THE EVOLUTION OF TRANSNATIONAL KNOWLEDGE NETWORKS OF CITIES: OUTLINING A FUTURE RESEARCH AGENDA

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Warsaw 2023
The Evolution of Transnational Knowledge Networks of Cities: Outlining a Future Research Agenda

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\textbf{Abstract}: The recent growth of transnational networks of cities requires a better understanding of their role as knowledge networks. For some actors, this growth has resulted in arbitrary or top-down decisions on network membership followed by low commitment and inefficient use of time and financial resources. By reinterpreting secondary data, this paper argues that not only the nature of their institutional settings and actors’ composition but also some specific qualities and the nature of collaborative mechanisms shape the networks’ overall systemic nature. Based on the network perspective the paper advances our understanding of transnational knowledge networks’ growth and the maximising of their effectiveness. Using exemplars, it develops a research agenda for the evolution of transnational networks of regions.

\textbf{Keywords}: Transnational knowledge networks, interregional knowledge transfer, regional innovation systems, city networks

\textbf{JEL codes}: P25, P48

\textbf{Acknowledgements}: This work was supported by the National Science Centre Poland (Narodowe Centrum Nauki) [grant number UMO-2019/35/B/HS5/04010].
Introduction

Collaboration among regions, cities and devolved nations has grown in the last 50 years in scale, scope, ambition complexity with an international reach (Weidenfeld et al., 2021; Guan et al., 2015). It addresses a wide range of policy dimensions such as science, innovation, land use, transport, housing, healthcare, economic development, sustainability, social inclusion, brand identity and investment-readiness (Moonen et al, 2020) and receives support from public and private actors and Non-Governmental Organisations (NGOs) (Acuto and Leffel, 2021; Nielsen and Papin, 2021).

Given the challenges of leadership and institutional capacity at the municipal level and the growing need to address societal challenges such as public health, climate crisis, digital transformation and global crises, such interregional collaborative mechanisms have emerged (Moonen et al., 2020). Cities in particular are facing an unprecedented crisis particularly due to the increasing interrelated impacts of climate change, social inequalities and environmental degradation that require innovative approaches and more effective tools (Galderisi et al., 2020). Evidently, transnational networks of cities are the most prominent than those of other sub-national governments (Canals, 2019) with the majority of the medium-sized metro regions in upper-income nations engaging in such international collaboration in both Global and North and South (Davidson et al, 2019; Moonen et al., 2020).

There is a considerable focus on studying knowledge transfer and its dynamics, which contributes to an understanding of city networks’ political economies and policy response to their key imperatives, that serve wide collective and public (Davidson et al, 2019). The focus on embeddedness and the positioning of networks of regional groups of actors from different regions, defined as Knowledge Networks of Regions (KNoRs) is growing (Weidenfeld et al., 2021). One type of such network is the transnational network of distant regions, and its prominent sub-type of Transnational Knowledge Networks of Cities (TKNoCs) as globe-spanning learning network nodes (Kitzmann et al, 2022), characterised by their governance and political agendas (Acuto and Leffèl, 2021; Agustí Fernández de Losada, 2019; Nielsen and Papin, 2021).

The decision on which KNoRs to join is essential given network duplication, budget and time constrains. However, the dearth of knowledge on KNoRs and the absence of well-defined aims and objectives along with being supply-side or personality driven leaves networks without a clear agenda and shared vision resulting in decisions that are ad hoc or dictated by national governments. The outcome is often low member commitment with the consequent losses of time and financial resources- both for less committed members themselves but also
for those members whose efforts may be undermined by free riders. Advancing our understanding of such networks may help regions prioritise network selection by considering their nature including objectives, operating models, resources, added value, barriers, and tools that build a genuine learning and innovation process (Moonen et al., 2020).

The main challenge is in understanding the innovation potential in network participation, which depends on the relative opportunity costs and the future value proposition when participation decisions are made. This is particularly useful for ‘levelling up’ disadvantaged regions’ participation, which requires these networks to be mapped and understood (Morgan and Marques, 2019). However, studies of their systemic nature from an evolutionary perspective remain scarce. More recently, a conceptual framework including the network-system continuum aimed at classifying different types of knowledge exchange mechanisms has been suggested with KNoRs at the network edge and a system at the other (Weidenfeld et al, 2021). This paper will theoretically discuss these overlooked aspects, explore and compare (with exemplars) the components and systemic nature of TKNoCs. There has been little attention towards the institutional dimension of city networks defined as formalised organisations with cities as their main members characterised by established and reciprocal communication, policy-making and exchange patterns (Acuto et al., 2017). We begin with justifying the rationale for interregional knowledge exchange and explaining the need for their mechanisms including networks and systems followed by the concept of TKNoCs and the analysis of 8 exemplars. The discussion and concluding sections develop this analysis in order to suggest a future research agenda of developmental trajectories, potential policy implications and understudied aspects and their transnational dimensions.

