



Institutionalising the digital transition: The role of digital innovation intermediaries

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ABSTRACT

We examine how digital innovation intermediaries, mandated to support the digital transition as part of digital policy agendas, engage in institutional work to facilitate the adoption and diffusion of digital technologies. Building on neoinstitutional theory and the socio-technical transitions literature, our investigation aims to uncover intermediaries' institutional work on cultural-cognitive, normative, and regulative institutions across three levels of intermediation: organisation-, network- and ecosystem level. Based on a large evidence base related to 18 publicly-funded digital innovation intermediaries in France, including primary and secondary sources, we uncover the various forms of institutional work intermediaries engage in while facilitating the digital transition. We find that intermediaries' institutional work focuses on disrupting symbolic systems, creating relational systems and artefacts, and creating and maintaining routines. Intermediaries carry out different kinds of institutional work at different levels of intermediation. Furthermore, different types of intermediaries focus on distinct levels of intermediation and different institutions. Implications for policy and management are discussed.

1. Introduction

The digital transition, as any socio-technical transition, brings about fundamental changes in technologies, user practices and institutional arrangements, resulting in new modes of production and consumption (Geels, 2011). In particular, different forms of institutional work – “the purposive action of individuals and organisations aimed at creating, maintaining and disrupting institutions” (Lawrence and Suddaby, 2006: 215) – are needed at different times to maintain (or consolidate), and disrupt existing rules of the game (North, 1990; Scott, 1995; Lawrence et al., 2009), and to create and diffuse new rules that are more aligned with the requirements of the new technological systems and the social dynamics around them (Geels et al., 2016).

An important phase of the digital transition is the diffusion of new technologies and business practices among economic agents and their adaptation to different uses and contexts. This phase is intricately linked with institutional work (Rogers, 1962, 1983; Redmond, 2003): the diffusion and adoption of new technologies require a transition in which

economic agents adapt routines, behaviours, beliefs and habits to accommodate the change (Redmond, 2003). Moreover, new technology needs legitimacy to be fully integrated into the socially constructed system of norms, beliefs and values of the potential adopters (Suchman, 1995). Bureaucratic hurdles, outdated regulations and policies, and resistance to change can hamper the adoption of innovative technologies (Edquist, 2010; Ekman et al., 2021). Overcoming these barriers requires not only innovative solutions but also institutional work.

Many economic agents can carry out institutional work, including: policymakers, who can encourage firms and other economic agents to adopt new technologies; educational institutions, which can foster a culture of innovation among students and researchers; industry associations, which can encourage the exchange of ideas and best practices among firms (Lawrence et al., 2009). Another important type of agents that perform institutional work, purposefully creating, maintaining and disrupting institutions, are innovation intermediaries (Gliedt et al., 2018). Innovation intermediaries are public or private organisations¹ that facilitate innovation by reducing the cognitive distance between

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¹ Although other entities can perform this role – such as individuals, or digital platforms – in this research we focus on organisations that act as innovation intermediaries.

actors in an innovation system, providing technical and managerial support to innovation, and stimulating interaction, information and knowledge exchange (Howells, 2006; Caloffi et al., 2023). They often occupy a central position within innovation ecosystems, where they deal with diverse constituents and different interests. These organisations can vary widely, including, among others: technology transfer offices (Alexander and Martin, 2013), innovation agencies (van Winden and Carvalho, 2019), business incubators (Vedovello and Godinho, 2003; Bergek and Norrman, 2008), and science parks (Chan et al., 2010).

While the institutional work of innovation intermediaries has been explored in several contexts, these do not include the digital transition. Studies have instead focused on public procurement (Uyarra et al., 2020; Selviaridis et al., 2023), specific sectors, such as agriculture (Klerx and Leeuwis, 2009), and the sustainability transition (Kivimaa and Martiskainen, 2018; Kivimaa et al., 2019a, 2019b). However, the institutional work of innovation intermediaries is particularly important in the current digital transition, as this transition is largely about finding new combinations between existing and new technologies, markets and society (Lee et al., 2018). In this context, creating new rules of the game, maintaining some existing ones, and disrupting others, are especially important activities (Schwab, 2017; Kodama, 2018). Moreover, although the digital transition is partly built around a set of existing technologies, many companies lag in their adoption: according to the DESI index (European Commission, 2022), only 55 % of SMEs had reached a basic level of digital technology adoption by 2021. Therefore, intermediaries that conduct institutional work to raise awareness, legitimise digital technologies and facilitate their adoption are particularly needed.

In addition to examining the institutional work of innovation intermediaries, it is essential to recognize the diverse contributions made by various types of intermediaries, as many different types of intermediaries – with different missions, governance and resources (Howells, 2006; Kivimaa et al., 2019a; Caloffi et al., 2023; Howells, 2024) – participate in the digital transition.

To contribute to filling these gaps, in the present study we focus on a specific kind of innovation intermediaries – organisations that have been specifically mandated by (regional, national and supra-national) policymakers to support the diffusion and adoption of digital technologies, as part of digital policy agendas – and we study *how such intermediaries carry out institutional work in the digital transition*. We use the term ‘publicly-funded innovation intermediaries’ or simply ‘public innovation intermediaries’, as they all receive some public funds – albeit in different measures – to respond to public policy objectives, even though they may not be public bodies per se.² Policy initiatives that identify, coordinate and fund such organisations – either by setting up new intermediaries or by recruiting existing intermediaries into the policy – have proliferated in Europe in recent years, and often represent centrepieces in the delivery of digital policy agendas. For example, the Digital Innovation Hubs (DIHs) are a core element of the Digital Europe Programme (European Commission, 2016) launched in 2016. DIHs are a particularly interesting type of public digital innovation intermediaries, as they are considered central players in supporting the digital transition, and institutional work should be part and parcel of their objectives. Yet, while there is some understanding of the general activities they are expected to perform, their role in creating, maintaining and disrupting institutions has neither been examined extensively nor is it well understood.

To study the institutional work of public innovation intermediaries in the context of the digital transition, we build on Scott’s (1995) typology of institutions – cultural-cognitive, normative and regulative –, and we study how different types of intermediaries carry out

institutional work (Lawrence and Suddaby, 2006) on each type of institutions. While doing so, we follow Kanda et al.’s (2020) and Scott’s (2013) frameworks and consider the level of intermediation at which the institutional work is carried out (organisation-, network-, and ecosystem level).

Drawing on secondary data and in-depth interviews with 18 DIHs in France, as well as with experts and policymakers, we articulate a comprehensive overview of the types of institutional work these organisations carry out. We show that: (i) public digital innovation intermediaries engage in several types of institutional work at different levels of intermediation, ranging from the individual organisation to the ecosystem; (ii) the purpose of the institutional work of intermediaries in the digital transition is largely focused on creating institutions, and to some extent on disrupting and maintaining institutions; (iii) while intermediaries collectively cover a broad spectrum of institutional work in support of the digital transition, different types of organisations tend to specialise in some areas of institutional work.

The paper is structured as follows. In Section 2 we review the literature on: (i) institutions and institutional work; (ii) institutions and the digital transition; (iii) the role of public intermediaries in the diffusion of new technologies; and (iv) levels of intermediation and socio-technical transitions, and we articulate our analytical framework building on the insights from the literature. In Section 3 we present the data that we used for the empirical analysis and our methodology. In Section 4 we present our findings, articulating the relationships between types of institutional work and types of intermediaries. In Section 5 we discuss our findings in light of the literature that we mobilised and our analytical framework. We also propose a conceptual model based on our findings and highlight how our study complements and extends the literature on intermediaries, institutional work, socio-technical transitions and digital transition. Lastly, in Section 6 we discuss the implications of our research for policy and practice, outline the limitations of our study and propose avenues for future research.

2. Literature review

2.1. Institutions and institutional work

Institutions are the rules of the game (North, 1990). They are “socially constructed systems of rules or programs that produce routines” (Jepperson, 1991, p. 146). As such, they are the product (intentional or otherwise) of the purposive actions of human agents (Lawrence and Suddaby, 2006).

Scott (1995, 2001) distinguishes three pillars of institutions – cultural-cognitive (e.g., shared conceptions), normative (e.g., values), and regulative (e.g., formal institutions such as laws). Cultural-cognitive institutions encompass shared conceptions that define social reality and imbue it with meaning. They imply that an individual’s behaviour is influenced by their internal representation of their environment. Cognitive institutions form part of individuals’ interpretative schemes, affecting how information is processed, retained, retrieved and organised into memory, which in turn will affect judgements, opinions and inferences. Compliance with cultural-cognitive institutions occurs because some types of behaviour are taken for granted, with other kinds deemed inconceivable. Mimetic mechanisms ensure adherence to these institutions (DiMaggio and Powell, 1983).

Normative institutions focus on normative rules that prescribe rights and privileges, responsibilities and duties. They include values – concepts of what is preferred or desirable –, and norms that define goals and legitimate ways to pursue them. While some values and norms apply to all members of a society, others apply to specific actors, giving rise to roles (Scott, 2001). In an organisational setting, for example, some job positions (such as managers or team leaders) carry specific rights and responsibilities. Normative institutions impose constraints on social behaviour while simultaneously conferring rights, responsibilities, privileges, duties and mandates. Compliance occurs through normative

² These intermediaries have also been referred to as “government-affiliated intermediary organisations” (Kivimaa, 2014), or “regime-based transition intermediaries” (Kivimaa et al., 2019a) in prior research.

mechanisms, based on an implicit, social agreement that a certain type of behaviour is appropriate (it is a norm) in a certain setting.

Regulative institutions involve establishing rules, inspecting conformity to these rules and implementing sanctions for non-compliance (Scott, 2013). They rely on prescriptive rules that constrain and regulate behaviour through regulatory processes – defining and imposing rules, monitoring and sanctioning. Indicators of regulative institutions include laws, rules, directives, regulations, and formal control structures (Scott, 2013). Compliance is ensured through coercive mechanisms.

All kinds of institutions – cultural-cognitive, normative and regulative – are transmitted by various types of repositories or “carriers” (Jepperson, 1991). Using the notion of “carriers” proposed by Jepperson, Scott (2001) identifies four types of carriers: symbolic systems, relational systems, routines, and artefacts. These repositories or carriers allow scholars to identify institutions and classify them into pillars. The three-pillar framework, including the carriers across institutional pillars, is summarised in Table 1. While all pillars are present in institutions, the latter can be classified based on the pillar that prevails.

