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Rethinking Roles, Resources, and Capabilities

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Technology transfer offices in the diffusion of transformative innovation: Rethinking roles, resources, and capabilities

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ABSTRACT

Technology Transfer Offices (TTOs) serve as intermediaries supporting the commercialization of new technologies in the market, with the aim of enhancing economic competitiveness. Recently, there has been a growing recognition of innovation's role in addressing societal challenges, referred to as transformative innovation. In this context, TTOs are expanding their scope and mission, tasked with acting as intermediaries aligning societal needs—beyond mere market demands—with potentially transformative technological solutions.

This paper empirically explores how TTOs interpret this new expanded role and examines as well the organizational resources and capabilities they mobilize to enact that role. We compare two TTOs that have recently been involved in projects related to the diffusion of transformative innovation. Our empirical findings reveal a disconnect between the prescribed expanded role of TTOs and their actual interpretation of that role. Additionally, TTOs lack the flexible mandates necessary for engaging in transformative innovation diffusion and the expertise to assess societal needs and impacts. They also face challenges in collaborating and co-creating with unfamiliar social actors. Rethinking the roles, resources, and capabilities of TTOs can help address this misalignment operationally.

1. Introduction

Technology Transfer Offices (TTOs) have long been recognized and studied as crucial knowledge brokers and intermediaries in the diffusion of research outcomes (Chapple et al., 2005; Siegel et al., 2003; Villani et al., 2017; Kivimaa et al., 2019). Historically, these innovations have empowered for-profit actors to achieve economic competitiveness and growth. However, innovation is increasingly being called upon to address urgent environmental and societal challenges. These 'wicked problems' are gaining more attention within the transformative innovation approach (Schot and Steinmueller, 2018; Diercks et al., 2019; Borrás and Edquist, 2019), which broadens its perspective from establishing a competitive advantage to tackling grand challenges.

As the grand challenges-oriented agenda gains rapid traction in the 'third mission' goals of universities and public research organizations (Donati and Wigren-Kristoferson, 2023), technology transfer offices (TTOs) have recently witnessed an expansion of their mission scope. In this context, TTOs are expected not only to transfer technology for economic returns in commercialization processes but also to maximize technology's positive social and environmental impacts.

In practice, this expanded mission scope entails new requirements for Technology Transfer Offices (TTOs). Therefore, as organizations, TTOs must contemplate how to integrate this new role, along with the necessary resources and capabilities. To carry out the tasks associated with this expanded role, these organizations need to mobilize new resources and develop new capabilities (Borrás et al., 2023). Recent literature has proposed several principles to guide TTOs in this new form of engagement (Mancha et al., 2017; Madl and Radebner, 2021; Zhou and Tang, 2020) and is creating new theoretical models that define the contextual barriers and opportunities for TTO engagement in this regard (Gerli et al., 2021; Lough, 2022). These normative and prescriptive approaches are valuable. However, a review of the literature reveals a gap in empirical studies examining how TTOs are actually interpreting and responding to the demands of this expanded role, as well as how they are mobilizing their resources and capabilities in that regard.

Two specific empirical dimensions warrant careful consideration. Firstly, there is a wealth of literature on the role of TTOs in research commercialization and related tasks (O'Kane et al., 2021; Bolzani et al., 2021). However, there is a paucity of empirical evidence regarding the role of TTOs when involved in the diffusion of transformative innovation

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processes. The second empirical dimension is about the resources and capabilities that TTOs mobilize when engaged in these diffusion processes. While there is extensive literature examining TTO capabilities and resources in commercialization-oriented diffusion (Weckowska, 2015; Soares and Torkomian, 2021), there is a lack of empirical analysis about their resources and capabilities when engaged in the diffusion of transformative innovation for addressing societal challenges. Therefore, this study poses the following research questions: How do TTOs interpret their newly expanded role? What organizational resources and capabilities do they mobilize to enact this expanded role?

Our exploratory study qualitatively investigates these research questions through an examination of two European TTOs. These TTOs have recently been involved in innovative projects focused on transferring technology and innovation to address societal challenges. The significance of this study lies in its effort to illuminate a largely understudied phenomenon, one with crucial theoretical implications for understanding the evolving intermediary role of TTOs and how to best harness their potential. Additionally, our analysis will provide valuable evidence-based insights into the practical implications related to the resources and capabilities that TTOs need to develop and access to fulfil the extended role.

The article is structured as follows: The next section reviews the literature concerning the traditional role of TTOs, their expanded role in transformative innovation, and the capabilities and resources of TTOs. This review helps identify current research gaps and establishes a conceptual framework for the empirical analysis. Section 3 explains the research design, case selection, and data collection. In Sections 4 and 5, we present the results of the analysis from the two case studies, and in Section 6, we compare and discuss these results. Finally, Section 7 concludes by summarizing the findings discussing their theoretical and empirical implications, acknowledging the limitations of the study, and suggesting avenues for future research.

2. TTOs in the literature and conceptual framework

In this paper, we focus on three specific aspects within the extensive academic literature on TTOs. Firstly, we examine the literature concerning the traditional commercialization-oriented intermediary role of TTOs. Secondly, we delve into the expanded intermediary role of TTOs within the context of the new approach of transformative innovation for addressing grand challenges. Thirdly, we review the literature concerning TTOs' specific resources and capabilities. This review allows us to identify gaps in the existing literature and establish a conceptual framework that draws on key concepts related to the roles, resources, and capabilities of TTOs, guiding our empirical analysis.

2.1. The traditional role of TTOs in the literature

The widespread establishment of Technology Transfer Offices (TTOs) in Europe was influenced by the desire to replicate the success of U.S. universities in promoting technology transfer (Feldmann and Breznitz, 2009) and was linked to the gradual globalization of this influential U.S. approach (Gores and Link, 2021). Most European TTOs came into existence after the passage of the U.S. Bayh-Dole Act in 1980, which established the legal framework for the commercialization of universities' research outputs.

European TTOs often have fewer resources and less extensive experience working with companies compared to their U.S. counterparts, and their mandates are frequently limited to a narrower range of activities. Empirical studies indicate that differences in licensing revenues between European and U.S. TTOs are, among other factors, related to variations in the industrial experience of TTO staff. Additionally, it's worth noting that revenue generation from licenses is one among other goals of TTOs. For example, Conti and Gaule (2011) suggest that TTOs goal is about facilitating local economic development by translating academic research into practical products.

In Europe, the core activity of Technology Transfer Offices (TTOs) has been to promote technology transfer by commercializing the research results of universities (Perkmann et al., 2013). They play a pivotal intermediary role, facilitating and supporting academic commercialization activities (among others, Siegel et al., 2003; Bolzani et al., 2021). As a result, TTOs serve as bridges between universities and industry (Rothaermel et al., 2007), acting as intermediaries connecting 'customers' (companies interested in innovative technologies) with 'suppliers' (university researchers whose research output is the new knowledge to be applied in industry) (Bolzani et al., 2021; Markman et al., 2008). TTOs' intermediation is essential for mitigating the 'information asymmetries' typically associated with technology transfer processes (Gallini and Wright, 1990).