**Interregional knowledge exchange mechanisms**

Networks and systems are the main mechanisms of interregional knowledge exchange and innovation and the network perspective emphasises the role of relations and structures in determining the behaviour of actors (Stuck et al., 2016). *Knowledge networks* are ‘pipelines’ for exchanging the dispersed information and knowledge of individuals and groups of actors (Bathelt et al., 2004) (Owen-Smith and Powell, 2004). They include weak and strong ties, cutting across departmental and organisational boundaries and ranging from local to global with cognitive and social similarities being important factors influencing their formation, rather than mere geographical proximity (Benneworth et al., 2014). They derive from informal ties between individuals, or those formally defined as contracts or strategic alliances (Owen-Smith and Powell, 2004; Wanzenböck et al., 2014; Sun, 2016).
Interregional knowledge exchange includes both transfers and spillovers of knowledge taking place through various mechanisms such as co-patenting, co-publications, formal and informal networking, trade, labour mobility and interaction of employees in social, civic, and professional organisations. They tend to be less spontaneous, require more effort and focus on a few selected issues or sectors and are effective particularly for less-advanced regions suffering from distance decay and other low levels of proximity e.g. cognitive, technological and cultural (Weidenfeld et al, 2021).

In general, such sets of complementary institutions, interactions and feedback mechanisms are considered superior mechanisms for innovation and problem-solving than purely network-based arrangements (Asheim et al., 2011; Cooke et al., 1997). KNoRs include regions as collective territorial entities which exchange knowledge among members and between them and other KNoRs (e.g. policy learning, training, running seminars) as well as connecting with non-member regions. To be defined as Inter-regional knowledge exchange Systems, they must constitute an array of organisations and their relationships (Roper et al., 2006) as well as three systemic qualities (Weidenfeld et al, 2021).

**Inter-Regional Knowledge Exchange Systems**

Regions innovate together through a wide range of formal and informal strategic alliances, peer groups and platforms (Moonen et al., 2020). The institutional set-up i.e. routines, rules, norms, and laws is a necessary dimension that defines relationships in Innovation Systems (ISs) (Lundvall, 1992). The institutional approach of North (1990) includes both formal and informal institutions, which are of equal important to development and function of ISs. Formal institutions include bridging organisations and their regulatory regimes which consequently define the ‘rules of the game’ for agents in a top-down and explicit manner. Conversely, informal institutions emerge bottom-up from interactions between relevant actors characterised as norms and ‘ways of doing things’ (Borrás, 2004). In this way, organisational networks give rise to informal institutions, which thereafter become inherent in the operation of future formal institutions. Therefore, organisations or strategic alliances can function as formal institutions. Any knowledge network of organisations (possibly also individual actors) with both formal and informal institutions as well as considerable levels of systemic qualities including coherence, unified function, and boundedness (discussed below) can be defined as system (Edquist, 2004a).
A unified function
This criterion involves identifiable aims to which all elements of the system contribute (Rakas and Hain, 2019). Unified function (UF) refers to identified themes, specific priorities (as in smart specialisation for example) and/or the innovative activities of specific sectors, addressing common challenges or opportunities, which require pioneering solutions. These actions include generating new knowledge, building competences, skills and training, and may thus maintain and indeed enhance the qualities mentioned above (Edquist, 2006a; Edquist, 2004).

Coherence
A system’s level of coherence is constituted by the degree to which its elements are consistently articulated and form a meaningful constellation that implies functionality. This is shaped by the beliefs and values behind attitudes and social interaction, which determine and characterise the way innovation processes take place (Borrás, 2004). As outlined by Roper et al (2006), coherence is characterised by ISs with ‘inward orientation’ such as complementary skills, knowledge bases and competences amongst their actors, the existence of feedback loops and shared developmental trajectories. Conversely, low coherence means loosely connected or isolated elements that are unlikely to produce meaningful collective outputs (Rakas and Hain, 2019).

Boundedness
Boundedness refers mostly to the spatial dimension i.e. internal cohesion and cultural embeddedness (Doloreux and Parto, 2005) delineating the system itself and the ‘rest of the world’. However, sectoral boundedness is also considered to be delimited by specific generic technologies and product areas (Edquist, 2006b). In practice, boundedness depends on the purpose of the systems analysis (Edquist, 2004a) such as administrative boundaries and regional functionality. Functionality i.e. frequency or intensity of economic interactions (Andersson and Karlsson, 2004) including indirect and direct interactions between stakeholders such as localised mobility of skilled workers as knowledge carriers and a minimum proportion of innovation related collaborations within certain regional boundaries (Edquist, 2006). Boundedness also considers high levels of coherence as an indicator measured in terms of localised learning spillovers among actors (Andersson and Karlsson, 2004). Thus, a sufficient scope for interaction and coherence as well as UF to enhance collective external economies can determine regional systemic boundaries (Asheim et al., 2011). The greater the geographical and industrial scope in terms of membership exclusiveness is, the higher the boundedness because it means KNoRs include regions that are often globally near e.g. a network of European regions with more sectoral commonality, shared foci and challenges compared to global KNoRs from
distant locations with little membership exclusiveness. The spatial distribution of knowledge activities and dissemination within member regions refers to the extent to which network activities are spatially distributed within each member’s boundaries. For example, a conditional threshold level of (un)even spatial distribution of activities within each members’ boundaries can be imposed on each member region. Additional parameters may include measures taken to localise activities in each member region. Accordingly KNoRs’ levels of boundedness may be determined by the sum of those in each member; the more there is evidence of even spatial distribution of innovation and learning activities within each member’s boundaries, the higher the network’s boundedness. KNoRs can be defined as systems (or characterised by systemic qualities) if two underlying conditions exist; first they include at least one regional network from each of its member regions (or a regional representative actor) and a set of both formal and informal institutions. Second, they provide a long-term, coherent and functional mechanism with a clear spatial boundedness and shared aims for its members i.e. the non-binding quality criteria of coherence, UF and boundedness. These three qualities individually and in combination, do not necessarily imply the existence (or not) of a system but rather a continuum ranging from no systemic properties i.e. a network on the one hand to fully a functioning system on the other. (Weidenfeld et al, 2021).

