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Transition to Circular Economy in Practice Through Network Governance in Conjunction with Public Governance; Comparative Longitudinal Action Research on Mattresses, Concrete, and Textile in The Netherlands

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Abstract

This paper investigates the practical implementation of transitioning to a circular economy through network governance in conjunction with public governance. The research focuses on a comparative, longitudinal analysis of three Dutch product chains (mattresses, concrete, and textiles) from 2016 to the present. The study based on action research, utilizes documents, reports from all meetings, and personal observations. Drawing from the fields of public administration and transition management, the paper addresses two critical knowledge gaps. First, the paper contributes to the transition management literature by shedding light on how complex systemic changes, such as the transition from a linear to a circular economy, can be realized in practice. The cross-case analysis demonstrates that, even with the distinct characteristics of each case, the overall network governance approach exhibits significant similarities. These commonalities are synthesized into ten guiding principles for building a circular economy through network governance. These principles comprehensively integrate all aspects of transition management mentioned in the literature, creating a coherent framework. They provide transition management practitioners with a systematic approach for thinking, acting, and collaborating. Secondly, the paper offers insights into the interplay

between network governance and public governance in real-world cases. The analysis demonstrates that network governance can significantly contribute to accelerating the transition to a circular economy. However, public governance continues to play a pivotal role, particularly during the scaling-up and mainstreaming phases of the transition. Implementing network governance is a learning experience, not only for the network partners but also in how they can collaborate with the government. Additionally, this process requires a shift in the government's mindset to embrace network governance as a complementary approach for governing complex transition processes. The network governance approach presented here can be further refined as additional practice-oriented studies are conducted in a broader range of countries.

Keywords
Circular economy; public governance; network governance, product chains of mattresses, concrete, and textile; public administration; transition management; ten guiding principles

1. Introduction

The Circular Economy is perceived as a novel strategy for companies of all sizes to embrace in their journey towards a sustainable future. It can be viewed as an economy that, instead of discarding products after use, as in a linear economy, operates within a closed-loop system that keeps products, materials, and resources circulating [1, 2]. To achieve circularity, businesses often must develop new business models, such as sharing and leasing products [3, 4], or align individual business models into a shared network business model [5]. The implementation of the circular economy is still in its early stages [6]. De Jesus and Mendonça [7] argue that transitioning away from the linear model will be challenging, as entrenched technical systems are fortified by risk avoidance and vested interests with significant short-term stakes. Moving towards a circular economy necessitates a profound shift, making this transition inherently disruptive [8]. Businesses will have to overcome various obstacles in adopting circular strategies, including economic and trade barriers, legal and regulatory barriers, social and attitudinal barriers, and technological and operational barriers [7-9]. Despite its importance, the literature has scarcely addressed how to govern sustainability transitions (mainly circular economy) in practice [10, 11]. This paper aims to fill this knowledge gap.

The paper integrates two research domains: a. public administration (specifically, recent literature on governance) and b. system innovation research (in particular, transition management). The term 'governance' has emerged as a prominent concept in public administration, sustainability science, and other disciplines in response to the realization that government alone is no longer the exclusive actor responsible for managing complex societal issues [12, 13]. While traditionally, governance was closely linked to the formal institutions of the state, it has evolved over the past few decades into a shared responsibility involving the state, market, and civil society [14]. This new form of governance has frequently been debated in the context of extending liberal democratic processes [15] but is also regarded as a global trend by other authors [13, 16]. In addition to the traditional hierarchical steering of government through policy objectives and instruments (public

governance), governance also involves networks that facilitate relationships between relatively autonomous yet interdependent actors, including business firms, public organizations, and private organizations [14, 17, 18]. This approach, known as network governance, does not replace public governance but complements it [2, 19]. Although network governance has gained increasing attention since the early 2000s, it is not a novel phenomenon. Many countries have a long-standing tradition of involving societal actors in formulating and implementing public policies. What sets the contemporary discourse apart is the recognition that governance networks are perceived as efficient and legitimate approaches to governing our increasingly complex and multi-layered societies [20]. The many articles on network governance recently published by scholars in academic public administration literature mainly deal with elaborating the concept itself and problems of governability, democratic anchorage, and representation of actors. How network governance can support public governance in accomplishing system change in practice has received limited attention. Furthermore, scholars in public administration do not address how system change can be achieved. Researchers in the field of transition management have explored this issue.

Transition management is a deliberative process that influences governance activities to accelerate system change toward societal ambitions [21]. This perspective brings a sense of urgency and societal engagement to the research and the necessity to engage deeply in practical contexts where actors deal with transitions [22]. Consequently, transition management strives to strategically leverage innovative developments by coordinating various levels of governance and fostering self-organization through novel forms of interaction and cycles of learning and action, focusing on radical innovations that offer sustainability benefits. It also acknowledges the significance of actors and agency in sustainability transitions [23] and the role of power within multi-actor networks [24, 25]. These networks include multiple possible modes of policy and decision-making (e.g., hierarchical, market, network) and multiple possible actors (e.g., government, industry, research, civil society) [26]. Much of the research on transition management has concentrated on European countries, while studies about North America, Japan, China, and India remain considerably underrepresented [27]. Despite the progress made by transition management researchers, the knowledge about the overall governance and its effectiveness in practice is still scarce [28, 29].

This paper bridges the two knowledge gaps mentioned above by examining the practical implementation of the circular economy in three Dutch product chains (mattresses, concrete, and textiles). The analysis entails a comparative, longitudinal study based on action research conducted by the author of this paper. It also contributes to the public administration literature by analyzing the interplay between network and public governance in real-life cases.

The paper's structure is as follows:

1. Theoretical background: This section will explore the origins and meaning of network governance as a contemporary form of governance, drawing inspiration from recent literature in public administration. In addition, this section summarizes the insights gained by scholars in transition management, offering a foundational understanding of how systemic changes can be accomplished.
2. Materials and methods: This section will explain the methodology used in the analysis. This includes an examination of the Dutch context in which the case studies were conducted, the rationale behind selecting these specific cases, and the data used. The section will also provide

an account of our research approach, emphasizing the importance of comparative, longitudinal analysis and action research.

3. Results of case studies: The paper will explore how network governance operates in conjunction with public governance, focusing on three Dutch product chains (mattresses, concrete, and textiles) that address the transition to a circular economy. Each case will be summarized and subsequently compared to one another.
4. Discussion: Reflecting upon the results of the comparative analysis will lead us to conclude that, despite contextual variations, network governance plays a supportive role in enabling the transition to a circular economy. Ten general principles that encapsulate the network governance approach will be outlined. This section will also discuss the broader applicability of these findings within the Netherlands and other countries. Furthermore, the scientific added value of these results within the existing literature and the managerial and practical implications for governing system change will be elucidated. Finally, the study's limitations and recommendations for future research will be addressed.

2. Theoretical Background

The concept of governance has gained widespread acceptance in the academic literature as a promising approach to addressing the complex societal challenges of the present day [12, 13]. The definition and implications of governance vary depending on the specific context in which it is applied. Governance can take various forms, such as good governance in economic development, as advocated by institutions like the World Bank and other international organizations; corporate governance within the private sector; good governance within the public sector; or the governance of collaborations between public and private entities [17]. Despite the diverse applications, these different approaches to governance share some fundamental characteristics. Overall, they reflect the belief that modern societies have experienced a destabilization of traditional governing mechanisms, leading to the emergence of new governance arrangements [17]. These approaches are characterized as pluricentric rather than unicentric.

The concept of governance, as an organizing principle for public management reform, reflects a widespread - though not universally held - belief that administrative practices in modern societies are shifting away from traditional hierarchical government structures toward a greater reliance on horizontal, hybridized, and associational modes of governance [14]. However, this transformation does not imply a complete replacement of government by governance; rather, it indicates the coexistence of different governance modes [19]. This coexistence suggests bidirectional movements along a continuum, ranging from state intervention (characterized by traditional hierarchical government control and authoritative allocation of values to society) to societal autonomy (where self-organizing networks of coordinating societal actors operate). Most governance modes can be placed somewhere along this continuum rather than at extreme poles. Thus, 'government' and 'governance' are not fixed and distinct entities but can be viewed as two ends of a spectrum [14].

