Moving from intentions to implementation and use. TTOs as collaborative spaces for technology transfer

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Abstract
This work aims at discussing technology transfer offices (TTOs) as organizations inhabiting physical boundary spaces that TTO managers may use in order to pursue technology transfer. After drawing on literature on boundary objects and boundary spaces, the study theorizes on mechanisms and strategies that TTO managers can adopt in order to configure the TTO space as a boundary space for technology transfer. Last, particular attention is given to the gap between how TTO managers intend to configure the boundary space and how the latter may be used and interpreted by the parties that engage in technology transfer with the support of the TTO.

Keywords: Technology Transfer Offices, collaborative spaces, boundary space

Introduction
Research indicates that public-private partnerships for innovation can help organizations pool new resources, enhance learning, face complex problems for which internal means are scarce, share risks, increase speed to market, provide better services for customer and clients and develop new skills and ideas, among others (see Amesse & Cohendet, 2001; Etzkowitz & Leydesdorff, 2000; Laranja et al., 2008; Stiglitz & Wallsten, 1999). To these regards, a vehicle for the development of public-private collaborations is technology transfer (TT) (Lazzeroni & Piccaluga, 2003). From a TT perspective, understanding why and how certain collaborations with innovation goals are more successful than others, requires a careful attention to the extent to which partnering organizations share their knowledge assets and fully value them during the collaboration (Benassi & Minin, 2009; Bozeman, 2000; Cooke et al., 1997; Siegel et al., 2007). Within this framework, technology transfer offices (TTOs) acquire a prominent position given their role as central hub in the web of relationships between university, industry, state, and other stakeholders such as investors, citizens or policymakers (Bigliardi et al., 2015; Ungureanu et al., 2019; Cooke et al., 1997; Geuna & Muscio, 2009; Roxas et al., 2011).

While numerous studies have explored the technology transfer according to a wide range of perspectives (for reviews see Agrawal, 2001; Autio & Laamanen, 1995; Bozeman, 2000), the role of intermediary organizations such as TTOs is still underinvestigated (Klerkx & Leeuwis, 2009). This is problematic because intermediary organizations bridging the boundaries between the different mindsets that co-exist inside the partnership are common in most innovation partnerships. Studies on regional innovation systems suggest that TTOs play an important role throughout their development stages (Benassi & Minin, 2009; Bigliardi et al., 2015; Perez & Sanchez, 2003; Roxas et al., 2011). For instance, since learning behaviors and cooperation do not occur spontaneously, it is necessary to support interaction around issues that tend to be complex in public-private partnerships (PPPs), for instance planning, resource allocation, decision-making, project control and evaluation. Studies usually refer to these strategies as network management (Perez & Sanchez, 2003; Roxas et al., 2011; Siegel et al., 2007; Ungureanu et al., 2018a, 2018b). However, as straightforward as the benefic effects of TTOs may seem, there are many challenges affecting their effectiveness (Audretsch et al., 2014; Geuna & Muscio 2009; Nelson & Byers, 2015; Siegel et al., 2007). It is argued here that an important yet under investigated issue about TTOs is the degree to which they are able to facilitate boundary spanning in networks of

technology transfer. We conceptualize technology transfer not only as an abstract process by which the functioning logics of the partner organizations blend (hybridization), but also as a material process by which the space of the TTO transforms to encompass the functioning logics of the partnering organizations. This choice is motivated by the call for more detailed, context-based analysis on the configurations that TTOs assume within PPPs, as well as to the people that inhabit them, the spaces that host them and the day-to-day practices through which technological transfer is made possible (Agrawal, 2001; Resende et al., 2013; Youtie & Shapira, 2008). In particular, the concrete elements (i.e., people, spaces, practices) through which hybridization materializes in the partnership environment have received no attention so far in the literature. To further explore these issues, the study will explore the relationship between technology transfer brokerage and organizational space transformation.

