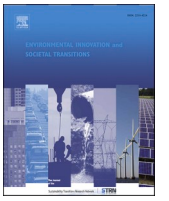
Environmental Innovation and Societal Transitions 49 (2023) 100787

Contents lists available at ScienceDirect

Environmental Innovation and Societal Transitions

journal homepage: www.elsevier.com/locate/eist



The Role of Global Actors in Sustainability Transitions – Tracing the Emergence of a Novel Infrastructure Paradigm in the Sanitation Sector

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ARTICLE INFO

Keywords:
Geography of Sustainability Transitions
Multi-Scalar Transitions
Distributed Agency
Socio-Technical Configuration Analysis
Citywide Inclusive Sanitation

ABSTRACT

The literature on sustainability transitions increasingly recognizes that sectoral structures transcending national boundaries can both hinder and promote sustainability transitions. Yet there is only limited evidence on the roles of global actors in transforming entrenched socio-technical structures directly at the global scale. To explore the mechanisms of agency at the global scale, we develop a conceptual framework and illustrate it with a case study of the World Bank's engagement in the sanitation sector. Based on a Socio-Technical Configuration Analysis of World Bank project documents combined with expert interviews, we demonstrate how a paradigm shift in the global sanitation sector was initiated by a coalition of global *advocates* and subsequently promoted by the World Bank in its role as an *amplifier*. The paper thus further conceptualizes and illustrates a multi-scalar transition trajectory that depends strongly on advocacy by global actors.

1. Introduction

Society is confronted with a multitude of global sustainability challenges, like poverty, inequality, demographic change, climate change or biodiversity loss (Johnson et al., 2017). Addressing these challenges requires radical transformations of socio-technical systems, i.e., the structures that fulfil societal functions such as energy, water, or food supply. However, in most sectors, well-aligned configurations of actors, institutions and technologies have become well established and globally legitimized, giving rise to strong path dependencies (Fuenfschilling and Truffer, 2014; Truffer and Coenen, 2012; Markard et al., 2012). Transitions literature conceptualizes these path dependent structures as socio-technical regimes and assesses how regime shifts come about through changes not only in technologies, but also in markets, user preferences, and institutions (Coenen et al., 2012; Geels and Turnheim, 2022).

Recently, scholars have started to investigate the geography of sustainability transitions (GeoST), focusing among other things on the multi-scalarity of transition processes and on how 'global regimes' (Fuenfschilling and Binz, 2018) shape sectoral path dependencies beyond national boundaries (Coenen et al., 2012; Coenen and Truffer, 2012; Truffer et al., 2015; Miörner and Binz, 2021; Miörner et al., 2022a). Scholars have argued that transition studies' conventional 'niche cumulation and upscaling' model represents a too narrow spatial understanding of transition processes, neglecting dynamics playing out in multi-scalar actor networks or directly at the global scale (Sengers and Raven, 2015; Loorbach et al., 2020; Miörner and Binz, 2021). They point to the important role that global

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https://doi.org/10.1016/j.eist.2023.100787
Received 14 October 2022; Received in revised form 20 October 2023; Accepted 6 November 2023
Available online 24 November 2023

actors play in institutionalizing alternative socio-technical configurations (or de-institutionalizing established ones) and developing new infrastructure paradigms (Miörner and Binz, 2021).

Although processes of (de-)institutionalization at the global scale hold significant potential for inducing sectoral transformations, we lack a thorough conceptual and empirical understanding of the roles of global actors in such processes. While transition studies has approached global actors primarily from a regime-perspective, focusing on their role in reproducing path dependencies (Kern and Markard, 2016; Fuenfschilling and Binz, 2018), more recent contributions have also investigated their role in local niche development (Hansen and Nygaard, 2013; Silver, 2017; Bhamidipati et al., 2019; Bauer and Fuenfschilling, 2019). Yet, only few empirical accounts illustrate how global actors can be directly involved in the transformation of regime structures in global arenas (Miörner and Binz, 2021; Kern et al., 2020). We thus lack conceptual and empirical accounts on how global actors may institutionalize novel socio-technical configurations directly at the global scale.

To address this gap in the literature, this paper focuses on actors who operate predominantly at supranational scales – e.g., multinational corporations (MNCs), international non-governmental organizations (INGOs), or international organizations (IOs) – and investigates their ability to shape global sectoral transformation processes. We draw on insights from transition studies, economic geography, organizational institutionalism and the literature on international organizations to develop a framework that further specifies the roles of global actors in multi-scalar sustainability transitions. We argue that in most transition trajectories, no single global actor has the capacity to depart from established socio-technical structures while at the same time possessing sufficient power and resources to institutionalize an alternative configuration from scratch (Hoogstraaten et al., 2020). Instead, our conceptual model outlines how global (de-)institutionalization processes are characterized by distributed agency among actors whose role is influenced by their social position in a given socio-technical system (Garud and Karnøe, 2003; Fuenfschilling and Binz, 2018; Battilana et al., 2009). To this end, we distinguish three actor roles, namely *advocates* who envision and frame novel socio-technical configurations, *amplifiers* who translate them into global sector standards, investment models or best practices, and *implementers* who realize change by turning the new paradigm and standards into material infrastructures.

We illustrate our conceptual model empirically with a case study of the World Bank's (WB) shifting engagement in the sanitation sector. The sector is known for being reluctant to embracing radical innovation and sticking to the same global 'gold standard' (extensive sewer networks and centralized treatment plants) despite huge investment needs and increasing environmental challenges (Baindur and Kamath, 2009; Schertenleib et al., 2021; Kiparsky et al., 2013). In the past, the WB has considerably contributed to spreading this regime configuration around the world. Yet, in the past five years, a new (potentially transformative) infrastructure paradigm labelled "Citywide Inclusive Sanitation" (CWIS) has emerged and is being publicly promoted by the WB (Gambrill et al., 2020; Schrecongost et al., 2020).

To explore the mechanisms of agency at the global scale that have led to the emergence and global diffusion of this new paradigm, we 1) validate the WB's recent strategy shift and 2) identify the mechanisms which induced it. To analyze the socio-technical configurations promoted by the WB in its water and sanitation projects between 2000 and 2021, we apply a mixed-methods approach consisting of a Socio-Technical Configuration Analysis (STCA) (see Miörner et al., 2022b; Heiberg et al., 2022) of 93 WB project documents combined with 14 semi-structured expert interviews. While the STCA identifies a clear structural shift in the socio-technical configurations promoted and financed by the WB, the expert interviews provide us with insights into the mechanisms of distributed agency that enabled this shift.

By developing a novel conceptual framework for analyzing the role of global actors in transitions and illustrating it empirically, we contribute to the literature on the geography of sustainability transitions in two important ways. First, we are among the first to illustrate under which conditions and how sustainability transitions can be initiated by actors operating predominantly at supranational scales. Second, by applying STCA to WB project documents, we further develop and improve the STCA methodology and demonstrate a new use case for this innovative approach to assessing socio-technical transitions.

The paper proceeds as follows: Section 2 reviews the relevant literature for developing our conceptual framework. Section 3 introduces data and methods, while section 4 presents the results of the empirical analysis of the WB's strategy shift in the sanitation sector. Section 5 discusses how agency in global institutionalization processes is distributed among actors assuming three different roles, and what this division implies for transition studies and policymaking concerned with understanding or supporting global sector transformations.

2. Conceptual Framework

Socio-technical regimes represent the deeply institutionalized, dominant formal and informal rules that have co-evolved with technologies over long periods of time and channel sectors into incremental development trajectories (Geels, 2019; Kemp et al., 1998; Markard and Truffer, 2008). Infrastructure sectors like electricity, transport, or urban water management, which are often the focus of transition studies, tend to be particularly prone to developing stable socio-technical configurations 'that work' (Kemp et al., 1998). Those regime configurations are taken for granted by many actors in the field, leading to a tendency to reproduce, maintain, and incrementally improve dominant socio-technical configurations (Fuenfschilling, 2019; Geels and Schot, 2007).

In transition studies, socio-technical regimes have long been regarded as a relatively homogenous structure evolving at the national scale (Hansen and Coenen, 2015; Fuenfschilling and Binz, 2018; Miörner and Binz, 2021). Recent contributions have challenged this assumption by highlighting the institutional and geographical complexity of transition dynamics (Coenen et al., 2012; Fuenfschilling and Truffer, 2014; Heiberg et al., 2022). First, scholars adopting insights from organizational institutionalism have re-conceptualized transitions as (de-)institutionalization processes (Fuenfschilling and Truffer, 2014; Fuenfschilling, 2019). Fuenfschilling (2019, p. 219) argues that *"transitions toward sustainability are ultimately about the destabilization or de-institutionalization of existing socio-technical*

configurations and the creation and diffusion, hence institutionalization, of new potentially more sustainable ones." This line of thinking has conceptualized socio-technical regimes as the most deeply institutionalized configuration in a socio-technical system held together by a guiding field logic (Fuenfschilling and Truffer, 2014; Heiberg et al., 2022).

Second, scholars working on GeoST have examined the multi-scalar actor networks and institutional rationalities that underpin particular socio-technical configurations (Fuenfschilling and Binz, 2018; Fuenfschilling and Truffer, 2014), conceptualizing socio-technical regimes as multi-scalar or even global constructs (Raven et al., 2012; Sengers and Raven, 2015; Fuenfschilling and Binz, 2018). A global regime constitutes the *"dominant institutional rationality in a socio-technical system, which depicts a structural pattern between actors, institutions and technologies that has reached validity beyond specific territorial contexts […]*" (Fuenfschilling and Binz, 2018, p. 739). Global regime rationalities diffuse through international networks, structures and processes (e.g., corporate networks, standardization systems and processes, global investment flows) and become influential in different places around the world (Fuenfschilling and Binz, 2018; Miörner and Binz, 2021). Consequently, in sectors with strong global regimes, different spatial contexts are subject to the same mimetic pressures, resulting in infrastructure solutions looking similar across countries, regions, and cities (Fuenfschilling and Binz, 2018).

Based on these considerations, scholars have addressed the multi-scalar nature of transition processes and the ways in which transformative innovation scales across and beyond territorially defined 'niche' contexts. Recent studies have shown that transition trajectories often not only transcend local/regional/national contexts, but also unfold at a global scale (Sengers and Raven, 2015; Binz and Truffer, 2017; Loorbach et al., 2020; Miörner and Binz, 2021). To enhance our understanding of the agency that enables sectoral transformation at supranational scales, we will introduce and further develop the notion of multi-scalar transition trajectories before developing a conceptual model for analyzing the role of global actors therein.

2.1. Multi-scalar Transition Trajectories

Miörner and Binz (2021) used the institutional lens on transitions to specify how transitions can follow different spatial and multi-scalar trajectories. In their framework, they distinguish between 'global' and 'territorially embedded' scales at which institutionalization processes take place and new socio-technical configurations emerge (Fig. 1). Since transitions are processes of (de-) institutionalization, different forms of institutional work (Lawrence and Suddaby, 2006) are critical to challenge local- and global regime structures. This includes formulating new rationalities and mobilizing support for their codification in formal rules, material structures, and practices. In addition to the process of (de-)institutionalization, the framework also considers the mechanism of *re-scaling*, which refers to how rationalities are translated into the regulatory, normative, and cultural-cognitive structures of another spatial scale through strategic agency.