While institutions affect behaviour of people, they are also influenced by human agency (Oliver, 1991). The concept of institutional work (Lawrence and Suddaby, 2006; Lawrence et al., 2009) is concerned with how actors and their actions affect institutions, in three broad categories: creating, maintaining, and disrupting institutions. To distinguish institutional work from other constructs in institutional studies of organisations, Lawrence et al. (2009) position it against the notions of accomplishment, intentionality, effort and unintended consequences. While “creating, maintaining, and disrupting institutions” describes a set of activities, the “creation, maintenance, and disruption of institutions” describe accomplishments. Institutional work is concerned with activities and not necessarily their accomplishments. In addition, institutional work is undertaken intentionally, and it requires effort. However, not all consequences of the institutional work are intended, as purposive actions can also influence unanticipated institutions in unintended ways.

Forms of institutional work associated with creating institutions that prior research has revealed include advocacy, defining, vesting, constructing identities, changing normative associations, constructing normative networks, mimicry, theorising and educating (Lawrence and Suddaby, 2006). Maintaining institutions involves enabling work, policing, deterring, valourising and demonising, mythologising, embedding and routinising. Disrupting institutions involves disconnecting sanctions, disassociating moral foundations, undermining assumptions and beliefs (Lawrence and Suddaby, 2006).

However, the forms of institutional work identified in prior research are by no means a complete and definitive list. Lawrence and Suddaby (2006) emphasise that in particular when it comes to disrupting and maintaining institutions, there should be many other forms of institutional work, their study describing only a small subset of potential forms of institutional work available to actors. In this research, we aim to uncover the institutional work on the three pillars of institutions that innovation intermediaries carry out in the context of the digital transition.

2.2. Institutions and the digital transition

The digital transition is a process in which the adoption and diffusion of digital technologies take place at different levels in society, resulting in overwhelming changes in industries, sectors, value chains, and geographical areas (Borrás and Edler, 2020; Münch et al., 2022). For example, the so-called Industry 4.0 technologies, such as robotics, 3D printing and Internet of Things (IoT) are reshaping production processes and value chains. Whilst digitalisation, by enabling global connectedness, generates new markets, new products and services, new and more efficient processes, these opportunities can be adequately exploited only by those companies that are able to redesign their activities to align with the new paradigm.

These profound technological changes take place within an institutional framework that influences and is influenced by the digital transition. Recent scholarly work has analysed how institutions affect the digital transition (Hinings et al., 2018). Focusing on the transnational and national levels, Lv et al. (2023) highlight how formal institutions matter in facilitating the adoption of certain digital technologies. Studies on specific sectors show that the presence of change-friendly institutions (not only formal institutions) facilitates the adoption of digital technologies (Shang et al., 2021). Focusing on the individual organisations, Van De Kerkhof and Noorderhaven (2019) analyse the role of informal institutions such as mental attitude – specifically resistance to change – and how it can slow the adoption of new digital technologies. The literature has also looked at how the digital transition influences institutions. For example, Kenney et al. (2015) stimulate reflection on how power dynamics change during the digital transition, especially at the hands of global digital giants, a theme also addressed by Rikap and Lundvall (2021), among others. Research has also looked into how digital transition affects institutional arrangements (embodied in relational systems for example) in ecosystems (Sklyar et al., 2019), supply chains and networks (Hamann-Lohmer et al., 2023; Paolucci et al.,

Table 1
Three pillars of institutions and their carriers.

		Pillars		
		Cultural-cognitive	Normative	Regulative
Antecedents and functioning	Basis of compliance	Taken-for-grantedness	Social obligation	Expedience
	Basis of order	Shared understanding		
	Basis of legitimacy	Constitutive schema	Binding expectations	Regulative rules
		Comprehensible	Morally governed	Legally sanctioned
Mechanisms	Logic	Recognizable		
	Indicators	Culturally supported		
		Mimetic	Normative	Coercive
		Orthodoxy	Appropriateness	Instrumentality
Carriers	Affect	Common beliefs	Certification	Rules
	Symbolic systems	Shared logics of action	Accreditation	Laws
	Relational systems	Isomorphism		Sanctions
	Routines	Certainty/Confusion	Shame/Honour	Fear Guilt/Innocence
Artefacts		Categories, typifications, schema	Values, expectations	Rules, laws
		Structural isomorphism, identities	Regimes, authority systems	Governance systems, power systems
		Scripts (knowledge about a sequence of events in a specific setting)	Jobs, roles, obedience to duty	Protocols, standard operating procedures
	Objects possessing symbolic value	Objects meeting conventions, standards	Objects complying with mandated specifications	

Source: Adapted from Scott (2001, p. 77; 2013, p. 60).

2021).

2.3. The role of public intermediaries in the diffusion of new digital technologies

Various actors operate at different levels of the digital transition process, from conceiving and designing digital technologies to facilitating their adoption and diffusion and integrating them into the operations of private and public organisations (Russo et al., 2022). Among those actors, innovation intermediaries play an important role in helping companies address the challenges brought about by the digital transition (Colovic et al., 2024). These intermediaries provide innovation services to firms and other organisations and facilitate innovation processes in individual organisations, networks of organisations, and innovation ecosystems (Howells, 2006; Caloffi et al., 2023). Governments worldwide have established intermediaries to support the dissemination of new digital technologies to enterprises (Rossi et al., 2022). Not all of these intermediaries are public, but all of them receive public funds – albeit to a variable extent – to carry out some of their activities in the public interest (Rossi et al., 2021; Abi Saad et al., 2024), and as such they respond to public policy objectives. Such ‘government-affiliated’ (Kivimaa, 2014) or ‘public’ innovation intermediaries usually supply knowledge-intensive services including diffusion of information about new technologies, technology audits, support in the search for funding opportunities, support to networking, training, testing, or even applied research. The range of services offered by each innovation intermediary can vary. Some focus primarily on networking support, some on applied research, while others specialise in policymaking support. SMEs are frequently designated as priority targets of intermediaries because they lack the financial resources, time and knowledge to embark on the digital transition independently. The role of innovation intermediaries as innovation disseminators requires them to help small enterprises familiarise themselves with new technologies and apply them in their production processes (Rossi et al., 2021).

Since the process of innovation diffusion requires creating new institutions and modifying existing ones (Redmond, 2003), innovation intermediaries carry out relevant institutional work. This work is particularly important in the context of the current digital transition because many of today’s innovations build on pre-existing digital innovations and not having innovated before can therefore make it much more difficult to innovate today (Schwab, 2017; Kodama, 2018; Lee et al., 2018). In addition, innovations have a strong network component, such that non-adoption carries a significant cost in terms of lost network economies (Skilton and Hovsepian, 2018). The institutional work that intermediaries carry out in this context is therefore crucial to the adoption and diffusion of digital technologies during the digital transition.

While the role of intermediaries in supporting the digital transition through institutional work remains unexplored, innovation intermediaries’ activities have been examined in the context of different innovation processes, including firm-level innovation (Hoppe and Ozdenoren, 2005; Stewart and Hyysalo, 2008; Sieg et al., 2010; Colombo et al., 2015), university-industry collaborations (Villani et al., 2017), public procurement (Edler and Yeow, 2016; Uyarra et al., 2020; Rainville, 2021; Selviaridis et al., 2023) and innovation policy interventions (Lerner, 2000; Cumming and Fischer, 2012; Dossou-Yovo and Tremblay, 2012). Studies that focus on institutional work of intermediaries are particularly relevant for our research. Applying the institutional perspective, Uyarra et al. (2020) advance the literature on public procurement that has examined its innovation impact (Uyarra and Flanagan, 2010) and its barriers (Uyarra et al., 2014) to conceptualise the roles of ‘innovation-oriented public procurement’ in regional innovation policy and analyse the institutional work associated with its implementation. Identifying forms of institutional work deployed, such as ‘advocacy’ and ‘lobbying’, Uyarra et al. (2020) analyse the institutionalisation of innovative public procurement in Galicia, Spain, and

show that institutional work of cultural and political nature was important in the early stages, and the more technical work in the later stages of the institutionalisation process. Selviaridis et al. (2023) also adopt the institutional perspective to study how innovation intermediaries as institutional entrepreneurs promote institutional change to facilitate public procurement of innovation. Analysing cases in the UK defence and health sectors, the authors identify four types of institutional entrepreneurship activities of intermediaries: boundary spanning, advocacy, design of change, and capacity building.

2.4. Levels of intermediation and socio-technical transitions

The role of intermediaries in socio-technical transitions has been primarily studied in the context of sustainability and energy transitions. Although these findings may not be directly transferable to the digital transition, they offer valuable insights. Hamann and April (2013), Mignon and Kanda (2018), Kivimaa (2014), Kivimaa et al. (2019a) and Kivimaa and Martiskainen (2018) have identified several roles that intermediaries can play in different stages of the transition toward sustainability, ranging from supporting the existence of relatively small niches within which sustainable innovations develop to orchestrating the entire economic system to drive change toward sustainability. Each of them requires some institutional work (Lawrence and Suddaby, 2006; Pelzer et al., 2019). Following Sovacool et al. (2020), intermediaries are often confronting several institutional failures in the context of socio-technical transitions: uncertainties about the directionality of change, active resistance to change from actors in established fields, lagging or incoherent policies, poorly articulated user preferences, norms and standards. To address these failures they engage in actions such as: facilitating access to decision-making and lobbying for more stringent regulatory change; creating and sustaining advocacy coalitions, including in between conflicting actor interests; articulating and shaping collective expectations; developing and strengthening standards or certification schemes; generating conditions where trust can overcome prevailing power, knowledge and resource asymmetries by empowering emerging actors, entities or discourses to bear on or overtake established configurations.

Even in works that do not focus on institutional aspects, it is recognised (explicitly or implicitly) that innovation intermediaries perform important institutional work in the context of sustainability transitions. For instance, Kanda et al. (2020) identify several types of activities typically performed by innovation intermediaries in supporting the sustainability transition – which range from helping firms articulate expectations and visions, supporting networking and the alignment of interests, processing the new knowledge and advocating for regulatory changes that support sustainability transitions – all of which involve some degree of institutional work.

Kanda et al. (2020) also distil four levels at which intermediation occurs:

- Intermediation in-between individual entities (Howells, 2006): intermediaries work in-between individual actors, organisations or projects.
- Intermediation in-between entities in a network (Van Lente et al., 2003): intermediaries mediate in-between different types of entities within a single network (e.g. within a technology cluster).
- Intermediation in-between networks of entities (Klerkx and Leeuwis, 2009): intermediaries span across different networks, fostering ‘many-to-many-to-many’ interactions.
- ‘System level’ intermediation in-between actors, networks, and institutions (Matschoss and Heiskanen, 2018): intermediaries encompass vertical interactions between actors, networks and relevant institutions, conducting policy or regime renewal (Kivimaa, 2014).

