

Partnership Development at the University-Industry-Government Nexus

Subjects: [Archaeology](#)

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The increasingly entrepreneurial intent of universities implies the commercialization of knowledge and innovation through the triple helix of interactions between universities, industry and government. However, there remains a lack of clarity concerning best practice partnerships for innovation.

triple helix

innovation

partnership development

sustainable development

1. Introduction

Since the 1940s, there has been a push to encourage universities and industry to increase their engagement to commercialize research ^[1]. This started with the use of government procurement to encourage research and the development of innovative products ^[2] initially in the space, defense and energy sectors ^[3]. The 1950s and 1960s saw the development of science and/or technology parks to commercialize research ^[4] in America, which was followed, during the 1980s, in the UK ^[5].

During the 1980s, universities developed an increasing focus on technology transfer ^[6] to facilitate engagement with business. However, it was only from the 1990s that universities became directly involved in the world of business, actively seeking to commercialize their knowledge and research ^[3].

The benefits of collaboration range from the local (commercialization of research and innovation ^[7]) to the regional (revitalization of regions ^{[8][9]}) or national (catalyst for techno-economic development ^[10]) levels. Collaboration is a key part of modern innovation ^[11], which in turn is an important part of a well-developed entrepreneurial industrial sector ^[12].

The triple helix model ^[13] highlights the importance of a partnership between universities, industry and government to create innovation that meets business objectives in developing and commercializing universities' research outcomes. Including government within the partnership creates outcomes that are socially and economically beneficial ^{[14][15]}. Others ^[16] have proposed the addition of a fourth helix (the quadruple helix) to promote a democratic approach to innovation, where society can provide feedback to create socially acceptable policies and practices. However, this model does not include the explicit consideration of non-market parameters, such as the natural environment ^[17]. The quintuple helix ^[18] seeks to address this shortcoming.

However, universities, industry and government struggle to effectively partner—particularly at scale—to deliver economic benefits from the commercialization of research outputs [19][20][21].

2. Discussion and Analysis of the Data

2.1. Articulated Data

2.1.1. Innovation at the University–Industry–Government Nexus

Economies have become increasingly dependent on the exploitation of knowledge for continued economic growth [1][4] and the role of the university is widely debated [22][23][24][25]. Universities play a key role in furthering future economic development, due to their missions to educate, carry out research and engage [26][27]. It is the third mission (engagement) that gets the most attention in terms of how universities can most effectively use the knowledge they create to further economic development [28][29] and do so in a manner that is in the economic interest of society [30][31]. To efficiently utilize their expertise in knowledge creation for the economic benefit of society, there is a need to interact, or partner, with other organizations [32]. There is limited discussion about how universities themselves might use innovation to improve their offerings under missions one and two (see, for example [33][34]).

There is an ongoing conversation about the triple helix, where universities, government and industry interact to help drive knowledge-based economic development, particularly in an industrialized economy [25][35]. The triple helix model is largely accepted as a useful starting point to understand the changing roles of universities, industry and government to partner in innovation to drive economic development.

2.1.2. Intermediaries for Innovation at the University–Industry–Government Nexus

The SLR reveals that the innovation intermediaries created by university, industry and government are created through an internal dynamic, and these are either management led (top-down) or led by an entrepreneurial individual or group (bottom-up) [28][35]. These types of intermediaries for innovation, as identified in the literature, are shown in **Figure 1**.

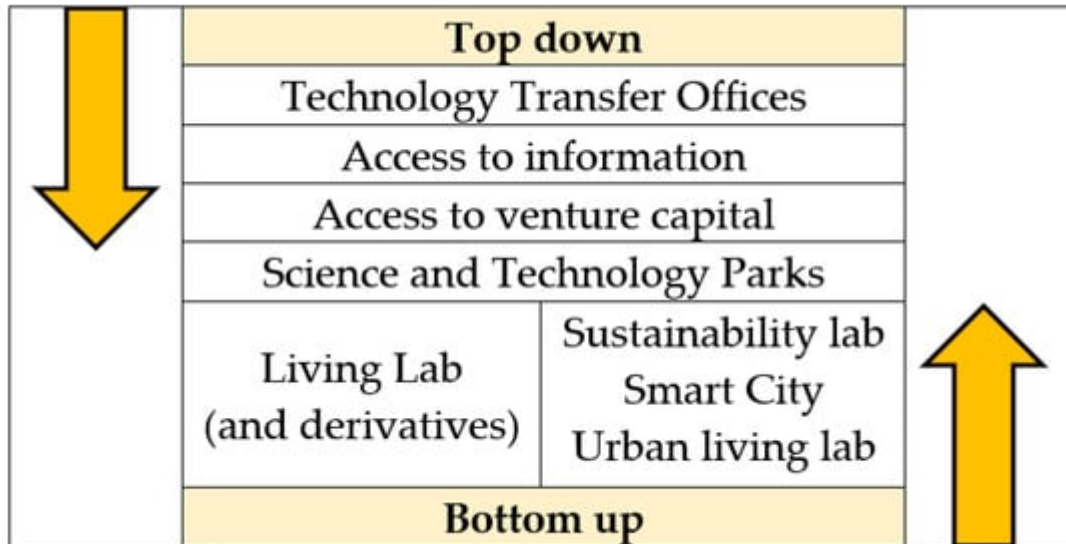


Figure 1. Innovation intermediaries in our society [\[28\]](#)[\[35\]](#).