Based on these two mechanisms (institutionalization and re-scaling), different transition trajectories for reconfiguring global regime structures can be defined. Traditionally, transition scholars refer to a 'niche cumulation and upscaling' trajectory as represented by the blue arrows in Fig. 1. It is (often implicitly) assumed that transformative innovations first develop in territorially embedded 'local/urban' niches (*bottom-left*), then gradually cumulate and scale up to challenge the 'national' regime (*bottom-right*) and only then start to transform 'global' sector structures (*top-right)* by diffusing across countries. However, this view has been increasingly challenged by research showing that niche innovations may travel and diffuse around the world without first transforming any territorially embedded regime, or that transitions may be initiated directly by global actors and only later influence specific 'local' niche experiments (Sengers and Raven, 2015; Wieczorek et al., 2015; Loorbach et al., 2020; Miörner and Binz, 2021).

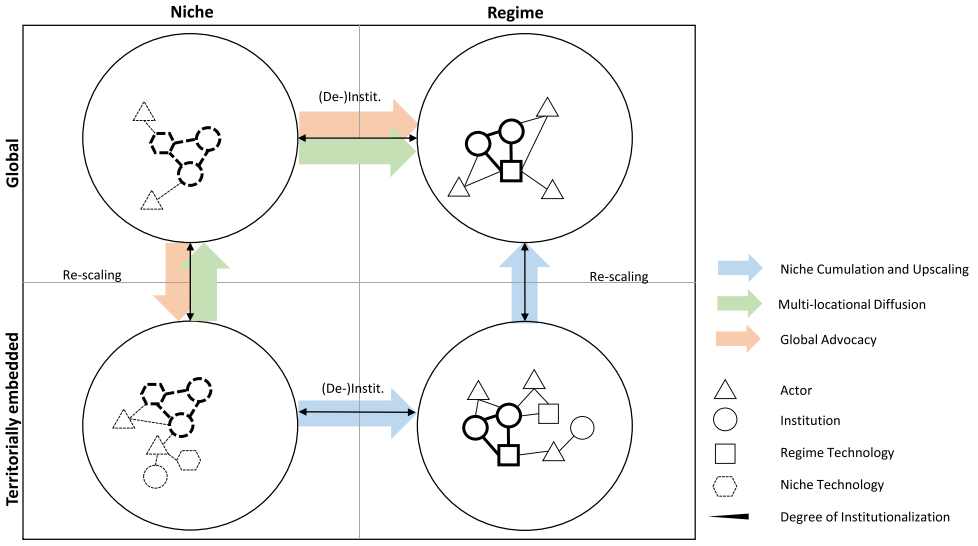

Figure 1. Multi-scalar Transition Trajectories. Source: own illustration based on Miörner and Binz (2021).

The framework points to (at least) two additional multi-scalar transition trajectories that have not received due attention in the literature, namely a 'multi-locational diffusion' and 'global advocacy' trajectory. In Fig. 1, the green arrows illustrate a multi-locational diffusion trajectory in which an alternative socio-technical configuration is developed in local niches and then directly re-scaled to a 'global niche' level (*top-left*) without first transforming any 'national' regime structures. In contrast, the orange arrows in Fig. 1 represent a 'global advocacy' trajectory in which an alternative socio-technical configuration is constructed by global actors and then institutionalized as a new global proto-regime (*top-right)* and re-scaled 'ex post' into diverse spatial contexts (*bottom-left*). The global advocacy trajectory is particularly noteworthy as it diffuses a new infrastructure paradigm that bears no relation to a socio-technical configuration that has previously proven to work "on the ground".

In a first illustration of this trajectory, Miörner and Binz (2021) investigated the activities of the philanthropic Bill and Melinda Gates Foundation (BMGF) and a consortium of global and national actors in the institutionalization of a new ISO standard for non-sewered sanitation. They could show that most of the rationalities reflected in the new global standard were constructed in a global actor network, which only loosely considered ongoing innovation dynamics in local niche contexts. Another example of a transition process following the global advocacy trajectory is the institutionalization of a 'smart city' rationale for urban planning, which was initially framed and pushed by a multinational company (IBM), and then quickly taken up by urban planners in cities around the world (Söderström et al., 2014; Carvalho, 2015; Hayat, 2016).

While these studies have illuminated some general mechanisms and patterns enabling global advocacy-based transition trajectories, we still lack a thorough understanding of the processes of distributed agency and institutional work that enable structural change in global regime structures. While it seems reasonable to identify actors that are able to 'write the scripts' for global regimes and cross-connect transition dynamics taking place in different places and at various scales (Kranke and Quitsch, 2021; Fuenfschilling and Binz, 2018), we will argue below that in most cases no single actor type is capable of doing so on its own. Rather, we follow the institutional entrepreneurship literature in proposing that agency is distributed between different actors taking up specific roles in global institutionalization processes (Garud and Karnøe, 2003), as their agency is constrained differently by their social position in a socio-technical system (Battilana et al., 2009).

2.2. Actor Roles in Multi-Scalar Transition Trajectories

The literature on institutional entrepreneurship (DiMaggio, 1988; Battilana et al., 2009) provides useful inroads for studying different types of actors, including individuals, organizations, governments, or civil society groups, how they engage in (de-)institutionalization processes and who is best positioned to do so (Fuenfschilling, 2019; Hoogstraaten et al., 2020; Hardy and Maguire, 2008). Yet, this literature has given limited attention to factors and conditions that enable actors to engage in agency at the global scale (Fuenfschilling and Binz, 2018). In the following subsections, we elaborate on the factors shaping institutional entrepreneurship and outline different actor roles in distinctly global institutionalization processes.

2.2.1. Social Position as an Enabling Factor in Institutionalization Processes

The literature on institutional entrepreneurship posits that the 'social position' of actors is an important prerequisite for agency (Battilana et al., 2009). Together with formal authority, the social position of an actor in terms of its status and network position affects its perception of a given field as well as its access to (im-)material resources (Ferguson et al., 2013; Fuenfschilling and Truffer, 2016; Fuenfschilling, 2019; Hoogstraaten et al., 2020), which in turn influences its ability to change relevant institutions (DiMaggio, 1988; Garud et al., 2002; Battilana et al., 2009). Arguably, this general argument also applies when drawing system boundaries at supra-national scales. In the following, we will thus focus on an actor's social and network position in global sector structures. In the present paper we, however, do not consider the effect of an actor's position in geographically core- versus peripheral contexts.

Core actors in a network typically have access to and control over resources and knowledge flows. Fuenfschilling (2019) argues that, on the one hand, high status and a central network position enable institutional entrepreneurship. On the other hand, however, central actors are most strongly embedded in the prevailing rationalities of the (global) regime, which limits their ability and will to deviate from the status quo (Hoogstraaten et al., 2020). In contrast, low-status actors in the periphery of a sector's social networks do not have much to lose when deviating from dominant rationalities and developing radically new ideas. At the same time, however, they are constrained by their unfavorable social position, resulting in a lack of resources and influence on the strategies of central actors (Hoogstraaten et al., 2020). In the remainder, we will label high-status central actors as 'implementers' and low-status peripheral actors as 'advocates'. Implementers typically lack the motivation to induce radical change, while advocates lack the resources and power to institutionalize a divergent rationality in global sector structures. Following Hoogstraaten et al. (2020), we therefore argue that a third actor role is needed in global regime transformations. We label this third role as mid-level 'amplifiers' that mediate and translate novel rationalities between advocates and implementers.

To illustrate the interplay of the three actor roles, we include insights from the literature on international relations (IR), particularly by utilizing work on the role of international organizations (IOs). This literature has examined in depth the role of supra- and transnational actors – from MNCs to INGOs – in international rule-making and standard setting (Risse, 2013). A variety of studies have shown how different characteristics and activities of global actors enable them to exert an authoritative influence that extends across the globe and into areas that were previously the exclusive domain of the state (Barnett and Finnemore, 2004; Risse, 2013). However, the IR and IO literature generally focuses on the conditions under which actors in international arenas transform/reform themselves as well as the impact they have on the international order and policies in specific countries, rather than on their specific capabilities and influence to (willingly and purposefully) transform *sectoral* structures. A key open question is thus how the broad variety of actors identified in IR/IO literature, ranging from formal, hierarchically organized entities (e.g., MNCs) and international NGOs, to loose,

non-hierarchical actors, such as advocacy networks, epistemic communities, transnational coalitions and social movements (Risse, 2013), play together in transforming global regime structures. To address this question we draw on constructivist accounts of transnational actors and international organizations (Barnett and Finnemore, 2004; Barnett and Finnemore, 1999; Béland and Orenstein, 2013).

In the next section, we will specify our conceptual model on how agency that is distributed across the three actor roles enables the transformation of entrenched global regime structures.

2.2.2. Actor Roles in Global Institutionalization Processes

Advocates. The role of advocates is to create novel visions, construct divergent socio-technical configurations and promote them through various forms of institutional entrepreneurship (Hardy and Maguire, 2017). Advocates are typically positioned in the periphery of a socio-technical system, standing somewhat apart from key incumbents, giving them freedom to develop radically novel ideas (Battilana et al., 2009). One will often find civil society organizations, academic institutes or INGOs taking on the role of advocates. Despite their lack of formal authority, and/or coercive power, some advocates may still possess high social prestige, considerable financial resources, and access to core experts in a field (see e.g. philanthropies such as BMGF in our empirical analysis). Advocates, who gain a certain level of status and resources without losing their outsider status in a sector, are accordingly in a very good position to mobilize allies, initiate new collaborations, and eventually establish their visions in international arenas. This in turn allows them to participate in elaborating and legitimizing novel field logics in a sector (Fuenfschilling and Binz, 2018; Miörner and Binz, 2021).

Nevertheless, advocates are unlikely to directly influence the strategy of the highest-status, core actors in a sector (implementers). But, as Battilana et al. (2009) note, they can mobilize coalitions with other actors with more formal authority to push their transformative agenda. Among others, research on the influence of INGOs on IOs has demonstrated that advocates' ability to mobilize amplifiers results from their strategic use of (non-)material resources, the mobilization of transnational networks, a high degree of professionalization, and the use of moral authority to mobilize public opinion (Risse, 2013; Abbott et al., 2021; Tallberg et al., 2018).

Amplifiers. Accordingly, the role of amplifiers is to translate and codify novel socio-technical configurations and their guiding field logics into global standards, strategic principles or financial investment models (Miörner and Binz, 2021). Typically, this role can be played by actors that fulfil the following criteria: 1) they hold a mid-status, brokerage position in a sector, 2) they are equipped with some degree of formal authority in technical, financial and/or legislative domains, and 3) they have transnational reach. Examples of potential amplifiers include, but are not limited to, consultancies, professional associations and international organizations (IOs) (Miörner and Binz, 2021; Loorbach et al., 2020; Schot and Kanger, 2018).

IOs are an interesting case, as in transition studies they are often regarded as regime incumbents (Kranke and Quitsch, 2021) that diffuse the agenda of their member states internationally (Gilardi, 2013). This stems from the nature of their organization, which is typically based on the membership of state actors (Simmons and Martin, 2013), and their mandate to enforce existing institutional arrangements, such as technical standards or trade regulations (Kranke and Quitsch, 2021). Yet, the constructivist accounts of IOs by Barnett and Finnemore (2004; 1999) and Béland and Orenstein (2013) grant IOs a degree of autonomy from their member states' agenda and influenceability by advocates. We thus recognize that IOs can take on the role of amplifiers in multi-scalar transition trajectories.