Introducing a new perspective: TTOs as boundary spaces

It is well known from studies on traditional organizational work spaces that the setup, design, planning and use of organizational space is highly dependent on an organization's mission, strategy, resource structure as well as on its culture and identity more in general (see Elsbach & Pratt 2007). For this reason, organizations are highly cautious in taking decisions about organizing or reorganizing their space because it implies balancing many complex variables such as the requirements of multiple stakeholders with contrasting needs and meaning systems, as well as the functioning logics of the different units or departments or, in the case of the public-private partnerships and their brokers (TTOs), the ability to reconcile the public and private functioning logics. However, a TTO office that aims at growing closer to its stakeholders might use space (re)organization as leverage in the process of logic hybridization. In particular, a TTO that was born or is hosted inside the organizational space of one of the partners (usually, the university) may use spatial reorganization to enact strategies of logic differentiation, logic integration or combinations between the two. Fayard and Weeks (2007) reveal that the organization of space has a paramount role in generating interaction, according to how organizations balance proximity, privacy and affordability (i.e., extent to which employers feel free to be co-creative). In relation to knowledge management, physical artifacts such as office alcoves, water coolers and coffee machines have been shown to afford an environment high on creativity and innovation capabilities, via physical proximity (Elsbach & Pratt, 2007; Ungureanu et al., 2018d). The use of organizational space, thus, could be a means to implement any of the hybridization strategies mentioned above, from differentiation and symbolic appropriation of a new logic, to integration and up to more sophisticated strategies based on selective coupling. For instance, designing a modular space may help integrate social and commercial interests, set the rules for communication between different stakeholders, strengthen and/or change an identity or regulate knowledge sharing, organizational roles and innovation. Based on these arguments, I further focus on the role of TTOs as collaborative spaces that attempt to implement private-public logic hybridization.

The role of boundary spaces: spacing from differentiation to integration

The literature tells us that the creation and use of boundary spaces allow individuals belonging to different groups, communities or organizations to work together and make interactions durable over time while also maintaining a certain distance to preserve their jurisdictions (Bartel & Garud, 2009, Bechky, 2003, Carlile, 2002, 2004; Kimble et al., 2010; Koskinen, 2005; Star & Griesemer, 1989; Swan et al., 2007). According to the seminal definition of Star and Griesemer (1989), what defines a boundary object is its in-betweenness or ability to "both inhabit several intersecting social worlds and satisfy the informational requirements of each of them". Boundary objects are thus "both plastic enough to adapt to local needs and the constraints of the several parties employing them, yet robust enough to maintain a common identity across sites." (Star & Griesemer, 1989: 393).

A large array of objects has been discussed as boundary objects; these include repositories, standardized forms, sketches and drawings, workflow matrices (Carlile 2002; Star & Griesemer 1989), physical prototypes and IT objects (Bechky, 2003; Bertolotti et al., 2004; Carlile, 2002; Pawlowski & Robey, 2004), and more abstract objects that play an important role in innovation and technology transfer such as metaphors (Koskinen, 2005), narratives (Bartel & Garud 2009, Boland & Tenkasi,1995), or work processes and methods (Swan et al., 2007; Ungureanu & Bertolotti, 2016, 2018), and more recently, few contributions have also looked at spaces as a category of boundary spaces (see Elsbach & Bechky, 2007, Elsbach & Pratt, 2007, Nicolini et al., 2012). The tradition of studying boundary spaces refers to arrangements of people and material artifacts that people act toward and with (Kornberger & Clegg, 2004, Hernes et al., 2006, Dale & Burrell, 2008, Clegg & Kornberger, 2006). Specifically, it has been argued that the materiality of spaces is essential for organizational members to accomplish common projects because it co-locates them in the same dimension, encourages them to explore each other and enables them to engage in joint courses of action (Elsbach & Pratt, 2007, Van Marrewijk & Yanow 2010). However, although the material dimension of objects matters, what we usually refer to as materiality does not derive from the use of objects itself, but from social action -the myriad of interpretations, intentions, goals and expectations that individuals project towards such objects as well as towards each other. In the case of a TTO building, for instance, building materials such as walls, windows, corridors, furniture and associated features such as size, scale, mass, color, shape, design or environmental impact, may combine in unique ways with the symbolical, affective, ethical or ideological connotations given to them by the different stakeholders that inhabit the space more or less stably, such as the TTO staff and management, the staff, managers and representatives of the partnering organizations, and other users as well (i.e., third parties to the partnership such as customers, clients, potential business partners, etc.). In addition, it must be considered that the meanings attributed to the TTO by its managers and users may change during the social practices in which the objects are involved (i.e., design, execution, use). From such standpoint, the role of the broker, thus the TTO management and staff, is fundamental for a better understanding of the use of boundary objects in technological transfer (Kimble et al., 2010). It is thus necessary to have a closer look at the uses of boundary spaces -design, execution and use, and the functions they afford for the TTO management and for the various stakeholders of the space.