Transnational Interregional knowledge networks

Transnational networks are considered the most effective channel for promoting political interests, allowing a critical mass needed to acquire international legitimacy, visibility, strength and influence in the international arena (Losada, 2019). They also function as interregional networks for exchanging experiences, transferring knowledge and boosting shared projects, therefore defined as Transnational interregional knowledge networks e.g. European networks for facilitating knowledge transfer and mutual learning and promoting transnational projects. Their raison d'etre is the coordination that cannot be achieved by the market-based solutions that are often mistakenly assumed to emerge by default once state actors ‘move out of the way’ (Morgan and Marques, 2019).

The early exploratory innovation stages are more common in transnational networks with often-incremental innovations in projects addressing societal challenges, that depend on institutional competences, arrangements, and the devolution of power as well as on know-how that needs to be addressed when promoting innovation (Acuto and Leffel, 2020). Their structure and the underlying qualities, which define their systemic nature are explained in the next section.
The evolutionary perspective of KNoRs

Networks of individuals are often characterised by informal institutions and those of organisations (e.g. networks of universities, commercial associations) by formal. It is assumed that both types generate the other over time and become inextricable to the operation of the other (Weidenfeld et al, 2021). Networks with either types at least initially follow pre-determined rules and regulations set up by their founders whether by an official funder or a group of individual actors. If they remain informal with little or no formal institutions, they cannot be perceived as systems. However, it is also assumed that most networks are dynamic; those emerging out of formal institutions tend to generate informal ones as their members create some unwritten rules and regulations that are convenient and acceptable by all. Those that are originally based on informal institutions may create bottom-up formal ones to regulate and manage behaviours and norms among members. This in turn implies that both formal and informal institutions may instigate network activities that generate the other depending on the actors involved throughout the evolutionary process. Those with informal institutions but few or no formal ones are unlikely to be systemic and fall on the network edge of the continuum. If both emerge with high levels of the abovementioned systemic qualities, KNoRs can be defined as systemic or as IRKENs i.e. as systems. The presence of formal and informal institutions may support the presence of systemic qualities, that determine locations on the continuum ranging from no systemic properties on the one hand to fully functioning system on the other i.e. a ‘full’ IRKENs (Weidenfeld et al, 2021). Another overlooked determinant is mission-led orientation, as explored below.

Mission led oriented regional innovation systems

Recent years have seen increased debate of ‘mission-driven’ approaches to address the grand societal challenges of our age (poverty, climate change, etc) (Mazzucato, 2021). Accordingly, the presence of mission-led approaches to innovation is a clear indicator of a UF, whose levels can be gauged by examining specific projects within the mission- i.e. their consistency with stated overarching objectives. However, not all apparent missions are equal in terms of engendering UF (Kay, 2021); indeed, the so-called ‘war on cancer’ envisaged by President Nixon and explicitly modelled on the Apollo programme, failed because the underlying science of cell mutation was not sufficiently understood and the goal not a single one. Thus, the technological, societal, and economic effects addressed by innovation objectives for
accomplishing the mission need to be clearly articulated in order for the legitimacy of the mission to be maintained (Boon and Edler, 2018).

Mission-led orientation is also germane to coherence, which requires a wide range of actors who deal with failures and problems involved in realising multi-scalar coordination and provide feedback and learning (Morgan and Marques, 2019). A focus on a specific, achievable innovation mission in terms of related priorities and objectives may increase UF but not necessarily coherence because commitment to certain mission innovation objectives cannot ultimately overcome practical or technical problems, and the risk is that if there is too much system homogeneity challenging feedback is marginalized and alternative ideas ignored (Bahcall, 2019). Thus, coherence is a necessary condition for truly successful mission-led innovation endeavours, because it engenders horizontal transmission between distinct ‘domains’ required by a mission goal (e.g. energy, health, etc) (Boon and Edler 2018). It is therefore expected that KNoRs without flexible goal setting, pre-defined priorities and foci tend to change boundedness in order to draw in new members that may increase coherence, and this is pivotal in their evolution.

**Evolution of KNoRs into systems and mission-led orientation**

It is assumed that some KNoRs, particularly mission-led, strive to increase their systemic qualities to maximise impact efficiency to achieve their mission. Accordingly, organisations, institutes, regions and any other members or network partners tend to join and/or are invited to join KNoRs based on their relevance and contribution to the systemic qualities throughout their evolution. Therefore, innovation mission orientation is pivotal in shaping the evolutionary trajectory of KNoRs in terms of their systemic qualities and their interrelationships, as further explored below.