In this regard, the literature highlights at least three primary tasks that TTOs are generally expected to perform as commercialization intermediaries. Firstly, TTOs are actively involved in protecting knowledge produced by university researchers through intellectual property rights (IPR). They assist in assessing the potential 'patentability' of new knowledge generated by university researchers, and they initiate, manage, and fund procedures for patent filing and licensing. The specific tasks of TTOs may vary depending on the stages of the patenting process they engage in, due to differences in national legislation regarding the ownership of academic research outcomes by universities and/or professors (Sellenthin, 2009). Secondly, TTOs serve as advisors to academic entrepreneurs, aiding them in gaining initial human and financial resources or actively advocating for university spin-offs (Rasmussen and Wright, 2015). Thirdly, TTOs are also involved in science and technology entrepreneurial education (STEE), functioning as entrepreneurship trainers for faculty and students (Bolzani et al., 2021).

The literature examining and assessing the performance of TTOs' activities is extensive (for a literature review, see Holgersson and Aabo, 2019). Evidence reveals that several decades after 1980, revenues related to intellectual property rights have not experienced exponential growth for European TTOs (Kenney and Patton, 2009; Lissoni et al., 2009). Nonetheless, it is observed that they have effectively facilitated technology transfer by alleviating information asymmetries and by promoting academic entrepreneurship in general (Perkmann et al., 2013).

2.2. An expanded role for TTOs in the literature

The recent advancement of a broader conceptualization of innovation for addressing grand societal challenges (Diercks et al., 2019, among others) has raised expectations for a new role for TTOs. This broader conceptualization of the 'third mission' of universities, extending beyond commercialization of research outputs, is increasingly advocated both internally and externally in university environments (Göransson et al., 2022), involving TTOs. The literature has approached this evolution from various angles.

Göransson (2017) suggests that the rise of innovation aimed at societal impact requires TTOs and universities themselves to expand their role. Pursuing a transformative innovation perspective implies an evolution of the entire university system, including TTOs. Along similar lines, some authors have proposed new university models such as 'developmental universities' or 'social entrepreneurial universities,' with a primary focus on inclusive socio-economic development and addressing grand challenges (Arocena et al., 2015). However, most of the literature views grand societal challenges as part of universities' 'third mission' (alongside the first and second missions of education and research), making it a goal for any university model (Compagnucci and Spigarelli, 2020).

In this context, the literature suggests conceptualizing TTOs as specialized 'boundary-spanning and fertilizing organizations' that are pivotal in stimulating universities' engagement with their broad third mission, particularly for promoting social and transformative innovation (Lough, 2022). TTOs are localized collaborative organizations

acting as intermediaries supporting universities in the development of new products and services aimed at societal impact. They operate as facilitators, boosters, and drivers of these transformations (Hodson et al., 2013; Hyysalo et al., 2022). In their extended mission to address grand challenges, TTOs are encouraged to prioritize social purpose organizations as institutional partners, incentivize public engagement and bottom-up processes among researchers, and facilitate the emergence of networks of social innovation from a 'quadruple helix' perspective (Lough, 2022).

The literature also suggests that, as intermediaries for social impact, TTOs' performance should be measured differently from profit-only knowledge commercialization activities (Kalmakova et al., 2021). Specifically, the extended role of TTOs requires their performance criteria for TTOs, in order to be evaluated against a broader understanding of value creation that goes beyond market commercialization (Mars and Burd, 2013; Mancha et al., 2017; Madl and Radebner, 2021). However, as some authors observe, there is a general problem: while the narrow mission of TTOs to foster research commercialization is well defined in terms of specific organizational requirements, incentive structures, and performance measurements, this is not the case for the expanded scope of TTOs towards societal impacts (Göransson, 2017).

Moreover, the literature suggests that a transformative innovation-oriented mission for TTOs also requires gaining added legitimacy within the university environment, particularly at the central administration level of the university, as well as among faculty members, and within university's own support services. This legitimacy should also extend to the external context where universities operate (Donati and Wigren-Kristoferson, 2023). This internal and external legitimacy can be stimulated through adequate incentive mechanisms and funding (Göransson et al., 2022).

Overall, this review highlights the literature's valuable normative and prescriptive insights regarding the expanded role of TTOs in transformative innovation for addressing grand challenges, which extends universities' third mission. However, it does not provide empirical evidence on how TTOs interpret this new expanded role, or the resources and capabilities they mobilize to fulfil it. These key empirical aspects remain unexplored in the literature. Next, we will review the literature on TTOs' resources and capabilities.

2.3. The capabilities and resources of TTOs in the literature

The specific literature on TTO capabilities and resources has predominantly concentrated on its traditional role in commercialization.

2.3.1. Capabilities

The literature conceptualizes and describes capabilities as an organization's skills to operationally engage in various actions required by its role (Förster et al., 2021). While the literature has extensively discussed TTOs' operational capabilities from various angles (as outlined below), rarely have these capabilities been associated with the extended mission scope of TTOs in transformative innovation for addressing grand challenges.

Some authors have concentrated on operational capabilities related to intellectual property rights (IPR), specifically the ability to assess the potential appropriability of research outcomes with a view to licensing or selling the intellectual property as a means of technology commercialization. It falls upon TTOs to evaluate the commercial (IPR-related) potential of university research outcomes and make decisions regarding patent applications (Lee and Jung, 2021). TTOs must be capable of keeping up with the technologies in the market, and identify potential markets for new technologies (Siegel et al., 2007). Consequently, TTOs need to ensure their employees are well-trained to support the patenting process and its subsequent commercialization (Bradley et al., 2013; Perkmann et al., 2013). Moreover, TTOs must be able to efficiently manage their budgets for patent applications and renewal fees, which often necessitate significant financial resources (Siegel et al., 2003).

Other studies have focused on operational capabilities associated with spin-off ventures. When investigating how TTOs can best support university spin-off ventures, Rasmussen and Wright identified the specific entrepreneurial competencies that spin-offs need to develop. Accordingly, the authors argue that TTOs must cultivate suitable mentoring and assistance capabilities (Rasmussen and Wright, 2015).

Another important capability extensively discussed in the literature is boundary spanning. Given the inherent differences in motivations, behaviours, and languages between university researchers and firms (Villani et al., 2017), TTOs play a fundamental role as boundary spanners between these two worlds (Chau et al., 2017). Regarding TTOs' boundary spanning activities, the literature underlines the paramount importance of TTOs' capability to coordinate between university researchers and industry representatives (Siegel et al., 2004).

2.3.2. Resources

An expansion of the role of TTOs arguably necessitates an increase in the allocated resources, both internal and external. Resources are essential assets for performing the various tasks associated with these roles. Current sets of resources, primarily defined by the institutional positioning of the TTO itself (Pelling et al., 2008), encompass human and financial aspects.

From the perspective of human resources, the literature has consistently emphasized the need for qualified personnel within TTOs. These personnel require technical and legal expertise to assess, protect, and commercialize academic patents (Brescia et al., 2016). They also need 'soft skills' to persuade academics to engage in research commercialization (Olaya-Escobar et al., 2020). Skilled staff is also crucial for activities related to spin-off promotion, where TTOs provide business coaching and mentoring (Lockett and Wright, 2005).

An essential resource for TTOs is the financial budget allocated for intellectual property (IP) protection. This resource pertains not only to the availability of funds but also to the capacity to seek external advice, when necessary, as noted by Lockett and Wright (2005).