Barnett and Finnemore (2004; 1999) outlined how IOs can act autonomously from their member states because of the co-constitutive effect of IOs being perceived and acting like a bureaucracy that presents itself as impersonal, technocratic, and neutral. The resulting rational-legal authority and control over technical expertise and information allows IOs to develop their own ideas, views and programs (Barnett and Finnemore, 2004; Barnett and Finnemore, 1999). Barnett and Finnemore (1999) point, for example, to the fact that the World Bank has used its internal expertise and self-representation as a neutral and technocratic decision-making body to exert a significant influence over the development trajectories of low- and middle-income countries. However, in addition to their autonomy, IOs are characterized by a certain degree of susceptibility to the influence of political and ideological shifts or expert inputs due to their need to maintain credibility and legitimacy (Béland and Orenstein, 2013). Illustrative examples in this regard are the European Commission's adoption of the circular economy concept, which was strongly shaped by consultants of the Ellen MacArthur Foundation (Kern et al., 2020), or the International Organization for Standardization's (ISO) key role in introducing a new global standard for on-site sanitation systems, shaped by the BMGF (Miörner and Binz, 2021).

The interplay between autonomy and influenceability makes access to and influence over IOs and similar actors, such as global consultancies or professional associations, a valuable asset for advocates. Their ability to channel investment flows (e.g., WB), define industrial development paths (e.g., ISO) or influence knowledge flows (e.g., consultants and professional associations) has a direct impact on the third actor role, i.e. the 'implementers'.

Implementers. Finally, the role of implementers is to plan, implement and operate the technologies and infrastructures that provide societal functions. In this process, they often reproduce dominant socio-technical configurations and align to the core rationalities of global regimes. However, when external pressures arise, they may seek to emulate or adopt novel socio-technical configurations to exploit new business opportunities and solidify their legitimacy (Hoogstraaten et al., 2020).

In many sectors, multinational corporations (MNCs) with high levels of prestige and financial resources occupy this role. They are the ones developing concrete infrastructure solutions on the ground and often possess the ability to directly influence domestic policies

in favor of their preferred solutions (Risse, 2013). While they often reproduce global regime solutions (Fuenfschilling and Binz, 2018), their key position in global industries, markets and values chains enables them, in principle, to fundamentally alter global regime structures (Hardy and Maguire, 2017; Johnstone and Newell, 2018). MNCs often share their implementer role with other actors with high (formal) authority, such as well-endowed utility companies or national governments, often in complex 'public-private partnerships' (PPP).

Implementers generally bear the responsibility for creating real-world solutions that will be used and evaluated by end-users. Consequently, they tend to be risk-averse, especially in PPP arrangements, and in favor of well-proven technologies and business models. While implementers certainly evaluate novel socio-technical configurations emerging in the international arena, they are unlikely to spearhead radical innovation processes or directly experiment with transformative socio-technical configurations proposed by advocates. Instead, they will pick up novel configurations when the broader selection environment, new standards, or changing investment criteria push them to deeply rethink their strategies.

Summary: Distributed Agency in 'Global Advocacy'-based Transition Trajectories. Fig. 2 summarizes our framework by illustrating how sectoral transitions that follow a 'global advocacy' trajectory depend on agency that is distributed between our three actor roles. It outlines a global institutionalization process in which an **advocate**, located in a global niche and not strongly associated with the global regime, successfully shapes a novel socio-technical configuration and guiding rationality at the global scale. While the advocate's social position allows it to develop a vision that deviates from dominant technologies and field logics, its lack of formal authority, prestige and resources prevents it from directly adapting relevant formal and informal institutions and influencing the strategies of implementers. To overcome this bottleneck, the advocate may leverage an **amplifier** that occupies a brokerage position in the sector and has the necessary formal authority to institutionalize the new guiding rationality into global regime structures. While formal authority enables the amplifier to codify the novel configuration into standards, norms or best practices, their translation into real-world solutions will finally depend on **implementers** which turn the novel configuration into infrastructures, products and services in concrete territorial contexts.

While Fig. 2 indicates types of actors who are likely to assume each role, we do not statically assign certain actor types to actor roles or limit actors to assuming only one role. We rather argue that all three actor roles need to be present in global institutionalization processes, but who takes on the advocate, amplifier and implementer role may differ and evolve over spatial, sectoral and temporal contexts. This also points to the importance of non-linearity and feedback loops in the stylized process depicted in Fig. 2.

3. Case Selection, Data and Methodology

In the remainder, we will empirically illustrate and validate our framework with a case study that demonstrates how distributed agency established the new infrastructure paradigm 'Citywide Inclusive Sanitation' (CWIS) as a guiding principle for the World Bank's sanitation projects. To examine the interplay of global actors that enabled this structural shift, we will first trace the extent to which a paradigm shift toward CWIS can be observed in World Bank documents, and then examine in depth the actors and processes that have turned CWIS into a new guiding rationality in this sector. In the following, we describe 1) the case selection rational, 2) the analytical steps taken to validate the WB's strategy shift toward CWIS, and 3) the analytical steps taken to examine the mechanism enabling this shift.

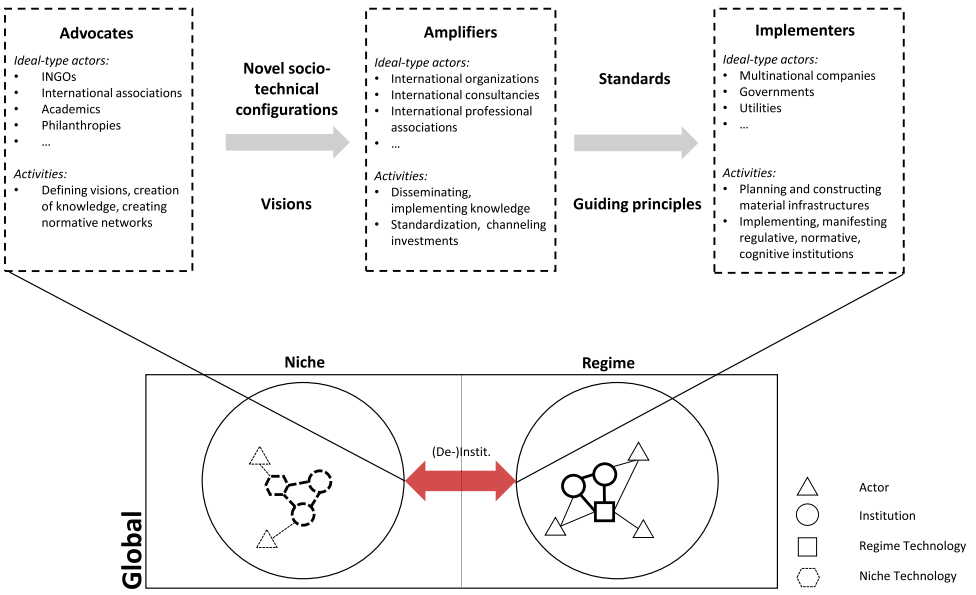

Figure 2. Distributed agency in 'Global Advocacy' based transition processes. Source: own illustration.

3.1. Case Study: A Paradigm Shift Toward Citywide Inclusive Sanitation in the Global Sanitation Sector

We follow an extreme case sampling rationale, which assumes that the relevant theoretical mechanisms are particularly salient in our empirical case (Flyvbjerg, 2006). Prior studies have shown that the water and sanitation sector features a particularly strong and globalized socio-technical regime, which is reproduced by a complex set of international organizations, MNCs, consultancies, national/regional governments and utilities (Lieberherr and Fuenfschilling, 2016; Fuenfschilling and Truffer, 2014). In low- and middle-income countries in particular, IOs such as development banks and donors have played a key role in diffusing global regime solutions. Especially the WB, the sector's largest lender (Winpenny et al., 2016; OCED, 2022), has been criticized for focusing on large-scale infrastructure, imposing neoliberal lending conditions, and creating a global consensus on water and sanitation privatization (Goldman, 2007; Heller, 2020).

Against this backdrop, it is surprising that one of the most recent attempts to institutionalize a new rationality for sanitation provision, namely 'Citywide Inclusive Sanitation' (CWIS), is being actively promoted by the WB. CWIS was launched in 2016 following a Call to Action by the Bill and Melinda Gates Foundation (BMGF), Emory University, Plan International, the University of Leeds, Water Aid, and the WB. It represents a transformative approach to urban sanitation, in which "*all members of the city have equitable access to adequate and affordable improved sanitation services through appropriate systems (sewered and non-sewered) of all scales, without any contamination to the environment along the entire sanitation value chain*" (Narayan and Lüthi, 2020, p. 19). CWIS thus calls for a paradigm shift in urban water management by promoting infrastructure solutions that diverge from the prevailing guiding rationalities in the sector (Gambrill et al., 2020; Lüthi et al., 2020). These include a range of 'on-site' decentralized solutions, such as modular, nature-based, small-scale treatment- and reuse systems (Hoffmann et al., 2020), which provide context-sensitive sanitation solutions where centralized large-scale systems are ineffective and/or infeasible in the face of water scarcity, huge investment needs, and high rates of urbanization (Kiparsky et al., 2013; Van Welie et al., 2018). CWIS can therefore be described as an overarching 'umbrella' that legitimizes various combinations of on-site and conventional water and sanitation solutions (Hoffmann et al., 2020).

If implemented at scale, CWIS could contribute to a more socially and environmentally sustainable urban water management sector by reducing inequities in access to sanitation and increasing the rate of wastewater retention and treatment. With CWIS being increasingly supported by other international development banks, development agencies, and a handful of governments and local regulators (Schrecongost et al., 2020), some experts speak of an extraordinary opportunity for a fundamental transformation of the global sanitation sector (Gambrill et al., 2020).

3.2. Analytical Step 1: Assessing Past Paradigm Shifts in the WB's Lending Practice

In a first step, we analyzed WB documents using the STCA methodology, which allows tracing how socio-technical configurations transform across time and space based on network analysis and visualization (Heiberg et al., 2022; Miörner et al., 2022b). In our case,

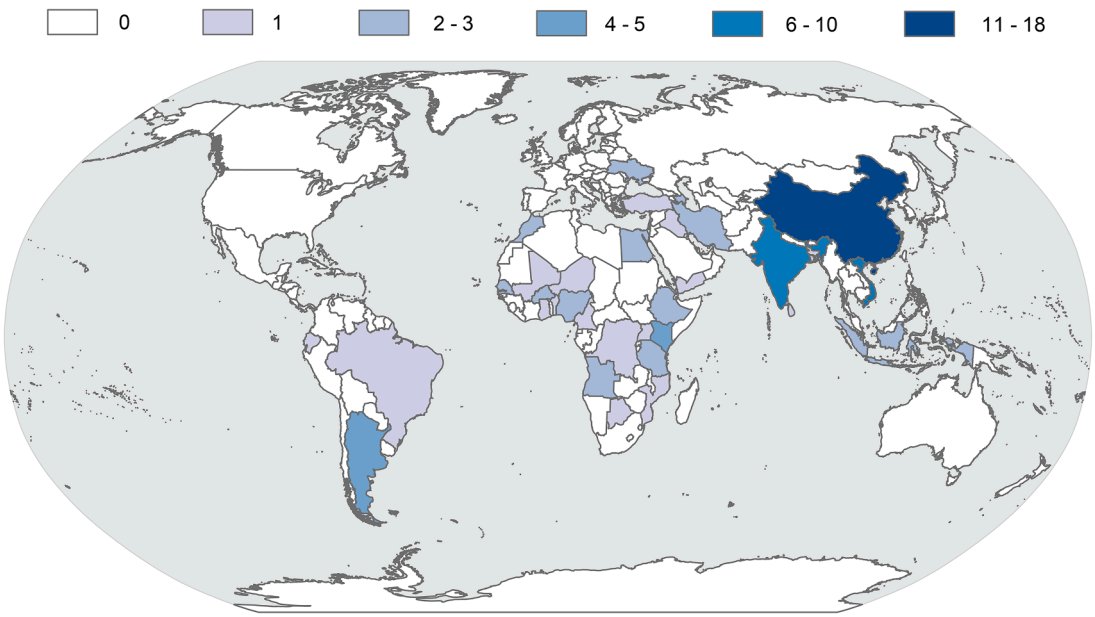

Figure 3. Spatial Distribution of Projects Included in the Database. Source: own elaboration, based on project data from the WB (2022). Map data: Department of Human Geography, Lund University.