*Unified Function*

The mission-led innovation approach constitutes UF that may change over time. The more networks’ innovation objectives address the mission the higher the UF. Networks may be focused on one or more defined innovation objectives that address a mission from their incipient stage, which may or may not change along their evolutionary paths. When a network is well defined by its funder and/or founder its UF is initially high and its objectives address a wider regional mission. The way funders and/or founders initially define the network objectives and govern it over time determines changes in its UF and the extent to which networks remain in line with the mission. If they are consistent and exclusive, UF will remain high but the more power is devolved to members to modify them the more it fluctuates. Thus, innovation mission
focus indicates high levels of UF and vice versa. When objectives are open for interpretation and change, UF may be initially low and fluctuate over time while being modified, negotiated and re-negotiated. Low UF may also increase and remain high if members adhere to each objective or if funding regimes change or become more exclusive in terms of scope or location. If regions do not share the same mission and UF remains low, coherence is unlikely to grow because collaboration between regions with differing missions is unlikely to emerge. However, when the motivation to maintain or increase levels of UF and coherence prevails, boundedness is an important factor in shaping the evolution of networks into systems. The role of geographical and/or sectoral boundedness can be explained through the following potential trajectorial scenarios (Figure 1). The above is linked to the discussion and exemplars of TKNoCs.
Unified Function

Scenario III: High UF and low coherence

- efficiency declines as do systemic levels.
- focus on increasing coherence by potentially relaxing their membership exclusivity and therefore their boundedness.

Scenario IV: Low UF and coherence

- bottom-up mechanisms may be established in each member region and/or by other partners resulting in a wide range of priorities leading to stable unified function, and boundedness remaining low or increase over time.

Scenario I: High UF and coherence

- Coherence remains high because innovation missions addressing the pre-determined objectives require specific complementary skillsets and similar perceptions (i.e. cognitive similarity). Thus, boundedness (high or low) is unlikely to change as long as coherence remains high.

Scenario II: Low UF and high coherence

- This scenario is unlikely as regions’ foci would be too different and independent of one another.

Figure 1. The role of boundedness in potential trajectorial scenarios of knowledge networks of regions
Transnational Knowledge Networks of Cities

TKNoCs range from fewer than 10 to more than 150 cities from two or more countries, offering project design and/or, implementing governance tools and acting as knowledge brokers, information sharing platforms and providing technical expertise. They are characterised by voluntary membership, horizontal relations, and autonomous, polycentric and voluntary institutional arrangements based on principles of self-governance and self-execution. The hybrid governance in more recent, mostly environmental, networks is becoming more exclusive, influenced and often dominated by private actors employing enforcement mechanisms and following formal and informal instruments to achieve their goals (Nielsen and Papin, 2021).

Knowledge networks of city members with established interactions are TKNoCs if their objectives and activities are related to knowledge exchange, learning activities, innovation, etc. (Acuto et al., 2017; Weidenfeld et al, 2021). An empirical investigation of case-studies employing primary sources is beyond our scope, being a task for future research. Thus an initial agenda-setting investigation of policy and strategy documents and related information from the TKNoC’s homepages is presented, complemented by third-party reports and evaluations- Moonen and al (2020) and additional academic literature. This allows ‘snapshots’ across networks in different geographic contexts with a representative international comparison (Acuto et al., 2017).

Exemplars of eight active TKNoCs from around the world were selected based on available sufficient data on their structure, scope, institutions, systemic nature and qualities, for assessing their hypothesised locations on Weidenfeld et al’s (2021) aforementioned network-system continuum. Five established transnational networks of cities (> 5 years) with identifiable evidence of their evolution (dynamic or stable) and three ‘young’ networks (< 5 years), which inherently presented little evolutionary evidence albeit with potential for investigation, were reviewed. Each exemplar’s network complexity and breadth across different sectors was examined while integrating between theoretical thinking and practice-based accounts (Acuto et al., 2017). A checklist was generated from the literature relating to relevant terms, processes, actors, and systemic network criteria, and how these might be manifested in real world examples. This served as a frame of reference for the assigned reviewing author, before moderation by the second, ensuring consistent interpretation indicating each TKNoRs’ systemic levels and its hypothesized continuum location. For example, exclusive membership (geographical and/or industrial scope) indicates high levels of
boundedness. When partial evidence was found, medium levels were assumed, and when counter evidence (such as open to all membership), low levels were identified. In cases of no evidence either way, low levels as the default were assumed, as was the existence of formal and informal institutions in each TKNoC as they are run by a formal organization/alliance with inevitable informal routines/norms. However, with strong evidence or counter evidence, positive or negative deviation from this position was determined.

**Knowledge mechanisms and systemic qualities of TKNoCs**

Transnational networks’ collaboration can be classified into three non-dichotomous mechanisms; managed networks of members, peer-to-peer (P-to-P) partnerships and expertise and solutions platforms. The first is aimed at running exclusive membership and sets up its institutions. The second is about strategic collaborations with more opportunist projects or trade collaborations and the third concerns knowledge platforms established by intergovernmental institutions or cities for sharing know-how and business-led platforms. These include discussions, mutual visits, sharing data on best practice, policy innovations in land use, transport, housing, economic development, systemic (institutional) innovation and/or improving relationships and coordination between actors (partnerships innovation) (Moonen et al, 2020).