Another fundamental resource for TTOs is their mandate, which defines the degree of autonomy TTOs have as organizations within the university structure. Authors suggest that 'divisional approaches,' which grant TTOs an autonomous mandate in a decentralized university structure, can be more efficient and effective than centralized ones (Bercovitz et al., 2001). The positioning of the TTO within its university structure impacts its coordination capability (orchestrating activities across various university units), information processing, and the alignment of incentives for various actors (Bercovitz et al., 2001). This highlights the intrinsic link between resources and capabilities, a well-established perspective known as the resource-based view of an organization as the stock of assets (the TTO's funding, mandate, staffing, etc.) and the dynamic view in terms of capabilities as routines within the TTO.

Lastly, the broader university ecosystems in which TTOs are embedded can serve as valuable resources for commercialization activities (Audretsch et al., 2012). Within the university, the presence of an entrepreneurial and market-oriented faculty can significantly influence TTO performance (Barney, 2001). Similarly, the availability of venture capital and high levels of R&D in firms located near the university are also predictors of TTO performance (Powers and McDougall, 2005).

In conclusion, the literature has identified several key resources and capabilities that TTOs require for their traditional commercialization-oriented role. However, there is a lack of explicit discussions regarding the resources and capabilities that TTOs need in their expanded role in helping the diffusion of innovations that address grand challenges and have a broad social impact.

2.4. Research gaps

Our literature review reveals two interrelated gaps. First, the literature does not empirically analyse whether and how TTOs interpret

their expanded role when actively engaged in transformative innovation diffusion initiatives. The literature tends to primarily present the new role of TTOs in a prescriptive manner rather than analysing concretely how these organizations are actually broadening their role (Hayter et al., 2018). Second, and related to this, the literature on TTOs is rich in studies about their resources and capabilities, but these studies mainly focus on those related to TTOs performing their ‘traditional’ role related to commercialization. Consequently, we still lack empirical evidence regarding the resources and capabilities of TTOs required to engage in their expanded role. To address both gaps, we pose the following research questions: How do TTOs interpret their newly expanded role? And what organizational resources and capabilities do they mobilize to enact this expanded role?

2.5. Conceptual framework

Drawing from the literature reviewed above, our conceptual framework comprises three elements (refer to Fig. 1). First, we aim to examine the role of TTOs in response to their expanded mission scope. To do so, we follow the track suggested by the prescriptive views mentioned earlier and investigate how conducive the context is in shaping the extended TTO role, as well as how the TTO itself interprets that role. Second, we build on the literature regarding TTO resources, exploring new types of resources that TTOs access or mobilize in relation to their new expanded role. Third, we consider the capabilities and routines developed by the TTO to fulfil the tasks of the new role. Fig. 1 visualizes these three elements emerging from the literature reviewed above, which contributes to a broader scholarly discussion about the capacity of organizations as intermediaries in transformative innovation (Borrás et al., 2023).

The different elements in Fig. 1 are ‘role,’ ‘resources,’ and ‘capabilities.’

The ‘role’ is conceptualized as the set of purposeful tasks and

activities that TTOs carry out as intermediary organizations. These activities characterize their institutional work in the processes of diffusing transformative innovation for societal impact. The role of the TTO is interconnected with the context in which it operates. Indeed, the context can contribute to prescriptively assigning a role that the TTO has to interpret. In the novel paradigm of transformative innovation, as seen in the literature, TTOs are prescriptively assigned the role of facilitators and mediators in the development of new products and services for societal impact, aligning research outputs with societal needs. This often involves engaging with novel ecologies of actors in addition to the traditional ones. However, the literature has not yet investigated how TTOs, as organizations, interpret and concretely perceive their role in relation to the expansion of their mission.

To fulfil such expanded role, TTOs may require novel or additional resources. Conceptually, we refer to ‘resources’ as the material and immaterial assets that the TTO can access for its activities. These resources are situational and can be either internal or external to the TTO organization. Specifically, TTOs resources are increased financial resources, appropriately (re)skilled human resources, or explicit administrative mandates. Elements in the external environment are also important resources of the TTO, for example, the network of external actors, or the degree of organizational autonomy and legitimacy in carrying out new activities (Donati and Wigren-Kristoferson, 2023).

To enact the new expanded role TTOs need to activate the available resources by using specific combination of their own organizational capabilities. The term ‘capability’ refers to a skill or ability found within organizational routines, practices, and procedures. Capabilities are more dynamic than resources, as they are about the organization being able to adapt to evolving situations and contexts (Teece et al., 1997). Therefore, operational, boundary-spanning, and coordination capabilities, as already discussed in the literature, may need to evolve in response to the TTO’s new expanded role in relation to transformative innovation (Hyysalo et al., 2022).

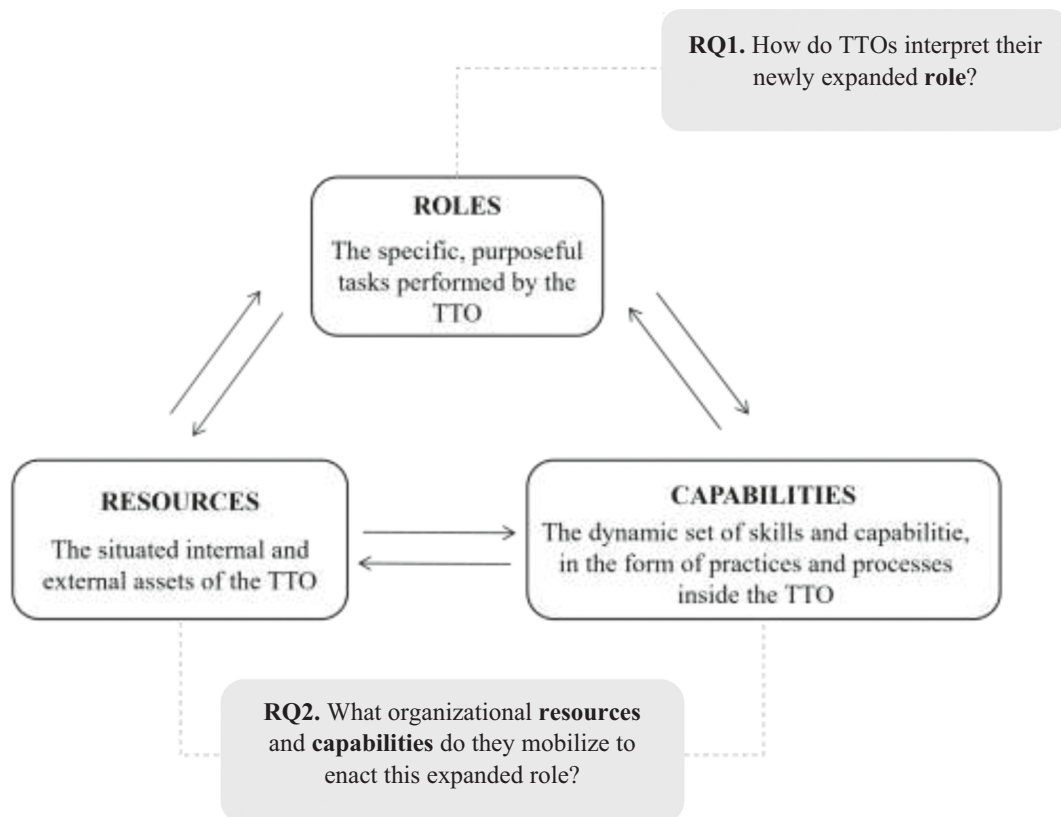


Fig. 1. The conceptual framework in relation to the RQs.

