KTO 1		
<p>“[...] but it’s a job that doesn’t have a particularly procedural aspect. It’s something that you have to create. You have to use flexibility, imagination; [...] you have to put some of your own into it, in short, even when we are confronted at an international, European level”.</p>	#7, M, KTO 1	Adopting an entrepreneurial behavior	Expression of the need for autonomy
<p>“[What] I am trying to do is to create initiatives and activities and attempt to focus on the creation of the opportunities of business”.</p>	#4, E, KTO 1		
<p>“I would say that I do like a lot of the variety of content, that is a good opportunity to learn and to put yourself in every time in a sort of challenge, and it challenges you every time.”</p>	#6, E, KTO1	Maintaining updated expertise	Expression of the need for competence
<p>“The job is such that every day you go to the office, and you will find at least three things that you don't know”.</p>	#1, M, KTO 1	Being inspired by knowledge-transfer	
<p>“[...] a very interesting job, a job that also gives [one] the feeling of being on the frontier, of being the most, so to speak, the most evolved, the most advanced, the most up-to-date people in the university, that is, the least closed”.</p>	#13, M, KTO 2	challenges	

* E=Employee; M=Manager

Table 4. Representative quotes for university-level antecedents of the basic needs

Representative quotes	#Nr./E M*/org.	University- level antecedents (first-order codes)	Need relation (second- order code)
“I really think that our current management has invested a lot in this area [TT]. This was part of their strategy from the beginning, I would say; so, they maybe thought it was important”.	#1, M, KTO 1	Contributing to social and economic development	Strategic plan to fulfill the need for relatedness
“[...] limited to the technology transfer part, there are, as in all universities, the strategic objectives decided at the university’s top management level and approved by the board of directors. And then there are the objectives that the director general assigns to each executive through a negotiation process. [...] our managerial objectives must be clearly inspired, they must be in line, they must be consequential to the strategic objectives of the university, and they must be implemented in practice [...]”.	#13, M, KTO 2		
“I think we have a really good brand at the [university 1], and we are not at the right level. I mean, we could do it much better [...]”.	#4, E, KTO 1	Enhancing overall knowledge-transfer perception	
“I think researchers feel that our work is not so useful because the results just have to jump to society. So, we should probably work on the perceived value, I think”.	#6, M, KTO 1		
“[...] we must necessarily do as the competition does, we cannot choose the staff we want, or, rather, the we are made to choose [...] it is not always easy. [Name of another unit] instead chooses people by doing, it is always with public evidence, but it puts a notice of selection on its site, who responds, and then it does some interviews and chooses who you want in short. In this sense, [name of another unit] allows us to overcome some of these difficulties, these obstacles”.	#13, M, KTO 2	Grounding on unconventional public-body regulations	Structural set-up for hybrid demand to fulfill the need for autonomy
“I cannot stand, for example, one of the things that I don’t like from my job today is the badge”.	#4, E, KTO 1		
“I try to take an approach that is not particularly hierarchical because in my opinion in the university there are not even the tools to have a hierarchical relationship, so it is much more functional”.	#7, M, KTO 1	Specialization of organizational units	✧ to fulfill indirectly the need for competence
“[...] we have established small teams at the moment covering three areas, which are bio economy, engineering and health. [...] covering the whole process [...] developed a matrix organizational structure where the business development teams related to the different research areas connect with legal people in my team, connect with the team in terms of IP-protection or management of IP”.	#1, M, KTO 1		
Evidence in the organizational chart, see Figure 1.			
“I can also tell you that when we are asking something, and they [university government] do listen to us. [...] we can discuss our idea. So, I think that this is important, and this is good for the environment”.	#3, M, KTO 2	Establishing direct contact with KTO management	✧ to fulfill indirectly the need for relatedness
“[...] the current governance, it seems to me, that it [technology transfer] certainly has a lot of importance, i.e., what I have perceived from the current governance is precisely that there is the ultimate example of having invented one of the roles within governance as well as [name of the scientific advisor]”.	#7, M, KTO 1	Supporting scientifically KTO activities	Scientific support to fulfill the need for competence

* E=Employee; M=Manager/✧ Expression of an additional need

Table 5. Representative quotes for organizational-level (KTO) antecedents of the basic needs

Representative quotes	#Nr./E M*/org.	Organizational antecedents (first-order codes)	Need relation (second order code)
“I am able to talk for 5 minutes with any scientist because, for better or worse, I know what he does, [...] I know what motivates him, I know what that discipline is [...]”.	#13, M, KTO 2	Taking advantage of rich relational opportunities	Hybrid team management to fulfill the need for relatedness
“And now we are like 90 companies. So, they are calling us because they would like to be part of our system and then to be part of the service so that we can give them despite [...]”.	#3, M, KTO 2		
“The mind-set is ‘commercial’ – everyone has to ‘catch contracts’ and at the same time they are project managers of those projects”.	#12, E, KTO 2	Supporting an entrepreneurial team-spirit	
“Most of the colleagues of mine are people who are really open minded, curious”.	#14, M, KTO 1		
“I think I’m lucky because I have this relationship with bosses [...] I completely share with them the vision and the values of the job. Also, with the governance at the moment and with our director of the division”.	#8, E, KTO 1	Managing by a public-good ideology	
“I would exchange a higher level of royalty when I can get a higher impact from a contract”.	#8, E, KTO 1		
“So we are very autonomous. Basically, I can set my own goals. Even though of course the goals are within a general framework of the office and the university. But I think that my job is very autonomous”.	#8, E, KTO 1	Providing clear and challenging goals	Goal setting to fulfill the need for autonomy and competence
“I would like more autonomy. I would like to achieve my goals in a sort of autonomy and not with the sort of oppression or a boss”.	#2, E, KTO 2		
“[...] with the patent, and what I feel is that I can influence, I think I can improve his motivation giving him or her all the skills, all the information to reach their goal”.	#2, E, KTO 2	Relying on a system based on feedback	Skill maintenance to fulfill the need for competence
“And this gives me satisfaction; this gives me a lot of satisfaction: to know that I have contributed to bringing that thing. It’s ok, first of all on the market, and then it’s also good for society”.	#7, M, KTO 1		
“The project in Argentina, I think is a sort of incentive. A personal incentive because I had the opportunity to go abroad [...], to discover a new world [...]”.	#2, E, KTO 2	Taking advantage of multiple learning opportunities	

* E=Employee; M=Manager