The TKNoCs examined were founded by public organisations e.g. member regions, national governments, and private funds. They were publicly funded e.g. the EU, the members themselves and by private sources (foundations e.g. Bloomberg and Rockefeller) and run as ‘managed’ or ‘P-to-P’ networks. Science, technology, innovation and sustainability agendas particularly climate change dominate their scope. The exemplars show compelling evidence that managed networks have significant formal and informal institutions as well as higher systemic qualities compared are more prominent than P-to-P solution platforms. Consistent with Weidenfeld et al (2021), most exemplars have some formal and/or informal institutions. Five of them have both, of which four are assessed as having high to medium levels of systemic qualities, and are mostly run as managed networks. Only three TKNoCs have high levels of UF and therefore are described as mission-led, and most of those with high levels of one criterion have medium and/or high levels in the other two. The findings confirm the KNoRs develop systemic qualities and fall towards the system edge of the continuum.
<table>
<thead>
<tr>
<th>Multinational Knowledge Network of Cities, Birth Year &amp; Sources*</th>
<th>Scope* &amp; Main mechanism</th>
<th>Members &amp; Partners</th>
<th>Founder/ Funding (if different)</th>
<th>Institutions</th>
<th>Unified Function</th>
<th>Coherence</th>
<th>Boundedness</th>
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<tr>
<td><strong>1</strong> Districts of Creativity Network-2004</td>
<td>Science, Technology &amp; Innovation P-to-P*</td>
<td>Triple Helix 13 metropolitan regions, other regions and devolved nations, state governments, government organisations, research institutions and other intermediaries</td>
<td>NGO of the Flemish government/ members regions for marketing and communication purposes and to coordinate the network (Public)</td>
<td>NE**</td>
<td>Low 1. Cross disciplinary innovation 2. empowering members to choose themes, foci and approaches</td>
<td>NE</td>
<td>NE</td>
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<tr>
<td><strong>2</strong> Global Resilient Cities Network 2013</td>
<td>Climate change, sustainability and related areas/ Managed Network (MN)</td>
<td>Diverse: public, private NGOs 98 major and mid-size cities and partners: NGOs and banks</td>
<td>Rockefeller Foundation (Private)</td>
<td>Formal to Informal - since 2019 less funding and interference from the funder</td>
<td>High</td>
<td>Low Some openness to engaging with external partners</td>
<td>Medium</td>
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https://resilientcitiesnetwork.org/

(Berkowitz and Kramer, 2018; Davidson et al, 2019; Nielsen and Papin, 2021)

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<th>C40 2005</th>
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<td>(Smeds, 2019, Moonen et al, 2020; Nielsen and Papin, 2021)</td>
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<td></td>
<td>Climate change, sustainability &amp; related areas/MN</td>
<td>Diverse: 96 cities, private companies &amp; NGOs</td>
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<td>Bloomberg Philanthropies, NGOs / Bloomberg, Realdania and the Children’s Investment Fund Foundation (private)</td>
<td>Formal to Informal-</td>
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<td>1. Formal- Demands placed on rigour membership</td>
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<td>2. Formal to informal: 2.1 Good Practice Guides create a set of ‘normative and</td>
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<td>High</td>
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<td>Coordination and knowledge-flow equilibrium that helps cities establish new policy norms</td>
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<td>High (has increased)</td>
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<td>High gradually becoming more regionalised by dedicated regional directors</td>
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<td>International Urban Cooperation – EU (2016, 2021)</td>
<td>Urban affairs &amp; Cross sector/ P-to-P</td>
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<th>Barcelona / Catalonia Innovation for influence and soft power (1996, 2008)</th>
<th>Innovation and science/ Varied collaboration types</th>
<th>Diverse; neighbouring regions, US states, developing and Latin American countries</th>
<th>Catalonia regional government / Barcelona city government (public)</th>
<th>Formal: Driven by Catalonia’s Secretariat for Foreign and European Affairs. Informal: Stated focus on ‘soft</th>
<th>Low (but increasing)</th>
<th>Medium Prioritises collaboration with similar interests, cultural relatedness and previous</th>
<th>Low Transnational</th>
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1 The webpage of ACCIO specifically – there is no single dedicated web presence for the wider network
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<th>Partnership for Healthy Cities 2017</th>
<th>Health &amp; MN</th>
<th>Diverse: Public and NGO</th>
<th>Former mayor of New York/Bloomberg Philanthropies (Private)</th>
<th>High predefined priorities</th>
<th>Unknown or low</th>
<th>High sectoral and medium geographical</th>
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<td>High predefined priorities</td>
<td>Unknown or low</td>
<td>High sectoral and medium geographical</td>
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<td>7</td>
<td>Expertise and solution platform &amp; Science, technology and innovation</td>
<td>Triple Helix</td>
<td>Mastercard (Private)</td>
<td>NE</td>
<td>Low</td>
<td>Multiple urban foci and no annual agenda</td>
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<td>8</td>
<td>Science Innovation &amp; Technology Managed</td>
<td>Diverse: Capital and smaller cities</td>
<td>Singapore government/external partners: World Bank, Asian Development Bank and Global</td>
<td>Little of both: Few formal and encouraging the evolution of informal ones via Low 1. multiple foci 2. Bottom-up approach-high flexibility</td>
<td>Low (but growing) 1. various competencies 2. Seeking missing</td>
<td>Low</td>
<td>Rapid global expansion</td>
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**Partnership for Healthy Cities 2017**

https://partnershipforhealthycities.bloomberg.org/

**Mastercard City Possible 2018**

https://citypossible.com/

**ASEAN Smart Cities Network 2018**

https://asean.org/our-communities/a
| **sean-smart-cities-network/** | Infrastructure Hub (NGO) | dialogue and flexibility | expertise with external partners 3. synergies between development efforts and coordination | external partners worldwide |

Source: Own elaboration, derived from Moonen et al (2020) augmented with additional sources as appropriate.