3. Research design, method, and data

This paper employs a qualitative approach to investigate the research questions. Specifically, we conduct a comparative analysis of two similar cases to explore the variations of the three conceptual elements identified above (roles, resources, capabilities) (Anckar, 2008). The analysis focuses on two TTOs, the Italian TTO of Politecnico di Milano and the Swedish TTO of the University of Borås, which have recently participated in projects that explicitly request them to act as intermediaries for transformative innovation.

The comparative research design is suitable for our study, as the two TTOs are embedded in very similar ecosystems and involved in similar transformative innovation diffusion projects. By comparing these cases, we aim to investigate how the widening of the concept of innovation (towards a transformative perspective) reflects how TTOs interpret their expanded role. Additionally, we seek to understand what resources and capabilities they mobilize.

Given the lack of academic literature on the topic, exploratory case study analysis provides a unique means of developing further theory by utilising in-depth insights into empirical phenomena and their contexts. Our approach combines the empirical results with the emergent conceptual framework defined in Section 2.5 on TTO roles, resources, and capabilities. This framework guides the analysis and highlights these three conceptual elements (Corbin and Strauss, 1990).

The use of a conceptual framework provides structure and rigour to the inductive analysis of the cases, as opposed to the hypothetico-deductive research approach that systematically designs research to test theoretical predictions (Johnson and Duberley, 2015).

The two cases being studied are situated in similar meso-level ecosystems, with the regions of Lombardy and Västra Götaland both being among the wealthiest and most innovative in Europe according to the European Commission (2023). Furthermore, both Politecnico di Milano and University of Borås are technical universities with a focus on engineering and design. Additionally, the engaged actors include not only research institutions, but also a science park, a start-up accelerator, and third-sector organizations that are involved in identifying societal needs.

The first case involves the TTO of Politecnico di Milano participating in “Get it! Twice” (2020–2021), which aims to facilitate technology transfer to address unmet needs in the welfare and healthcare sectors of Lombardy. The TTO actively participated in the “call for solutions” by matching technological solutions to emerging needs, selecting and supporting the winning teams, and accessing the local network of third-sector organizations and social entrepreneurs.

The second case involves the TTO of the University of Borås, known as the “Innovation advisory service,” participating in “SUITCEYES” (2018–2021), which aims to develop haptic communication technologies for people with deaf blindness. The project involves co-designing novel research-based tactile solutions with deafblind users represented by a civil society organization. The TTO’s intermediary role was to facilitate the co-design process with users and ensure coherence to access the market.

The two TTOs are relevant as they engage in processes of diffusion of transformative innovation, combining technological and intentional social innovation aspects in the holistic transformative perspective outlined by Göransson (2017). The ecology of involved actors was much larger and more oriented towards social purposes than in conventional commercialisation-oriented technology transfer processes (Hyysalo et al., 2022), changing the underlying objective of the entire intermediation process (Lough, 2022). Consequently, the projects are expected to push TTOs to interpret their new role in the project, mobilize different resources and develop new capabilities, as the relationship with a clearly articulated existing demand is missing.

To collect data, we used qualitative content analysis from different data sources. We conducted 31 semi-structured interviews, reaching as many actors as necessary to achieve meaning saturation, which was indicated by the stability of the coded content (Hennink et al., 2017).

Table 1 in the Appendix summarises the interviews and analytical procedures conducted in the two cases.

The semi-structured interviews focused on investigating how the TTOs perceived their role and the combinations of resources and capabilities that TTOs leveraged (or lacked) to fulfil it in the projects. An open interview protocol was designed to capture the rich contextual perspective.

The interviews were conducted online between December 2021 and March 2022 with the support of Microsoft Teams. The analysis of interviews was accompanied by the content analysis of secondary data sources, such as articles and program materials. More details about the interviews and the data collection can be found in the Appendix.

4. Analysis of the Italian case: “Get it! Twice”

The “Get it! Twice” project engaged the Technology Transfer Office (TTO), university researchers, and external partners from the innovation, entrepreneurship, and third-sector ecosystem in an empowerment program aimed at transferring “purpose-driven technologies” to address unmet local needs in the fields of social welfare and healthcare. All participants expressed a positive outlook regarding the project’s potential to foster cross-fertilization between research and social entrepreneurship. However, TTO officers displayed limited confidence in its effectiveness, revealing scepticism about the long-term economic sustainability of the social businesses built around the selected technologies.

4.1. The role of the TTO

The project design did not explicitly define a new role for the Technology Transfer Office (TTO), despite involving it in non-traditional activities, such as aligning societal needs with technological research outputs. The interviewees suggest that, within the program context, the TTO did not consider its new role as an intermediary. Most respondents did not even perceive it as necessary for the TTO to expand its engagement with new stakeholders and activities. The few respondents who were open to consider the TTO’s role were those with more experience in the social innovation sector. These same respondents observed a lack of willingness on the part of the TTO to redefine its typical commercialization-oriented intermediary role.

4.2. The resources of the TTO

Many respondents described the TTO organization as having all the necessary resources to engage in a project like “Get it! Twice.” Only interviewees who embraced a broader conception of innovation beyond commercialization identified a lack of resources. The “Get it! Twice” project organized specific lectures on social impact assessment methodologies and the characteristics of social enterprises. Although some TTO officers participated in these lectures, the interviews indicate that they did not acquire sufficient practical resources to apply these concepts in their work. They viewed the lectures as overly theoretical and disconnected from their routine activities.

In general, the TTO organization claims a shortage of resources, encompassing staff expertise, time availability, and an explicit official mandate, to allocate to transformative innovation alongside its usual activities. A TTO Officer expressed concerns about the TTO’s historical lack of focus on social impact and the absence of a culture related to it among their researchers. As a result, the TTO seem to have lacked the essential elements for effective “interaction with the third sector and social entrepreneurship.” (Q1, TTO officer #1). This highlights the necessity for a more comprehensive approach to resource allocation to better engage with transformative innovation societal impact.

4.3. The capabilities of the TTO

The interviews suggest that the TTO was unable to establish proper connections and coordination with the network of third-sector organizations with which they had no prior interaction. This disconnect may be attributed, as highlighted by University researcher #2, to a language barrier, as she pointed out that “there is a specific language within the sector” (Q2, University researcher #2). The TTO appeared unfamiliar with this specialized language, which presented a challenge when engaging with impact investors and other stakeholders. Consequently, they faced difficulties in effectively communicating and building relationships with these groups.

During ‘Get it! Twice’ initiative, the TTO encountered “organizations from the social sector that operate with very different logics,” as noted by TTO officer #3. This underscores the TTO’s need to develop the skill of effectively “interacting with non-business-as-usual organizations” (Q3, TTO officer #3). Coordinating with such a diverse group of actors requires greater flexibility and more advanced coordination capabilities.

The TTO’s inability to engage effectively with a wide range of actors within the third sector suggests a deficiency in both language skills and soft skills, particularly in dialogue and communication. This highlights the urgent need for the TTO to enhance its communication capabilities to navigate the complex landscape of third-sector organizations and stakeholders.