In this research, we follow Kanda et al.’s (2020) framework, insofar as we consider the following levels of intermediation: in between

individual entities (in our case individual organisations), in between entities in a network (in our case in between organisations in a network), and system level (in our case digital ecosystem level). This is also in line with Scott's (2013) approach to levels of intermediation. We consider intermediation levels because research on the digital transition suggests that institutional arrangements play a role at organisation, network and ecosystem levels (Van De Kerkhof and Noorderhaven, 2019; Hamann-Lohmer et al., 2023; Paolucci et al., 2021; Rossi et al., 2022). In addition, explicitly considering the level at which institutional work takes place in the digital transition is important, because of the different natures of cultural-cognitive, normative, and regulative institutions and their different relevance at varying levels of observation.

Our framework for analysis (Fig. 1) therefore articulates institutional pillars (and carriers) proposed by Scott (1995), the notion of institutional work of creating, maintaining and disrupting institutions proposed by Lawrence and Suddaby (2006) and the levels of intermediation (organisation-, network-, and ecosystem level) as per Kanda et al. (2020).

3. Method and data

3.1. Research setting: digital innovation hubs in France

Digital technologies are central to digital transition policy in many countries, including the United States, the European Union, Korea and Japan. The European Union has invested in the creation of Digital Innovation Hubs (DIHs), intermediary organisations supporting companies in the digital transition. Launched in 2016 as part of the Digitising European Industry initiative, DIHs are tasked with providing a range of innovation support services, essentially to SMEs. They should play a one-stop-shop role for innovation support and coordinate all innovation support actors on the ground in the following technologies: Big Data and Artificial Intelligence (AI), Internet of Things (IoT), Manufacturing/Industry 4.0, Robotics, High Performance Computing (HPC) and Photonics. Typically, DIHs are existing organisations or networks of existing organisations (meta-organisations) that provide innovation support services for companies in a specific territory, including: services for technology testing and experimentation with new digital technologies; training; support for investment, research and development of innovation projects; support for networking and the development of an innovation ecosystem.³ Their activity is mainly on a regional scale, but some DIHs offer services on an interregional or national scale (Sassanelli et al., 2020).

By early 2023, approximately 700 DIHs had been accredited in Europe, following a specific procedure. Subsequently, in the framework of the Digital Europe Programme, the European Commission focused on the creation of a network of DIHs, which should operate both on a regional scale and within European networks of excellence in at least one of three specific fields: artificial intelligence, cybersecurity, and high-performance computing.

The initiative to support DIHs complements the initiatives put in place by individual member states to support the digitisation of industry. The French case is particularly interesting because the support for innovation and business competitiveness has long been organised through a thick network of organisations operating on a regional scale. Apart from the network of chambers of commerce, business innovation centres, regional development agencies, and technology transfer centres linked to universities and research centres, France has long had a network of *pôles de compétitivité* whose role is to improve the competitiveness of French industries (Peres, 2020). Created to support the development and competitiveness of the companies and regions where they are located, the poles have over time become important agents supporting innovation (Rossi et al., 2022). It is precisely around some of

them – though not exclusively – that DIHs have developed.

At the beginning of 2023, the network of French DIHs counted 45 organisations, some of which also obtained the European DIH (EDIH) label, and the associated funding from the European Union. These organisations are recognised, both nationally and at the level of the EU, as important actors in the digital transition. Most of these organisations had existed before the EU DIH policy, such as Cap Digital and Minalogic competitiveness poles.

3.2. Data and method

We contacted all French DIHs on the list published by the European community by e-mail. After sending several reminders, we received responses from 18 DIHs (Table 2). Different types of organisations are included in our sample: incubators, research and technology organisations (RTOs), clusters and competitiveness poles, development agencies, professional associations and EDIHs (consortia of research institutes, poles and public institutions). Our sample reflects the nature of the DIHs in France and allows us to account for specificities in DIHs' institutional work depending on DIHs' nature.⁴ We conducted interviews with all of the organisations in our sample, some face-to-face, and more recently online. The interviews were carried out between February 2019 and September 2023, and each lasted approximately one hour. The interviews were conducted by three of the co-authors, individually or in pairs. To gain a broader perspective, we also interviewed policymakers responsible for national strategies for supporting digitalisation, beneficiaries of DIHs' activities and digitalisation experts. The full list of interviewees ($n = 27$) is available in Appendix 1. While the names of the intermediaries are anonymised, in Table 2 we report some essential information about the DIHs in our sample.

The interviews were recorded and professionally transcribed. Each of the authors of the study manually coded the transcripts independently, then the codes were compared to achieve a consensus view. At least two of the authors reviewed each of the coded transcripts and discussed the interview content. The interview guide that we used is available in Appendix 2. We also collected a large volume of secondary data, in the form of content from websites, articles in the media, PR announcements, social media posts, brochures, booklets and other promotional material to support the findings from the interviews and to provide several examples documenting the action of intermediaries. We propose a list of examples of secondary sources that we used in Appendix 3. The sources that were considered as most relevant were coded, using the same procedure as the one for the interview data. Other secondary sources were read through and essential information was extracted from them.

To code the data and analyse it, we followed the methodology proposed by Gioia et al. (2013), which we adapted to the specific purposes of our research, in so far as our coding structure was developed both inductively and by relying upon the literature, in particular Scott's framework (Fig. 2). In the first step, we open-coded the data. Our first-order codes refer to different *activities* the intermediaries are involved in while performing their role of facilitating the digital transition. In the second step, we moved from open coding to axial coding, grouping first-order codes into second-order codes, which are characterized by a greater level of abstraction. In our analysis, they correspond to *forms of institutional work* emerging from the activities that DIHs carry out while facilitating the digital transition. In other words, second-order codes emerge from first-order codes, they characterise the forms of institutional work undertaken through the DIHs' activities. Some of our second-order codes correspond to the forms of institutional work identified by Lawrence and Suddaby (2006) and also revealed in prior research on the institutional work of intermediaries (Uyarra et al., 2020) – such as advocacy and lobbying – but some are specific to the particular

³ <https://digital-strategy.ec.europa.eu/en/activities/edihs>

⁴ It is worth noting that no individual and no platform are recognised as DIH in the European DIH list for France.

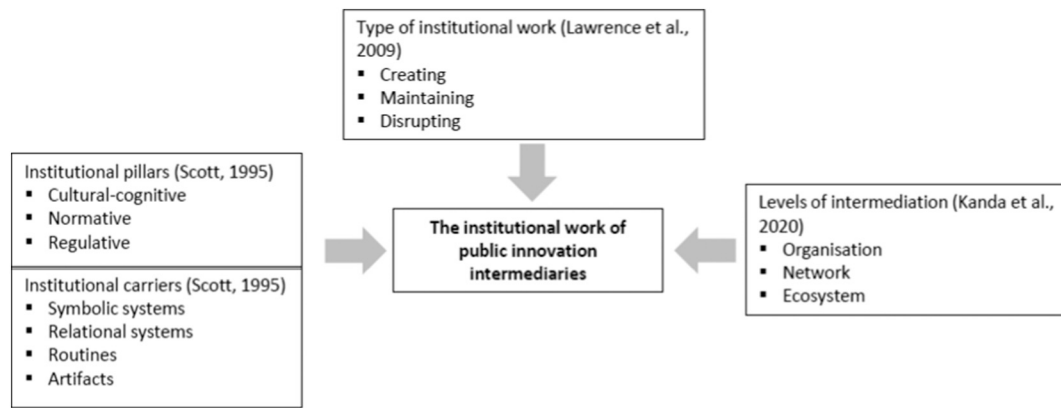


Fig. 1. The institutional work of innovation intermediaries in the digital transition: interpretative categories.

context of our research (the digital transition) and to the nature of the organisations under investigation (public innovation intermediaries recognised as DIHs). As a third step, we linked the second-order codes (forms of institutional work) to aggregate dimensions, which correspond to *institutional work on institutional carriers – symbolic systems, relational systems, routines, and artefacts*. Carriers are manifestations of institutions and are more easily detectable than actual institutions. As the nature of carriers is specific for each institutional pillar, we are able to associate the institutional work on institutional carriers to particular types of institutions – cultural-cognitive, normative and regulative.

All co-authors of the paper discussed the coding structure and the findings together until an agreement was reached on the categorisation of institutional work as emerging from the data.

In parallel, we traced the evidence related to different codes, attributing them to different DIHs we interviewed. This allows us to present detailed and accurate findings regarding which DIHs are involved in which types of activities and on which institutions they seek to carry out institutional work while facilitating the diffusion of digital technologies.

4. Findings

In what follows we present our findings for each of the institutional pillars – cultural-cognitive, normative, and regulative – detailing the institutional work on each carrier. The titles of the subsections correspond to the aggregate dimensions in our data structure, presented in Fig. 2.

4.1. Intermediaries' work on cultural-cognitive institutions

Public innovation intermediaries' institutional work on cultural-cognitive institutions manifests itself in the following ways: reducing the cognitive distance to digital technologies and encouraging experimentation, building intermediation identity and reducing the distance between actors in the digital ecosystem, establishing digital innovation routines, and developing digital technology artefacts. Table 3 provides illustrative verbatims related to this type of institutional work.

4.1.1. Reducing the cognitive distance to digital technologies and encouraging experimentation

The first kind of institutional work on symbolic systems of cultural-cognitive institutions focuses on reducing the cognitive distance to digital technologies and encouraging experimentation. Although digital technologies are considered inevitable, many firms lack knowledge, understanding, and some even fear these technologies and the risks their use generates, as can be evidenced by the verbatims in Table 3. Intermediaries put a lot of effort into removing barriers in people's minds and undermining their assumptions regarding these technologies.

Testing or experimentation helps companies gain confidence, which then paves the way to easier adoption of digital technologies. Intermediaries' institutional work on the symbolic systems of cultural-cognitive institutions can be considered as work aimed at *disrupting* institutions.

Among the intermediaries in our sample, we have found evidence of this type of institutional work in RTOs, incubators and development agencies and the EDIHs that work with companies essentially at the organisational level of intermediation.

4.1.2. Intermediation identity building and reducing the distance between actors in the digital ecosystem

The institutional work on relational systems focuses on intermediation identity building and reducing the distance between actors in the ecosystem. Intermediaries bridge gaps between different ecosystem constituents, such as universities and companies, or digital technology providers and potential users. They build their identity as DIHs emphasizing their impartiality and public mandate, not having to "sell" anything, but working for the benefit of the companies.

This kind of institutional work is about *creating* institutions and it is carried out by RTOs, incubators, development agencies, professional organisations, poles, clusters and EDIHs, to varying extents. Incubators and professional organisations essentially conduct this work at the network level, while development agencies, poles, clusters and EDIHs carry it out at both network and ecosystem levels, with a stronger focus on the latter.

4.1.3. Establishing digital innovation routines

Intermediaries play an active role in establishing digital innovation routines, i.e. in codifying (or supporting firms in the codification of) sequences of activities and rules of behaviour around the new digital technologies, in order to diffuse them both within the organisation and among different organisations. They coordinate projects, facilitate the emergence of such projects, and identify external partners that can help firms with innovation projects around digital technologies. They are also involved in creating thematic communities.