So far, technology transfer strategies may be discussed using the distinction between differentiation strategies and integration strategies. Differentiation refers to the strategy by which an organization tries to expand its mission in another sector by relying on external partners (i.e., balancing dual performance) and not by developing the new logic internally (Battilana & Dorado, 2010; Battilana & Lee, 2014; Ebrahim et al., 2014; Mair et al., 2015; Pache & Santos, 2010). In the case of a university TTO, differentiation would mean specializing one's resources in relation to the competencies and objectives of the university (patenting, academic research commercialization, fund raising, spin-off venturing) and at the same time establishing strong partnerships with the TTOs of the other partners such as the R&D offices of private companies participating to the partnership, or the innovation offices of public organizations such as municipalities or public utility companies, provided these offices exist, that they are also strongly specialized in carrying forward the innovation mission and objectives of their organization of reference, and provided they are motivated to develop such strong collaborations with the other offices for the sake of the partnership. Integration, by contrast, refers to internal recombination based on interaction between the two logics (private and public) and on control mechanisms that try to ensure that one logic does not prevail on the other. Integration may be focused on reconciling and reducing the tensions between different stakeholders, for instance by creating a unique point of refence (i.e., unique TTO) for the partnership and hiring personnel that can learn to apply logics synchronously, providing the TTO with mixed capital, creating a governance system that is both strong and independent from the single partners, as well as creating a strong

organizational identity for the TTO that incorporates values from both logics and transforms them into something new (Battilana & Dorado 2010; Ebrahim et al., 2014; Mair et al., 2015).

The intention-implementation-use gap in collaborative boundary spaces

In this work, it is suggested that to understand which opportunities, challenges and traps may be associated to designing a collaborative space that aims at facilitating public-private logic hybridization, increasing attention should be dedicated to possible gaps between intentions (i.e., the sum of purposes for which a space is designed), implementation (i.e., how the space is realized and brought to life) and use (how the space is experienced by users in their daily lives).

As far as intentionality is concerned, according to Foucault (1984) the power of spaces derives from their being real dispositions of materiality (i.e., buildings, rooms, furniture, machines/equipment) but with an ideal component, that is, the projection of ideas, goals, characterizations, assessments or hierarchies into those spaces. Organizing boundary spaces or creating boundary objects thus brings together the material and ideal. Specifically, those who design technologies, objects, buildings or spaces have images of how these will or should be used and try to impose them on others. The same dynamic may apply to the configuration of a TTO's space that can be strongly conditioned by ideas that the university, or the TTO itself, have a priori about the social functions that the space should accomplish for the partnership. A further distinction can be made here, according to the strategy pursued by the TTO, thus whether the TTO organizes its physical space to enhance hybridization through logic differentiation or through logic integration.

Intention-implementation-use gap in the differentiation strategy

An important documented finding is that organizations often use objects and spaces in ways that are at odds with original designs (Hernes et al., 2006; Dale & Burrell, 2008; Clegg & Kornberger, 2006; Kellogg et al., 2006; Orlikowski, 1992). Orlikowski (1992, 2006) distinguished between the intentions of those who design and commission boundary objects and the intentions and behaviors of those who use them. She called the former the "design mode" and the latter the "use mode". This might lead to misunderstandings between those concerned with the technical manipulation of organizational spaces (i.e., architects, space managers and builders) and those living out the social organization of the space as employees, managers or customers (Hernes et al., 2006; Dale & Burrell, 2008; Clegg & Kornberger, 2006). In the case of TTOs, a conflict may arise from the way the space is designed by the university, or by the TTO management, in order to favor collaboration, and the day-to-day experiences of those who experiment the space of the TTO.