Despite encountering challenges in engagement and establishing proximity with socially oriented actors addressing territorial social needs, TTO officers were compelled to develop “reflexive” capabilities regarding the societal needs and impacts of the organization’s activities, as well as those of the transferred technologies. This transformation in their skill set is evident in the words of Innovation and Entrepreneurship Trainer #2, who mentioned that “they have acquired new skills by immersing themselves in a new world through initiatives like ‘Get it! Twice’” (Q4, Innovation and Entrepreneurship Trainer #2). Additionally, TTO Officer #3 emphasized the significance of learning “to understand the needs of the social sector” and referred to it as a “commercial” capacity, underscoring the necessity for the “ability to listen” and engage effectively (Q5, TTO Officer #3).

Nevertheless, the interviews indicate that the TTO continues to assess the success of its technology transfer outcomes using primarily “profit-oriented” metrics. In addition to training modules like those offered to “Get it! Twice” participants, TTO officers require deeper and more analytical capabilities to evaluate and manage the broader societal and environmental outcomes and impacts of technologies and innovations.

4.4. Summary of the case

In summary, despite the widespread enthusiasm surrounding the ‘Get it! Twice’ project and the available resources within the ecosystem (such as the dedicated training module), our interviews reveal a lack of responsiveness and proactiveness on the part of the TTO in interpreting its new role. The TTO officers did not perceive a shifting role or felt empowered to embrace it. They struggled to view ‘Get it! Twice’ as a strategic opportunity to adopt a new type of intermediary role, leverage available resources (like the training module or the expertise of the CSR office), and develop new capabilities.

The TTO’s lack of awareness, formalized mandate (for involvement in the early ‘needs assessment’ phase or participation in the training module), dedicated human resources, and coordination and communication capabilities rendered it passive in seizing the opportunities presented by ‘Get it! Twice.’ The fact that the TTO never collaborated with the university CSR office further underscores that social impact is not perceived as one of the TTO’s responsibilities.

5. Analysis of the Swedish case: SUITCEYES

The SUITCEYES project required coordination among the Technology Transfer Office (TTO), researchers from the University of Borås, a civil society organization (CSO) dedicated to serving deafblind individuals, international academic partners, a Science Park, and a technological firm. However, all the respondents expressed disappointment with the project. While they appreciated its ambitious goals, the co-produced technology did not make it to the market. The TTO was aware of its limitations in terms of resources and capabilities and primarily assumed its usual intermediary role. In contrast, the researchers believed that the involvement of the CSO was crucial to testing the developed solution’s suitability for deafblind users and following a “social needs-based” approach.

5.1. The role of the TTO

The case reveals that despite the awareness shared by TTO officers, the TTO did not adopt a new intermediary role oriented towards social impact, as the CSO was not considered the ultimate recipient of the technology transfer process. The CSO’s engagement only occurred during the early phase of prototyping tactile technologies. According to all respondents, the absence of coordination in the final stages of the project, due to the vacant intermediary role, prevented the prototype from reaching the market and benefiting society. Specifically, the research prototype’s alignment with the needs of deafblind users needed to transition into a much broader and long-lasting relationship involving the users, and the research prototype. Unfortunately, this did not happen.

This sentiment was echoed by Researcher #1, who expressed a desire to “involve innovation advisers [TTO officers] more extensively in the process,” highlighting the untapped potential in their development role. They could have done more as the project progressed further towards innovation development (Q6, Researcher #1). While the TTO supported the technical aspects of prototyping, there was a gap in their direct engagement with users and their contribution to bridging the divide between initial user engagement and the development phase leading to the market. This underscores the need for a more integrated approach in which TTO officers play a more active role throughout the entire process, connecting research outcomes with both end users and the market to ensure successful diffusion and societal impact, as emphasized by Researcher #1: “We have come so close to the market, but we have not reached it” (Q7, Researcher #1).

5.2. The resources of the TTO

The interviewees emphasized that, in general, the Science Park possesses more resources than the TTO, primarily due to its flexible institutional mandate, which offers greater “degrees of freedom” and decision-making autonomy. This flexibility allows the Science Park to engage in transformative innovation activities beyond the traditionally research-oriented work of the TTO. Innovation Advisor #1 noted that “interaction is developing” within the Science Park, and they have conducted “focus group research” to further their efforts (Q8, Innovation Advisor #1). This suggests that the Science Park can operate in ways that might be considered less stringent compared to academic institutions, enabling them to “have more opportunities related to innovation” and establish “strong collaborations with other organizations” (Q9, Innovation Advisor #2).

According to the respondents, the TTO is more research-focused and, consequently, more resource-constrained, given the short time horizon characteristic of the daily activities of researchers and academics. In contrast, the Science Park can rely on financial resources to engage in much longer time spans and undertake more complex and inclusive projects, aligning with the nature of transformative innovation initiatives. Consequently, the Science Park has a broader scope of action,

translating into a more resourceful institutional mandate, longer time horizons, as well as direct support from other actors, such as the local municipality. The interviewees also emphasized that the Science Park's engagement is evolving and that it can operate in areas where academic institutions might be too rigid, thus providing more opportunities for innovation and fostering strong collaborations with other organizations.

5.3. The capabilities of the TTO

Despite the “unfulfilled” intermediary role of the TTO, the interviews and observations collected from the actors involved in the SUITCEYES case revealed a high level of understanding among individual TTO officers, referred to as “Innovation Advisors,” about the specific capabilities required for a TTO to formally adopt the new intermediary role in transformative innovation diffusion. Most of the interviewed TTO officers believe that TTOs need new “institutionalized” coordination and communication capabilities to engage and co-create with civil society organizations (CSOs) and end-users with special needs. Universities and TTOs must establish an “atmosphere” of inclusive, interactive, and open collaboration with end-users to co-create technological solutions that address real challenges. This can be achieved through participatory workshops, where TTOs employ strategies to facilitate interaction, co-creation, and coordination among these stakeholders. As highlighted by a university advisor, developing skills to “effectively work with groups, understand people's specific needs,” and employ “methods for scheduling meetings and engaging with them” are essential aspects of this collaborative process (Q10, University Innovation Advisor #1). It appears crucial for universities and TTOs to continually enhance their capabilities in these areas to foster successful partnerships and innovation.

University interviewees also emphasized the crucial importance of developing appropriate analytical capabilities related to impact assessment when measuring societal outcomes. TTOs need analytical skills to assess their goal achievement, especially when their objectives extend beyond traditional commercialization, which is “much more challenging,” as noted by University Innovation Advisor #3. In cases where the objectives are less straightforward, such as addressing societal challenges, the question of “how to measure success” becomes more complex (Q11, University Innovation Advisor #3).

The close presence of the Science Park in Borås, which is regularly involved in projects related to community empowerment, social innovation, and the circular economy, was an important factor in this case. Respondents indicated that the presence of the Science Park positively influenced the individual capabilities of the innovation advisors employed at the TTO because they had the opportunity to work and collaborate with the Science Park, gaining access to “new skills” necessary for navigating projects with broader societal impacts (Q12, University Innovation Advisor #2).