To facilitate complex societal change, researchers in public administration recommend an interactive, multi-actor form of governance, defined as follows: "the complex process through which a plurality of social and political actors with diverging interests interact to formulate, promote, and achieve common objectives using mobilizing, exchanging, and deploying a range of ideas, rules, and resources" ([30], p.2). Because these complex multi-actor interactions cut across the state,

market, and civil society, this form of steering is commonly called network governance [13]. Networks in this context are comprised of actors who are highly dependent on each other, as solving problems requires the contribution of various actors who possess different resources. The interdependencies among these actors, combined with their varying and occasionally conflicting perceptions and strategies, result in a high degree of strategic complexity and unpredictability during network interactions. One actor's actions can significantly impact others' interests and strategies [13]. Network governance encompasses the conscious steering attempts or methods of actors within governance networks to influence these networks' interaction processes and characteristics [13]. Provan and Kenis [31] argue that while network governance may not be legal, it remains crucial for achieving effectiveness complementary to public governance. Especially in the public and non-profit sectors, where collective action is often necessary for problem-solving, goal-directed networks play a significant role as formal mechanisms for achieving multi-organizational outcomes [31]. The authors assert that some form of governance is indispensable to ensure that participants engage in collective and mutually supportive actions, address conflicts, and efficiently and effectively acquire and utilize network resources.

Despite the growing acceptance of the new mode of network governance, concerns are expressed in the literature about problems related to democratic anchorage, the representation of actors in networks, and the governability of networks. Many authors recognize the tensions between representative democracy with a more vertical accountability structure and the direct democracy of network governance processes [13]. Some fear this undermines democratic equality and transparency [32], but most authors prefer the new governance approach to the traditional decision-making model [20]. The latter argue that governance networks might be undemocratic but that this does not necessarily mean a rejection thereof. Instead, governance networks should be assessed regarding their 'democratic anchorage' in a set of democratic rules and norms and several political constituencies [20].

Network governance is a dynamic and intricate form of collaborative steering. It involves diverse actors working together to address common objectives, relying on mutual interdependencies within governance networks. Researchers in public administration advocate that network governance can enhance the political leadership of elected politicians through their interaction with networks of engaged actors, fostering joint ownership of solutions to complex societal issues. Although they do not consider it a panacea, network governance can improve the democratic character of decision-making [13, 20]. To establish its democratic legitimacy, the introduction of transparent rules and norms is needed [33].

Researchers in public administration primarily focus on new modes of governance, particularly in solving complex societal issues. However, they do not address how system change can be realized. This area of research is discussed in system innovation, particularly in the subfield of transition management [22, 34, 35]. Over the 21st century, this field of research has gained significant traction, particularly among scholars in the realm of sustainability [27]. The impetus behind the growth of transition research is to empower disruptive innovations and transformative capacity, facilitating desirable sustainability transitions [22].

Inspired by innovation research, scholars in transition management adopted the multi-level perspective (MLP) [36]. The MLP perceives transitions as non-linear processes that arise from the interplay of developments at three analytical levels: niches, regimes, and the landscape [37]. Niches are the breeding ground for radical innovations that diverge from prevailing regimes [38]. Niche

actors often lack the broader acceptance of their innovations in the market. Regimes, on the other hand, represent the established practices and associated rules that maintain the stability of existing systems [37]. They are usually hampered by risk avoidance considerations and special interests, with much to lose in the short run [39, 40]. Overcoming the tension between regime and niche actors and empowering circular businesses are underexamined issues in the literature [41, 42]. The landscape constitutes the broader exogenous environment that niche and regime actors cannot immediately influence. Landscape pressures encompass trends such as globalization, urbanization, climate change, and events like wars and natural disasters [36, 43].

First insights into how the transition towards sustainability evolves were provided by Rotmans et al. [44]. The authors developed an evolutionary model of transition management consisting of the following subsequent stages:

- "A pre-development phase where the status quo does not visibly change
- A take-off phase where the process of change gets underway because the state of the system begins to shift
- A breakthrough phase in which structural changes take place through an accumulation of sociocultural, economic, ecological, and institutional changes that react with each other
- A stabilization phase where the speed of social change decreases and a new dynamic equilibrium is reached" ([44], p.17).

Simons and Nijhof [45] complemented this four-phase model of Rotmans et al. [44] by including a business perspective. Their framework of sustainable market transformation consists of the following four stages: inception, first movers, critical mass, and institutionalization. They also note that stakeholders such as governments, industries, NGOs, and financial institutions have evolving roles and instruments in each phase. The significance of actors in sustainability transitions, as well as the role of power within multi-actor networks, has also been emphasized by other authors in transition management [23-25].

To facilitate and coordinate such networks, various scholars emphasize the significance of a neutral intermediary capable of aligning all relevant actors and expediting the change process through goal-oriented network governance [2, 46-50]. In this paper, the intermediary, a 'transition broker,' acts as an orchestrator in the transition process, serving as a leader with clear societal objectives in mind [51]. The perspective of goal-oriented network governance, facilitated by a transition broker, provides the guiding approach adopted in this paper.

A significant portion of the scholarship on sustainability transition management has focused on designing, analyzing, or evaluating governance in transitions. However, there has been limited examination of how sustainability transitions can be governed over time [35, 40, 52]. This paper bridges this knowledge gap by analyzing the evolution of transitioning to a circular economy in three Dutch product chains in practice. It also contributes to the public administration literature by examining the interplay between network and public governance in real-life cases.

3. Materials and Methods

This paper presents a comparative, longitudinal analysis of three Dutch product chains (mattresses, concrete, and textiles) transitioning to a circular economy. These three product chains are central to the circular economy policies of the Dutch government. In alignment with the EU's Circular Economy Action Plan of 2015 [53], the Dutch government adopted a comprehensive circular

economy program [54], which was subsequently followed by an execution program [55]. The program aims to develop a circular economy by 2050 and achieve a 50% reduction in primary raw materials, such as minerals, fossil fuels, and metals, by 2030. To attain these ambitious goals, five vital economic sectors and value chains were identified: food and biomass, plastics, manufacturing, construction, and consumer goods. The mattresses and textiles cases fall within the consumer goods category, while concrete is associated with construction. These product chains were selected because they exemplify significant sustainability challenges. They encompass diverse market dynamics, ranging from predominantly local consumer markets (mattresses) to global consumer markets (textiles) and local business-to-business markets (concrete). At the outset of the study, the adoption of circular economy principles was nascent across all three cases, with a lack of government instruments to guide the transition process. The cases were initiated from the grassroots level through network governance. The analysis primarily focuses on gradually implementing network governance, in conjunction with public governance to facilitate the shift towards a circular economy.

Throughout the transition process, the goal was to achieve the highest possible level on the circularity ladder. The highest priority on this ladder is refusal of use, followed by reduction, which means decreasing material use per unit of product. Afterward, priority should be given to rethinking the product in view of circularity; next to product options such as reuse, repair, refurbishment, remanufacturing, and repurposing, and then to material and resource recycling. Finally, any remaining residue that cannot be recycled should be incinerated with energy recovery, although this practice is not part of a circular economy [2]. In addition to responsible and careful management of resources, the ecological dimension also highlights the utilization of renewable energy sources and the preservation of natural ecosystems' resilience [2].

The research was carried out from 2016 to the present. The three circular initiatives examined in this paper were initiated from the bottom up through networks of interested actors. The data were collected through action research conducted by the author of this paper. Several scholars in transition management emphasize the importance of action research [22, 56, 57]. This approach involves scholars actively engaging and becoming part of the change process. In the three cases analyzed here, the author acted as an intermediary ('transition broker') orchestrating the transition process through network governance. Following the model proposed by Loorbach and Rotmans [58], the intermediary primarily focused on frontrunners, also known as 'niche actors.' However, ‘regime actors’ representing established practices that maintain the stability of existing systems were also involved from the start, provided they were willing to embrace change [37]. The transition broker's role consists of building coalitions with parties willing to take transformative steps forward, aligning relevant parties, and accelerating the transition process. The transition broker was assisted by a co-broker responsible for secretarial and organizational tasks, including documenting minutes of all meetings and events. They participated as a transition broker and acquired in-depth knowledge about the process, content, and preconditions for change. A critical attitude and self-reflection are essential to prevent a biased interpretation of the data [59]. Therefore, the transition broker regularly reflected on critical participants and shared findings with a broader audience. These reflective pauses aided the author in interpreting the results as a thoughtful scientist [59]. No ethical issues were encountered in gathering the data.