Table 1
Two-Mode Project-Concept Adjacency Matrix and One-Mode Concept-Concept Adjacency Matrix.

X

	c_1	...	c_m
p_1	e_{11}	...	e_{1m}
...	...	...	...
p_n	e_{n1}	...	e_{nm}

Y

	c_1	...	c_m
c_1	s_{11}	...	s_{1m}
...	...	...	...
c_m	s_{m1}	...	s_{mm}

Source: own elaboration.

we derived socio-technical configurations from project documents of major WB water and sanitation projects.[1] To this end, we first identified projects that meet the following criteria: 1) project start between 2000 and 2021, 2) project cost of more than US$100 million, and 3) water, sanitation, or sewerage as the target sector.[2] The final dataset included 93 projects (see Fig. 3 for an overview).

To identify socio-technical configurations, we used NVivo to code the project description sections of the project documents according to a coding scheme, which was inductively developed by constantly generating and aggregating concepts *c* that relate to the different technologies, targets and values mentioned in the documents.[3] To establish a relation between the concept codes *c* and the project documents we also coded the entire project documents with project codes *p*. Subsequently, we extracted a two-mode project-concept matrix from NVivo. In Table 1, X represents such a matrix with $e = 1$ indicating if a concept is included in a project or $e = 0$ if not. This representation allows for the calculation of the column sum *k,* which in our case can be interpreted as a proxy measure for a concept's degree of institutionalization. The intuition is that the most deeply institutionalized concepts are included in many WB projects of a given time period, while less deeply institutionalized concepts are mentioned less in project documents.

Next, in order to identify and visualize coherent socio-technical configurations, we converted the two-mode project-concept matrix into a one-mode concept-concept similarity matrix based on the Jaccard similarity index (see Appendix A for details) (Heiberg et al., 2022; Miörner et al., 2022b). In Y in Table 1, *s* establishes the relation between different concepts based on their similarity *s* in terms of their frequent common use (*s* close to *1*) or rare common use (*s* close to *0*) in project documents. In the network visualization of Y, *s* is expressed by link width and shading.

To assess the evolution of the socio-technical configurations promoted by the WB over time, we derived one-mode concept-concept similarity matrices for three time periods: Y_1 acts as a baseline and considers projects promoted between 2000 – 2009, Y_2 considers projects promoted between 2010 – 2015, and Y_3 considers projects promoted between 2016 -2021.

We identified two coherent subsets of concepts *a* and *b* promoted by the WB in the baseline network (2000-2009) by applying Ward's hierarchical agglomerative clustering algorithm to Y_1.[4] The hierarchical illustration of clusters generated by this algorithm was appropriate for our dataset and our goal to determine an appropriate number of meaningful clusters *t* inductively. We chose $t = 4$, which identified two large clusters (*a* and *b*) that clearly represent two distinct socio-technical configurations (i.e., 'centralized' versus 'on-site' socio-technical configurations).

We then examined the evolution of concepts belonging to *a* and *b* by coloring them accordingly and illustrating their evolution over Y_1, Y_2 and Y_3 visually with the software Visone (Baur, 2008) and quantitatively with two indicators: *I,* which illustrates the degree of institutionalization of certain concepts, and s_d, which illustrates the degree of alignment between concepts of two (or more) different clusters (here representing socio-technical configurations).

The first indicator $I = k/n$ refers to the relative frequency with which a concept was included in a project in a given period and can be calculated for all concepts included in the analysis. *I* ranges from *0* to *1*, with values near *0* indicating a low degree of institutionalization and values near *1* indicating a high degree of institutionalization. *I* is expressed in terms of node size in the network visualization. The second indicator s_d provides information about how concepts of two (or more) different socio-technical configurations relate to each other. In our case, s_d evaluates the alignment of the concepts belonging to the two different socio-technical configurations *a* and *b*. The indicator s_d is based on the similarity of two concepts in terms of their frequent common use (s_d close to *1*) or rare common use (s_d close to *0*) in project documents. As shown in Appendix A, the calculation of s_d disregards concepts that do neither belong to *a* nor to *b*. To evaluate how the two socio-technical configurations relate to each other, we calculate the average of s_d

[1] More specifically, we coded project appraisal documents. These are prepared once all project details have been negotiated and accepted by the governments and the WB. Although the project appraisal documents vary in scope, they follow the same standardized outline, which facilitates structured coding of the identified concepts.

[2] US$100 million was chosen as a suitable threshold, as it is assumed that cost-intensive projects also receive more attention within the WB and in the countries and are thus more decisive for sectoral development.

[3] In the case that no project appraisal document was available, the project description section was coded in the corresponding project information document. This was the case 12 times, and mainly for additional financing commitments.

[4] Starting from the similarity matrix Y, Ward's method identifies clusters of concepts bottom-up by starting from each concept as a cluster and by iteratively merging the clusters into higher level clusters by minimizing the squared distance of any point within a newly merged cluster from the cluster's centroid, compared to the squared distances to the centroid of any other potential cluster until all concepts are merged into one cluster (Murtagh and Legendre, 2014).

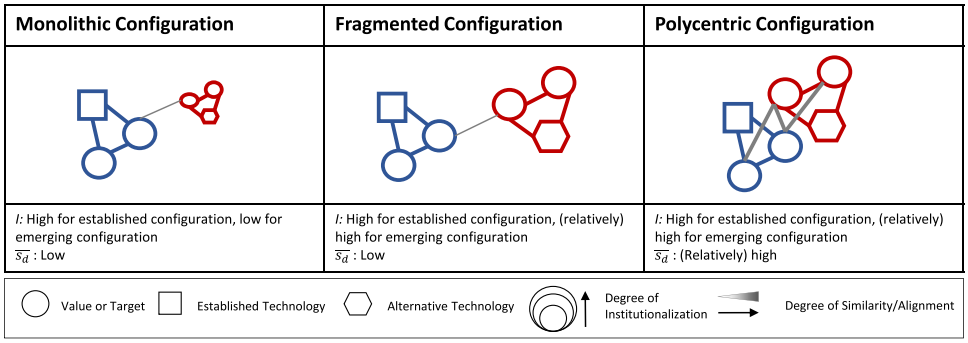

Figure 4. Indicators used to assess shifts in the socio-technical configurations promoted by the WB. The established configuration is depicted in blue, while the emerging configuration is depicted in red. We do not include a splintered sectoral regime at this point because we will not consider (mis-)alignments *within* configurations in our analysis. Source: own elaboration inspired by Van Welie et al. (2018).

($\overline{s_d}$) for each time period and assess changes in $\overline{s_d}$ between the different time periods.

Consequently, the interaction between I and $\overline{s_d}$ can be used as an analytical tool to trace the (de-)institutionalization of core concepts and shifts in the relationships between socio-technical configurations over time. Fig. 4 uses the typology by Van Welie et al. (2018) to illustrate how the respective measures would shift as a socio-technical system moves from a monolithic to a more polycentric architecture. We will draw on this intuition throughout our analysis to assess structural shifts in the socio-technical configurations promoted in WB documents.

3.3. Analytical Step 2: Examining Mechanism enabling the Identified Paradigm Shifts

In a second step, we conducted 14 semi-structured expert interviews with key stakeholders in the global sanitation sector. This allowed us to examine the mechanisms of agency at the global scale through which CWIS was constructed and institutionalized within the WB. To this end, we developed two different interview guides based on our conceptual framework, one targeting WB staff and the other targeting global advocates for transformative change in the sector. The interview guide for WB staff additionally addressed WB-internal processes that have led to changes in promoted strategies and approaches.

The identification of potential interviewees followed a snowballing technique (Flick, 2018), which resulted in 14 expert interviews being conducted by the first author via videoconferencing software (12) and face-to-face (2) between April and May 2022 (see Table A1 in Appendix A for an overview). The interviews lasted between 22 and 70 minutes and were recorded and subsequently transcribed. The transcripts were coded according to a coding scheme derived from the conceptual framework and the concepts identified in the STCA. After coding the interview transcripts, we further triangulated the resulting case narrative using the WB project documents, scientific articles and grey literature, such as annual letters from BMGF or sector reports from UN institutions.

4. Results

In each of the following sub-sections, we will first use the STCA results to assess how the guiding rationality of WB-funded water and sanitation projects shifted, and then discuss how the respective changes can be explained using our model and the contextual knowledge gained through expert interviews. Triangulation of our findings from the STCA, expert interviews and secondary data revealed that the transition process went through three different phases. Our narrative essentially comprises a baseline period (2000-2009) before the transition started and then two distinct shifts to the two subsequent phases. Our empirical sources suggest a robust link between key sector events and shifts in investment activities by the WB. These events are illustrated in the timeline in Fig. 5.

During the baseline period from 2000 to 2009, the global regime was for the first time (unsuccessfully) challenged by the Millennium Development Goal (MDG) no. 7, which set an international target to halve the proportion of the world's population without sustainable access to improved drinking water sources between 1995 and 2015 (Schertenleib et al., 2021). A first shift in WB-promoted socio-technical configurations occurred only around 2010, when the United Nations General Assembly recognized safe drinking water and sanitation as vital to the realization of all human rights (Schertenleib et al., 2021). A second shift is discernible around 2016, when the Sustainable Development Goal (SDG) no. 6 for water and sanitation was introduced and institutionalized globally,[5] in parallel with the introduction of CWIS.

[5] Particularly decisive are SDG 6.1, "By 2030, achieve universal and equitable access to safe and affordable drinking water for all", and 6.2, "By 2030, achieve access to adequate and equitable sanitation and hygiene for all and end open defecation, paying special attention to the needs of women and girls and those in vulnerable situations" (UN, 2020).

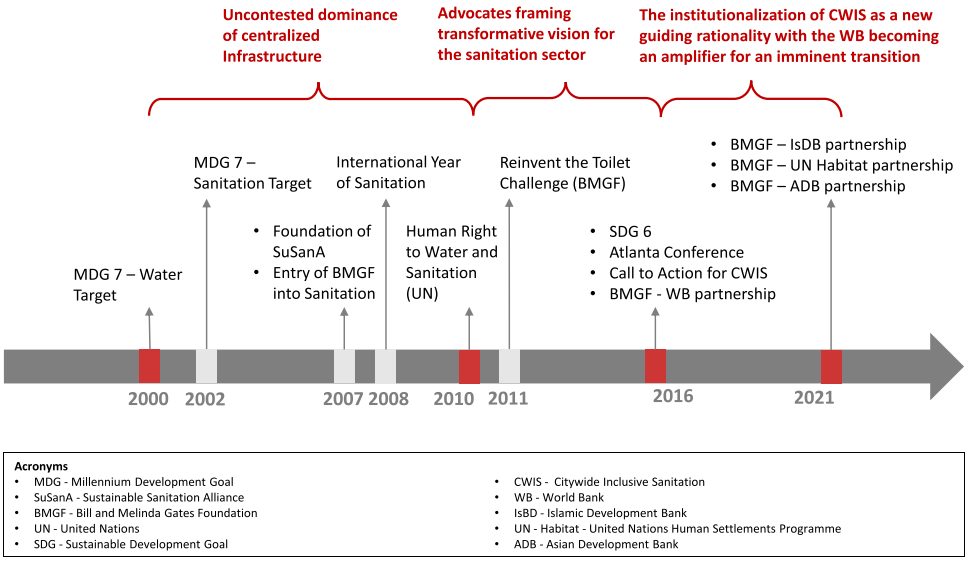

Figure 5. Evolution of the Water and Sanitation Sector. Source: own elaboration.