5.4. Summary of the case

In summary, the TTO involved in the SUITCEYES project was aware of the novel capabilities required to fulfil its new intermediary role in the diffusion of transformative innovation, encompassing coordination, communication, co-creation, and analytical skills. Despite this awareness, the case revealed the challenges the TTO faced in developing these capabilities and carrying out the new role. Limited resources, attributed to the short time span of its research-focused work and the constrained autonomy within its institutional mandate, made it difficult for the TTO to proactively embrace the new intermediary role. Instead, the TTO outsourced the role to another organization—the local Science Park—which had prior experience in such roles. The Science Park appeared to possess greater resources in terms of time and autonomy within its mandate, which, when combined with its own organizational capabilities, proved pivotal for fulfilling the new role.

6. Comparative findings and discussion

The analysed cases reveal the complexity and difficulty faced by TTOs in interpreting and operationalizing their expanded roles. This challenge is closely linked to the availability of resources and the development of appropriate organizational capabilities needed to carry out these new responsibilities.

The Italian case, “Get it! Twice,” demonstrates that the broader intermediary role assigned to the TTO on paper was not embraced by the TTO organization itself. The TTO showed limited awareness of the need to incorporate this new role as a mediator between technological solutions on one hand and societal needs involving civil society organizations on the other. The Politecnico University (to which this TTO belongs) did not recognize the strategic importance of considering the new expanded intermediary role of the TTO, and it did not formulate a formal mandate for the TTO. Consequently, the TTO was motivated to maintain a ‘business-as-usual’ role, which led to the underutilization of available resources, particularly the training module for social impact assessment. It also led to the lack of development of new capabilities within the TTO, particularly new coordination capabilities to engage with a more diverse range of actors. Strategically, Politecnico University invested more effort in designing an innovative process than in considering the organizations involved, particularly the role, resources and capabilities of the TTO.

In contrast, the Swedish SUITCEYES case reveals a higher level of awareness within the TTO regarding the expanded intermediary role in the diffusion of transformative innovation, focusing on co-creating innovations for societal impacts with users. There was a recognition of the need to mobilize resources and develop relevant capabilities. However, the actual development and implementation of these novel sets of capabilities, particularly in terms of interaction, communication, and long-term assessment of societal impacts, remains a work in progress. The perceived lack of suitable resources within the academic environment hindered the TTO from fully embracing the new intermediary role. Interestingly, the TTO ‘outsourced’ this new role to an external and less constrained organization, the Science Park, which was strategically equipped for such a role. The latter organization appears to have more resources, particularly a more flexible mandate and a longer time horizon, as well as capabilities to engage with a broader variety of actors.

In the following, we discuss these findings in the context of the current literature to demonstrate how they contribute to our understanding of TTOs' roles, resources, and capabilities.

Starting with a discussion of roles, our study provides empirical support for general approaches that emphasize the complexity of the new role of intermediaries in the diffusion of transformative innovation (Hyysalo et al., 2022; Kivimaa et al., 2019). More specifically, our study of TTOs reveals that it is not merely a matter of designing an overall process; it also involves the necessity for key intermediaries to recognize and embrace the expanded role within their organizational boundaries. As observed earlier, Lough (2022), Göransson (2017), Madl and Radebner (2021), and Donati and Wigren-Kristoferson (2023) have theoretically proposed an expanded role for TTOs as enablers of university engagement in transformative innovation, acting as intermediaries that transcend the institutional barriers of universities through boundary spanning. Our study empirically examines this matter rather than prescribing it. When analysing how TTOs have (or have not) interpreted their new expanded role, our findings demonstrate that TTOs may tend to adhere to their traditional role, even when they are exposed to projects like ‘Get It! Twice’ and interact with various actors in transformative innovation projects. In other words, the new expanded role of TTOs does not automatically manifest, as suggested by previous literature; instead, it is crucial for TTOs to develop a clear awareness of this new role within their organization.

When discussing resources, our results indicate that the four resource categories outlined by Powers and McDougall (2005) remain relevant for TTOs' expanded tasks but require updates and supplementation.

More financial resources are necessary to fulfil the new intermediary role. Trained and experienced human resources are indeed critical, as emphasized by Brescia et al. (2016) and Olaya-Escobar et al. (2020). Additionally, our findings contribute to this understanding by highlighting that TTO staff require training in new areas such as social impact assessment, along with the need to co-design suitable methodologies.

We have also discovered that TTOs need a specific and formal mandate to autonomously and legitimately carry out their new activities towards transformative innovation. This aligns with the arguments put forth by Lough (2022) regarding the autonomous “decentralized” nature of TTOs, which is essential for them to become legitimate intermediaries in the realms of social and transformative innovation within an inclusive third mission (Donati and Wigren-Kristoferson, 2023). Such decentralization can also be related to the necessity of an appropriately “located” autonomous physical space for the TTO.

Finally, our findings underscore the significance of longer time spans for technology transfer processes in contexts involving social impact beyond commercialization. Interestingly, it appears that the literature has not adequately recognized this aspect.

Regarding capabilities, our findings highlight as well that the mentioned resources are essential for TTOs to develop the organizational capabilities critical for the diffusion of transformative innovation. Our study provides concrete evidence that the development of new capabilities is contextual and necessitates adequate resources. As highlighted by Chau et al. (2017) and Siegel et al. (2004), coordination and boundary-spanning abilities are pivotal but must become more inclusive, extending towards social purpose-oriented organizations. Furthermore, effective “communication” is crucial in a manner that places societal impact objectives at the forefront rather than focusing solely on profits (Lough, 2022; Donati and Wigren-Kristoferson, 2023). Operational and analytical capabilities are imperative for transitioning from the traditional focus on scouting markets and profit potential demand, as emphasized by Siegel et al. (2007) and in alignment with Göransson (2017), to the assessment of the social impact potential of innovations and technologies. This evolution in analytical and operational capabilities is fundamental to support the role of a “TTO for social benefit” (Mars and Burd, 2013; Madl and Radebner, 2021; Mancha et al., 2017), capable of acting as an intermediary to facilitate transformative innovation.

7. Conclusions

Transformative innovation demands that TTOs expand their role beyond the traditional intermediary role in innovation diffusion. Traditionally, TTOs facilitate and support academic commercialization activities, acting as intermediaries between research outputs and market demands. However, in the context of transformative innovation diffusion, TTOs are tasked with aligning research outputs with societal needs in order to produce societal impacts alongside economic returns (Hyy-salo et al., 2022; Göransson, 2017; Göransson et al., 2022; Lough, 2022; Madl and Radebner, 2021; Mancha et al., 2017).

This paper delves into how TTOs perceive and enact their expanded intermediary role and examines the organizational resources and capabilities they deploy in this regard. These are pivotal questions that the existing literature has yet to adequately address.

Our study offers three contributions to the literature. Firstly, our empirical investigation reveals that assuming this new role poses significant challenges for TTOs. Specifically, the analysis of two cases indicates that TTOs do not automatically embrace this new intermediary role when confronted with specific requests to broaden their mission scope to integrate transformative innovation for addressing major challenges. Our study further demonstrates the difficulty TTOs encounter when engaging with actors from the third sector, such as private non-profit organizations. Therefore, we contribute by illustrating that introducing new roles alongside traditional ones is a

complex process that demands TTOs to evolve their understanding of innovation, value, and the network of actors with whom they interact. Additionally, our analysis suggests that the resources and capabilities required for fulfilling the traditional commercialization-oriented role appear to be inadequate and inappropriate for the new expanded role.