The comparative analysis relies on relevant documents, meeting reports, and personal observations. The specific data used for each case will be explained below. The format of the case

descriptions is similar, which facilitates comparability. Each case will be analyzed as an evolutionary process consisting of four subsequent but cyclic phases: the preparing phase, the building phase, the scaling-up phase, and the mainstreaming phase. The main activities in each step will be described, including the sense of urgency felt by the actors in the product chains to take collective action. A coalition of willing actors was formed to catalyze the transition in the preparation phase. An overview of these primary actors will be provided. Attention will also be given to the broader group of network actors involved throughout the entire process, the role of the transition broker, and the interaction with public national agencies.

4. Results of Case Studies

4.1 Case Mattresses

The Mattresses case was initiated within the framework of a regional circular economy program established in 2015 by this paper's author, a member of the Amsterdam Economic Board [2]. Mattresses were one of the nine resource streams selected due to their significant yearly disposal volume (1.2 million) and the conventional practice of incineration [35]. The challenge was to shift from incineration to extending the lifespan of mattresses, promoting reuse, and enabling high-value recycling. Several preconditions favored this transition: the primary waste incineration plant in the region did not prefer to accept mattresses, as they are prone to catching fire when stored and disrupt the incinerator's heat balance due to the high energy intensity of the mattress materials. Additionally, two recycling facilities were already operational as alternatives to incineration. However, these facilities were not yet highly efficient, and the recycling process remained costly. New financial arrangements were sought to address this impasse, but none were deemed attractive for regional implementation. Switching to recycling resulted in higher costs for municipalities, leading to increased waste management levies for citizens. In response, the transition broker organized a circular economy lab involving all participants in the mattress chain at the national level, including the government. The lab's objective was to address the main obstacle (the financial challenge) and explore options for achieving higher levels of circularity. In preparation for the lab, the transition broker interviewed 10 individuals representing various stages of the product chain. Most were invited to participate in one of the two panels held during the lab. Detailed minutes of each interview were documented, providing an overview of the current mattress situation. Through these preparatory interviews, a consensus emerged: the interviewees leaned toward introducing an Extended Producer Responsibility (EPR) scheme, allowing for an additional fee (approximately €4 on top of the product price). This collective fee could fund mattress collection, logistics, recycling, and efforts to achieve higher levels of circularity. During the lab, representatives from the entire product chain agreed on introducing an EPR scheme. A video recording of the whole lab and a report documented the lab's proceedings.

The lab initiated a nationwide collaboration among key stakeholders in the Dutch mattress chain. The branch organization representing municipal cleaning services was willing to take the lead in preparing the voluntary Extended Producer Responsibility (EPR) program in partnership with representatives from the entire supply chain. This branch organization invited all actors from the chain to attend follow-up meetings, all of which were well-documented. However, due to the diverse actors present at these meetings, many issues were raised without a clear order of priority. Additionally, the sessions were chaired by a junior employee of the branch organization, who lacked

the time and authority to negotiate the differences of opinion within the group effectively. In response, the transition broker intervened and requested subsidy assistance from the Dutch government to hire an independent senior professional for EPR preparation. Given time constraints, the transition broker could not fulfill this role, so another senior individual (a former director of Green Growth within the Ministry of Economic Affairs) was hired. Initially, he focused on individual discussions with key players, namely the branch organization of the mattress industry and the five largest mattress manufacturers and importers in the Netherlands: IKEA, Beter Bed, Auping, Swiss Sense, and Hilding Anders. This small group of key players has a high local presence, although some belong to a worldwide brand. With some assistance from the transition broker, these key players resolved their differences of opinion and reached an agreement to increase the mattress recycling rate to 60% by 2025 and 75% by 2028. In response to this decision, the recycling industry quickly expanded to create a nationwide system. In the wake of these developments, municipalities and logistics market participants also established a new collection and logistics system. With more than 70% of mattress manufacturers agreeing to the voluntary EPR, it became mandatory for all manufacturers. The Dutch government officially made the EPR generally binding from January 1, 2022, to October 31, 2025. The scheme focused on recycling and did not specify other circularity options, such as reuse, lifespan extension, and material substitution. Manufacturers preferred to address those options in the next phase of the EPR.

As part of the network governance framework, the primary stakeholders developed the EPR, with coordination by an independent senior professional and some support from the transition broker. Public governance was primarily limited to formally declaring the EPR's binding status for the entire mattress industry.

4.2 Case Concrete

Concrete is a relatively simple product of sand, gravel, and cement. The Netherlands has minimal cement production, and the concrete output primarily caters to a local, business-to-business market. The initiative to draft a Concrete Agreement among representatives of the entire concrete chain was launched in 2016. This effort aimed to unite stakeholders at a national level in response to societal criticism regarding the sector's significant environmental impact. Worldwide, the concrete industry generates important waste streams and is responsible for 7-8% of total anthropogenic CO_2 emissions, with cement alone contributing to approximately 80% of these emissions [60]. In the Netherlands, CO_2 emissions are lower, ranging from 3-4%, primarily due to the use of blast furnace slag and fly ash. However, with the increasing scarcity of these raw materials, the concrete industry is compelled to seek sustainable alternatives. Furthermore, the annual production of aggregate concrete and its water consumption contributes to the depletion of natural resources. To mitigate these impacts, redesigning the concrete chain, substituting cement, reducing the amount of concrete (including cement) per product unit, extending the lifespan, promoting reuse, and enhancing recycling practices should become standard. In the Netherlands, approximately 90% of demolished concrete currently finds use as pavement under roads. Opportunities for higher-value recycling and increased reuse exist but have not yet been widely implemented.

It took two years to formulate and sign the agreement in 2018, involving 82 representatives from the concrete chain and the Dutch government. The signatories represented both frontrunners, followers, and some laggards. This hampered the process of formulating an ambitious agreement.

The author of this paper has been serving as a transition broker since the start of the execution phase in September 2018. Throughout this period, all activities have been meticulously documented through meeting minutes, reports, and summaries of individual conversations, diligently maintained by the secretary of the Concrete Agreement. This secretary, an expert in concrete with a comprehensive understanding of the sector's key actors, has played a pivotal role in this process.

The transition broker, supported by a Steering Committee, established self-steering teams responsible for developing roadmaps for CO2 reduction, recycling and reuse, circular construction, performance indicators (environmental cost and circularity indicators), monitoring tools, an innovation program, and procurement guidelines. Negotiations within these teams proceeded sluggishly, with participants engaging in continuous discussions but struggling to make decisions or formulate ambitious roadmaps. As a result, the intervention of the transition broker was necessary on multiple occasions to expedite the process. Notably, when it came to the roadmap for CO_2 reduction, team members refrained from criticizing each other for their reluctance to embrace change. Consequently, the team adhered to the relatively modest target outlined in the Agreement. However, one team member's analysis of potential alternatives for current concrete revealed the opportunity for more ambitious goals.

Since the self-steering teams primarily consisted of mainstream actors, with only a few representing innovative entities, the negotiations stagnated in various groups. Consequently, the transition broker established a final delivery date for the team's outcomes and concluded their work. The results obtained were then utilized for the subsequent activities. As these activities required the participation of various stakeholders, the initial steering committee, primarily composed of mainstream actors, was replaced in 2020 by a second committee with a more excellent representation of commissioning parties and innovative concrete companies. This newly constituted steering committee supported the transition broker in orchestrating the Agreement toward a more ambitious yet realistic direction. Moreover, it played a pivotal role in identifying and addressing the primary bottlenecks that impeded the scaling-up process.

The primary barriers to scaling up were as follows: The introduction of concrete innovations with a low CO_2 impact faced obstacles due to the quality standard EN206, which mandates a minimum percentage of cement in concrete. Approvals for alternative binders instead of cement were difficult to obtain unless many tests convinced certification bodies. Changing the existing standard would require years of negotiations with dominant players in the concrete industry, with uncertain prospects for success. As a result, a new quality assurance methodology was proposed in parallel to the current standard, focusing on assessing performance-based innovations. Introducing this methodology was controversial and consequently consumed a considerable amount of time. Now, innovative companies can test their new products based on the new method, ‘concrete based on performance.’ At the same time, a working group concurrently develops a general standard for this methodology, which is expected to be completed in approximately three years.