This kind of institutional work is concerned with *maintaining* and *creating* institutions and is conducted mostly by *pôles de compétitivité* and, to a lesser extent, by clusters that are typically of smaller size and with a stronger industry or technology focus. This type of institutional work is conducted mainly at the network and, to a lesser extent, at the ecosystem level.

4.1.4. Developing digital technology artefacts

Digital innovation intermediaries also develop cultural-cognitive artefacts – objects possessing symbolic value. They thus engage in developing MOOCs about digital technologies, serious games, use cases, and training modules. Intermediaries also produce "proofs of concept"

Table 2
List of DIHs interviewed.

DIH	Type of organisation	Territorial scope	Specialised/generalist (industry)	Specialisation sector
A	Science-based business incubator	Regional	generalist	none
B	Consortium of research institutes, clusters, and public institutions (EDIH)	Regional	specialised	artificial intelligence
C	Research and Technology Organisation - RTO	National / interregional	specialised	agriculture
D	Business incubator	Regional	generalist	none
E	Cluster	Regional	specialised	robotics
F	Consortium of research institutes, clusters, and public institutions (EDIH)	Regional	specialised	digital technologies
G	Local Development Agency	Regional	generalist	none
H	Pôle de compétitivité	Regional	specialised	digital technologies
I	Professional association	National / interregional	specialised	printed news media
J	Pôle de compétitivité	Regional	specialised	health, tourism, administration and agriculture mobility
K	Pôle de compétitivité	Regional	specialised	
L	Research and Technology Organisation - RTO	National / interregional	specialised	health
M	Consortium of research institutes, clusters, and public institutions (EDIH)	Regional	specialised	digital technologies
N	Research and Technology Organisation - RTO	National / interregional	specialised	digital technologies, mobility
O	Research and Technology Organisation - RTO	National / interregional	specialised	digital technologies, energy
P	Consortium of research institutes, clusters, and public institutions (EDIH)	Regional	specialised	digital technologies
Q	Pôle de compétitivité	Regional	specialised	digital technologies
R	Local Development Agency	Regional	generalist	none

and digital tools. This type of institutional work focuses on *creating* institutions and is mostly carried out by RTOs, professional organisations and EDIHs. It takes place at all three levels of intermediation.

4.2. Intermediaries' work on normative institutions

Intermediaries' work on normative institutions includes legitimising digital technologies, building cooperative structures in ecosystems, orchestrating ecosystems, and providing standard informal and formal

infrastructure. This work occurs primarily at the network and ecosystem levels. Table 4 contains illustrative verbatims regarding institutional work on normative institutions.

4.2.1. Legitimising digital technologies

Legitimising digital technologies is institutional work on symbolic systems of normative institutions. Intermediaries legitimise digital technologies by vehiculating principles of ethics regarding these technologies, as well as trust in the diffusion of digital technologies. They also attribute value to digital technologies. They do so by explaining the appropriateness and demonstrating the usefulness of digital technologies. For example, a development agency emphasises the value of digital technologies for preserving jobs in the region.

This kind of institutional work is *disrupting* institutions because it is undermining assumptions of digital technologies being unethical and distrustful. It is carried out by development agencies, clusters, poles and the EDIHs, at network and ecosystem levels of intermediation.

4.2.2. Building cooperative structure in ecosystems

For certain types of intermediaries, in particular poles and EDIHs, structuring the ecosystem is important institutional work. Intermediaries structure the ecosystem by brokering between actors and instilling collaboration. They do so by putting together supply chains, organising collaboration, smoothing the relationships and creating cohesion. In this area, a particular objective seems to be integrating SMEs into the ecosystem because it is believed that SMEs can be more successful in adopting digital technologies when they are part of the ecosystem.

This kind of institutional work is about *creating* institutions and is carried out by poles, clusters and EDIHs, essentially at the ecosystem level.

4.2.3. Ecosystem orchestration

Intermediaries engage in institutional work of ecosystem orchestration. In particular, they engage in strategic guidance and ecosystem animation, such as forecasting, competence mapping, brokering, organising, and mobilizing actors. This work, focused on *maintaining* institutions, is conducted by clusters, poles, and EDIHs at the ecosystem level.

4.2.4. Providing standard informal and formal infrastructure

While performing their intermediation role, intermediaries produce normative artefacts (support systems and norms), such as information platforms, data, methodologies, digital observatories, labels, and rules of conduct. This type of institutional work is about *creating* institutions and is carried out at the ecosystem level by clusters, poles, and the EDIHs.

4.3. Intermediaries' work on regulative institutions

While we found some evidence of intermediaries' work on regulative institutions, it appears that, for most intermediaries, this does not constitute a very large share of their work. Intermediaries influence regulative institutions by taking part in rules and regulations definition, influencing governance and power structures, operating standardised protocols and procedures, and developing artefacts that meet regulatory specifications. Illustrative verbatims on intermediaries' institutional work on regulative institutions are presented in Table 5.

4.3.1. Taking part in rules and regulations definition

Intermediaries take part in the definition of rules and regulations by discussing policies and regulations with policymakers, providing feedback and proposing new regulations. This work, involving both *creating* and *maintaining* institutions, occurs at the ecosystem and higher levels (e.g., regional or national level of policymaking, thus beyond the intermediation framework that we apply in this research), and is

A. Intermediaries’ institutional work on cultural-cognitive institutions

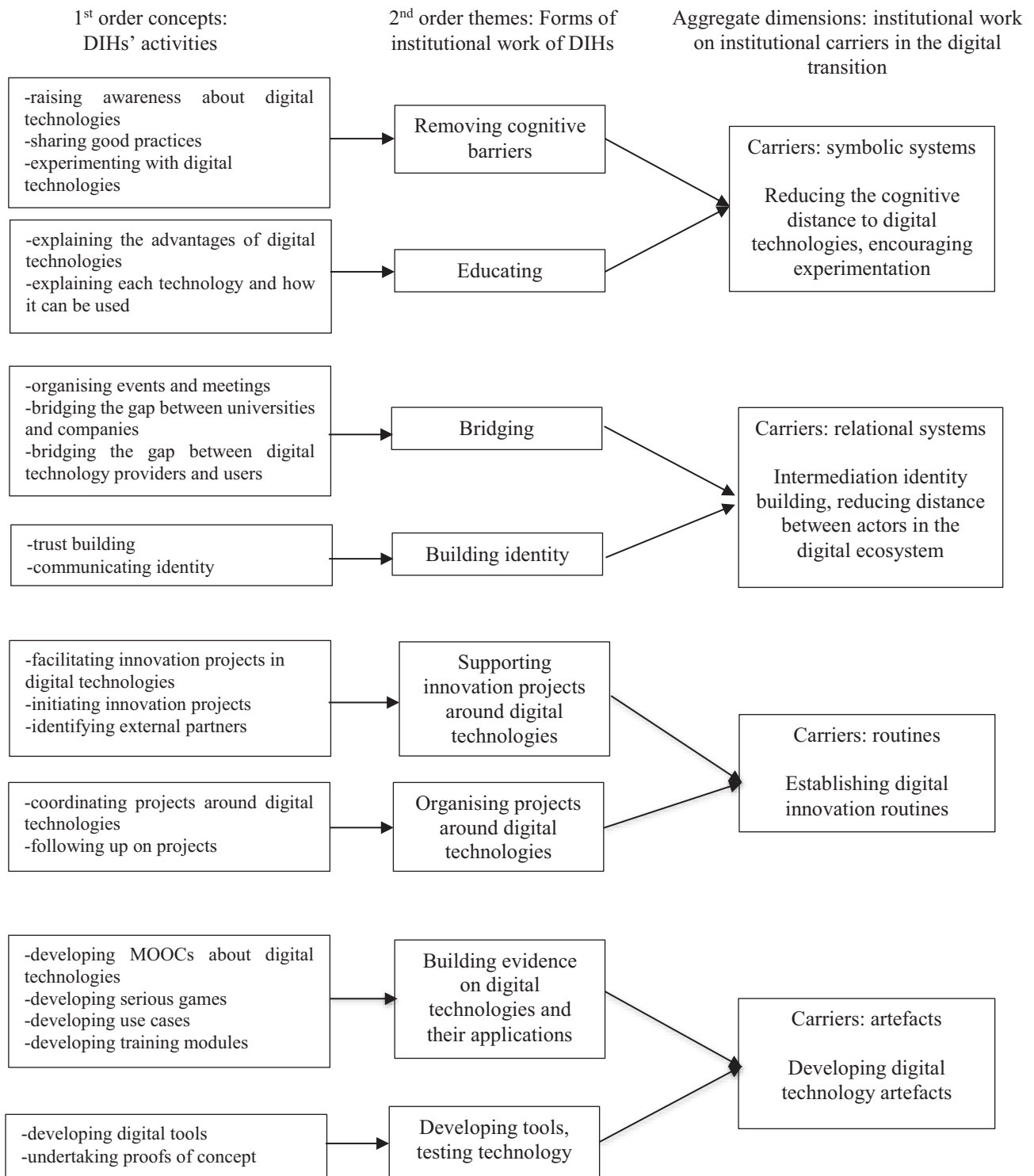


Fig. 2. Coding structure

A. Intermediaries’ institutional work on cultural-cognitive institutions

B. Intermediaries’ institutional work on normative institutions

C. Intermediaries’ institutional work on regulative institutions.

performed by local development agencies, and to a lesser extent, poles and clusters.