4.1. Baseline Situation: Uncontested Dominance of Centralized Water and Sanitation Solutions (2000-2009)

4.1.1. Results from the STCA

Fig. 6 maps the socio-technical configurations supported by the WB between 2000 and 2009. It shows a clear division between two clusters of concepts, which differ strongly in their degrees of institutionalization. The blue nodes and edges depict a dominant cluster of highly institutionalized concepts, hereafter referred to as the 'centralized cluster', which includes core regime technologies like *centralized water* and *wastewater infrastructure*, targets such as *institutional capacity strengthening, business operations improvement, access to water supply* and *sanitation*, and a strong core value of *financial sustainability*. In contrast, the 'on-site cluster' (red) includes less deeply institutionalized concepts like *on-site sanitation infrastructure, small-scale water supply infrastructure,* targets such as *behavior change*, or *human development,* and alternative core values like *social inclusion* and *community thinking*. The remaining concepts (gray) belong to two small clusters containing less common technologies, targets and values that remain peripheral throughout our analysis period and were thus omitted from further analysis.

In the first phase, the centralized and on-site clusters co-exist largely isolated from each other, as two separate configurations with different degrees of institutionalization and limited interaction, which is reflected in the indicators I and s_d. While I indicates a high degree of institutionalization of concepts in the centralized cluster, ranging from 0.34 to 0.86, the value is much lower for concepts in the on-site cluster, ranging from 0.11 to 0.17. The low s_d between concepts of the two clusters (averaging $\overline{s_d} = 0.15$) furthermore illustrates a low alignment of both clusters, as they are only linked by a few select boundary concepts such *access to sanitation, access to water supply* and *centralized water infrastructure*.[6] In the baseline situation, the WB thus promoted a fairly monolithic set of solutions, framed around providing *access to water* and *sanitation* through centralized infrastructures operated under market principles.

4.1.2. Mechanisms of distributed agency at the global scale and key sectoral developments

Our interviews and secondary literature suggest that the strong dominance of the global regime rationality in the baseline period is largely a legacy from developments in the 20th century. In the late 1990s, when (urban) water management became a priority for international donors (In3), a novel ideology that framed water as an asset with economic value was adopted (see e.g., The Dublin Statement on Water and Sustainable Development (GDRC, 1992)), and also strongly promoted by the WB in its propagation of the Washington Consensus (In5, 10) (Goldman, 2007). The guiding rationality was that the private sector could correct failures of the public sector in establishing functional water supply infrastructures (In2, 5, 13) (Bayliss, 2003). Sanitation, in contrast, was for a long time "*seen as something […] very complicated, something to do after water is there*" (In13). As a result, in the late 1990s and the beginning of the new millennium, many advocates active in global arenas remained occupied with creating basic awareness about the importance of sanitation (In4, 10).

Lobbying by several stakeholders, including the Water Supply and Sanitation Collaborative Council, led to the inclusion of a sanitation target in the MDGs in 2002 (In10).[7] This resulted in a first global mobilization of resources for sanitation (In10). However, the MDGs' exclusive focus on *access* to (drinking) water and 'basic' sanitation led donors (amplifiers) and governments (implementers)

[6] For a comprehensive overview of I and s_d, see Table B1 and B2 in Appendix B.

[7] The Water Supply and Sanitation Collaborative Council was established in 1990 as a global membership organization under the administration of the United Nations to promote cooperation between countries and development organizations in the field of water supply and sanitation.

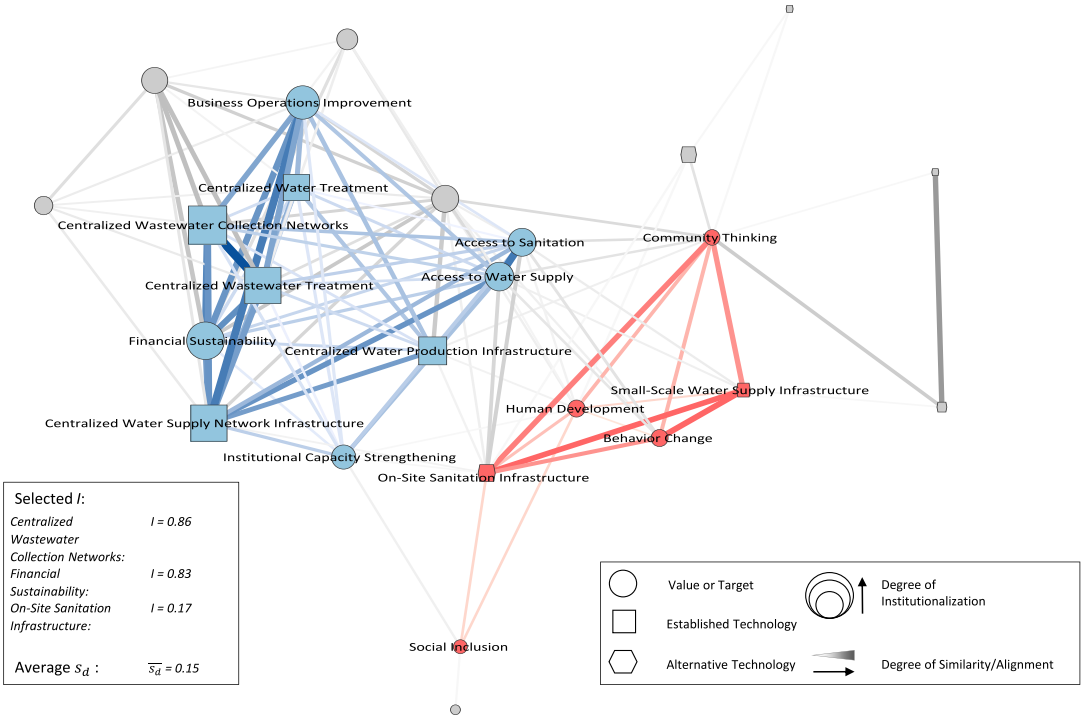

Figure 6. One-Mode Concept Network for the Period 2000 to 2009. For better representation, links between two concepts connected by a Jaccard index smaller than 0.2 have been omitted. Source: illustration by the authors based on WB (2022) data.

to focus on the *"lowest hanging fruit"* (In10), i.e., large-scale water and sanitation infrastructure that had already been institutionalized as the *"traditional approaches used in the developed world"* (In13). Within the WB, the MDGs thus pushed the water, sanitation and hygiene (WASH) agenda (In5), but mainly in terms of providing centralized infrastructure in urban areas, as also evidenced in Fig. B1 in Appendix B. The excessive focus on centralized infrastructure in urban areas, however, exacerbated problems of equity of access, as infrastructure interventions mainly benefited the wealthier segment of the population (In7, 10).

Despite the sector's strong focus on centralized infrastructure, some advocates developed alternative visions for on-site sanitation provision from time to time.[8] However, these only marginally reached the WB (Gambrill et al., 2020), as WB engineers rejected anything but sewered systems and advocates were occupied with lobbying for the importance of sanitation in general rather than with proposing concrete alternative solutions (In10).

> *"The goal now was to convince people that sanitation is important. It does not help that we show alternatives, and people do not want anything else." (In10)*

As a result, the WB implemented alternative on-site solutions only locally in a few projects in rural areas, focusing, for example, on providing access to latrines, yet without sufficient consideration of how human waste is effectively managed and treated (In1). The on-site configuration therefore appears as weakly institutionalized and as clearly separated from the centralized configuration in Fig. 6, linked only in the context of the MDG goals, i.e. by *access to water supply* and *access to sanitation*. Consequently, the WB remained far from becoming a promoter of on-site approaches in the baseline situation. Nonetheless, the local application of on-site solutions in rural areas resulted in the regime rationality not being entirely without alternatives.

Toward the end of the baseline period, some advocates emerged to promote these alternatives, most notably the Sustainable Sanitation Alliance (SuSanA) and BMGF (In1, 4). SuSanA is an informal network in which several key sanitation advocates, including NGOs, INGOS, private sector actors, research institutions, governmental organizations and multi-lateral organizations (e.g., Water Supply and Sanitation Collaborative Council), came together to coordinate their activities for the "International Year of Sanitation 2008" (In1) (UN-Water, 2008). SuSanA defined criteria for sustainable sanitation and began advocating for a systemic approach to sanitation planning (Schertenleib et al., 2021). By advocating for a systemic approach that went beyond just building toilets, it implicitly challenged the approach of the MDGs and directed the focus to the entire "sanitation chain", which includes not only access to a toilet, but also the transport, treatment, and potential reuse of human waste (In1) (Schertenleib et al., 2021). In this context,

[8] These include, for example, the Water and Sanitation Program, a multi-donor partnership of various countries and organizations administered by the WB to promote safe access to water and sanitation (In4, 10).

SuSanA served as a sounding board for a publication[9] (2008) that demonstrated the feasibility of on-site approaches to serving the entire sanitation chain (In1). According to a SuSanA representative, this publication influenced the BMGF in their decision to include on-site sanitation as a priority in their water, sanitation and hygiene program (In4).

The activities of these early advocates were obviously not yet reflected in the socio-technical configuration promoted by the WB or installed on the ground. However, they arguably laid the foundation for considerable transition potential in next development phases.

4.2. Shift 1: Advocates Framing and Promoting a Transformative Vision for the Sanitation Sector (2010 – 2015)

4.2.1. Results from the STCA

The comparison between Network A and B in Fig. 7 Illustrates an increasing diversification of the socio-technical configurations supported and financed by the WB between the first and second phase. While I remains high for most centralized concepts, it also increases for almost all on-site concepts, particularly for *on-site sanitation infrastructure* ($\Delta I = +0.2$), *community thinking* ($\Delta I = +0.17$), and *behavior change* ($\Delta I = +0.12$), and for the previously peripheral concept of *on-site sanitation* ($\Delta I = +0.12$). Average s_d, in turn, increases only slightly in the second phase ($\overline{\Delta s_d} = +0.02$). Thus, the overall institutionalization of on-site concepts increases, while links between on-site and centralized concepts remain weak, apart from an increasing alignment between on-site technologies and the aforementioned boundary concepts.

4.2.2. Mechanisms of distributed agency at the global scale and key sectoral developments

After 2010, the contextual conditions for institutionalizing on-site sanitation infrastructure improved significantly. First, the Declaration of the Human Right to Water and Sanitation (2010) marked an important turning point, recognizing the importance of water and sanitation as a human right after years of debate (In13) (see also Schertenleib et al., 2021). Like SuSanA's systemic approach, this declaration fundamentally challenged the focus of the MDGs by explicitly stating that all people should have access to water and sanitation, exposing the shortcomings (e.g., the focus on urban areas) of global regime solutions. It is conceivable that the declaration had a direct impact on the WB, with the bank increasing the number of high-cost projects channeling funding to rural areas from 9 to 21. Consequently, support for on-site sanitation also increased slightly, leading to a diversification of the socio-technical configurations supported by the WB (see Fig. B2 in Appendix B).