Whilst there is a focus on economic development, it is clear from the literature that the deepening knowledge-based economy is affecting not only how industry, government and universities interact, but also how consumers and citizens [\[32\]](#) interact with other partners in the innovation ecosystem. The pace of change affects all sectors of society (university, industry, government as well as people), and this dynamic relationship is rapidly changing, which is leading to new forms of intermediaries that are highly individualized [\[36\]](#). This, in turn, leads to the opportunity for innovation at different scales and under differing dynamics and delivering different outcomes [\[37\]](#)[\[38\]](#).

Various forms of intermediaries are being created as a result of internal dynamics, but also being facilitated by external opportunities and stimuli (exogenous factors). It is this overlay of changing dynamics that has led to new forms of intermediaries for emerging innovation [\[39\]](#) and that are being led by, or include, different actors [\[40\]](#) or different power dynamics and approaches [\[37\]](#)[\[41\]](#). Additionally, new models for innovation are being adopted by different sectors—including the public sector [\[42\]](#) or cities [\[43\]](#). It is this change in dynamics, structure and power relationships that is leading to the nascent creation of innovation that is seeking to deliver economic, social and environmental enhancements at the same time [\[19\]](#).

2.1.3. Evolution of Intermediaries for Innovation

This SLR reveals an evolution in the ecosystem of intermediaries for innovation. Intermediaries for innovation are individuals or organizations whose role it is to span the boundaries between organizations to facilitate innovation [\[44\]](#). Innovation intermediaries are evolving from a simple partnership model of a technology transfer officer, through to the development of science and technology parks (STPs) and through to living labs and smart cities. This is a non-linear pathway [\[35\]](#), partly due to the rapid change in the nature of the knowledge-based economy—where knowledge is increasingly shared rather than owned [\[42\]](#), partly as a reflection of a change in knowledge production [\[16\]](#) and partly due to an increased focus (particularly in industrial economies) on the importance of the service-

based economy, where service (experiential or simply more tailored [45]) is seen as another key to unlock economic development.

- On Campus Structures

On-campus structures includes the creation of several organizational structures within universities to promote the development of partnerships for innovation. These forms of partnership are the simplest and are an organizational response to facilitate the creation of an increasingly entrepreneurial university [35]. In the initial phases at least, this is conducted on campus.

The structures put in place range from technology transfer offices [44], academic liaison officers [30] to act as an intermediary between the university and business, processes to facilitate access to library information for business [26] and the creation of incubators to help start-ups grow into functioning businesses [46]. The purpose of these mechanisms is to assist the transfer of knowledge from the researcher to the consumer via a business.

There is also some evidence in this SLR of the campus itself being used as an innovation, and these were underpinned by a planning perspective [47], asset management [48], by opening up the campus [49] or using the campus to drive radical innovation through institutionalization [50]. These studies show the potential for the entrepreneurial university to drive all three modes (education, research and commercialization) through the operation or development of the campus.

- Development of Campus-Adjacent Structures

The second significant phase in the development of intermediaries for innovation is the creation of campus-adjacent structures to further the partnership between universities and business. In this SLR, there were 28 case studies looking at STPs. The impetus for the creation of these off-site structures seems to be university, or government driven, but there are examples of it being driven by the private real estate sector [51]. In this SLR, most papers considering STPs focused on a traditional form of STP, where a university creates spaces for businesses to occupy to deliver innovative goods and services (ideally based on or related to the intellectual output of the university).

These campus-adjacent structures have a complex nomenclature, but in this SLR, they are referred to as science and technology parks (STP). This is a generic term to take in research parks, technology parks, innovation parks and business parks. The key definition issue is that they are developed to create an environment conducive to the co-creation of economic value by business, ideally using university created knowledge. They are geographically proximate to the university and tend to focus on the research strengths of the university.