Another barrier was the lack of support for innovation. In 2022, a substantial innovation program named 'Concrete Reinvented' was developed in close cooperation with the Ministry of Infrastructure and Water Management and submitted to the Dutch National Growth Fund. Material substitution, reuse, recycling, and circular design and construction supported by IT applications (3D printing, AI, and topological and parametric designing) were focal areas in this application. Notably, IT was vital as it could help green the product chain and industrialize the production processes [61]. Unfortunately, the submission did not yield a successful outcome. However, it has garnered

increased support from companies across the concrete supply chain and the Ministry of Infrastructure and Water Management to pursue innovation. In 2023, a new initiative was launched to foster collaboration between commissioning parties and innovative industrial entities to accelerate change and jointly prepare a revised innovation proposal for the Dutch National Growth Fund.

Another remaining bottleneck is the absence of regulation. Regulatory measures are essential to encourage the adoption of new innovations with lower CO2 impact and higher circularity by established regime actors in the industry. All parties involved in the Concrete Agreement acknowledge that these followers ('peloton') are unlikely to take action unless compelled to do so. The most viable approach to regulation is harmonizing the procurement requirements, which will become much stricter in time. In 2021, on behalf of the Steering Committee, the transition broker wrote a letter to the Secretary of State requesting this harmonization. The primary arguments were that it establishes a level playing field and provides certainty for innovative companies regarding the outlook for their investments. It requires alignment between commissioning parties and innovative companies to create viable business cases. At the outset, negotiations for this harmonization were progressing slowly due to a misalignment with the government's plans. Although there was some interaction between network governance (the Concrete Agreement) and public governance, it did not initially constitute a self-evident cooperation. The government initially maintained a distance to preserve its independence. Nevertheless, the close collaboration in formulating an innovation program has fostered increased trust and a greater willingness to collaborate. As a result, mutual understanding has developed between the government and the concrete product chain, likely leading to a shared approach to harmonization.

The concrete sector and its entire chain will undergo a profound transformation upon removing all the barriers mentioned above. CO_2 emission reduction may lead to climate neutrality by 2030 (compared to 1990), reuse and recycling may reach 100%, and circular design and construction, when combined with IT applications, can lead to significant reductions in material usage and yield greater circularity gains in the future.

4.3 Case Textile

Societal pressure on the textile industry is intensifying, demanding improved environmental and social performance. Globally, the clothing industry accounts for nearly 10% of total CO_2 emissions [62]. Furthermore, the production of clothing, particularly in regions where most textile and clothing manufacturing occurs, such as India, China, and Bangladesh, has resulted in severe environmental, economic, and social challenges, including water shortages and pollution [62]. Achieving a transformation towards a circular textile industry is an enormous challenge. The Dutch clothing and fashion sector is highly globalized, competitive, and oriented towards rapid, cost-effective production. Market dominance by major, worldwide brands poses a significant barrier to newcomers attempting to scale up circular products [63]. Consumers are still very attached to fast fashion consumption and do not see the negative consequences associated with high levels of consumerism. Slow fashion has not yet conquered market space because of this [63]. Similarly, limited attention is given to phasing out hazardous substances and releasing plastic microfibers [64].

The initiative to establish closed textile loops within the clothing and textile sector in the Netherlands dates back to 2017 when the plan, "On the Road towards Circular Textiles: Roadmap

for the Dutch Textile Industry," was introduced [65]. This plan was formulated by the Dutch Circular Textiles Platform and was followed by a sector-specific program. These documents outline the fundamental principles of circular textiles and delineate the critical strategies for achieving circularity. Additionally, in April 2020, the Dutch government issued a letter articulating ambitious policy objectives to steer the clothing and textile industry toward greater sustainability [66]. By 2025, the government aims to have 25% of the materials in textile products as recycled or sustainable and 30% of all products marketed as recycled. By 2030, the goal is for 50% of all textile products on the market to consist of at least 30% recyclates or sustainable materials (20%), while 50% of the textile products are recycled. The government intends to achieve these objectives in close collaboration with the sector, potentially through introducing an Extended Producer Responsibility (EPR) policy. Like the mattress case, EPR was required to establish a viable business case for chain partners.

In addition to these national policy-oriented initiatives, numerous business initiatives have been launched, particularly after 2014. These initiatives address specific components of the clothing product chain. For instance, pioneers in the fashion industry have introduced more eco-friendly product lines and take-back systems for used clothing. Newcomers, including startups and scale-ups, have developed various slow fashion alternatives in response to the prevailing fast fashion trends in the mainstream market. Instead of increasing clothing production, these newcomers advocate for reduced consumption, increased clothing sharing, and responsible new clothing production. While significant progress has been achieved, these circular initiatives are still primarily isolated projects scattered across different regions of the Netherlands.

To strengthen these innovative circular initiatives, transition brokers in four distinct regions in the Netherlands collaborated with Modint, the industry organization for fashion, interiors, textiles, and carpets. By aligning their regional efforts, they aimed to generate greater synergy in innovation across the entire clothing chain. This collaboration established the Dutch Circular Textile Valley (DCTV) in May 2019. The initiative has been recognized as a flagship project within the Dutch government's agenda for transitioning towards sustainable consumption goods. The flagship project aims to transform a collection of valuable, predominantly small-scale initiatives into a widely supported circular textile movement. The DCTV aims to empower textile industry frontrunners, especially newcomers, and encourage innovative fashion brands and retailers to join the cause. Modint has supported the establishment of the DCTV as a catalyst for innovative circular initiatives that mainstream textile producers can adopt in the future.

The DCTV is an independent, nonprofit organization. The author of this paper serves as the chair of its national Steering Board. Under the DCTV's umbrella, there is a national coordinating body and four active hubs, each dedicated to different themes:

- Hub Twente centers on high-value textile mechanical and chemical recycling
- Hub Amsterdam Metropolitan Area focuses on circular aesthetics (including circular design, new business models, and consumer awareness) and the high-value use of post-consumer textiles
- Hub Tilburg concentrates on the fiberization of workwear materials and the reuse of recycled fibers in new workwear
- Hub Gelderland explores new biomaterials for fabrics.

In the initial phase (2019-2021), the Dutch government executed and funded four distinct projects. These projects were primarily oriented toward assisting individual companies and arranging a circular fashion exhibition. While these endeavors were valuable, they lacked

substantial integration with the four hubs and the overarching goal of creating a circular movement. Consequently, a shift in direction occurred, with increased emphasis on developing a collective network of innovative business partners under the coordination of the DCTV hubs and the national transition broker. Their collaboration was recently formalized by adopting a shared mission and strategy. The DCTV also requested the executive body of the Extended Producer Responsibility (EPR) for Textiles (called PRO), in which major brands are represented, to accept the DCTV as the innovative driving force behind the EPR. DCTV proposes coordinating the EPR innovation program funded by the additional fee on textile prices in the Dutch market. Negotiations are underway to finalize this division of responsibilities with the governing body of the EPR Textile. Once approved, the DCTV can play a pivotal role in enhancing the innovative character of the existing EPR and in shaping the objectives and instruments for future policies to be introduced in 2030. This case study highlights the DCTV's journey in pursuing an optimal approach to bolster the circular initiatives of innovative textile companies. The DCTV must establish its credibility before gaining recognition as a valuable partner. The government has led in steering the transition toward circular textiles and aims to maintain this position. The network governance function performed by the DCTV must align with government policies. Over time, the DCTV has gradually gained acceptance as an innovative force among mainstream textile producers and within government circles.

4.4 Comparative Analysis

Below, the three cases will be compared based on their evolution over time, action plans, and the involvement of actors. The analysis indicates that the implementation of the three circular initiatives can be clearly defined as a four-stage process that is both sequential and cyclical:

1. Preparing the circular initiative.
2. Developing one or more joint business cases.
3. Scaling up a successful circular initiative.
4. Mainstreaming the circular initiative.

It's important to note that this four-stage process should not be viewed as a linear journey toward improvement. Instead, it requires multiple rounds of more far-reaching enhancements while avoiding technological lock-in. Thus, the transition should be seen as implementing an ever-increasing number of meaningful building blocks on the path to a circular economy rather than a sudden and radical system change.

In the mattress's case, a voluntary Extended Producer Responsibility (EPR) was introduced as a significant steering instrument. In the first round, the strategy mainly focused on recycling. In the textile case, the EPR also included reuse. However, second and probably more rounds are needed in both cases to achieve circularity at the highest steps on the circularity ladder. In the concrete case, it will also take several rounds to become fully climate-neutral and circular. As shown in Figure 1, the three product chain initiatives followed a similar trajectory, albeit at different speeds. The mattress case exhibited the most accelerated progress, as it was relatively simple to organize with just a few key actors (the mattress producers). The concrete case evolves more slowly. Although the material may seem simple, replacing cement with other binders is challenging due to strict standards, certification procedures, and a lack of government guidance.