In parallel, novel actor constellations around alternative sanitation solutions gained more significance in international arenas. For example, in 2011, BMGF undertook a prominent foray into the sanitation sector in the form of the 'Reinvent the Toilet Challenge'. To support people lacking sanitation facilities, BMGF invested in a number of research initiatives with the goal of developing transformative toilet technology that can dispose of human waste in a decentralized, safe, and cost- and resource-efficient manner (Schertenleib et al., 2021; BMGF, 2022). While this initiative has not (yet) succeeded in establishing an inclusive, alternative solution to the centralized sewer system, it has helped to reframe on-site sanitation as a sustainable, long-term infrastructure option and stimulated various new research projects and professional exchanges (Schertenleib et al., 2021; BMGF, 2022). Nevertheless, advocates faced the difficulty of diffusing the emerging on-site configuration beyond rural areas to challenge the established centralized paradigm fundamentally (In5, 8). To achieve this, SuSanA and BMGF pursued different strategies toward the end of the second period.

SuSanA indirectly paved the way for a paradigm shift in urban sanitation (Lüthi et al., 2020) through its advocacy work, especially in relation to shaping a sanitation-focused SDG target. Prior to 2016, SuSanA's various partners (over 380 as of September 2022) lobbied national governments to advocate at the UN for an SDG target consistent with SuSanA's systemic definition of sustainable sanitation (In4). SuSanA thus indirectly leveraged the UN as an amplifier. The new sanitation agenda, which aimed to achieve safely managed sanitation (SDG 6.2) and a reduction of the portion of untreated wastewater (SDG 6.3), directly affected the WB. In order to maintain its social legitimacy, it adapted to the new agenda by focusing on managing the entire sanitation chain in an inclusive manner (In13).

At the same time, BMGF also decided to directly address the failure of global regime solutions in serving the urban poor. In 2014, a group of advocates from Emory University, the University of Leeds, and the BMGF decided at an informal lunch to address the issue of slum sanitation and organized a conference in Atlanta (2016) to explore different ideas and develop a new vision for urban sanitation (In9). The group was very deliberate when deciding who to invite, having "*an idea of who needed to be there*" (In 9), and invitations were organized according to predefined categories. For example, representatives of development banks were considered important for inducing the scale up of a novel infrastructure paradigm (In9). The Atlanta conference resulted in important outcomes, including the decision to re-frame "slum sanitation" as "Citywide Inclusive Sanitation" to make the issue less politically sensitive and more attractive for potential investors. It also resulted in a Call to Action for CWIS (In9), which explicitly recognized that:

> *"Citywide inclusive sanitation means that: everybody benefits from adequate sanitation service delivery outcomes; human waste is safely managed along the whole sanitation service chain; effective resource recovery and re-use are considered; a diversity of technical solutions is embraced for adaptive, mixed and incremental approaches; and onsite and sewerage solutions are combined, in either centralized or decentralized systems, to better respond to the realities found in developing country cities"* (BMGF, Emory University, Plan International , The University of Leeds, WaterAid and World Bank, 2016, p.1).

SuSanA's advocacy combined with the new paradigm created by the coalition of advocates around BMGF had a major impact on the

[9] The compendium of sanitation systems and technologies (Eawag, 2008).

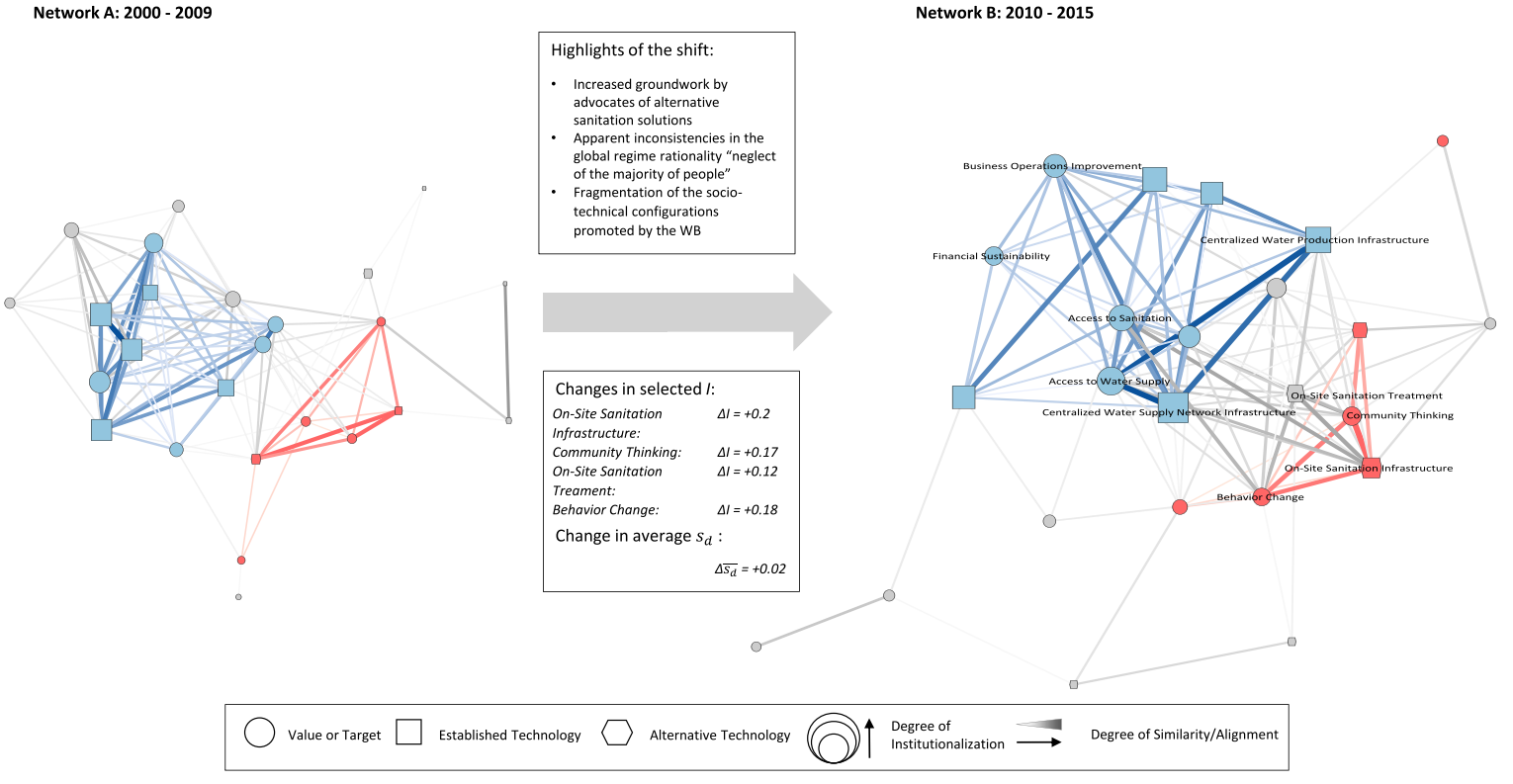

Figure 7. One-Mode Concept Network for the Period 2000 to 2009 (A) and 2010 to 2015 (B).
For better representation, links between two concepts connected by a Jaccard index smaller than 0.2 have been omitted. Source: illustration by the authors based on WB (2022) data.

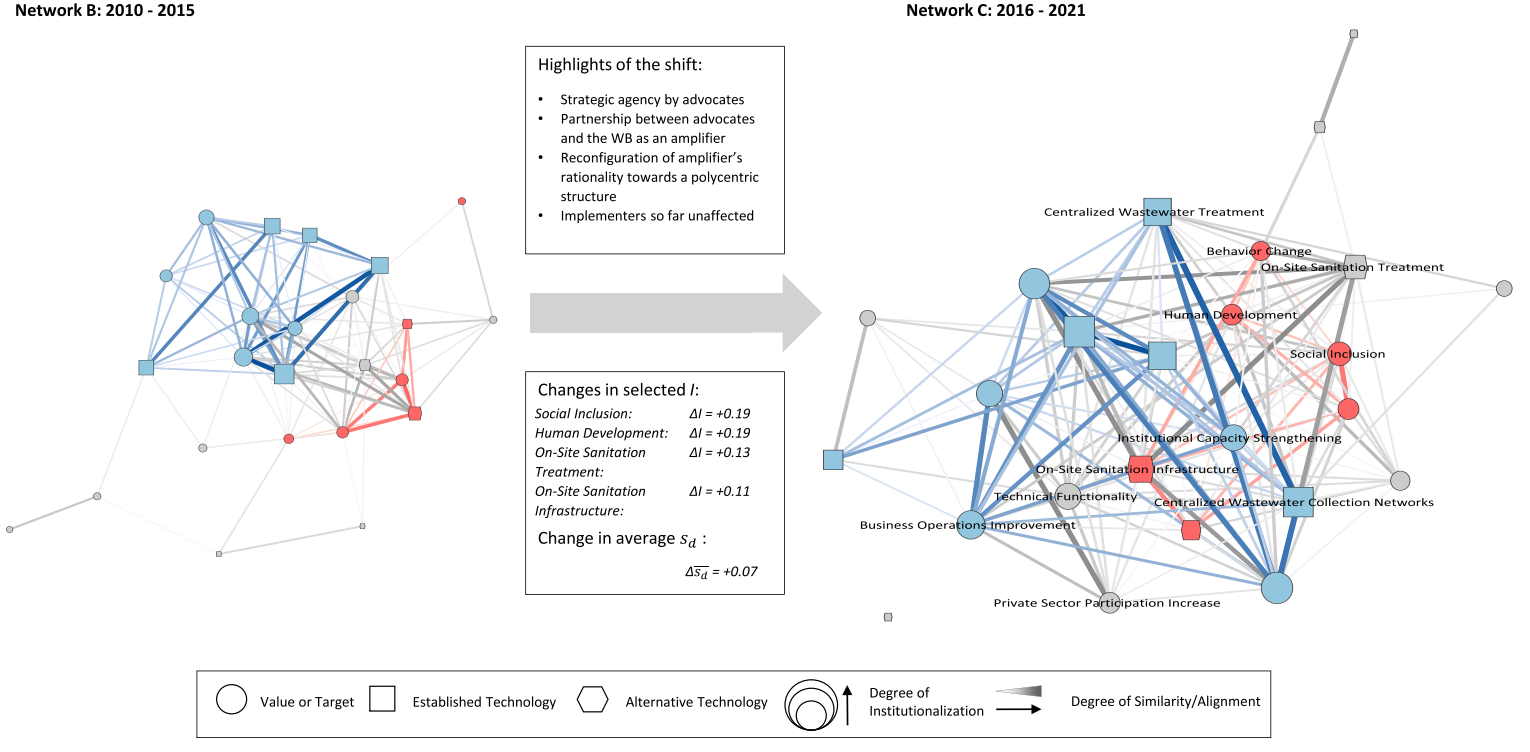

Figure 8. One-Mode Concept Network for the Period 2010 to 2015 (B) and 2016 to 2021 (C).
For better representation, links between two concepts connected by a Jaccard index smaller than 0.2 have been omitted. Source: illustration by the authors based on WB (2022) data.

WB, as an examination of the next shift in the global sector structures will illustrate.

4.3. Shift 2: Institutionalization of CWIS and the WB Becoming an Amplifier for an Imminent Transition (2016 – 2021)

4.3.1. Results from the STCA

Comparing Networks B and C in Fig. 8 shows that between 2010 and 2021 *I* increases considerably for various on-site concepts and particularly for targets like *social inclusion, human development* ($\Delta I = +0.19$), and alternative technologies like *on-site sanitation infrastructure* ($\Delta I = +0.11$) and *on-site sanitation treatment* ($\Delta I = +0.13$). In fact, on-site technologies are now mentioned almost as frequently as *centralized wastewater treatment* and *centralized wastewater collection networks*. The two clusters now overlap more strongly, which is reflected in an increase in the average s_d ($\overline{\Delta s_d} = +0.07$). Most notable is an increasing common mentioning of on-site technologies and centralized wastewater technologies in WB projects. Fig. 8 thus nicely illustrates that the structure of WB investments in water and sanitation shifts quite radically from two largely separated clusters towards a more polycentric or hybrid structure, in which the WB promotes centralized and on-site solutions in a more integrated manner.