The value of geographical proximity is much debated [52]. This SLR showed strong informal connections between universities and business [26][53][54][55] based on geography but with less evidence of formal connections that deliver innovation based on university-created knowledge [52][56]. One study found that 92% of the on-park research and technology output was through private industry [57], with others considering the role of private capital to innovation

success [24], the role of university finance to spin-off success [58] or the role of management [59], or the network benefit [60]. This does not, in itself, mean that STPs represent a failed policy, but that there is not strong evidence for the successful transference of knowledge from creator to consumer via a business based in the university's STP. The depth of these relationships depends upon the level of service offered by the university to its tenants—with non-core assistance (for example, human resource management functions) being valued by tenants [54] or the value of social capital to start-up success [23].

There is also a stream of work researching the connection between the university and the STP covering the role of knowledge transfer facilitated by librarians [30], the influence of the university on the STP [61], the impact of doctoral education [62] or a more holistic consideration of the STP compared to a technology transfer officer or other intermediaries (see [Section 4.1.3](#)) [44].

Although the usefulness of STPs is still subject to debate, the creation of STPs has been adopted in Europe [7][9][63][46][56][57][64][65][66][67] and North America [1], and STPs are widely emulated in the former Eastern bloc countries [11][68][69], as well as the centralized economies of China [2][29][70], Taiwan [71][72], Malaysia [27] and others in Asia; the creation of STPs is also seen as a pathway for economic development in developing nations [8][73][74][75] as well as being subject to international comparisons [4][32][76][77].

- Development of Living Labs

The next phase in the evolution of intermediaries for innovation is the creation of living labs. These are partnership structures that are focused on user engagement and open innovation. The partners are varied but generally involve university, business, and government (at some level). Living labs (and derivatives) are driven by a desire to innovate within the partnership and this might be the deepening of research findings [78], creating a product or service to commercialize the research [79] or co-creating a new product or service [80].

The external change that is facilitating the development of living labs is the ability for a range of stakeholders to become freely involved in the process of innovation [81]. The service-dominant logic [22], open innovation [82], user innovation [83], user-centered design [84] or even social (rather than economic) innovation [85] have become possible due to the ability to create communities of interest for almost anyone.

Living labs (and derivatives) are widely debated in the literature and are normally considered a network that incorporates both user engagement and open innovation [86]; they have the characteristics as set out in **Table 1**. There are several forms of living labs, which are also evolving. Sustainability labs [87] are focused on the delivery of economic, social and environmental outcomes at a geographic location. Smart cities are developed as a higher systems level solution under which living labs enable the demonstration and prototyping of products and services. Urban living labs are a network structure within an urban environment [39].

Table 1. Living lab characteristics [83].

Characteristic	Explanation
Real life environments	Real life experimentation to test, develop, research new products, services, systems, processes
Stakeholders	Range of partner involvement to co-create. Stakeholders are key to the outputs of the living lab
Activities	What the living lab will focus upon. This is defined by whoever is driving the innovation (and is key to delivery of the output/outcome)
Business models	Covers how the living lab will operate (essentially why it exists and how it will continue to exist)
Methods and tools	The approach taken to innovation
Challenges	Economic, social and/or environmental
Output and/or outcomes	What the living lab delivers
Sustainability	Emergence of innovation that moves society toward delivery of the sustainable development goals [83] [39]

to create business cases to build them [\[40\]](#)[\[87\]](#), or even best practice guides to help manage them [\[88\]](#). They are a rapidly evolving creation that, in many respects, is a direct expression of the partnership that created them [\[87\]](#). That said, there are structures to suit different desired outcomes, such as wicked issues [\[89\]](#) or radical innovation [\[50\]](#), and they are grouped into a genus containing 4 typologies characterized by open innovation: utilizer driven, enabler driven, provider driven, and user driven [\[86\]](#).

At the heart of living labs are two key elements: user engagement and open innovation [\[86\]](#). These two aspects are evident in the case studies in this SLR. It is these two aspects that stand them apart as intermediaries for innovation. Because of this commitment—facilitated by the knowledge economy and technological developments—living labs are footloose. They can be on campus [\[34\]](#)[\[47\]](#)[\[49\]](#)[\[90\]](#)[\[91\]](#)[\[92\]](#)[\[93\]](#), off campus [\[9\]](#), in an STP [\[22\]](#), on a high street [\[94\]](#), local [\[40\]](#)[\[69\]](#)[\[78\]](#)[\[95\]](#)[\[96\]](#), precinct scale [\[97\]](#), urban [\[81\]](#)[\[98\]](#)[\[99\]](#)[\[100\]](#)[\[101\]](#)[\[102\]](#), suburban [\[103\]](#)[\[41\]](#), rural [\[15\]](#), regional [\[82\]](#)[\[89\]](#), peripheral [\[104\]](#) or city scale [\[43\]](#)[\[80\]](#)[\[84\]](#)[\[100\]](#)[\[105\]](#)[\[106\]](#)[\[107\]](#)[\[108\]](#). They can also be virtual [\[109\]](#).