In the case of a differentiation strategy, the space of the TTO may serve as a material scaffold for partnership coordination. The term 'scaffold' refers to a temporary or movable platform for workers (such as bricklayers, painters, or miners) that can be used to stand or sit on when working at a height above the floor or ground. Applied to a hybrid organizational space that tries to implement logic differentiation, scaffolding can be seen as the creation of a material platform characterized by modularity and connectivity that may allow for controlled interaction between the specialized TTOs of the partnering organizations (for a discussion see also Orlikowski, 2006). Research on physical space configurations (see Dul et al., 2011; Elsbach & Pratt, 2007) suggest that certain configurations of the physical environments such as creating barriers and enclosures, setting up adjustable work arrangements, equipment and furnishings and allowing people to personalize the work space are associated with job satisfaction and job performance, because they account for people's need for control over the workspace, as well as for their need for affiliation. I speculate that this may be even more the case when the TTO adopts a differentiation logic that requires both a high degree of specialization -i.e., each TTO represents the functioning logic, and

thus the meaning framework, the strategic objectives and the motives of a partnering organizations- and a high degree of coordination for the TTOs to act as a collective of brokers and not as a collection of competing or divergent innovation brokers operating in different sectors. For this to occur, it is likely that the space of one of the TTOs (I have here hypothesized that this may be the University TTO but other configurations may apply as well) will become the collaborative space where the staff and managers of the specialized TTOs meet to develop new ideas, coordinate on existing projects or make decisions about future developments of the partnership.

However, as shown above, in order to function, the differentiation strategy must be characterized by the high ability in all involved parties to maintain their own specialization and at the same time adopt a highly cooperative attitude by which expertise is communicated timely and relevant knowledge transferred effectively (Battilana & Dorado, 2010; Battilana & Lee, 2014; Besharov & Smith, 2014; Mair et al., 2014; Pache & Santos, 2013). Given that the staff of each brokering organization is likely to actively seek for a balance between coordination needs and the needs to safeguard expert specialization, the organization of the physical space will need to provide concrete tools for these specific needs. For instance, creating for members of the partnering organizations separate spaces that are both modular and connected to each other through bridging structures may effectively sustain the dual tension between expertise preservation and timely coordination.

In terms of the competencies required for a TTO to manage the trade-offs and complexities of an organizational space designed for logic differentiation, I suggest that at least three competencies are required. First, a TTO must have a good understanding of the other TTOs and of their strategies of differentiation. Even a perfectly balanced space that allows for both privacy, autonomy and discretionary sharing may fail if it does not reflect the way in which the specialized brokers intend to implement the differentiation strategy. Second, since differentiation relies heavily on providing each broker with high autonomy and complete jurisdictional control, a highly effective tool for reducing the intention-implementation-use gap may be to actively involve all brokers early on in the process of design of the collaboration phase, and throughout the following phases of realization. Co-designing collaborative spaces has been shown to tear down resistances and prejudices about the intentions of the designer, create a sense of shared belongingness to the space, and enhance openness to new ideas and creativity (Bohas et al., 2018; Cnossen & Bencherki, 2018; Fabbri & Charue-Duboc, 2013; Mitev & De Vaujany, 2013; Peschl & Fundneider, 2014). Consultation and co-design competencies are thus essential for TTOs that strive to achieve hybridization through differentiation, especially when partnering organizations have a strong identity, such as is the case of collaborations between universities, industry and public organizations (Bertolotti et al., 2019; Ungureanu & Macri, 2018). Last, studies have repeatedly suggested that a dangerous tendency of collaborative space promoters is to pay more attention to the physical features of a space than to the social and psychological processes that it affords (Skelcher et al., 2005; Ungureanu et al., 2018a, 2019). Without tools such as brainstorming rooms, dynamic planning and imaginative interior design, the work outcome may become less creative and characterized by openness. Differences between TTOs representatives may lead them using physical barriers inside the common space to lock themselves away from unwanted interactions, turning this way the collaborative space from a collaboration-based scaffold to a transparent box that serves as a mere container for smaller black boxes representing the partnering organizations (see Ungureanu et al., 2018b; 2019).