4.3.2. Influencing governance and power structures

In terms of relational systems, intermediaries advocate for public investment in digital technologies, engaging in lobbying. This work,

B. Intermediaries’ institutional work on normative institutions

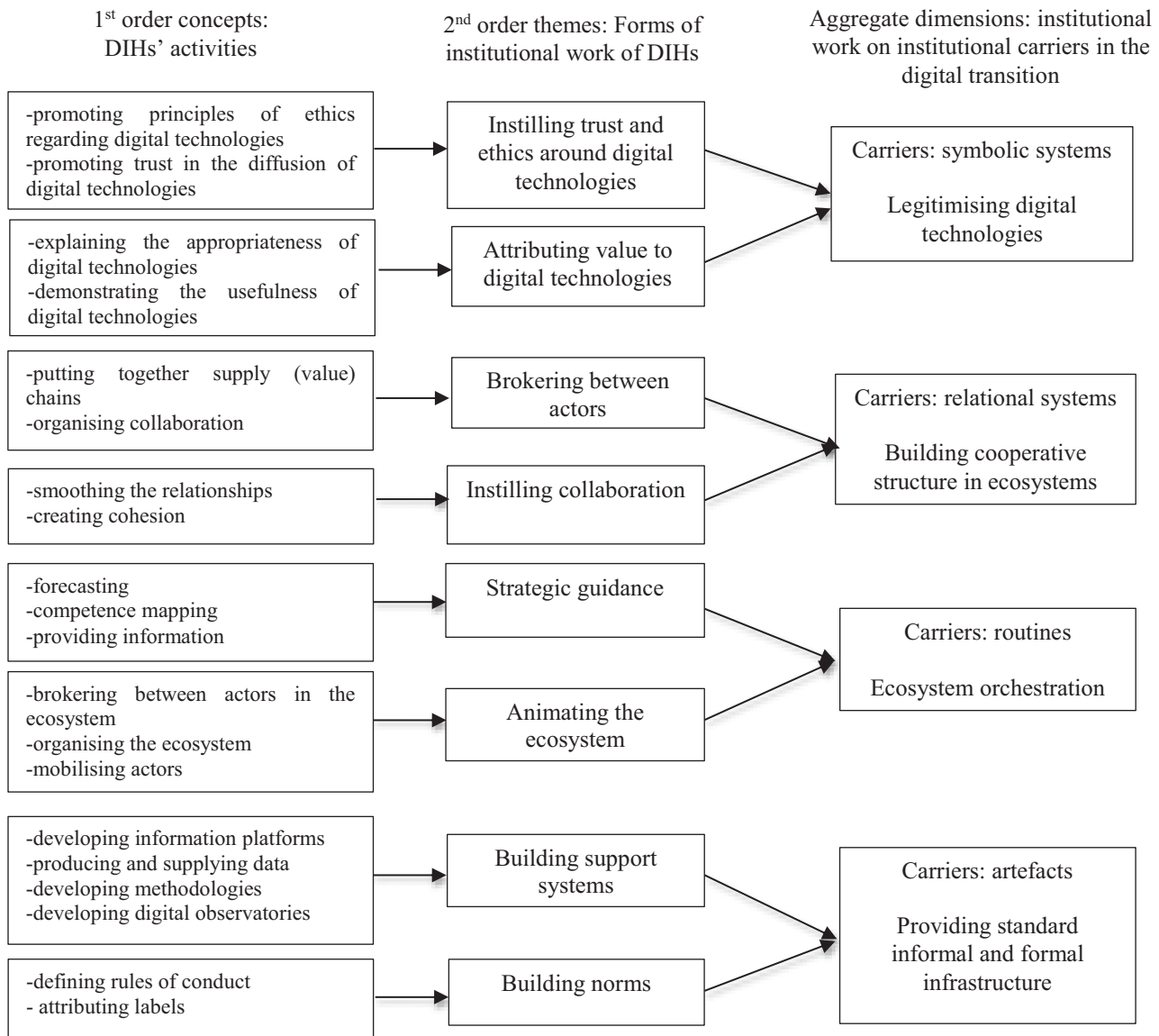


Fig. 2. (continued).

focused on *creating* institutions, is conducted by development agencies and poles at ecosystem and higher levels.

4.3.3. Operating standardised protocols and procedures

When it comes to routines, as carriers of regulative institutions, innovation intermediaries operate standardised protocols and procedures. They conduct digital assessments of SMEs that comply with EU rules, lead discussions on the socio-economic impact of digital technologies and define standard operations, like protocols, and processes for organising competitions and prizes to stimulate digital entrepreneurship. This institutional work is mostly about *maintaining* institutions and is performed by EDIHs, clusters and poles at the ecosystem level.

4.3.4. Providing artefacts that meet regulatory specifications

Intermediaries provide artefacts that meet regulatory specifications by developing and providing regulated infrastructure and material. They set up research units and institutes, and provide experimentation space and tools. This work, involving both *creating* and *maintaining* institutions is carried out by EDIHs, poles, and to a lesser extent, RTOs,

development agencies and incubators, and is carried out at ecosystem level to support individual organisations as well as networks.

A summary of our findings is presented in [Table 6](#).

Our results indicate that intermediaries engage in a variety of institutional work, with each type of intermediary focusing on specific aspects. [Table 7](#) shows the institutional pillars and their carriers each type of intermediary focuses on in its institutional work. The boxes in grey indicate the areas of institutional work for each type of intermediary. Regarding EDIHs, although we have not found evidence of institutional work on cultural-cognitive routines and regulative symbolic systems and relational systems from the interviews conducted with EDIHs’ representatives, given that the EDIHs are meta-organisations, consisting of several organisations that had pre-existed the creation of the EDIHs, institutional work in these areas is carried out by the intermediaries that are part of the EDIHs (for example poles). For this reason, we indicated the areas of institutional work covered by members of EDIHs with light grey in the EDIH column.

C. Intermediaries’ institutional work on regulative institutions

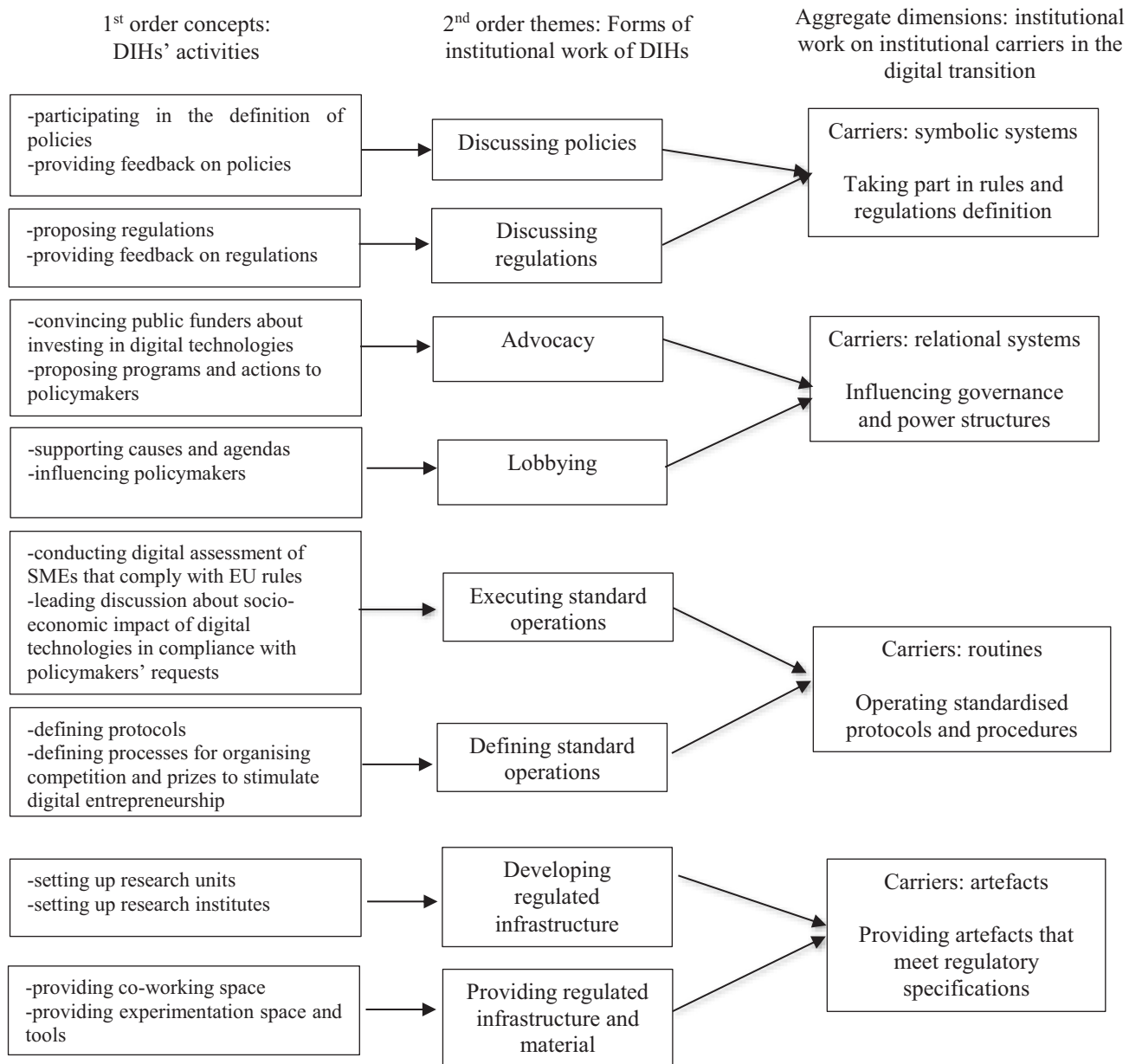


Fig. 2. (continued).

5. Discussion

This research advances knowledge on the institutional work of digital innovation intermediaries by examining how DIHs carry out institutional work on cultural-cognitive, normative and regulative institutions at different levels of intermediation (organisation-, network-, and ecosystem levels). Our findings suggest that supporting the digital transition requires innovation intermediaries to engage in institutional work across all three types of institutions and their carriers (symbolic systems, relational systems, routines and artefacts). Innovation intermediaries are involved in disrupting, creating and maintaining institutions at different levels of intermediation.

We also uncover forms of institutional work through which intermediaries act on institutions. For cultural-cognitive institutions, we conceptualised the following forms of institutional work: removing cognitive barriers, educating, bridging, building identity, supporting

innovation projects around digital technologies, organising projects around digital technologies, building evidence about digital technologies and their applications, developing tools, testing technology. For normative institutions, we identify the following forms of institutional work: instilling trust and ethics around digital technologies, attributing value to digital technologies, brokering between actors, instilling collaboration, strategic guidance, animating the ecosystem, building support systems and building norms. Last, for regulative institutions we identify the following forms of institutional work: discussing policies, discussing regulations, advocacy, lobbying, executing standard operations, defining standard operations, developing regulated infrastructure and providing regulated infrastructure and material.

We find that intermediaries’ institutional work on carriers exhibits certain regularities. The work on symbolic systems focuses on questioning the beliefs and assumptions based on old habits and creating new ones. In this area of institutional work, DIHs are mainly focused on

Table 3
Institutional work on cultural-cognitive institutions.