	 Mattresses	 Concrete	 Textile
Preparing	Circular economy lab with the whole product chain	Concrete Agreement prepared by a diverse group of stakeholders	Establishment of regional, circular textile hubs
Building	Agreement among producers on a voluntary extended producer responsibility (EPR)	Development of roadmaps, monitoring system, new standards, procurement guidelines and innovations	Creating an innovative network of regional hubs that can support the current EPR and shape future policies
Scaling up	In full swing	Has started in 2021	Has not yet started
Mainstreaming	Has not yet started	Has not yet started	Has not yet started

Figure 1 Four-phase model for implementing circular economy in product chains.

Furthermore, the concrete sector is hesitant to embrace change until innovations have been proven on a larger scale and there is a more robust demand for more sustainable concrete. The textile case progresses the slowest, as this product chain is highly globalized and dominated by large brands whose current business models are at odds with principles higher on the ladder of circularity. The innovative circular textile movement is steadily expanding, yet it necessitates further momentum to emerge as a robust counterforce.

At various stages, each initiative focused on specific activities necessary to achieve the established goals. In the mattress's case, the preparatory phase commenced with a circular economy lab, leading to an agreement among all partners in the product chain to introduce an Extended Producer Responsibility (EPR) scheme to finance the new, more circular system. Negotiations among the primary actors (mattress producers) during the building phase resulted in a voluntary EPR formally introduced in 2022. As over 70% of the market, in terms of volume, had committed to the Extended Producer Responsibility (EPR), the government mandated it for the entire sector. This has led to the scaling-up phase.

In the concrete case, the Concrete Agreement was signed after two years of negotiations involving all parties in the product chain. During the building phase, self-steering teams carried out the work, which included many stakeholders with conflicting views, making it challenging to reach unanimous, ambitious conclusions. Consequently, the transition broker urged the groups to complete their work. The remaining work was managed by ad-hoc dedicated teams chaired by the transition broker. The scaling-up phase began in 2021, during which the national government's involvement became crucial for harmonizing procurement requirements. Most of the work could be done through network governance, but scaling up public governance was indispensable. In the textile case, an EPR also catalyzed change. In this instance, the Dutch government took the lead in formulating ambitious targets for recycling and reuse. To provide innovative input for the current EPR and future policies, the four regional Dutch Circular Textile Valley hubs and the national hub collaborated. However, the scaling-up phase for these innovative initiatives has not yet commenced.

The first step in sparking a transition is identifying actors with urgency to change. In the three product chain initiatives, the level of speed varied across the entire chain. In the mattress's case, the urgency was high because the existing solution – incineration – faced criticism from all partners in the chain, particularly the waste treatment plant in Amsterdam and the two recyclers already operating in the market. In the concrete case, some actors formulating the Concrete Agreement

strongly felt the urgency, while others were less concerned. In the textile case, more prominent, influential brands awaited government regulation to take action, while the frontrunners proactively initiated change on a stand-alone basis. The number of participants in the three product chain initiatives also varied. The mattress case involved a limited number of actors, whereas the other two cases had many participants.

Additionally, the scale at which the transformative change process was organized differed. The mattresses and concrete cases were focused on a national scale, while the textile case also operated on a regional scale. These differences in urgency, the number of participants, and the scale in the three product chains are summarized in Figure 2.

	 **Mattresses**	 **Concrete**	 **Textile**
Urgency	High	Medium	Scattered
Number of participants	Limited	Many	Many
Scale	National	National	National and regional

Figure 2 Urgency, number of participants, and scale in the three product chains.

In the three product chain initiatives, the relevant actors could be categorized into prime, complementary, and supportive actors. Generally speaking, prime actors have the ability to steer the transformational change process toward scaling up, complementary actors can assist the change process, and supportive actors play a role in creating broad support. In the scaling-up phase, public governance is indispensable in all three cases. The importance of the actors' roles can change during execution. In the case of mattresses, many relevant actors were identified during the circular economy lab organized at the beginning of the transition process. It became evident that mattress producers played a crucial role as the prime actors in the change process. At the start of the Concrete Agreement, representatives from various segments of the concrete chain, including sand and gravel extraction, concrete mortar, prefabrication, concrete goods, binders (cement), demolition, recycling, contractors, builders, architects, as well as the government and research institutes, were involved. However, during the transition process, the prime actors were the commissioning parties and innovative concrete chain partners.

In the textile case, the national government and a significant number of stakeholders within the Dutch Circular Textiles Platform initiated the transition process. However, innovative brands and the slow fashion industry emerged as critical players in advancing circular textiles. These three cases demonstrate that it takes time to assemble a coalition of willing partners committed to making significant strides in transitioning to a circular product chain. Once formed, they assume a central

role in driving the change process, with other actors following suit. The prime, complementary, and supportive actors involved in these three product chains are summarized in Figure 3.

	Mattresses	Concrete	Textile
Prime actors	Coalition of willing mattresses companies and branch organization of mattresses	Innovative concrete chain-actors and commissioning parties	Slow fashion industry and innovative fashion brands
Complementary actors	Recyclers, municipal cleaning departments, researchers and government	Concrete and building industry, demolition/recycling companies, sand/gravel companies, government, certification bodies and researchers	National and local government, consumers' organizations, professional customers, recyclers and researchers
Supportive actors	Branch organization of mattress retailers, raw material suppliers and consumers.	Branch organization of building sector, non-governmental organizations and broader public	Consumers

Figure 3 Actors involved in the three product chains.

Comparing the three product chain initiatives reveals that similar tasks need to be performed by the transition brokers. However, the amount of work and time required for each job varies among the initiatives. The studies to be carried out during the four subsequent transition phases are summarized in Figure 4. Those mentioned in Phase 4 are indicative and have not yet been tested in practice.

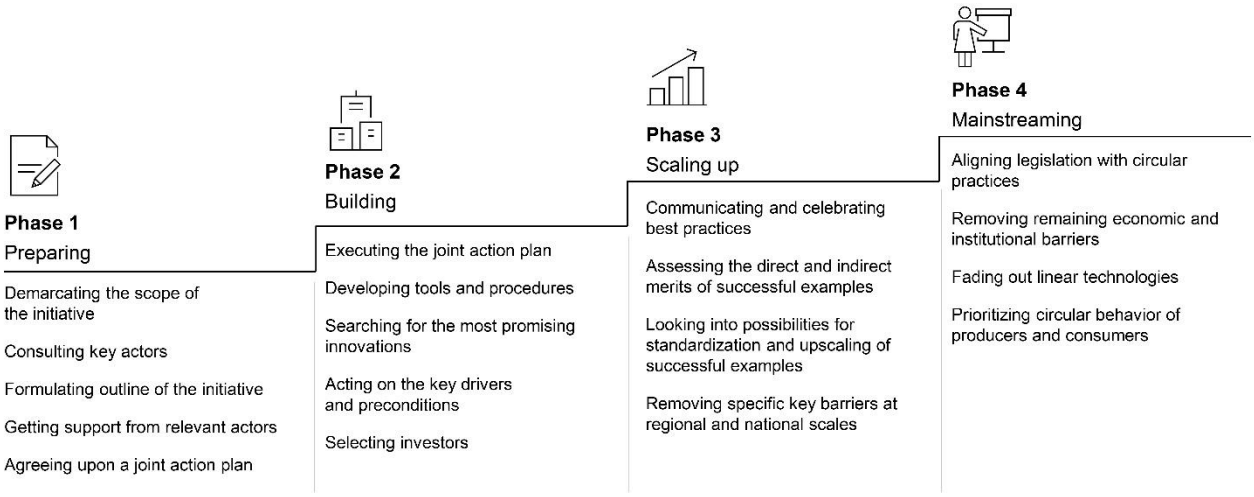

Figure 4 Tasks to be carried out during four subsequent phases.

While implementing the tasks, actors could not strictly follow a predetermined set of activities. Experimentation is crucial in a fundamental system change, such as the transition to a circular economy. It is not a project with a predefined plan from start to finish but a flexible process that requires adaptability, learning, and responsiveness to new situations. While aiming for ambitious goals, it is essential to approach each goal step by step. This process can be likened to a journey

where the destination is clear, but the path is undefined. The specific context in which the change occurs varies from case to case, including the type of innovations needed, key drivers and prerequisites, and the involved parties. Additionally, it requires tailored alignment among chain partners to create viable business cases. However, the general approach of network governance to steering towards a circular economy remains similar.