Intention-implementation-use gap in the integration strategy

As emphasized above, integration aims at not only reconciling but also reducing the differences between stakeholders (i.e., stakeholders, consumers, shareholders at large etc.) and it is based on making sure that logics co-exist and do not prevail on each other but, on the contrary, that they

merge to form a coherent whole (Ebrahim et al., 2014; Mair et al., 2015). So far, integration intentions have been associated to the material features of a collaborative space (e.g., tangibility, proximity, concreteness), which have been considered particularly powerful tools for bringing different frames and objectives together and consolidating them in a new, shared framework.

Boundary objects in general, and boundary spaces in particular, have been conceived as an interface where shared attributes, collaboration goals and collaboration practices may come together to create something new, a new starting point for the involved parties. From such standpoint, the tangibility of collaborative spaces is often seen as an evoking force that allows organizations to cross social boundaries and define a common membership. Koschmann (2013) for instance suggests that where formal authorities or market incentives are absent, organizations might use boundary objects or spaces as triggers for collaboration commitment. Thus, a common space that is designed with open spaces, rooms that facilitate spontaneous encounters and face time together, may play a facilitating role in the construction of a collective identity and thus on leaving behind inter-organizational and inter-logic differences (Ungureanu et al., 2019). As far as interfirm collaboration is concerned, Storper and Venables (2004) have referred to the 'buzz' that arises from physical co-presence, via intentional face-to-face contacts, accidental meetings or the mere fact of being in the same location. An anecdote presented by Elsbach and Bechky (2007) narrates the extreme case of a UK creative agency that facilitated interaction and problem solving between different departments by using an enormous desk that seated all its 104 employees which every three weeks played a version of workplace musical chairs in which everybody took their laptops and files and moved to a different seat for the daily work. Thus, designing office buildings as open spaces where workers can meet spontaneously and talk by coffee machines, bars and lounge rooms, take their notebooks and change work stations, is believed to enhance a culture of flexibility, transparency, and employee responsibility, as well as encourage creativity and innovation, facilitate negotiation and joint decision making and push towards higher overall performance (see Boschma, 2005; Fayard & Weeks, 2007; Storper & Venables 2004). However, as several studies suggest, most of the social effects of space proximity are taken for granted rather than empirically verified (Boschma, 2005). Interestingly, it has been even shown that using proximity as the main design consideration for shared informal spaces often leads to ephemeral interactions that bear little fruit (Fayard & Weeks, 2007). Thus, an important aspect in space design is the relationship between ideal features, how these are implemented and especially how these are perceived by actual users. For instance, some recent studies on science parks owned and managed by multiple stakeholders such as universities, industrial associations, municipalities, chambers of commerce and TTOs, suggest that when proximity designs are not accompanied by articulated collaboration plans, users may experience high degrees of dissonance concerning the intentions of the space managers and their own needs, with the negative consequence that the differences between partners (and the associated inter-logic gaps) are exacerbated instead of being reduced and integrated in a common frame (Ungureanu et al., 2018a). Summarizing, organizing for proximity can be a double-edged sword that must be managed carefully by TTO managers. In terms of competencies that a TTO must develop to pursue a hybridization strategy based on integration, I mention the pivotal role of sustaining proximity designs through adequate collaboration practices. Ideally, collaboration practices must anticipate the design of the collaborative spaces and subsequently develop it, stimulating users to go looking for new space configurations as the partnership evolves and the collaboration objectives change (Bohas et al., 2018; Fabbri & Charue-Duboc, 2013; Miettinen & Virkkunen, 2005; Mitev & De Vaujany, 2013).