4.3.2. Mechanisms of distributed agency at the global scale and key sectoral developments

Evidence from our interviews suggests that significant efforts were made to institutionalize CWIS after its introduction. For example, shortly after the Atlanta conference, the WB and BMGF entered into a close partnership to promote CWIS (In5, 9). The partnership between the two organizations was not a coincidence, but rather a direct and strategic attempt of an advocate (BMGF) to integrate its guiding vision (CWIS) in the strategies of an amplifier (WB). An important step in establishing the CWIS vision at the WB was a BMGF grant of approximately US$21 million to one of the WB's Multi-Donor Trust Funds.[10] This grant enabled a small team of WB specialists to work exclusively on setting a CWIS agenda for the bank's urban sanitation projects (In5; Gambrill et al., 2020). By organizing workshops and education events and supporting WB project managers and government officials with best practices and standard terms of reference, the WB's CWIS team increasingly institutionalized the concept within the WB and relevant external expert circles (In5, 9, 12, 13, 14).

In addition to the growing realization among WB staff that conventional regime solutions had failed in various (low-income) parts of the world, it was the (relatively) small investment by BMGF that succeeded in leveraging *"the whole WB institution [...] to promote this approach across the [...] 2 billion portfolio that [the WB] has annually in water and sanitation"* (In13). And indeed, our STCA results illustrate that the WB's CWIS team was successful in its efforts to spread CWIS principles in WB projects. Particularly noteworthy is the increasing institutionalization of on-site solutions in investment streams targeting urban areas, as also illustrated in Fig. B3 in Appendix B. On-site technologies are now being used to complement centralized infrastructure, making them subject to conventional regime concepts such as *institutional capacity strengthening, business operations improvement* and *private sector participation.*

In terms of the relationship between BMGF and the WB, an advocate and amplifier have played to each other's strengths in institutionalizing CWIS, or in the words of one interviewee:

> *"The WB is like an oil tanker in the sea, which takes a long time to change direction sometimes, and the Gates Foundation is more like a speedboat that can change direction very quickly, and can mobilize funding and fund things much more quickly". (In5)*

Although BMGF is characterized by a significantly lower level of investment compared to other organizations active in the water and sanitation sector (OCED, 2022), they could still initiate transformative change. While BMGF is characterized by a typical advocate outsider position, it has comparatively high levels of resources (i.e., money) and prestige (i.e., through Bill Gates) that can be flexibly and strategically deployed in various investments. As one BMGF specialist puts it:

> *"[W]e can exactly invest in these kinds of things, in convening people and doing trainings. [...] So we are a small fish, but I do think the ability to convene and the ability to think about who needs to learn from who and how we do this has been important." (In9)*

Exemplary in this regard are other attempts of BMGF to leverage amplifiers, including BMGF's technical cooperation agreement with the Islamic Development Bank *"to embed and institutionalize CWIS"* (In8), and financial support to a working group hosted by the Asian Development Bank (In8, 9). As a result of these efforts, CWIS is already on the minds of various key development actors and widely recognized as the way forward for international development assistance (In1, 2, 5, 6). Nevertheless, CWIS has not yet left the "development realm", and other potential amplifiers such as international engineering consultants, as well as large implementers, including water MNCs and utilities, remain rather unaffected (In1, 2, 7), as *"[t]he concept [CWIS] is nowhere taken up except when it is funded [by donors]"* (*In7).*

While there is general agreement that much has happened in 'the minds' of global actors, not as much has found implementation in practice yet, and the first results of CWIS-inspired projects are only now becoming visible (In9, 10). According to a WB practitioner, the challenge will be to make CWIS *"more mainstream"* (In13), so that standards and guidelines around CWIS will eventually find their way into material infrastructures and into regulative, normative and cognitive institutions across the world. To this end, important efforts have been made by BMGF to engage amplifiers and implementers active beyond the traditional 'development domain'. These include a BMGF-funded Consultant Capacity Development program aimed at familiarizing local and regional consulting firms (potential

[10] The Global Water Security & Sanitation Partnership is the largest trust fund managed by the WB. It is situated within the WB's Global Practice Water but is supported by a wide range of stakeholders. Its goal is to generate, collect, and disseminate knowledge and expertise by learning from and influencing WB water and sanitation projects (WB, n.d.).

amplifiers) with the new paradigm, and funding for a UN Habitat initiative to integrate (sustainable) sanitation strategies into its global water operator partnership alliance (i.e. a network of implementers) (In11).

In summary, our analysis reveals that the advocate coalition promoting CWIS had a transformative effect on how the WB (and other development banks and donors) frame and allocate their most recent investments into sanitation infrastructure. The shifts in the investment portfolios of these large IOs are a clear proxy for an imminent shift in the types of sanitation infrastructure to be built in low- and middle-income countries in the coming years. The key position of CWIS principles in WB projects might also incentivize implementers such as large water MNCs or utilities to explore on-site solutions in more depth so as not to miss future development opportunities. Based on the analysis, the global advocacy trajectory explored in this paper has laid a promising ground for transforming the sector's regime structures, both globally and especially in low- and middle-income countries. At the same time, it remains to be seen how performative the new CWIS paradigm will become. One potential drawback is that CWIS is a rather polycentric paradigm which combines two infrastructure solutions that follow diverging institutional rationalities. Whether and how the resulting increase in institutional complexity can be managed in real-world implementations remains an open question (Hacker and Binz, 2021). The jury is also still out on whether and how quickly the CWIS idea will travel from low-and middle-income contexts to high-income countries around the world.

5. Conclusion

In a globalized world facing immense transformation challenges, improving our understanding of multi-scalar transition trajectories is paramount. While previous research has illustrated that global actors may institutionalize alternative socio-technical configurations directly at the global scale, the questions of which actors are capable of doing so and through which mechanisms have not been adequately explored. In this paper, we propose that an examination of the distributed agency among global actors fulfilling three distinct roles (advocates, amplifiers and implementers) provides new insights into how 'global advocacy'- based transition trajectories evolve (Miörner and Binz, 2021).

Our in-depth analysis of a structural shift in the socio-technical configurations promoted by the World Bank in the sanitation sector substantiates our conceptual arguments. Global institutionalization processes rely on a complex interplay between 1) advocates who create new visions and socio-technical configurations, 2) amplifiers that translate them into global standards, investment criteria, and best practices, and 3) implementers who solidify them by turning them into physical infrastructures. In our empirical case study, a coalition of advocates led by the Bill and Melinda Gates Foundation (BMGF) effectively institutionalized the new 'Citywide Inclusive Sanitation' paradigm at a global scale. The interaction with the World Bank (an amplifier) was repeatedly highlighted as a decisive factor that enabled the rapid global diffusion of CWIS. This confirms our initial hypothesis that in sectoral contexts characterized by strong global regime structures, advocates are unlikely to gain direct access to implementers who control the resources and capabilities to implement infrastructure solutions in diverse spatial contexts (Fuenfschilling and Binz, 2018; Schertenleib et al., 2021). Instead, engaging amplifiers becomes a necessary condition for successful global advocacy trajectories. This key hypothesis emerging from our analysis should now be validated and further specified in future research.

The study also has important implications for policymakers interested in supporting infrastructure transformation globally. As national governments are the main members of international organizations such as the World Bank, they can push these organizations to more actively support alternative/transformative solutions. This also points to the notion that national governments, and not only INGOs and change-oriented actor coalitions as in our empirical case, could take on the role as advocates in multi-scalar transition trajectories. Single states or, more likely, coalitions of forward-oriented nations would have the power to mobilize the financial and organizational capabilities needed to support the formation of 'global niche' configurations in many key infrastructure sectors. This could be particularly important in cases where a strong global lead advocate such as the resourceful philanthropy BMGF is missing. Our study has demonstrated the importance of creating global arenas and networks in which diverse actors with transformative ideas can meet, engage in collective sense-making and frame transformative socio-technical configurations. Policy could proactively support the formation of global niche structures and support them in developing strategies for identifying and influencing key amplifiers in different sectors.

With our paper, we have made an important conceptual contribution to the study of multi-scalar transitions, which opens several interesting lines of further research. In particular, we have elaborated on the important role of amplifiers and illuminated the importance of (previously neglected) international organizations in this regard (Kranke and Quitsch, 2021). We see great potential in further exploring the interface between transition studies, which focus on the 'purposeful' transformation of sectoral structures, and the literature on international relations, which focuses on the activities of different types of global actors and the conditions under which they succeed in linking structural transformations at global, national, and local scales (Risse, 2013). While our study mostly covered the advocates-amplifiers axis, future work should also explore the mechanisms through which amplifiers influence the implementers' core strategies. One could for example examine how amplifiers employ different modes of governance to influence implementers (Abbott et al., 2021), and how domestic- (Risse, 1995), and sectoral structures influence the success of different strategies (Miörner et al., 2021). Furthermore, one could explore in more depth whether actors can hold multiple roles in multi-scalar transitions or investigate how their roles evolve over time.

Moreover, while this paper focused on the social position of actors in global sector structures, future studies should explore how actors' territorial embeddedness shapes their potential roles and 'spatial reach' in sectoral transformation processes. For example, actors in global innovation hotspots may on the one hand easily leverage their resources in global transformation trajectories but on the other hand may be constrained by strong historical place-specific path dependencies. Studying the association between the geographical location of advocates, implementers and amplifiers, in, for example, core vs. peripheral regions, and whether this matters

for their influence in adapting global regime structures, could further strengthen our understanding of the spatial intricacies of multi-scalar transition trajectories (see also Chlebna et al., 2023). In this regard, we also want to highlight that we have illustrated a global advocacy trajectory in which actor networks and organizations dominated by members from high-income countries have envisioned and initiated a transition in the way sanitation solutions ought to be planned in low- and middle-income countries. This arrangement hints to "neo-colonialist" structures persisting in the global sanitation sector, which should be critically assessed in future work. One could e.g., assess how (coalitions of) advocates rooted in low- and middle-income countries could be empowered and given a stronger voice in future transformation processes of infrastructure sectors.

Last but not least, this study is to the best of our knowledge the first to apply Socio-Technical Configuration Analysis to World Bank project documents. In doing so, it complements previous applications of the method that have analyzed transformation dynamics based on actor statements in public media or in expert interviews (see e.g. Heiberg et al., 2022; Miörner et al., 2022a; Heiberg and Truffer, 2022). This approach differs from prior applications in that it identifies socio-technical configurations based on 'substantive' (Miörner et al., 2022b) information on concrete material activities (infrastructure investments) rather than through actors 'discursive' representations of key developments in a field. We thus further illustrated the vast potential of STCA for tracing socio-technical transition dynamics over space and time.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

Acknowledgements

This research received financial support from the Swiss National Science Foundation through the GLORIWA project (grant no. 10001A_179219) and the MULTITRANS project (grant no. 10001A_215101) as well as from Formas: Swedish Research Council for Sustainable Development (grant no. 2022-00585). In addition, we would like to thank Mario Angst, Abishek Sankara Narayan, Muhil Nesi and Bernhard Truffer for their valuable inputs on the paper. In 2022, the paper also benefited from insightful comments from colleagues at seminars at Eawag, the Global Conference on Economic Geography, the International Sustainability Transitions Conference and the Globelics International Conference. Finally, we would like to thank the two anonymous reviewers as well as the handling editor for their constructive comments.