A second original contribution arising from our empirical study pertains to the specific combinations of resources and capabilities that may support the enactment of the new intermediary role. Concerning resources, our study provides new insights in several ways. An important resource is the official mandate of TTOs. In this context, TTOs require explicit and flexible mandates to engage in activities beyond the commercialization of research outcomes. As our analysis indicates, the absence of changes in their institutional official mandate created tensions within TTOs regarding how to interpret the expectations surrounding this expanded role. Similarly, in terms of resources, our study sheds new light on the need for TTOs to acquire new expertise to support researchers beyond business training and the protection of intellectual property. This is related to other resources needed by TTOs, namely, more flexible time horizons that account for longer-term processes of social impact, and specific budgets for the new tasks. In terms of capabilities, our findings show evidence that TTOs encounter difficulties in their external relations. For that reason, it suggests that TTOs need to develop suitable communication and co-creation capabilities to establish a “challenge-oriented” language in order to interact with new types of actors (particularly civil society organizations and social enterprises). This will enable a more reflexive and “societal need-oriented” approach to technology transfer. Furthermore, TTOs encounter difficulties with assessing societal impact of research outcomes; therefore they need to cultivate analytical capabilities to be able to perform this new form of assessment.

This new evidence has relevant practical implications for TTOs, university managers, policymakers, and stakeholders involved in the capacity building of TTOs. Our study highlights that TTOs do not naturally embrace a new expanded role for the diffusion of transformative innovation, nor do they possess the requisite resources and capabilities to do so. TTOs, as public offices, require an institutional official mandate that is issued with a clear understanding of what transformative innovation entails and how TTO roles should evolve to transfer research outcomes to unfamiliar contexts. In light of pressing societal challenges, policymakers should be aware that unlocking the strategic potential of TTOs to support transformative innovation and its diffusion necessitates both theoretical and practical reskilling and additional organizational resources and capabilities.

This study has certain limitations. Although the two cases presented in this study are relevant, they are limited to European experiences in the healthcare and welfare sector, which may restrict the external validity and generalizability of our findings. Furthermore, the specific characteristics of the involved universities, such as size, technical and applied research tradition, and organizational culture, may influence our conclusions.

To overcome the inherent limitations of this study, we encourage future research to conduct larger cross-country analyses that investigate the new role of TTOs as intermediary actors in the diffusion of transformative innovation for addressing major challenges. Specifically, we propose that future studies analyse empirically TTOs’ roles, resources, and capabilities in relation to their approach to transformative innovation and classify TTOs based on their engagement with societal challenges. Finally, it is crucial to investigate how social impact can be measured and assessed in a manner that actively involves TTOs in delivering public and social value, beyond economic and commercial value. To enhance our understanding of the extent to which TTOs contribute to these social impacts, it would be essential to develop studies and tools suitable for measuring the effectiveness of TTOs’ action in facilitating the diffusion of transformative innovation.

CRedit authorship contribution statement

Susana Borrás: Conceptualization, Methodology, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing. **Francesco Gerli:** Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Supervision, Validation, Writing – original draft, Writing – review & editing. **Rebecca Genzato:** Data curation, Formal analysis, Investigation, Methodology, Software, Visualization, Writing – original draft, Writing – review & editing.

Declaration of competing interest

The authors have no conflict of interest to declare.

Appendix A. Appendix

A.1. The interviewees

The interviewees represented various social groups, encompassing TTO staff, university researchers, and representatives from civil society organizations, social enterprises, and other participating partners. Further details about them are provided in [Table 1](#).

Table 1
Summary of case interviews.

Case	Typology of respondent	Alias	Membership organization	Background	Gender
"Get it! Twice"	TTO officer	TTO Officer #1	Polytechnic University of Milan	Engineering, technical	Female
	TTO officer	TTO Officer #2	Polytechnic University of Milan	Engineering, technical	Female
	TTO officer (senior)	TTO Officer #3	Polytechnic University of Milan	Law, managerial	Male
	University researcher (senior)	University researcher #1	Polytechnic University of Milan	Economics, managerial	Male
	University researcher (junior)	University researcher #2	Polytechnic University of Milan	Engineering, technical	Female
	University researcher (junior)	University researcher #3	Polytechnic University of Milan	Engineering, technical	Male
	Candidate social entrepreneur (junior)	Grantee #1	Polytechnic University of Milan	Engineering, technical	Male
	Candidate social entrepreneur (junior)	Grantee #2	Polytechnic University of Milan	Engineering, technical	Male
	Candidate social entrepreneur (junior)	Grantee #3	Polytechnic University of Milan	Engineering, technical	Male
	Candidate social entrepreneur (junior)	Grantee #4	Polytechnic University of Milan	Engineering, technical	Male
	Candidate social entrepreneur (junior)	Grantee #5	Polytechnic University of Milan	Engineering, technical	Female
	Employee (senior)	Third sector network organization officer #1	Partner third sector organization	Economics, managerial	Male
	Employee (senior)	Third sector network organization officer #2	Partner third sector organization	Economics, managerial	Female
	Employee (senior)	Impact investor #1	Partner impact investing organization	Health, managerial	Male
	Employee	Impact investor #2	Partner impact investing organization	Economics, managerial	Male
	University's social responsibility projects officer	Social responsibility officer #1	Polytechnic University of Milan	Design and engineering, technical	Female
	University's social responsibility projects officer	Social responsibility officer #2	Polytechnic University of Milan	Design and engineering, technical	Female
	University's social responsibility projects officer	Social responsibility officer #3	Polytechnic University of Milan	Design and engineering, managerial	Male
	Innovation and entrepreneurship support officer (junior)	Innovation & entrepreneurship trainer #1	Partner organizations	Economics, managerial	Male
	Innovation and entrepreneurship support officer (senior)	Innovation & entrepreneurship trainer #1	Partner organizations	Engineering, technical	Male
	Innovation and entrepreneurship support officer (senior)	Social tech and innovation expert #1	Partner organizations	Engineering, technical and managerial	Male
SUITCEYES	University researcher	University Researcher 1	University of Borås	Information Science	Female
	University researcher	University Researcher 2	University of Borås	Engineering	Male
	University researcher	University Researcher 3	Partner University	Engineering & Design	Female
	Public officer	Public Officer	Partner Institution	Pedagogics	Female
	TTO Officers (Innovation Advisors)	TTO Officer 1	University of Borås	Engineering	Male

(continued on next page)

Table 1 (continued)

Case	Typology of respondent	Alias	Membership organization	Background	Gender
	TTO Officers (Innovation Advisors)	TTO Officer 2	University of Borås	Innovation Management	Male
	TTO Officers (Innovation Advisors)	TTO Officer 3	University of Borås	Biochemistry/Natural Sciences	Male
	Manager	R&D Manager Partner Enterprise	Partner Enterprise	Engineering	Female
	Employee	Employee Users CSO 2	Users CSO	Economics/Management	Male
	Employee	Employee Users CSO 1	Users CSO	Social work	Female
Total					31

A.2. The interview protocol

The interview protocol was designed around theory-driven topics: the TTO role, resources, and capabilities in transformative innovation diffusion, following the conceptual framework outlined earlier. The protocol had three parts: the organization's role in the project, resources and capabilities needed/developed compared to traditional ones, and the TTO's role within the ecosystem and its relationship with the embedding ecosystem. An example of the interview protocol structure for 'Get it! Twice' is shown in Fig. 2. All interviews lasted between 30 min and one hour.