*P-to-P- Peer to peer

**NE- No Evidence
The Evolution of TKNoCs

This section explores the evolution of the five exemplars of ‘older’ TKNoRs with a 10 year or more history, which is depicted by stasis or dynamic change in their components and systemic qualities illustrated in Figure 2. In the light of these, it then briefly outlines three younger networks (numbers 6-8), for which available data is less comprehensive.

Districts of Creativity Network (1)

This TKNoC was initially (2004) a political network that transformed into a more content-driven and technical undertaking. Its P-to-P mechanism advocates cross-disciplinary innovation as a route to a more sustainable economic model for altering norms and improving confidence for unlocking entrepreneurship. Its diversity is reflected in its geographic and industrial scope, and members’ size, that include regions, states and devolved nations. These are represented by different organisations, institutes and/or intermediaries. Its evolutionary trajectory is static as UF is low with no real evidence of coherence and boundedness. Its bottom-up approach empowers members to choose a wide range of themes, foci and approaches that allows high dynamics among its individual members, and an increasing range of stakeholders over time. Given its cross-disciplinary innovation focus on sustainable economy, shaped by its members, it is an example of a non-mission oriented TKNoC, which sits on the left edge of the continuum and can be associated with scenario II.

Global Resilient Cities Network (2)

Pioneered and funded by the Rockefeller Foundation, the mission-led network was founded in 2013 as a separate NGO to help cities face three major threats and challenges: growing urbanization, globalization, and climate change. The mission was defined as both delivering the Resilience Strategy and monitoring its implementation. Initially, a chief resilience officer in each city was appointed, which has been extended to empower practitioners in all existing member cities, liaising with private and NGO organisations and opening up to all types of cities (Galderisi et al, 2020). This TKNOC is an example of what Nielsen and Papin (2021) define as a new-generation of TMNs representing a hybrid governance structure reflecting a recent trend identified in similar climate mission-led KNoRs such as the Carbon Neutral Cities Alliance and Champion Mayors initiatives. Since its beginning it has been increasingly influenced by private actors and corporates, who funded and steered its activities as well as monitored membership with exclusion in cases of non-compliance. In line with our assumptions, this case demonstrates the need for fluid boundedness and increasing membership inclusiveness to engender high levels of coherence and a ‘glocalised’ approach by ensuring
activities take place in every city. Thus, this network is assumed to be situated in the middle of
the continuum 'moving' towards the KNoR edge and can be associated with scenario III.

*C40 (3)*

A mission-oriented systemic network of the world's largest cities covering 650 million people
and 25% of the global GDP with an extended scope of climate change policy responding to
perceived deficits (Davidson et al, 2019). It has always maintained considerable levels of
systemic qualities regardless of the number of its members, which began with 18 mayors of
large global cities in 2012. Formal and informal institutions are evident with the former creating
the latter e.g. guidelines helped to ‘softly’ govern the members and informal connections
embedded through formalizing links, through engaging them in existing mechanisms. Its
evolution is successful for creating one of the world’s most successful TKNoCs with a high
global profile and notable knowledge and innovation activities. Its boundedness is quite
exclusive in terms of allowing only major metropolitan cities join under certain performance
conditions, but has increased since regionalizing its capacity through undertaking a glocalised
approach whereby dedicated regional directors were appointed in each city. Since its inception
it has been increasingly influenced by private actors, such as foundations and run on a hybrid
governance model mixing public and private actors in its functioning. There is also indication
of increasing coherence by improving coordination and information flows among members and
sub-networks allowing a better understanding of member involvement and outcomes. Thus,
C40 has begun as a TKNoC with high levels of systemic qualities, which have been growing
even stronger and can be associated with scenario I.

*International Urban and Regional Cooperation (4)*

This TKNoC (2016) has fairly low UF and boundedness. The latter has decreased in 2020 by
changing its membership policy to inclusive, allowing any worldwide cities and regions (rather
than exclusively European) to join. This move has already been successful in generating some
coherence albeit difference in regions' size. Nonetheless, its systemic evolution is questionable
as two-city pairings, as the main mechanism, are sometimes hampered by major differences in
population, resources and executive capacities limiting opportunities for working together in
a sustained and mutually proactive way. Thus, this newly ‘boundlessness’ TKNoC with some
systemic value is located near the KNoR edge of the continuum and can be associated with
scenario II.

*Catalonia /Barcelona International network (5)*

A KNoR which had its beginnings in 1996 as Barcelona began to seek global leadership,
transforming itself from industrial to knowledge/technology city and autonomous capital in
conjunction with Catalonia Trade & Investment (ACCIO). Founded in its present form in 2008, ACCIO is driven by Catalonia’s Secretariat for Foreign and European Affairs, and presently has 40 Foreign Trade and Investment Offices. Although operating in parallel to ACCIO, the network is a distinct entity with a stated focus on ‘soft power’ primarily through science. It can thus be conceived as the means by which Catalonia undertakes ‘foreign affairs’ in the areas corresponding to its powers (Tavares, 2016). UF overall is low but increasing over time as less developed partners advance. There are two parallel functions – innovation as a source of soft power for Catalonia, governance and capacity building for technical projects to less-developed partners. Formal institutions are evident in the former purpose – i.e. Catalonia’s Secretariat for Foreign and European Affairs, with various Memoranda of Understanding and bilateral agreements in place. Collaborators with similar interests and economic relations are prioritized, e.g. culturally related regions in Latin America. Thus, boundedness is medium rather than low for being exclusive in terms of specifying South American regions albeit with some cultural and sectoral similarities. Coherence is medium with evidence of complementary skills and knowledge bases across network partners, but limited by the somewhat asymmetric functional set-up. This case is unique in that it operates as a foreign policy network for a sub national government that defines the UF and mission, and requires further insight regarding the non-Catalonian perspective on the functions and purpose of the network.