Carrier	Institutional work	Verbatims
Symbolic systems	Reducing the cognitive distance to digital technologies and encouraging experimentation	<p>“A lot of them are ... not really afraid but some of them are ashamed to not well understand what the digital can bring them in their business. [...] They are afraid or they don't know very well what they can do.” (In7, G)</p> <p>“Our daily work is really to explain the interest and also the risk of these technologies.” (In3, C)</p> <p>“With new technologies such as AI there is a new barrier even for technological and innovative companies because the technological gap to understand and explore these technologies is increasing.” (In7, G)</p> <p>“We try to convince companies who are questioning themselves about this to try to use these technologies.” (In7, G)</p> <p>[Companies need to] “find confidence in this, start working on this, train themselves.” (In7, G)</p>
Relational systems	Intermediation identity building, reducing distance between actors in the digital ecosystem	<p>“We communicate about our cluster, about robotics, about the technologies we are developing [...] for example, the construction people they had a distorted vision about what robotics was.” (In5, E)</p> <p>“You have lots of different kinds of CEOs with different backgrounds and different views so you have to create trust before going to a more techno subject and business subject.” (In12, K)</p> <p>“There is this question of trust, typically because I'm not linked to IBM, I'm not linked to Microsoft [...] and a lot of things happen here because we are this kind of théâtre de confiance.” (In8, H)</p> <p>“We appreciate the very transparent way of working of the [name of DIH].” (Secondary data source, K)</p>
Routines	Establishing digital innovation routines	<p>“We connect universities and research centres with companies, to set up projects [...] so for example, in my community we have a member who came to see us because he wanted to do a working group around the blockchain of education. The idea is that we put them in contact with other members of the field, we put them in contact with ed-tech and then schools also who were interested in the subject and eventually, the idea is to end up creating a project, an experiment, etc., a deliverable in fact, a collaboration.” (In9, H)</p> <p>“So, like any competitiveness cluster, we have the ability to label projects and stimulate collaborative innovation in order to be able to promote the emergence of innovations, particularly within companies.” (In11, J)</p>

Table 3 (continued)

Carrier	Institutional work	Verbatims
Artefacts	Developing digital technology artefacts	<p>“So, there are MOOCs, things like that, which can be free courses.” (In15, M)</p> <p>“We have some use cases.” (In1, A)</p> <p>“The employees of [name of company] could attend workshops organised by [name of intermediary] with use cases and discussion of concrete needs.” (Secondary data source, K)</p> <p>“We interview them and then we write articles about what they are doing. And we publish this on our website. It's free. So, we probably have around 100 cases.” (In10, I)</p> <p>[It goes as far as] proof of concept to check, to plan and see if the technologies we imagine can be of interest to SMEs.” (In15, M)</p> <p>“And we propose to have them tested and then promote their deployment.” (In6, F)</p> <p>“We also co-design some prototypes, some digital tools.” (In3, C)</p>

disrupting existing institutions. In particular, they focus on dismantling those fears, misperceptions, and reticence that drive entrepreneurs and firms to avoid or postpone change – in this case, experimentation with new digital technologies – even in the face of social pressure (e.g. policies) that promote change (Montalvo, 2006). The work on relational systems and artefacts focuses on creating institutions. Here intermediaries work to create webs of relationships between actors that facilitate the diffusion of digital technologies. They also create artefacts that support technology acceptance and diffusion, as can be evidenced by our findings. Institutional work on routines is mainly concerned with incorporating new beliefs, attitudes, and mental forms into codified sequences; this type of institutional work focuses mainly on maintaining, and, to a lesser extent, on creating institutions. Routines allow digital technologies to take strong roots, in other words, to anchor in the ecosystems. This does not mean that routines do not evolve, but rather that they allow the institutions to be reproduced over time (Giddens, 1984; Lawrence and Suddaby, 2006). This echoes Lawrence and Suddaby (2006) and Lawrence et al. (2009) who point to the need to better understand the social mechanisms that ensure the continuation of institutions, because “although institutions are associated with automatic mechanisms of social control that lead to institutions being relatively self-reproducing (Jepperson, 1991), relatively few institutions have such powerful reproductive mechanisms that no ongoing maintenance is necessary” (Lawrence and Suddaby, 2006, p. 229). These results allow us to conclude that the institutional work of intermediaries in the digital transition is (mainly) about *disrupting symbolic systems, creating relational systems and artefacts and maintaining routines*. This is a novel finding in the literature on the digital transition and, more broadly, in the literature on socio-technical transitions pointing to the existence of patterns in the institutional work on carriers, as repositories of institutions.

Looking at the institutional work carried out on the three pillars of institutions, we observe that the work on cultural-cognitive and normative institutions involves disrupting, creating and maintaining institutions, but the work on regulative institutions is limited to creating and maintaining institutions rather than disrupting them. This could be explained by the fact that among the tasks of the DIHs is also support for policy formulation, but this task is generally residual and takes the form of making some suggestions – at the explicit request of the policymaker – on the stages of policy implementation. DIHs do not take a central role in breaking existing regulations, but rather support the policymaker in

Table 4
Institutional work on normative institutions.

Carrier	Institutional work	Verbatims
Symbolic systems	Legitimising digital technologies	<p>“[Name of intermediary]’s objective is to contribute to the deployment of digital technologies in the ecosystem and the regional territory, taking care that the deployment of these technologies, and in particular of artificial intelligence, is done following the principles of ethics and trust.” (In6, F)</p> <p>[We tell them that] “there is a European strategy on this, I think we have to try and continue this effort.” (In7, G)</p> <p>“We help them to better understand how they can use data and AI, for which kind of problem in their company, and their processes. And the technology is the answer.” (In2, B)</p> <p>“Now the thing is factory 4.0, the factory of the future. And so, we have to take this turn to be always competitive. And to be competitive, our ecosystem, all the people around us, the subcontractors, have to be in the same dynamic as us, we are in the co-construction [...] if we perform it will be win-win and we will be able to maintain jobs in the region.” (In21, R)</p> <p>“The aim of the game was to unite all the players of the ecosystem around innovation [...] so it created fluidity, networking.” (In21, R)</p> <p>“The mission of poles is to create a dynamic, to unite people, to have visibility, develop collaborations, joint projects.” (In13, K)</p> <p>[Name of intermediary] is working on integrating the SMEs into the ecosystem that concerns them.” (In15, M)</p> <p>[Name of intermediary’s objective is] local structuring of the ecosystem to help SMEs to digitise.” (In15, M)</p> <p>“Thanks to the [name of intermediary], we were able to gain awareness regarding the high number of innovative firms with whom we can work.” (Secondary data source, K)</p> <p>“We are only public actors of the ecosystem who animate this ecosystem.” (In19, P)</p> <p>“We create a network of companies that are concerned with the medical sector, that is to say, companies that develop surgical robots, companies that supply these companies with either robotic arms or solutions.” (In5, E)</p>
Relational systems	Building cooperative structure in ecosystems	<p>“We create content about trends, especially if we say, oh this is what we think will happen next year.” (In8, H)</p> <p>“So we try to have events where people can meet together and decide to create some projects together [...] we create a lot of events, so we create about 120 events per year and the largest of them is called [name of event], it is a ten-day festival that happens in June, and that happens in all the region, so we’ve got three days at one place and one week it spreads in the region.” (In8, H)</p> <p>“From January to March [name of intermediary] criss-crosses the region to meet the actors of the ecosystem.” (Secondary data source, Q)</p> <p>“We have to animate the ecosystem to create a climate of trust, which is very important to our business. People have to</p>
Routines	Ecosystem orchestration	

Table 4 (continued)

Carrier	Institutional work	Verbatims
Artefacts	Providing standard informal and formal infrastructure	<p>have physical contact, not only by email, you have to see the person. We have lots of conferences, and workshops to ensure that, also to make the emergence of projects.” (In12, K)</p> <p>“We developed a common information system. We share a lot of information, except for the confidential.” (In21, R)</p> <p>“We have set up since last year, about a year and a half now, what is called the Regional Digital Observatory.” (In11, J)</p> <p>“We developed a charter and we make them sign the charter to which they commit. Good collaboration between them, respect for each other et cetera.” (In5, E)</p>

refining or creating new regulations (e.g., for the financing of innovative projects). This is because the task of disrupting existing regulations requires a degree of legitimacy to change formal rules, which intermediaries generally lack. Rather, when it comes to breaking existing regulations that are considered outdated or inadequate, they can at most adopt an advocacy role, outlining the views of their members or clients to policymakers who would be in the position to make changes.

Regularities regarding the levels of intermediation at which institutional work takes place can also be identified. In this research, we build on the framework by Kanda et al. (2020) and we observe institutional work on organisation-, network-, and ecosystem levels. At the organisation level, intermediaries are essentially concerned with cultural-cognitive institutions: they conduct institutional work on cultural assumptions, beliefs, and barriers, using direct one-to-one communication. At the network level of intermediation, intermediaries work both on cultural-cognitive and normative institutions, creating an environment for digital technology acceptance and institutionalisation. At the ecosystem level, intermediaries engage in institutional work on normative but also regulative institutions, for example through lobbying and advocacy. The key insights from our study are combined in an emergent framework of institutional work of innovation intermediaries in the digital transition depicted in Fig. 3. Our emergent framework suggests that levels of intermediation affect the type of institutional work conducted by the digital innovation intermediaries. Intermediaries seem to devise and carry out work on specific institutional pillars at specific levels of intermediation.

Our findings also reveal that different kinds of intermediaries perform a diverse range of institutional work, as shown in Table 7. Some of them focus their work on only a few pillars or a few carriers (this is the case, for instance, for professional organisations, but also for incubators or RTOs), while others (e.g., poles, clusters and EDIHs) have a broader scope of institutional work, contributing significantly to the institutionalisation of the digital transition. The differences between intermediaries regarding the areas of institutional work they focus on can be explained by their differences in terms of functional specialisation – thus, internal competencies and business models – (Rossi et al., 2022), specifically their key resources and value propositions. This is consistent with a large literature on innovation intermediaries, which has repeatedly stressed the variety of intermediaries (Stewart and Hyysalo, 2008; Kanda et al., 2020; Kivimaa et al., 2019b; Caloffi et al., 2023). Intermediaries that focus on research activities (RTOs) – and thus possess personnel specialised in this type of activity – develop value propositions that revolve around research and technology, as these are the areas where they can truly add value. They are consequently less likely to be involved in institutional work related to the construction of networks or territorial identities, for which skills other than research are required. Meta-organisations such as poles, clusters and EDIHs possess instead a broader range of competences, which can be mobilised in the

Table 5
Institutional work on regulative institutions.