The transition broker has fulfilled various roles in orchestrating the transition process. The role differs depending on the phase of the change process and the specific tasks to be performed in each case [51]. However, some general characteristics can be derived from the three product chains analyzed, which are summarized in Figure 5.

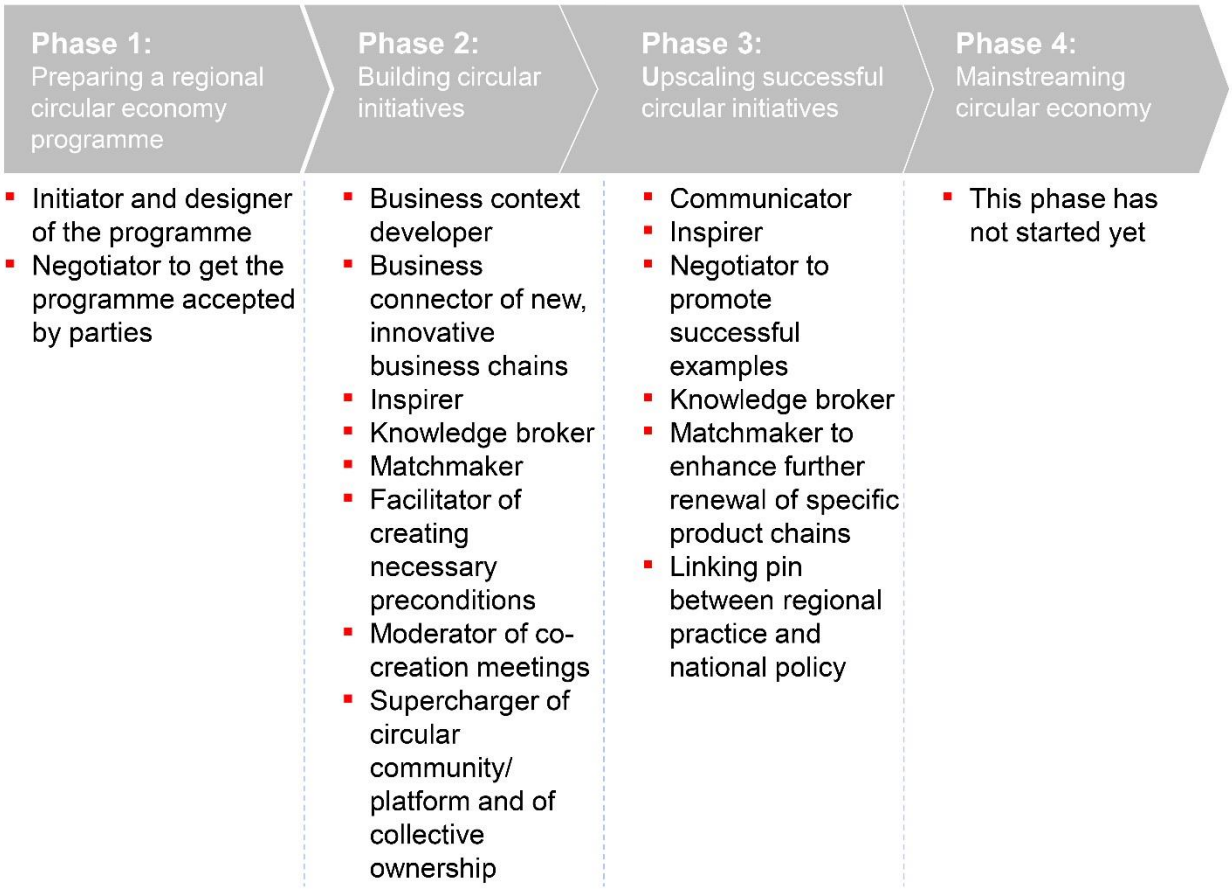

Figure 5 Roles of transition brokers in four subsequent phases.

The role of the national government varies across the three cases. Regarding mattresses, the government remained detached from the bottom-up network initiative within the product chain. The government's involvement was limited to formally declaring the binding status of the EPR for the entire mattress industry. In the textile case, the government has taken the lead in implementing an EPR with ambitious targets for 2030. The textile chain followed this government policy and established two networks: one for mainstream producers coordinated by the branch organization Modint and one for newcomers and innovative existing companies coordinated by the DCTV. The concrete case started as a diverse network of actors supported by the Dutch government. Still, it developed into an innovative network of willing actors mainly governed by the concrete chain and commissioning parties. However, in the scaling-up and mainstreaming phases, the steering role of

the government seems to be indispensable to activate the followers ('peloton') in the concrete sector and among the commissioning parties.

5. Discussion

The main objective of this paper is to investigate the practical implementation of the transition to a circular economy through network governance in conjunction with public governance. This research aims to conduct a comparative and longitudinal analysis of three product chains (mattresses, concrete, and textiles) in the Netherlands. This analysis is based on action research conducted by the author of this paper.

Relying upon the public administration and transition management literature, the paper aims to bridge two knowledge gaps. First, the paper contributes to the literature on transition management by illuminating how complex system changes, such as the transition from a linear to a circular economy, can be realized in practice. This focus on the practical implications has been examined a little. Secondly, it offers insights into how network governance can complement public governance in facilitating the transition to a circular economy. Since the beginning of the 21st century, scholars in public administration have advocated the need for this new form of network governance, particularly when addressing complex societal changes. However, the interplay between network governance and public governance in real-life cases has remained underexposed.

The three circular initiatives of mattresses, concrete, and textiles examined in this paper were initiated from the bottom up through networks of interested actors. These actors gave the author of this paper the mandate to orchestrate the transition processes as an intermediary (‘transition broker’). The transition broker’s role was to align the actors and accelerate the process in the desired direction. The approach adopted was in line with the principles of network governance. The comparative analysis of the three transition processes reveals the nuances of implementing systemic change. Each transition is customized, yet the general approach exhibits similarities in accomplishing tasks. All three cases can be categorized within a four-stage cyclic process involving multiple rounds of progressively more profound enhancements, ultimately leading to circularity.

In the three cases, the initial group of actors was diverse. The transition process gained momentum as this group transformed into a goal-oriented coalition of willing partners. These willing partners acknowledge the urgency for change and understand the need for cooperation to facilitate that change. They are often frontrunners in their respective sectors interested in developing innovative solutions. When they take the lead, they can demonstrate to the followers, usually established parties, that change is possible. Innovative pilot projects can reinforce their arguments. However, scaling up pilot projects often faces challenges, as existing rules and regulations must also change. The government is ideally positioned to modify these rules. The desired transition can be realized and democratically legitimized through a well-coordinated interaction between network governance and public governance. Numerous obstacles that impede growth can be identified, but often, a select few emerge as primary. The three cases systematically address and remove these central obstacles in collaboration with the government.

The comparative analysis of the three cases provides insights into how complex systemic changes, such as the transition from a linear to a circular economy, can be practically achieved. These insights are synthesized into ten guiding principles for building a circular economy through network governance, as outlined in Table 1.

Table 1 Ten guiding principles for building a circular economy through network governance.