It is partly this footloose, open and creative element that means that they are potentially difficult to harness at scale: indeed, difficult to harness by policy makers, but also difficult to harness by businesses, universities and the public. These structures are innovative in themselves; each is unique (even with common elements) and each is designed to serve a purpose. Their amorphous shape and shifting nature make them difficult to grasp and initiate at scale. Whilst STPs could be created by policy diktat [\[53\]](#), living labs cannot and as such are more ephemeral and can be a conundrum to universities, business and government. This transformational change of the modus operandii means that a once linear, or apparently linear evolution [\[35\]](#), is now beset by new branches and new forms (such as sustainability labs, urban living labs, and smart cities). These branches and forms are being created at such a pace that the literature is struggling to define them [\[39\]](#), or adequately develop theories to help amortize their existence [\[110\]](#).

- Living Labs and Sustainable Development

In this SLR, living labs (and derivatives) are the partnership structure that is being used successfully to drive social and economic development [\[37\]\[111\]](#). It is also the structure that is used in the limited number of studies that are using innovation to drive the delivery of sustainable development [\[19\]\[83\]\[103\]\[49\]\[75\]\[91\]\[93\]\[99\]\[112\]\[113\]\[114\]\[115\]\[116\]\[117\]](#), with the emphasis on both sustainability labs and urban living labs. The literature does not provide guidance for the reasons for this. In a time when the Sustainable Development Goals have been unanimously agreed by the United Nations, it is noteworthy that the literature around developing partnerships for innovation is largely silent on the implications for innovation (an issue also noted by others [\[83\]](#)).

2.2. Attributional Data

Outlined in **Table 2**, and as defined by Massey (2011), but amended here to meet the needs of an SLR, attributional data relate to comments and discussion about a priori hypotheses or theories that the evaluator brings to the discussion. The data collected are the result of author expertise and assessment, as, in most cases, the theory that underpinned each study went unstated in the study.

Table 2. Categorization and paper breakdown of theories underpinning SLR.

Theme	Theory	Sub-Theory
Economic development [1][8][10][31][53]		Open innovation theory [3][86][122][123][33][37][39][42][44][78][82][97][102][110][124][125][126][127]
Economic geography [52][75]		Innovation management theory [81][98][117]
	Innovation theory [7][11][15][45][23][27][28][35][37][38][46][55][69][73][94][108][118][119][120][121]	User innovation theory [128][129]
		Collaborative knowledge production [92][102]
		Service or product dominant [22][41][48][50]
		Frugal innovation [118]
		Knowledge transfer theory [26]
	Growth theory [76][59][84]	Knowledge spill-over theory of entrepreneurship [58]
		Development economics [130]
	Regional development [28][43][60][71][72][90][93][104][105][131]	Agglomeration economics [29][132]
	Management theory [4][133][24][56]	Business design concepts [134]

Theme	Theory	Sub-Theory
		Business excellence/total quality management [88]
		Construction management [135]
		Corporate real estate management theory [51]
		New public management theory [63]
	Socio-institutional economics [104]	
	New institutionalism [68]	
	Neo-institutional economics [100]	
	Network theories [32] [86] [77] [96] [136] [137]	Business network theory [84]
	Self-organizing systems [47]	Actor network theory [138]
Systems Theory [11] [70] [139] [140]	Socio technical Systems [49] [91]	
	Process-based engineering [76]	
	Transition theory [141] [67] [71] [101]	Urban sustainability transition [80] [106]
Planning [109] [110]		Transitions theory (sustainability) [142] [75] [92] [101] [114] [116]
		Transition management [91]
		Value of sustainable development [103] [114] [116]
	Design theory [87]	Academic capitalism [47] [139]
	Social practice theory [36] [87] [93]	
	Social capital theory [103] [23]	
Social theories	Social network analysis [9] [57] [61] [64] [65] [66]	
	Social entrepreneurship [85]	
	Social institutionalism [25]	
Theories of learning	Interorganizational learning [62] [26]	

Theme	Theory	Sub-Theory
	Experiential learning [30] [112]	e theories ent, social
	Informed learning [109]	
	Social learning [79]	apers and
	Audit-based learning [34]	ining and
	Absorptive capacity [143] [54]	

Aligned with economic development is a suite of papers dealing with social theories. This encapsulates both how society develops, but also how individuals interact with partnerships. To some degree, this is the practical element in the development of the papers, as it focuses the papers on the theory of how individuals in society interact with innovation.

The final theoretical category is around theories of learning. This is a shallower vein of research that links through to economic development and social theories but can be divided into two theoretical strands. One is how, particularly, (though not exclusively) universities can use innovation to help deliver learning to their students. The other strand relates to continuous improvement and considers how organizations (individually and collectively) can retain and improve upon their learning by doing.

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