*The Partnership for Healthy Cities (6)*

This is a health mission-led TKNoC (sectoral boundedness) with well-defined related objectives and an increase in membership since 2019. It is open for any city worldwide and allows some flexibility in terms of choosing its preferred areas of intervention with some degree of regionalized approaches. It is an example of hybrid governance with strong involvement, funding and therefore control of private actors over a majority of member cities situated in less advanced economies. Given its similarity to C40 and Global Resilient Cities it is predicted to maintain or even increase its already high systemic levels. However, there is little evidence of coherence or attempts to increase it such as collaboration amongst skillsets and knowhow complementary among members. If such efforts are made, it is likely to move towards the ‘system’ edge rather than its current location as having high levels of systemic value.

*Master Card City Possible (7)*

This network with a platform mechanism represents the weakest one with very little evidence of institutions and systemic qualities leaving it on the ‘network’ edge of the continuum without any supporting evidence of change in the near future.
ASEAN Smart Cities Network (8)

A young KNoR with low boundedness and UF but considerable coherence with some evidence of using resources to increase its levels by inviting new actors and partners. As long as its UF and boundedness remain low with little evidence of both formal and informal institutions, its systemic value will remain near the ‘network’ edge of the continuum.

Levels of Systemic Qualities

Figure 2. Classifications of transnational knowledge networks of cities on the network-system continuum

Systemic components, qualities and network-system continuum

Institutions

Most TKNoCs have formal and informal institutions that guide their operation and those with little evidence of both (e.g. 1, 7) have low levels of systemic qualities. Formal institutions, for example, define TKNoC’s membership policy i.e. exclusiveness versus inclusiveness. Some follow pre-determined rules and regulations set up by their founders and/or funders. Some evidence of both types generating the other over time and becoming inextricable to the operation of the other was found. However, given that informal institutions consist of unwritten rules, informal regulations and cultural norms, which require direct empirical evidence from primary sources, this aspect has not been gauged directly from interviewees and necessitates further investigation of members directly.

Systemic Qualities

The exemplars show that unlike the assumption that KNoRs develop systemic potential (Weidenfeld et al, 2021), some of the TKNoCs make little or no effort to strengthen their low systemic qualities and develop considerable formal and informal institutions. This remains marginal to their operation and may be associated with understudied lack of motivation, resources and disincentives. Contrary, mission-led TKNoCs (e.g. exemplars 2, 3, 6) are considerably more systemic or invest resources in maintaining or strengthening their systemic qualities. Most of these are managed networks, funded and managed by the private sector compared to the low systemic ones which are publicly funded and run as P-to-P networks.
TKNoCs with high levels of systemic qualities particularly UF were more mission-oriented than the others in terms of addressing learning and knowledge objectives. However, in-depth analysis of their objectives, projects and consistency with their stated objectives and the technological, societal, and economic effects addressed by innovation objectives for accomplishing the stated mission is needed (Boon and Edler, 2018).

**Boundedness**

Boundedness is often compromised to engender increasing coherence throughout network evolution because it allows regions with complementary skillsets and capabilities needed for addressing the mission’s objectives to join (exemplars 2, 8). This can be explained by the fact that high levels of coherence indicate localised learning spillovers and tacit knowledge within specified boundaries (Andersson and Karlsson, 2004) and therefore increasing coherence contributes to boundedness. Boundedness in general and in transnational KNoRs in particular is more than the boundaries in which knowledge dissemination and learning take place. It refers to spatial distribution of such activities and the extent to which KNoRs empower local players to act on their behalf through local officers and allocated budgets. These have to be gauged when measuring boundedness while considering the relative impact of each. For example, empowering local officers may have equal importance to even distribution of knowledge dissemination and creating ‘glocalised’ KNoRs as a sub type of KNoRs.

Boundedness mostly refers to geographical scope but its understudied industrial scope may come at the expense of the other; for example, if the sectoral one is deemed more important, KNoRs may prefer compromising their boundedness if there are not enough potential members falling under its sectoral scope within existing boundaries (e.g. exemplars 5, 6). Boundedness is shaped over time by both internal/external factors such as funders’ and members’ motivation and global crises, which also affect KNoRs’ systemic nature. Such changes may be a-synchronous with actors’ involvement, which could lead to new actors joining while others leaving thereby modifying boundedness. Compromising boundedness is affected by founders’ and/or funders’ political and governance interests that are beyond the scope of this paper. Stable boundedness may be secured to prevent high turnover of members, which conversely risks collaborative continuity and institutional structures. Thus, maintaining high boundedness over time can benefit KNoRs when introducing new policies and objectives for addressing joint missions or when overcoming interregional diversity in their characteristics i.e. political, technological, innovation agenda, cultural, etc.
Unified Function and Coherence

Future studies need to examine whether and under which conditions UF could be compromised to strengthen coherence and shape boundedness, e.g. by tracking the future development of the ‘young’ networks’ exemplars. Understanding how the systemic qualities intersect and how their combination can be optimised to realise innovation policy more effectively is a potentially important contribution. Changes in KNoRs’ UF and innovation missions may result in some member regions dropping out while others join and thereby changing boundaries and boundedness. For example, if a UF focusing on high-tech shifts to low-tech industries over time, peripheral regions with such industries may join or even replace core ones.