Another type of spatial integration strategy is building new physical structures (i.e., containers) that can be filled with new people, work practices or processes that represent the partnership rather than the single partnering organizations (Ungureanu et al., 2018c). These spaces can play a useful role in marking the separation between what organizations are as singles and what they have become as integrated partners. For instance, building new offices that function according to an

integrated public-private logic, as well as creating new management positions or hiring new personnel that has experience in working in hybridized conditions or is neutral towards both logics and can learn to apply them both, can play an important part in creating a strong and stable association between the space of the TTO and its hybridized functioning.

Discussion

This study suggests that physical spaces that are designed for collaboration provide by themselves stimuli for spontaneous interaction and support the creation of a sense of shared belongingness. However, it is also suggested that regardless if the TTO opts for a hybridization logic based on integration or differentiation, if a collaborative space intended for users with very different backgrounds and expectations is not managed carefully, it can have extremely negative consequences for the partnership, aggravating perceived inter-logic differences instead of promoting hybridization. Thus, the study urges for a closer attention to possible discrepancies between intended (i.e., designed) spaces, implemented spaces and user-experienced spaces, both from an empirical and a theoretical standpoint.

As far as differentiation strategies are concerned, it has been argued that a particular important role is played by the process of material scaffolding that brokers usually perform in search for a delicate equilibrium between privacy and partnership interaction. As future research question, more needs to be understood about cases when the TTO space is perceived by TTO partners as too disconnected (too much privacy and separation), or as too public and thus threatening of partners' need to maintain differentiation. Also, when the TTO is very much connected to the university partner, other partners' perceptions of the space must also be carefully investigated, as these latter may perceive their autonomy as threatened or the TTO space as not really theirs. Another aspect that deserves further attention regards the connotations that each partner projects upon the hybrid space, via their own understanding of what hybridization implies. Regarding the competencies that TTOs need in order to design effective boundary spaces for technological transfer, it is important that TTO management sets up protocols to investigate, both formally and informally, partners' private strategies for hybridization in order to effectively leverage such understandings within their differentiation strategy. Additionally, it is important that managers develop co-design and consultation skills to prevent and dismantle partners' resistance towards the common space and acquire in-depth, specific abilities in order to provide inspirational support that can enhance the identity of the space.

As far as integration strategies are concerned, the hypothesis that permanent geographical proximity facilitates knowledge transfer occupies a central role both in managerial commonsense and in scientific accounts. The long list of local systems of production or innovation (growth poles, scientific parks, industrial and technological districts, technopoles, innovation milieus, etc.) rely on the hypothesis that the co-location of innovating firms and research laboratories is necessary and benefits both from the innovation activities and the processes of economic development. An implicit assumption is that co-location imperatives will trigger processes of social organization to foster knowledge sharing, adaptive responses and, most importantly, shared knowledge infrastructures. As shown above, collaborative spaces provide not just square footage for research and innovation projects; they convert the abstraction of "networks" into something more palpable, stable, and enduring. However, as discussed above, TTO managers may often assume that proximity is purely a function of physical factors: how far involved parties are from one another or how close they are to a break room. But it is not just the physical attributes of a space that influence informal interactions. Proximity depends on traffic patterns that are shaped by subjective (i.e., social and psychological) aspects and by intersubjective and interobjective dynamics. In fact, physical centrality can be often unimportant unless it is backed up by social

centrality— willingness and ability to modify the organizational structure of the TTO in order to incorporate a new space and the social relations migrating around it. Therefore, I highlight that in both integration and differentiation strategies, TTOs need to embed physical features in tangible and well-articulated collaboration projects because the discrepancies between tangible spaces and intangible projects can have a negative role on partners' perceived ability to integrate differences in a unique, shared framework. In the same way, spaces that are unbalanced in favoring privacy through the creation of separate or autonomous areas risk becoming mere containers of weakly integrated organizations that reclaim their spatial and social autonomy.

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