Carrier	Institutional work	Verbatims
Symbolic systems	Taking part in rules and regulations definition	<p>“We should distinguish between local authorities, with whom we interact a lot, we bring them ideas and opinion, we fuel their reflections regarding how they should carry out public policy on the territory. Besides our local territory, we have no other influence more broadly, in particular in these digital technologies. Paris doesn't hear us at all. [...] For the local level, [Name of agglomeration], we have participated in the definition of policies in the digital domain. We were the leader in the making of the roadmap.” (In1, A)</p> <p>“They [public authorities] have ideas on how they want to develop the industry or the economy in general and it affects robotics at that time so they ask us. To have our opinion, one opinion among many others, but we are indeed consulted.” (In5, E)</p> <p>“When I say I do only what public funders tell me, it's not always true. In fact, this subject, the digital, we have taken it and we have tried it on our own. I said to my funders “I think we have a real subject, there is a European strategy on this, I think we have to try and continue this effort. It has been our idea and a proposal from my service, and I had to convince my funders to accept it.” (In7, G)</p> <p>“The advantage of being in an association like the association that we have of competitiveness clusters, is also to assert our voice at the national level and also to have lobbying power at the ministerial level. So that's why we are a member of this type of organisation there in particular.” (In11, J)</p> <p>“We are doing these Digital Maturity Assessments to identify on what points we can help SMEs.” (In15, M)</p> <p>“This assessment, it allows us all, it is already a mandatory request from the European Union to have an assessment at a zero, zero plus one year and at the end of the project in order to be able to measure the impact of this transformation and of technology deployment. So, we start with an assessment. This makes it possible to know what the needs of the company would be and what solutions can be offered to it, both in terms of services or in terms of technology.” (In6, F)</p> <p>“We have a whole metric on our service offer, we try to estimate the socio-economic impact of our support for SMEs. [...] The socio-economic impact is roughly the jobs created, cost reductions, risk reduction, fundraising too. This kind of thing, a panel of indicators that are not necessarily easy to collect because the impact there is not measurable immediately after the services are offered so what we try to do is to have one of the evaluations regularly six months, 12 months, 18 months after the end of the actions.” (In15, M)</p>
Relational systems	Influencing governance and power structures	<p>“We wanted to have a co-working space, to bring firms that would be integrated to the place.” (In9, H)</p> <p>“[Name of intermediary] is putting in</p>
Routines	Operating standardised protocols and procedures	<p>“We are doing these Digital Maturity Assessments to identify on what points we can help SMEs.” (In15, M)</p> <p>“This assessment, it allows us all, it is already a mandatory request from the European Union to have an assessment at a zero, zero plus one year and at the end of the project in order to be able to measure the impact of this transformation and of technology deployment. So, we start with an assessment. This makes it possible to know what the needs of the company would be and what solutions can be offered to it, both in terms of services or in terms of technology.” (In6, F)</p> <p>“We have a whole metric on our service offer, we try to estimate the socio-economic impact of our support for SMEs. [...] The socio-economic impact is roughly the jobs created, cost reductions, risk reduction, fundraising too. This kind of thing, a panel of indicators that are not necessarily easy to collect because the impact there is not measurable immediately after the services are offered so what we try to do is to have one of the evaluations regularly six months, 12 months, 18 months after the end of the actions.” (In15, M)</p>
Artefacts	Providing artefacts that meet regulatory specifications	<p>“We wanted to have a co-working space, to bring firms that would be integrated to the place.” (In9, H)</p> <p>“[Name of intermediary] is putting in</p>

Table 5 (continued)

Carrier	Institutional work	Verbatims
		<p>place a dedicated 'IoT Centre' allowing to test, experiment and validate IoT technologies.” (Secondary data source, J)</p> <p>“There are laboratories where we can set it all up [proof of concept] and validate.” (In15, M)</p> <p>“So, we are involved in one of them, which is [name] research institute in autonomous vehicle and electrical vehicle. And that institute was a project of [name of intermediary].” (In17, N)</p>

Table 6
Summary of findings.

Carriers	Pillars		
	Cultural-cognitive	Normative	Regulative
Symbolic systems	Reducing the cognitive distance to digital technologies and encouraging experimentation Disrupting institutions Organisation level of intermediation	Legitimising digital technologies Disrupting institutions Network level and ecosystem level of intermediation	Taking part in rules and regulations definition Creating and maintaining institutions Ecosystem level of intermediation
Relational systems	Intermediation identity building and reducing distance between actors in the digital ecosystem Creating institutions Network level and ecosystem level of intermediation	Building cooperative structure in ecosystems Creating institutions Ecosystem level of intermediation	Influencing governance and power structures Creating institutions Ecosystem level of intermediation
Routines	Establishing digital innovation routines Maintaining and creating institutions Network level and ecosystem level of intermediation	Ecosystem orchestration Maintaining institutions Ecosystem level of intermediation	Operating standardised protocols and procedures Maintaining institutions Ecosystem level of intermediation
Artefacts	Developing digital technology artefacts Creating institutions Organisation, network and ecosystem levels of intermediation	Providing standard informal and formal infrastructure Creating institutions Ecosystem level of intermediation	Providing artefacts that meet regulatory specifications Creating and maintaining institutions Ecosystem level of intermediation

Note to table, we highlight: in italics and bold the type of institutional work (creating, maintaining or disrupting); in italics the levels of intermediation.

development of different types of institutional work (Rossi et al., 2022). Consequently, their value proposition is different from that of RTOs. The differences are also evident in the levels of intermediation. For example, poles and clusters – which receive a mandate from the policymakers to aggregate and support enterprises within the technological or territorial innovation system – operate substantially at the ecosystem level (Bakici et al., 2013; Russo et al., 2022). Other intermediaries – such as, for instance, RTOs – may not be explicitly mandated by the policymakers to operate at a specific level of intermediation. For this reason, their institutional work may develop at different levels (Meyer et al., 2019; Sheikheldin, 2021).

Some of our findings align with the literature on sustainability transitions, suggesting intermediaries play similar roles in constructing new technology architectures and facilitating transitions (Boon et al., 2008; Kivimaa et al., 2019a, 2019b). In particular, there are two types of

Table 7
Institutional work of intermediaries on different institutional pillars and carriers.

Institutional pillar	Carrier	Research and technology organisations	Incubators	Professional organisations	Development agencies	Poles	Clusters	EDIHs	Category of institutional work
Cultural-cognitive	Symbolic systems								disrupting
	Relational systems								creating
	Routines								maintaining and creating
	Artefacts								creating
Normative	Symbolic systems								disrupting
	Relational systems								creating
	Routines								maintaining
	Artefacts								creating
Regulative	Symbolic systems								creating and maintaining
	Relational systems								creating
	Routines								maintaining
	Artefacts								creating and maintaining

Note to table, we highlight: in dark grey the direct institutional work of digital innovation intermediaries, and in light grey the work they are involved in indirectly.

institutional work performed by intermediaries in the context of digital transition that are similar to what happens in the field of sustainability transitions: intermediaries mobilise actors to promote the transition, promote new networks to disrupt the existing system (Kivimaa et al., 2019b) and facilitate collective sense-making with regard to the new system (Boon et al., 2008). However, our research identifies specific institutional work forms in the digital transition, possibly offering insights for socio-technical transitions research. Thus, we show that, at cultural-cognitive level, intermediaries conduct important work on removing cognitive barriers and educating about digital technology, organising projects, and developing digital technology artefacts. At normative level, they build support systems for digital technology diffusion. At regulative level, they discuss policies, engage in advocacy and lobbying, execute and define standard operations, and develop and provide regulated infrastructure and material.

Our findings can also be analysed from the perspective of a recent literature that has studied the institutional work of innovation intermediaries in the field of innovative public procurement (Uyarra et al., 2020; Selviaridis et al., 2023). In particular, in our research we identified several of the forms of institutional work identified by Uyarra et al. (2020), such as educating, advocacy and lobbying (to institutionalise innovative public procurement, in that case). Advocacy is also identified by Selviaridis et al. (2023) to promote institutional change to facilitate public procurement of innovation. However, we also identify other forms of institutional work – removing cognitive barriers, building identity, instilling trust and ethics, attributing value to digital technologies, strategic guidance, building norms and support systems, discussing policies and regulations, executing and defining standard operations, and developing and providing regulated infrastructure. The fact that we uncover some types of institutional work that were already uncovered in prior research, and some new types of institutional work suggests that there could be a common set of institutional work forms for intermediaries regardless of the setting in which they operate, and some others which could be more specific to the context in which

intermediation takes place. In our case, new forms of institutional work aim at the acceptance of technology, building of a support structure for the new technology and developing different kinds of artefacts to facilitate its use and diffusion.

In our analysis of the literature, we have evoked studies that examine how institutions are impacting the digital transition (e.g. Hinings et al., 2018; Lv et al., 2023; Shang et al., 2021). Our study complements this line of research by providing detailed and systematic evidence of how intermediaries carry out institutional work to influence institutions in the digital transition. As Kenney et al. (2015) have predicted, policy-makers are faced with dilemmas, as they need to support the digital transition while, at the same time, promoting ethical use of technologies, preserving firms, privacy, and income equality among others. Mandating innovation intermediaries to support the digital transition and address the tensions arising from it is a way for the public policy to increase its influence in this delicate area characterized by high speed of technological change and the ever-growing power of technology giants.

We provide a comprehensive view of the institutional work of intermediaries in support of the digital transition. We show that collectively, different types of intermediaries cover a very broad spectrum of institutional work at three levels of intermediation. This has not been uncovered in prior research and is indicative of the important role intermediaries play. We also provide insights on how, supported by public policy and public funding, innovation intermediaries act on institutions, creating an environment in which a broader number of agents, including SMEs, can benefit from digital technologies.

6. Conclusion

We examined how public innovation intermediaries carry out institutional work in the digital transition. We show that intermediaries act on cultural-cognitive, normative, and regulative institutions, by performing institutional work on institutional carriers – symbolic systems, relational systems, routines and artefacts – at different levels. Depending

