

Innovation Intermediaries: From the Third to the Fourth Industrial Revolution

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Intermediary organisations that support firm-level and collaborative innovation, often called knowledge or innovation intermediaries, have gained increasing prominence in knowledge-intensive economies. The label “intermediaries” is not meant to be reductive. Intermediaries do not merely offer matchmaking services, but provide a wide range of knowledge-intensive services including, among others, knowledge and technology mapping, technical assistance in R&D projects, dissemination and commercialisation of research results, support for university-industry collaborations (Bessant and Rush, 1995; Lynn et al, 1996; Hargadon and Sutton, 1997; Den Hertog, 2000; Howells, 2006; Doganova, 2013). Most importantly, they are innovation catalysers, as they “mobilise, reframe and structure expertise and policy imperatives” (Meyer and Kearnes, 2013, p423). Intermediaries are not third parties, but they are often an integral part of innovation processes. While typical intermediaries include knowledge-intensive business services providers, technopoles, technology transfer agencies, science parks and incubators, a wide range of organisations can provide at least some intermediary functions (Howells, 2006; Caloffi et al, 2015a).

In what follows we review the features and role of innovation intermediaries, and focus on the challenges involved in the design of innovation intermediaries that can appropriately support the ongoing Fourth Industrial Revolution.

1. Innovation intermediaries: characteristics and role

Innovation intermediaries are often created and/or funded through public budgets, in order to support R&D, innovation, and technology transfer (Uotila et al, 2012; Knockaert et al, 2014; Fiordelmondo et al, 2014). Examples include competitiveness poles in France, innovation poles in Italy, technology catapults in the UK (Longhi and Rainelli, 2010; Kerry and Danson, 2016; Russo et al, 2016a).

System failure rationales (Klein Woolthuis et al, 2005) appear to underpin most policies funding innovation intermediaries (Dalziel, 2010; Dalziel and Parjanen, 2012; Russo et al, 2016b). In fact, intermediaries can be expected to address failures in the information infrastructure of an innovation system, by diffusing information about opportunities for collaborations with other actors (Bougrain and Haudeville, 2002), as well as about useful and applicable techniques or technologies for product and service development (Howard Partners, 2007; Rosenkopf and Nerkar, 2001). They can help firms to address their capabilities failures (Bessant and Rush, 2005; Knockaert et al, 2014) by providing

training and knowledge and technology mapping services. Very often, intermediaries are required to address interaction failures in the innovation system (Russo et al, 2016a). Finally, intermediaries can be called upon to address the lack of formal or informal institutions supporting innovation, and facilitate the emergence of social norms that underpin good innovative performance (Etzkowitz and Leydesdorff, 1998). In many cases, intermediaries are required to specifically provide services to small and medium-sized enterprises (SMEs), which are less likely than large firms to carry out R&D activities systematically and, therefore, are often less innovative and more easily prey to cognitive lock-ins (Laranja et al, 2008). Our long-term research agenda on publicly-funded innovation intermediaries, has produced a number of key policy implications.

The pro-networking activity of intermediaries. Innovation policies that aim to encourage SMEs to network with other organisations, should target intermediaries. Intermediaries perform a key role in connecting firms or firms with other agents (Caloffi et al, 2015b), and this is particularly true for specialised intermediaries, which have specific knowledge and competencies in the field of innovation support and technology transfer. Instead, their presence seems to be redundant in more complex multi-agent relationships, such as those developing in complex consortia (Caloffi et al, 2013).

Variety is important. Different types of innovation intermediaries can play a role in different environments and at different stages of the innovation process. For instance, intermediaries operating in technologically turbulent environments or supporting knowledge exploration processes need to bridge previously unconnected organisations with very different knowledge and competencies, while intermediaries operating in more stable environments or supporting knowledge exploitation processes need to coordinate organisations that are part of overlapping communities (Caloffi et al, 2015b). Therefore, there is no a unique model of innovation intermediary that policy makers should support.