Appendix A

Derivation of s and the indicators I,and s_d

I is based on the column sum k,

$$k(c_i) = \sum_{i}^{n} e_{ij}$$

of the two-mode binary project-concept matrix. While k indicates the number of projects in which a concept c_i was mentioned,

$$I_i = \frac{k_i}{n_i}$$

refers to the relative frequency with which a concept c_i was included in a project in a given time period i taking into account the absolute number n of projects in this time period. I ranges accordingly from 0 to 1.

s illustrates the Jaccard similarity score, which is derived according to the following formula

$$s = \frac{f}{(f+g+h)}$$

where f represents the number of projects that use two concepts together, and the sum $(f+g+h)$ represents the number of projects that referred to both (f) and either one (g) or the other (h) of the two concepts (Heiberg et al., 2022). When $s = 1$, the numerator and denominator are equal, indicating that both concepts are always used together in a project., while s close to zero implies that the two concepts are rarely used together in a project.

s_d is calculated in the same way. However, the calculation only takes connection between concepts c_a and $c_b$from clusters a and b into account. Connections to other concepts are disregarded. It follows:

$$s_d = \frac{o}{(p+q+r)}$$

where *o* represents the number of projects which have used the two concepts c_a and $c_b$together, and the sum *(p + q + r)* represents the number of projects that referred to both *(p)* and either one *(q)* or the other *(r)* of the two concepts c_a and c_b. When $s_d = 1$, the numerator and denominator are equal, indicating that, within the scope of the investigated connections, the concepts c_a and c_b are always considered together, while s_d close to zero implies that the two concepts are rarely considered together.

Table A1
Overview of Interview Partners.

Interview	Person/Institution	Date
1	Academic researcher, Eawag	06.04.2022
2	Academic researcher, Eawag	12.04.2022
3	Sector expert	13.04.2022
4	Organization staff, GIZ	19.04.2022
5	Former organization staff, WB	20.04.2022
6	Consultancy staff, Aquaconsult	20.04.2022
7	Organization staff, IWA	21.04.2022
8	Organization staff, IsDB	22.04.2022
9	Organization staff, BMGF	24.04.2022
10	Academic Researcher, Eawag	26.04.2022
11	Organization staff, UN Habitat	26.04.2022
12	Organization staff, WB	28.04.2022
13	Organization staff, WB	03.05.2022
14	Organization staff, WB	11.05.2022

Appendix B

Table B1
Institutionalization Index for Concepts in the One-Mode Concept Networks (*I*).

	2000 -2009		2010 - 2015		2016 - 2021	
Concept	k	I (n = 35)	k	I (n=35)	k	I (n=23)
Technical Functionality	2	0.06	4	0.11	11	0.48
Social Inclusion	4	0.11	7	0.20	9	0.39
Physical Well-being	15	0.43	12	0.34	6	0.26
Human Development	6	0.17	4	0.11	7	0.30
Financial Sustainability	29	0.83	11	0.31	11	0.48
Environmental Sustainability	7	0.20	4	0.11	4	0.17
Community Thinking	5	0.14	11	0.31	7	0.30
Small-Scale Water Supply Infrastructure	4	0.11	7	0.20	6	0.26
Small-Scale Wastewater Collection Infrastructure	2	0.06	2	0.06	1	0.04
On-Site Sanitation Treatment	5	0.14	9	0.26	9	0.39
On-Site Sanitation Infrastructure	6	0.17	13	0.37	11	0.48
Decentralized Water Supply Infrastructure	1	0.03	0	0.00	1	0.04
Decentralized Sanitation Infrastructure	1	0.03	2	0.06	2	0.09
Centralized Water Treatment	14	0.40	15	0.43	6	0.26
Centralized Water Supply Network Infrastructure	27	0.77	28	0.80	15	0.65
Centralized Water Production Infrastructure	16	0.46	20	0.57	12	0.52
Centralized Wastewater Treatment	27	0.77	16	0.46	12	0.52
Centralized Wastewater Collection Networks	30	0.86	18	0.51	14	0.61
Private Sector Participation Increase	9	0.26	5	0.14	7	0.30
Institutional Capacity Strengthening	12	0.34	15	0.43	11	0.48
Environmental Conditions Improvement	14	0.40	3	0.09	4	0.17
Business Operations Improvement	23	0.66	17	0.49	13	0.57
Behavior Change	6	0.17	10	0.29	6	0.26
Access to Water Supply	17	0.49	25	0.71	15	0.65
Access to Sanitation	16	0.46	21	0.60	16	0.70

Source: calculation by the authors based on WB (2022) data.

Table B2
Jaccard Similarity Index Between Concepts Belonging to the Centralized and On-Site Cluster (s_d).

2000 - 2009										
	Financial Sustainability	Centralized Water Treatment	Centralized Water Supply Network Infrastructure	Centralized Water Production Infrastructure	Centralized Wastewater Treatment	Centralized Wastewater Collection Networks	Institutional Capacity Strengthening	Business Operations Improvement	Access to Water Supply	Access to Sanitation
Social Inclusion	0.10	0.13	0.07	0.11	0.07	0.10	0.23	0.08	0.11	0.11
Human Development	0.17	0.11	0.14	0.22	0.14	0.16	0.20	0.04	0.21	0.22
Community Thinking	0.13	0.12	0.19	0.24	0.07	0.09	0.06	0.12	0.29	0.31
Small-Scale Water Supply Infrastructure	0.06	0.06	0.15	0.11	0.03	0.10	0.14	0.04	0.24	0.25
On-Site Sanitation Infrastructure	0.09	0.18	0.22	0.22	0.10	0.16	0.20	0.12	0.35	0.38
Behavior Change	0.13	0.05	0.18	0.16	0.06	0.13	0.13	0.07	0.28	0.29
2010 - 2015										
	Financial Sustainability	Centralized Water Treatment	Centralized Water Supply Network Infrastructure	Centralized Water Production Infrastructure	Centralized Wastewater Treatment	Centralized Wastewater Collection Networks	Institutional Capacity Strengthening	Business Operations Improvement	Access to Water Supply	Access to Sanitation
Social Inclusion	0.06	0.10	0.21	0.13	0.10	0.19	0.22	0.14	0.23	0.22
Human Development	0.07	0.12	0.10	0.09	0.11	0.10	0.06	0.11	0.07	0.04
Community Thinking	0.10	0.08	0.30	0.29	0.08	0.12	0.24	0.04	0.38	0.45
Small-Scale Water Supply Infrastructure	0.06	0.05	0.21	0.23	0.05	0.04	0.10	0.09	0.28	0.27
On-Site Sanitation Infrastructure	0.14	0.17	0.37	0.27	0.12	0.15	0.27	0.11	0.46	0.55
Behavior Change	0.05	0.04	0.23	0.20	0.13	0.17	0.32	0.08	0.30	0.48
2016 - 2021										
	Financial Sustainability	Centralized Water Treatment	Centralized Water Supply Network Infrastructure	Centralized Water Production Infrastructure	Centralized Wastewater Treatment	Centralized Wastewater Collection Networks	Institutional Capacity Strengthening	Business Operations Improvement	Access to Water Supply	Access to Sanitation
Social Inclusion	0.05	0.15	0.33	0.24	0.24	0.28	0.25	0.10	0.41	0.32
Human Development	0.20	0.00	0.22	0.12	0.36	0.40	0.13	0.18	0.16	0.28
Community Thinking	0.06	0.00	0.22	0.12	0.27	0.31	0.20	0.18	0.29	0.35
Small-Scale Water Supply Infrastructure	0.13	0.09	0.24	0.20	0.06	0.18	0.13	0.27	0.31	0.29
On-Site Sanitation Infrastructure	0.22	0.06	0.44	0.35	0.28	0.32	0.38	0.41	0.63	0.59
Behavior Change	0.13	0.00	0.24	0.20	0.29	0.25	0.21	0.19	0.31	0.38

Source: calculation by the authors based on WB (2022) data.

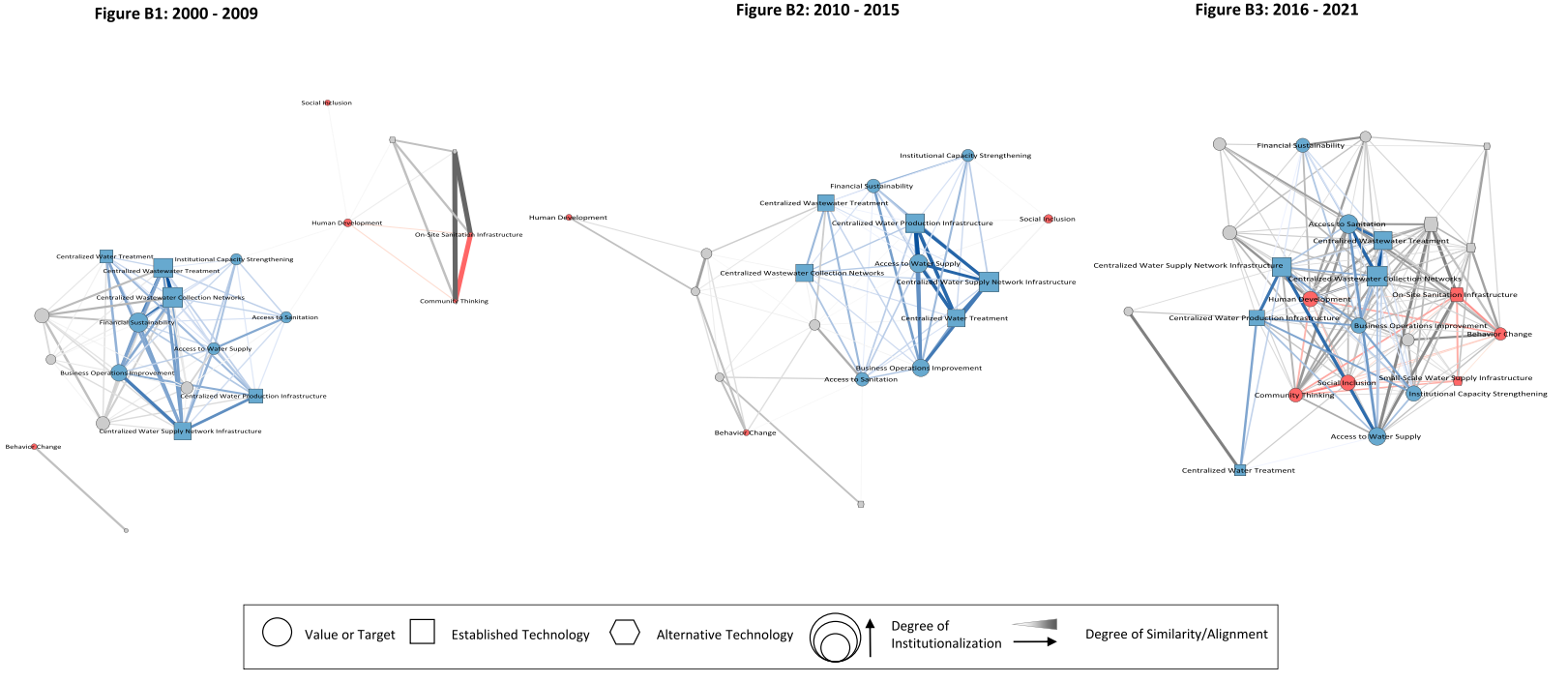

Figure B1. One-Mode Concept Network for Urban Projects in the Period 2000 -2009 (B1), 2010 to 2015 (B2) and 2016 to 2021 (B3).
For better representation, links between two concepts connected by a Jaccard index smaller than 0.2 have been omitted. Source: illustration by the authors based on WB (2022) data.

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