Sparking the transition
Implementing circular initiatives is not business as usual; it requires a transformative change. The transition from a linear to a circular system goes through different phases, ultimately leading to the mainstreaming of the circular economy. The first four guiding principles help lay the foundation for a successful transformation.
Guiding Principle 1: The circular initiative starts with a coalition of willing partners who feel the urgency to move to a circular economy but realize that no one can make this change alone. They join forces aimed at reaching ambitious goals.
Guiding Principle 2: The implementation of circular initiatives occurs in four sequential phases. This four-stage process should not be viewed as linear but as a cyclic journey toward improvement. A circular product chain cannot be realized in one go; it requires several more far-reaching improvements. This means that the transition should be seen as implementing a continuously growing number of meaningful building blocks on the road to a circular economy rather than a sudden and radical system change.
Guiding Principle 3: Tasks for each circular initiative are roughly the same, but the focus is case-specific. The amount of work and time required to perform a task differs per initiative.
Guiding Principle 4: Building a circular economy is a journey with a clear destination but no predetermined path. It is a transformational change process in which participants should continuously adapt, learn, and respond to new situations. One has to think big but approach each goal step by step.
Context is key
Several key system variables should be considered when transitioning from a linear to a circular economy. Understanding the context in which the transformational change is to take place is crucial. The following three principles delve further into this context:
Guiding Principle 5: Focus on the most promising and disruptive innovations. The transformation towards a circular economy requires fundamental changes, making innovation indispensable. The objective should be to create space for innovative solutions while resisting the pressure from companies that defend the current system.
Guiding Principle 6: Map the key drivers and preconditions for successful implementation. To effectively steer towards the desired circular direction, one must understand the force field in which they operate. Awareness of fundamental barriers—whether economic, financial, legal, or social—and how these barriers can be removed step by step and by whom is essential. When it comes to scaling up and mainstreaming, the national government often plays a crucial role. This form of government intervention also enhances the democratic legitimacy of the initiative.
Guiding Principle 7: Identify the relevant actors and assess their willingness to collaborate. The first step is to identify actors that can drive the change. Initially, it can be challenging to determine which actors are interested in participating in the change process and which are the prime actors. A rough assessment can be made, but a fuller understanding typically develops over time.

Successful implementation

Successful implementation of a circular initiative hinges on three key factors underpinning the last three guiding principles.

Guiding Principle 8: New circular business models should benefit all network partners. Financing a circular initiative involving multiple partners presents a significant challenge. The alignment of their business models into a shared network business model is crucial.

Guiding Principle 9: Transition brokers can expedite circular initiatives. Since many of the actors are accustomed to working in silos, sometimes even within their organizations, establishing circular initiatives through new forms of cooperation poses a real challenge. Intermediaries, referred to here as transition brokers, can assist in aligning all relevant stakeholders. The tasks they undertake vary depending on the phase of the transition.

Guiding Principle 10: A transparent division of labor among relevant actors is essential. To effectively build a circular initiative, key actors must feel accountable for executing the necessary activities related to their roles in the system. Therefore, it is crucial to define each actor's functions, tasks, and responsibilities in both general and specific terms, initially and as the process progresses.

The ten guiding principles presented here are not entirely novel. Scholars in transition management have previously formulated four-phase models to structure the transition process [44, 45]. The understanding that transitions are long-term processes in which small wins will ultimately accumulate in transformative change is not a new concept either [67]. Critical activities for building an innovation system have also been extensively discussed [34]. Furthermore, the significance of multi-actor networks and internal power relations has been explored by other scholars in transition management [23-25]. The importance of a neutral intermediary in expediting the change process through goal-oriented network governance has also been examined [46-48]. The value added by this paper lies in the comprehensive integration of all aspects of transition management into a coherent framework based on long-term action research. It contributes to the transition management literature by amalgamating and synthesizing knowledge on transitioning to a circular economy.

The ten guiding principles were also implemented in other circular initiatives, particularly at the regional scale of Amsterdam [2]. Here, as well, the principles were found to be applicable. Furthermore, they were regionally tested for other transitions, including energy, medical technology, and digital transitions, yielding positive results [68]. By summarizing the essential components of a change into ten building blocks, this paper provides transition management practitioners with a systematic framework for thinking, acting, and collaborating. By emphasizing the critical role of the transition broker, this paper also clarifies the pivotal functions performed by this intermediary in orchestrating a transition over time. These ten guiding principles also support industry, local government, and non-governmental organizations in effectively managing complex societal change processes.

The cross-case analysis of the three product chains also offers insights into the interplay between network and public governance in real-life cases. This aspect has received limited attention in the public administration literature. The analysis illustrates that network governance can significantly

contribute to expediting the transition to a circular economy. However, it's essential to emphasize that public governance continues to play a pivotal role, particularly during the scaling-up and mainstreaming phases of the transition. While innovative companies can lead the way, guidance from public governance is crucial to bringing other companies in the product chain (the 'peloton') on board. The interaction between network governance and public governance varied among the three cases. In the case of mattresses, the network predominantly organized the transition process, except for the formal declaration of the EPR's binding status for the entire mattress industry. The government welcomed the active role of the network. In the concrete case, the transition process was primarily orchestrated through network governance. Although the government signed the Concrete Agreement and participated in the Steering Board, its governing role in the Agreement initially remained limited. Tensions arose between the government's formulation of building policies and the Agreement's call for harmonizing procurement policies. However, through collaboration on the National Growth Fund application for innovation, mutual understanding and trust between the Ministry of Infrastructure and Water Management and the Concrete Agreement have strengthened. In the textile case, similar tensions emerged between the government's policy to achieve specific recycling and reuse goals by 2030 and the more ambitious objectives of the DCTV, which unites innovative companies striving for higher circularity in textiles. Nevertheless, a consensus on the division of labor was reached through a better understanding of each other's positions and strategies.

Consistent with Hill and Lynn [14], 'government' and 'governance' are not fixed and distinct entities but can be seen as two ends of a spectrum. The government's role in steering varies among the cases, placing them at different positions on this spectrum. The interaction between network governance and public governance in the three cases demonstrates that implementing network governance is a learning experience for the network partners and a journey to collectively collaborate with the government to advance the circular economy. Additionally, this process necessitates shifting the government's mindset to embrace network governance as a complementary approach for governing complex transition processes. Establishing transparent communication between the government and critical network partners regarding the objectives of a specific transition initiative from the beginning can foster trust and mutual understanding. When the government gives one or more transition brokers the mandate to orchestrate a particular transition process, network governance can play a supportive role in advancing the transition goals outlined by the government. Rather than primarily negotiating with established ('regime') partners, as is the norm, network governance can mobilize coalitions of willing partners who recognize the urgency for change and collectively strive for innovative solutions. These partners are better suited to lead the transition than market partners who resist change. The tension between niche and regime partners can be alleviated through network governance, provided that transition brokers effectively steer the process toward an ambitious direction. This is a challenging task for the government, which is accustomed to negotiating with established entities like industry associations representing frontrunners, followers, and laggards within their respective sectors. When governments gain more experience incorporating network governance into their operational approach, they become better equipped to solve the complex societal issues they confront.

The insights mentioned above were derived from action research conducted in the Netherlands. The applicability of network governance in different socio-cultural and political contexts has received limited attention [69]. To provide an initial assessment, a separate study was conducted.

Local practitioners in the circular economy, representing fifteen other countries, were interviewed by Cramer [69] regarding the suitability of network governance in their respective nations. The study revealed a consensus on the necessity of network governance and the pivotal role of a transition broker in orchestrating the transition to a circular economy. However, how network governance and public governance interact varies based on each country's unique socio-cultural and political context. The critical variables identified included strong government leadership in the circular economy, high receptivity to network governance, active engagement of various stakeholders (government, industry, and societal organizations), and additional change drivers [69]. The likelihood of successful implementation depends on the interaction among these factors and the ability to leverage the most influential ones.

This paper has established the groundwork for implementing transition management through network governance in practice, which complements public governance. Nevertheless, as additional practice-oriented studies are conducted in a broader array of countries, encompassing developing nations and those with different political cultures (e.g., China, India, and South Africa), and exploring complex societal topics beyond the circular economy, the network governance approach outlined in this paper can undergo further refinement. This refinement will be invaluable in addressing the governance of the societal challenges that societies are grappling with globally.

Author Contributions

The author did all the research work of this study.

Competing Interests

The author has declared that no competing interests exist.

References

1. Murray A, Skene K, Haynes K. The circular economy: An interdisciplinary exploration of the concept and application in a global context. J Bus Ethics. 2017; 140: 369-380.
2. Cramer J. How network governance powers the Circular Economy. Ten guiding principles for building a circular economy, based on Dutch experiences [Internet]. Amsterdam: Amsterdam Economic Board; 2020. Available from: https://amsterdameconomicboard.com/wp-content/uploads/2022/06/AMECboard_boekje-Engels_web-aangepast.pdf.
3. Tukker A. Product services for a resource-efficient and circular economy: A review. J Clean Prod. 2015; 97: 76-91.
4. Michelini G, Moraes R, Nobre da Cunha R, Costa J, Ometto A. From linear to circular economy: PSS conducting the transition. Procedia CIRP. 2017; 64: 2-6.
5. Planko J, Cramer J. The networked business model for systems change: Integrating a systems perspective in business model development for sustainability transitions. In: Business models for sustainability transitions. London Borough of Camben: Palgrave Macmillan; 2021. pp. 59-88.
6. Ghisellini P, Cialani C, Ulgiati S. A review on circular economy: The expected transition to a balanced interplay of environmental and economic systems. J Clean Prod. 2016; 114: 11-32.
7. De Jesus A, Mendonça S. Lost in transition? Drivers and barriers in the eco-innovation road to the circular economy. Ecol Econ. 2018; 145: 75-89.