Background and general view

Q1) How were you/your organization involved in the Get It! Twice project? In what stages? What is the added value that your organization brought to the project?
 Q2) How does the Get It! Twice project differ from the classic call for solutions/projects aimed at commercial/business-oriented enterprises?
 Q3) Would you characterize the Get It! Twice project as a success? Why?
 Q4) In your opinion, what are the criticalities of Get It! Twice that need improvement/overcoming?

Open questions,
divergent questions,
process questions

The interviewee is facilitated in sharing their stake on and perception of the role of the TTO in the **generalisation** process.

Inside the TTO: resources, skills and capacities

Q5) PoliMi TTO was involved in the project. In your opinion, did the TTO have sufficient resources in terms of manpower, budget, social legitimacy, access to knowledge/data, etc. during its involvement?
 Q6) Which of the traditional skills and capabilities of TTOs did PoliMi TTO have, that proved to be particularly useful within the Get It! Twice Project? By the concept of capability, we specifically mean the ability of the organization to mobilize and use available resources that are both inside and outside the organization itself. Some of these traditional skills are for example: legal skills, marketing/commercialization-oriented skills, research/analytical skills.
 Q7) Which new skills do you think PoliMi TTO acquired while participating in this project? For example: reflexivity/impact assessment skills, stakeholder coordination skills, social engagement skills, skills about integrating and bringing together different disciplines and needs, co-design / co-creation skills, participatory action skills, a non-market-related definition of social needs, new forms of leadership skills, etc.
 Q8) Broadly speaking, what skills do you think are useful for TTOs to engage with social innovation, social enterprises and civil society organizations? Does PoliMi TTO already have such skills?

Open questions,
divergent questions

The interviewee is facilitated in problematizing the role of the TTO, its **resources and available or acquired capabilities** during the generalization process.

Outside the TTO: relationships within the ecosystem

Q9) In the Get It! Twice project there were other actors directly and indirectly involved, like some impact investors, some philanthropies, some associations, etc. How do you generally perceive their role? How much does the presence of this ecosystem of organizations help in explaining the positive (or not) outcome of Get It! Twice?
 Q10) How important is the territorial dimension (the specific context of Milano) in explaining the positive (or not) outcome of Get It! Twice? What was "special" about Milano? Why?
 Q11) Do you think that a project like Get It! Twice is scalable and/or replicable also in other geographic and institutional contexts? If so, under what conditions?
 Q12) How do you imagine the TTOs (and incubators) in the upcoming future (next 20 years)?

Divergent questions,
application questions,
problem-solving questions

The interviewee is facilitated in questioning the relationship between the TTO and the ecosystem in which it is embedded, with a focus on the **role of the TTO**.

Fig. 2. The interview protocol structure for the Get it! Twice project. The semi-structure was adapted for SUITCEYES.

A.3. Code book for data analysis

We employed various data sources to triangulate and enhance data reliability (Jonsen and Jehn, 2009). Our data collection methods included direct participation in project meetings and the review of relevant project documents. During the analysis phase, we transcribed the interviews, allowing us to identify and aggregate codes into inductive categories and theoretical themes (see Fig. 3 for details). The coding process entailed pattern matching using criteria such as frequency, similarity, difference, and correspondence, primarily following the approaches recommended by Gioia et al. (2010) and Hatch (2002). From the interview transcripts, we extracted the most significant and illustrative quotes, which we incorporated into the manuscript text.

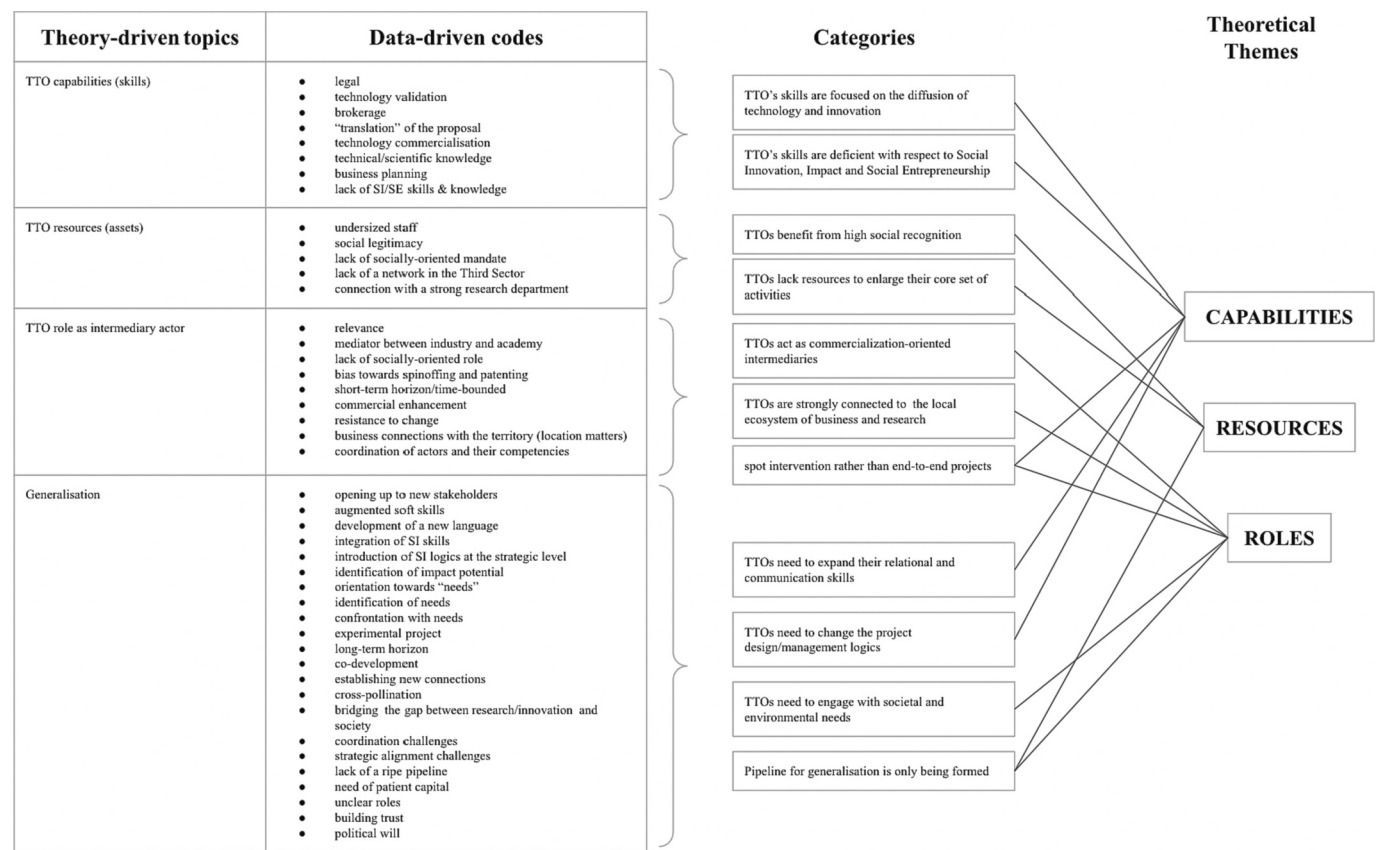


Fig. 3. The codebook: topics, codes, categories, and theoretical themes emerged during the analysis of the interview transcripts.

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