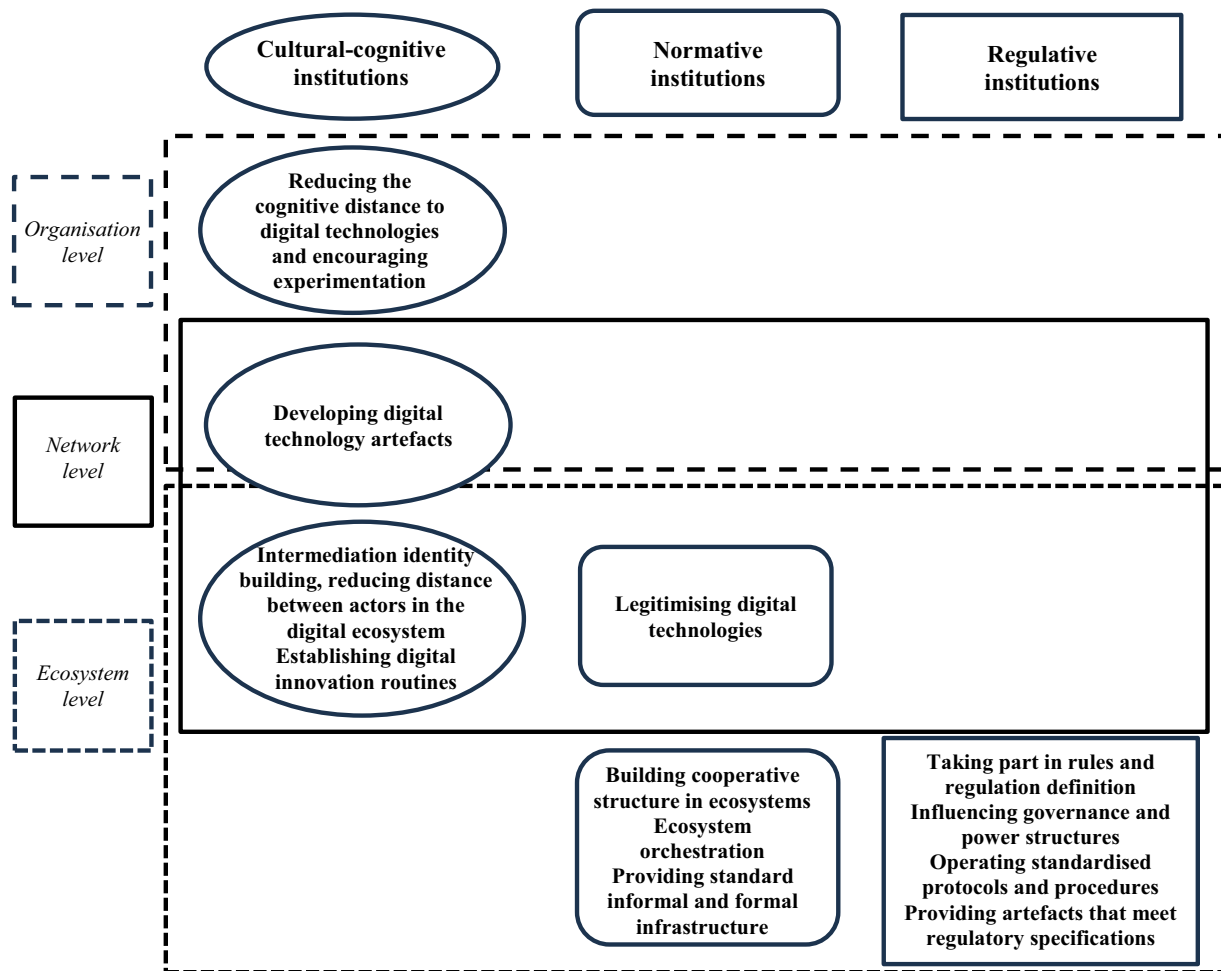


Fig. 3. An emergent framework of institutional work of innovation intermediaries in the digital transition, by institutional pillar and level of intermediation.

on the type of organisation, the focus of institutional work varies significantly.

Our findings have significant policy implications, suggesting that policymakers should recognize and support the institutional work of innovation intermediaries. Ensuring public funding for intermediaries is crucial, as their impartiality and public mandate are essential for effective digital transition. Reduced public funding risks compromising their role and legitimacy, making them over-dependent on private funding. Specifically, public innovation intermediaries’ focus on SMEs is worth emphasizing, as these actors struggle to keep up with the pace of digital technologies. For this and other reasons, such as their impartiality and work for the public good, we believe that only public innovation intermediaries can carry out the needed institutional work to serve all actors and facilitate the digital transition. As our findings indicate, some of the functions in digital ecosystems, such as building the cooperative structure and the animation of the ecosystems are performed only by public innovation intermediaries. However, in France (and also in other European countries), many public intermediaries are seeing their public funding reduced. For example, the funding structure of poles is switching from a high share of national funding to a dominance of regional and private funding. This can compromise the promotion of the national digital agenda as regions might have other priorities and might assign poles with different mandates. Even more importantly, intermediaries are incentivised to look for private funding. This might delegitimise them as impartial, neutral actors in innovation ecosystems, distract them from their traditional intermediation work and make them over-dependent on private funding. We believe that policy should secure public funding to intermediaries because of their

unique position in the digital transition, which can be compromised should they lose public funding, public mandate and the legitimacy conferred upon them by the public policy.

When it comes to obstacles to performing their institutional work, in addition to the lack of public funding, lack of resources – including human, technological and financial resources and time –, are important obstacles to intermediaries’ performing their institutional work. Moreover, some intermediaries report inadequate levels of support or understanding of their roles in the digital transition by the public authorities. These issues should be discussed in the framework of public policy.

In terms of implications for management, our findings can help innovation intermediaries better understand the type of institutional work they are involved in and explore new opportunities for action. In particular, certain types of intermediaries are not involved in institutional work at the ecosystem level as much as other types of intermediaries, which might open up new opportunities for action for them. Conceptualising their activities as institutional work can also aid intermediaries in advocating for their role and evaluating their impact.

Our study is not without limitations, which, at the same time, open avenues for future research. While building on empirical evidence from a single country allows us to keep many of the external (economic, political, institutional etc.) contextual factors constant, we acknowledge that our findings might exhibit limited generalisability to other settings, particularly where there is a lack of structured funding programmes for public innovation intermediaries, or where intermediaries are targeting larger firms rather than SMEs. Future research could adopt a comparative perspective, examining innovation intermediaries across different

countries. Furthermore, while in this research we have focused on how intermediaries act on institutions, we have not examined how intermediaries themselves adapt and change in this process. While conducting institutional work on cultural-cognitive, normative and regulative institutions, intermediaries become more focused on some areas of their actions or new areas to be opened up, they gain awareness and internal competencies to guide their actions, build legitimacy and trustworthiness, and modify their governance. Thus, similarly to the institutions they act on, intermediaries themselves evolve, through the accumulation of refinements, and adjustments at the micro-level, that, at some point, lead to major changes in them as organisations and, in particular, in their business models (Rossi et al., 2022). Considering this aspect in conjunction with the institutional work they carry out as a co-evolutionary process could yield particularly interesting insights.

CRedit authorship contribution statement

Ana Colovic: Writing – review & editing, Writing – original draft,

Validation, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Annalisa Caloffi:** Writing – review & editing, Writing – original draft, Validation, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Federica Rossi:** Writing – review & editing, Writing – original draft, Validation, Resources, Methodology, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Margherita Russo:** Writing – review & editing, Writing – original draft, Validation, Methodology, Investigation, Formal analysis, Data curation, Conceptualization.

Declaration of competing interest

Authors report no conflict of interest.

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Appendix 1. List of interviewees

Interviewee ID	Number of interviews	DIH / Other
In1	1	A
In2	1	B
In3	1	C
In4	1	D
In5	1	E
In6	1	F
In7	1	G
In8	2	H
In9	1	H
In10	1	I
In11	1	J
In12	2	K
In13	1	K
In14	1	L
In15	1	M
In16	1	N
In17	1	N
In18	1	O
In19	1	P
In20	1	Q
In21	1	R
In22	1	H
In23	1	Ministry of Higher Education, Research and Innovation
In24	1	Higher education institution
In25	1	Former public official, independent consultant

Total: 27 interviews.

Appendix 2. Interview guide

Part I – About the DIH (general info and “ID card”).

1. Can you please tell us a little bit about your background? (education, experience, when you joined the DIH, ...)
2. Can you tell us a bit about your organisation? When was it created, by whom, how, ...?
3. When did your organisation receive the DIH label?
4. What does being a DIH imply? Do you have to do something specific, present some reports etc.?
5. Are there some institutions in France that are similar to yours in terms of the status, role (so that we can situate you in the digital landscape)?
6. What is the internal structure of your organisation?
7. What kind of competences do you think are the most important/valuable for your organisation?
8. Can you tell us a bit about your governance?
9. What is the source of your funding?
10. Do you have a legal status and if so, what is it?

Part II – Mission and activities of the DIH.

11. What are the missions/objectives of your organisation?
12. Have you decided about your mission/objectives or did someone else decide about these (the government, funders, the region...)?
13. What are your main activities? Can you group them according to their nature?
14. In terms of digital technologies, what exactly do you do? How do you support digitalisation?
15. What do you see as key obstacles/challenges of the digital transition?
16. In terms of networking, what kind of activities do you do? What is your network like?
17. Do you work with individual companies or groups of companies, or the entire ecosystem?
18. How do you see your position within the ecosystem? Are there other players that perform the same role as you do?

Part III – Perception of influence on institutions.

19. Do you think that your activities have some impact on the way companies, groups of companies and the entire ecosystem perceive digitalisation? For example in terms of awareness, mindset, acceptance of technology. Can you please elaborate?
20. Do you think your activities have some impact on the way companies, groups of companies or the ecosystem work? For example, in terms of routines, norms, habits. Can you please elaborate?
21. Do you think that your activities have some impact on more formal rules and regulations? Do you have some links with policymakers/decision-makers at local, regional, national level? Are you sometimes asked to provide your opinion, write reports, advise the public administration about the digital transition?
22. What do you think about the policy? Is the policy framework important in this area and if so how?

Appendix 3. Examples of secondary data sources

- European Digital Innovation Hubs Network https://european-digital-innovation-hubs.ec.europa.eu/edih-catalogue?f%5B0%5D=edih_soe%3Aedih&f%5B1%5D=edih_soe%3Asoe
- European Digital Innovation Hubs Network (France) https://european-digital-innovation-hubs.ec.europa.eu/edih-catalogue?f%5B0%5D=country%3AFrance&f%5B1%5D=edih_soe%3Aedih&f%5B2%5D=edih_soe%3Asoe
- Presentation of each DIH on the European Digital Innovation Hubs Network site.
- Website of each DIH in the sample.
- Detailed presentation slides of one of the 18 DIH (supplied by the DIH).
- La French Tech - <https://lafrenchtech.gouv.fr/fr/>
- France Stratégie (2020) Les pôles de compétitivité: Quels résultats depuis 2005? <https://www.strategie.gouv.fr/sites/strategie.gouv.fr/files/atoms/files/fs-2020-ns-pole-competitivite-aout.pdf>
- France Stratégie (2017). Commission Nationale de l'Evaluation des Politiques d'Innovation (CINEPI), Avis sur la politique des pôles de compétitivité, https://www.strategie.gouv.fr/sites/strategie.gouv.fr/files/atoms/files/avis_pole2017annexe_02.02.pdf
- Statista (2019). Les objets connectés – Faits et chiffres, <https://fr.statista.com/themes/2972/les-objets-connectes/>
- Next Move, Success Stories, various years. Next Move, Saint Etienne du Rouvray.
- Cap Digital (various years), press releases https://www.capdigital.com/type_document/communiquede-presse/
- Cap Digital (various dates), Blog <https://medium.com/cap-digital>
- Mov'eo (2019). Stratégie 2019–2022. Mov'eo, Saint Etienne du Rouvray.
- Ministère de l'Economie, des Finances et de la Relance web site, section dedicated to Pôles de compétitivité with various documents and subsections <https://www.entreprises.gouv.fr/fr/innovation/poles-de-competitivite/presentation-des-poles-de-competitivite>
- Next Move, web portal dedicated to Industry 4.0 <https://nextmove.fr/services-2021/lean-industrie-4-0/>
- Next Move (various dates), Newsletter.
- Next Move web portal dedicated to R&D projects <https://nextmove.fr/nextmove-projets/les-projets/>
- Minalogic, newsletters, various dates.

Data availability

The authors do not have permission to share data.

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