It is an important insight that coherence in the pursuit of a UF requires resources to be committed for inter-organisational coordination (see also Morgan and Marques, 2019). Thus, the nature of the relationship between coordination of resource allocation and network success, the mechanisms and timings by which they are most effectively deployed, are issues further research would do well to explore.

Only three (exemplars 2, 3, 6) demonstrate highly systemic TKNoCs and only 2 and 3 a significant evolutionary trajectory (in our observed timeframe) towards the systemic end of the continuum. Possibly, several TKNoCs are ‘wrongly’ located on the continuum (and have remained so for quite some time) implying that a lack of motivation, skills or resources might play a role in overcoming the under-investigated barriers to optimum network alignment. Conversely, potentially these TKNoCs are actually in the ‘right’ position for addressing their initiated missions and set goals. It is likely that both possibilities are relevant, which should be addressed in future empirical case studies, particularly longitudinally a horizontally rather than via a single snapshot in time. More generally, a future research aim is to expand from positive to normative outcomes – i.e. not only observing what is happening in network development (and why), which should also include actors’ embeddedness and positioning such as ‘structural holes networks’ where a small number of actors act as knowledge hubs of subnetworks, while others maintain fewer and less important links (e.g. Liefner and Hennemann, 2011). It should also address questions of what actors and policy-makers should do in different scenarios for achieving the best outcomes. Some answers to these questions and the highlighting of potential fruitful cases and examples are provided below.

Homogeneity of KNoRs

Another overlooked dimension is the dichotomy of urban versus rural and core versus peripheral KNoRs, which may differ in their challenges, scope, systemic nature, political motives, interrelationships between qualities and the other examined aspects in this paper.
Comparison between networks of transnational worldwide regions and those from more regionally-specific networks e.g. the same continent (Acuto et al., 2017) in relative proximity is also needed e.g. the European Regions Research and Innovation Network may constitute a new sub typology of transnational knowledge networks of neighbouring regions versus distant ones. The members of KNoRs from the same ‘international neighbourhood’ are assumed to share more similar political, cognitive, cultural, natural, and geographical similarities and challenges than the globally distant networks. For example, KNoRs with worldwide member regions rather than those located in the same continent are less likely to share the same missions and challenges and their systemic qualities may be lower, which is important for forming Transnational KNoRs. Also, dimensions of proximity (spatial, cultural, cognitive) and interregional homogeneity may be higher among the neighbouring ones compared to that in more global KNoRs.

Mission-lead innovation versus policy for innovation

The subtle but important differences between innovation policy that is mission-led and aimed at achieving specific objectives, and policy for innovation, which is about setting the supporting governance infrastructure, are pivotal. Typically, innovation policies themselves are the focus, while policy for innovation remains neglected. Similarly fruitful is discerning between networks set up specifically to deliver a mission, and those seeking to adopt one post-hoc. In the latter, successful innovation missions require system transformations, supported by the state (or other actors) and being multifaceted beyond the spheres of science, technology and innovation. For example, the state or equivalent may act as facilitator, lead user, gatekeeper, moderator, observer, or guarantor (Borras and Edler, 2020). How these roles can be managed considering which modes of governance will facilitate coherence is an important future research topic. Finally, by definition, achievable missions are finite – at some point, they will succeed and thus end, and its delivering structures will either dissipate, or at least be partially repurposed, towards new goals.

Discussion and Implications

The paper contributes to our knowledge on optimising approaches for shaping the growth of transnational networks, and maximising their effectiveness. It employs secondary data on the structure, scope actor composition, membership exclusiveness, funders’ motivation and involvement in the operationalisation of the Knowledge Networks of Regions (KNoRs) (Nielsen and Papin, 2021) and systemic qualities of 8 exemplars of Transnational Knowledge
Networks of Cities (TKNoCs). It also suggests a future agenda for studying the under-researched internal and external factors which shape the operation and evolution of KNoRs in general and transnational ones such as TKNoCs in particular. This includes the evolution of systemic and system-related components and qualities, the homogeneity of regions and driving forces such as mission innovation policy and policy for innovation, which are important to consider when forming and running new and existing KNoRs respectively.

This paper highlights priorities for future research on KNoRs in general and TKNoCs in particular regarding the mutual impact of the evolution of systemic qualities and respective institutions. Some of our evidence supports Weidenfeld et al.’s (2021) conceptual clarity for the terms networks and systems and the evolution of the former into the latter. However, boundedness and UF do not always remain high throughout their evolution into systems and the mission orientation dimension is inextricably linked to the components of KNoRs.

This paper has several caveats in analyzing secondary data of a limited number of TKNoCs rather than a primary data methodology, particularly for measuring and comparing systemic qualities and their overall impact. Additionally, it is problematic to untangle evidence of past events from assumptions made regarding future development. Future analysis of TKNoCs should include testing the impacts of specific changes by operationalizing the formulated assumptions we develop and present here.

References