Intermediaries by policy design. Policymakers should refrain from defining ex ante the specific type of intermediary that must be part of an innovation project. The best option is to let the organisations that develop the project define the partnership that is needed to carry it out. Indeed, imposing constraints on the composition of the partnership that can apply for public funds does not always get the expected results, as compliance with policy requirements stifles experimentation (Rossi et al, 2016).

The evaluation of intermediaries' performance.

Intermediaries' performance is often assessed through indicators that, to be effective, need to be closely aligned with policy objectives. The lack of such alignment - a phenomenon that is quite common and often overlooked - can lead intermediaries to implement actions that, while allowing them to reach their performance targets in a short time, are not consistent with the final objectives that the policy intends to achieve (Russo et al, 2016a, 2016b). Therefore, policymakers are required to pay careful attention to the design of performance indicators.

Intermediaries to address system failures. The fact that intermediaries are often called upon to address a number of system failures has implications for both the type of assessment that these organisations should undergo, and the kind of knowledge and skills they need. In this respect, we argue that a system-based framework of performance indicators to assess the intermediaries' publicly-funded activities would be particularly useful. We provide an example of these indicators by looking at a specific type of innovation intermediaries, the innovation poles (Russo et al, 2016a, 2016b). We also argue that a system-based evaluation of intermediaries' activities should provide some implications in terms of policy design, with particular reference to the type of specialised competencies intermediaries need to effectively support the development of their innovation system.

2. Intermediaries for Industry 4.0

The Fourth Industrial Revolution is in progress. Building on the achievements of the Third Industrial Revolution, which has witnessed the rise of information technology, the Fourth exploits the power of digitalisation to connect people and objects globally (Schwab, 2016). In factories, so-called Industry 4.0 technologies like robotics, 3D printing, and the Internet of Things (IoT) are reshaping production processes and the associated value chains (McKinsey, 2013; World Economic Forum, 2016). To remain competitive, firms need to rapidly adapt their skills, processes, and technologies to the new paradigm (Brynjolfsson and McAfee, 2016). Since the Fourth Industrial Revolution has a markedly systemic and recombinant character (Brynjolfsson and McAfee, 2016; Schwab, 2016), we believe that intermediaries can play an important role in this context, helping firms, particularly SMEs, to proficiently adopt and integrate new technological and organisational systems and processes.

However, as technological revolutions tend to disrupt established relationships among individuals, organisations and artifacts (Tushman and Anderson, 1986), it is by no means assured that this important role will be played by existing intermediaries such as technopoles and technology transfer agencies - which have been funded largely by regional and national governments in order to broker the supply and demand (particularly from SMEs) of innovative technologies and specialised competences. Indeed, as other scholars have observed, the Fourth Industrial Revolution "call us to re-think the roles of the university, government, and industries that form the Triple Helix of the innovation eco-system and re-imagine their interfaces in the governance of emerging technologies" (Kim, 2017, p11). While some technical and policy reports have tried to illustrate the actual or possible new applications of technologies (e.g. European Parliamentary Research Service, in Davies, 2015), there are no systematic analyses of the

role, competences, governance and business models of intermediaries in the implementation of Industry 4.0 technologies. In this scenario, new characteristics of innovation intermediaries will play a crucial role in the generation and diffusion of innovations.

Current structural changes require us to update our understanding of how to support firm-level and collaborative innovation, and what type of organisations are able to perform this task, so as to inform policy-making and to help firms organise their technological upgrading.

The industry of the future will be very different from that of the past, to the extent that robotics, 3D printing, and IoT will have a strong impact on production processes, and interconnected bundles of technologies (mechanical, electronics, digital) characterize these applications. Intermediaries can facilitate and even drive the emergence of some technological applications and the related innovations, and their diffusion to user firms, particularly SMEs that are unlikely to possess (or to be able to acquire) the internal skills and knowledge needed to seamlessly transition to the Industry 4.0 paradigm (Motohashi, 2017). Moreover, they can help firms to implement the organisational transformations that are essential to fully exploit the opportunities of the new technologies. By looking at how innovation intermediaries are creating their own competences, structure and business model, and which kind of support they provide to help firms facing the structural changes inherent in the Fourth Industrial Revolution, our future research will support an innovative perspective to address a well-known set of real-life challenges brought about by technological change.

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