8. Ritzén S, Ölundh Sandström G. Barriers to the circular economy–Integration of perspectives and domains. Procedia CIRP. 2017; 64: 7-12.
9. Allwood JM, Ashby MF, Gutowski TG, Worrell E. Material efficiency: A white paper. Resour Conserv Recycl. 2011; 55: 362-381.
10. Kalmykova Y, Sadagopan M, Rosado L. Circular economy–From review of theories and practices to development of implementation tools. Resour Conserv Recycl. 2018; 135: 190-201.
11. Ddiba D, Andersson K, Koop SH, Ekener E, Finnveden G, Dickin S. Governing the circular economy: Assessing the capacity to implement resource-oriented sanitation and waste management systems in low-and middle-income countries. Earth Syst Gov. 2020; 4: 100063.
12. Lange P, Driessen PP, Sauer A, Bornemann B, Burger P. Governing towards sustainability—Conceptualizing modes of governance. J Environ Policy Plan. 2013; 15: 403-425.
13. Klijn EH, Koppenjan J. The shift toward network governance: Drivers, characteristics and manifestations. In: Theory and practice of public sector reform. New York and London: Routledge; 2016. pp. 158-177.
14. Hill CJ, Lynn LE. Is hierarchical governance in decline? Evidence from empirical research. J Public Adm Res Theory. 2005; 15: 173-195.
15. Bogason P, Musso JA. The democratic prospects of network governance. Am Rev Public Adm. 2006; 36: 58-78.
16. Osborne SP. The new public governance: Emerging perspectives on the theory and practice of public governance. London: Routledge; 2010.
17. Van Kersbergen K, van Waarden F. Governance as a bridge between disciplines: Cross-disciplinary inspiration regarding shifts in governance and problems of governability, accountability and legitimacy. Eur J Polit Res. 2004; 43: 143-171.
18. Sørensen E, Torfing J. Network governance and post-liberal democracy. Adm Theory Pract. 2005; 27: 197-237.
19. Driessen PP, Dieperink C, Van Laerhoven F, Runhaar HA, Vermeulen WJ. Towards a conceptual framework for the study of shifts in modes of environmental governance–experiences from the Netherlands. Environ Policy Gov. 2012; 22: 143-160.
20. Sørensen E, Torfing J. The democratizing impact of governance networks: From pluralization, via democratic anchorage, to interactive political leadership. Public Adm. 2018; 96: 302-317.
21. Kemp R, Loorbach D, Rotmans J. Transition management as a model for managing processes of co-evolution towards sustainable development. Int J Sustain Dev World Ecol. 2007; 14: 78-91.
22. Loorbach D, Frantzeskaki N, Avelino F. Sustainability transitions research: Transforming science and practice for societal change. Annu Rev Environ Resour. 2017; 42: 599-626.
23. Fischer LB, Newig J. Importance of actors and agency in sustainability transitions: A systematic exploration of the literature. Sustainability. 2016; 8: 476.
24. Farla J, Markard J, Raven R, Coenen L. Sustainability transitions in the making: A closer look at actors, strategies and resources. Technol Forecast Soc Change. 2012; 79: 991-998.
25. Jakob M, Flachsland C, Steckel JC, Urpelainen J. Actors, objectives, context: A framework of the political economy of energy and climate policy applied to India, Indonesia, and Vietnam. Energy Res Soc Sci. 2020; 70: 101775.
26. Patterson J, Schulz K, Vervoort J, Van Der Hel S, Widerberg O, Adler C, et al. Exploring the governance and politics of transformations towards sustainability. Environ Innov Soc Transit. 2017; 24: 1-16.

27. Markard J, Raven R, Truffer B. Sustainability transitions: An emerging field of research and its prospects. Res Policy. 2012; 41: 955-967.
28. Jones S. Waste management in Australia is an environmental crisis: What needs to change so adaptive governance can help? Sustainability. 2020; 12: 9212.
29. Wishart LJ, Bebbington J. Zero waste governance: A Scottish case study. Int J Sustain Dev. 2020; 23: 128-147.
30. Torfing J, Peters BG, Pierre J, Sørensen E. Interactive governance: Advancing the paradigm. Oxford: Oxford University Press; 2012.
31. Provan KG, Kenis P. Modes of network governance: Structure, management, and effectiveness. J Public Adm Res Theory. 2008; 18: 229-252.
32. Papadopoulos Y. Problems of democratic accountability in network and multilevel governance. Eur Law J. 2007; 13: 469-486.
33. Dal Molin M, Masella C. From fragmentation to comprehensiveness in network governance. Public Organ Rev. 2016; 16: 493-508.
34. Hekkert MP, Negro SO. Functions of innovation systems as a framework to understand sustainable technological change: Empirical evidence for earlier claims. Technol Forecast Soc Change. 2009; 76: 584-594.
35. Cramer J. Practice-based model for implementing circular economy. The case of the Amsterdam Metropolitan Area. J Clean Prod. 2020; 255: 120255.
36. Rip A, Kemp R. Technological change. In: Human choice and climate change. Resources and technology. Volume 2. Columbus, OH, USA: Battelle Press; 1998. pp. 327-399.
37. Geels FW. The multi-level perspective on sustainability transitions: Responses to seven criticisms. Environ Innov Soc Transit. 2011; 1: 24-40.
38. Seyfang G, Haxeltine A. Growing grassroots innovations: Exploring the role of community-based initiatives in governing sustainable energy transitions. Environ Plan C Gov Policy. 2012; 30: 381-400.
39. Meadowcroft J. What about the politics? Sustainable development, transition management, and long term energy transitions. Policy Sci. 2009; 42: 323-340.
40. De Jesus A, Antunes P, Santos R, Mendonça S. Eco-innovation in the transition to a circular economy: An analytical literature review. J Clean Prod. 2016; 172: 2999-3018.
41. Khitous F, Strozzi F, Urbinati A, Alberti FA. Systematic literature network analysis of existing themes and emerging research trends in circular economy. Sustainability. 2020; 12: 1633.
42. Savini F. The economy that runs on waste: Accumulation in the circular city. J Environ Policy Plan. 2019; 21: 675-691.
43. Geels FW. Technological transitions as evolutionary reconfiguration processes: A multi-level perspective and a case-study. Res Policy. 2002; 31: 1257-1274.
44. Rotmans J, Kemp R, van Asselt M. More evolution than revolution: Transition management in public policy. Foresight. 2001; 3: 15-31.
45. Simons L, Nijhof A. Changing the game: Sustainable market transformation strategies to understand and tackle the big and complex sustainability challenges of our generation. London: Routledge; 2021.
46. Gliedt T, Hoicka C, Jackson N. Innovation intermediaries accelerating environmental sustainability transitions. J Clean Prod. 2018; 174: 1247-1261.
47. Kanda W, del Rio P, Hjelm O, Bienkowska D. Technological innovation systems approach to

analyse the roles of intermediaries in eco-innovation. J Clean Prod. 2019; 227: 1136-1148.
48. Kivimaa P, Boon W, Hyysalo S, Klerkx L. Towards a typology of intermediaries in sustainability transitions: A systematic review and a research agenda. Res Policy. 2019; 48: 1062-1075.
49. Kanda W, Kuisma M, Kivimaa P, Hjelm O. Conceptualising the systemic activities of intermediaries in sustainability transitions. Environ Innov Soc Transit. 2020; 36: 449-465.
50. Rohe S, Chlebna C. The evolving role of networking organizations in advanced sustainability transitions. Geography of Innovation and Sustainability Transitions; 2021; GEIST Working Paper No. 2021(4).
51. Cramer JM. The function of transition brokers in the regional governance of implementing circular economy–A comparative case study of six Dutch regions. Sustainability. 2020; 12: 5015.
52. Homrich AS, Galva G, Gamboa Abadia L, Carvalho MM. The circular economy umbrella: Trends and gaps on integrating pathways. J Clean Prod. 2018; 175: 525-543.
53. European Commission. Closing the loop: An EU action plan for the circular economy. Brussels: European Commission; 2015; COM/2015/0614 final.
54. Dutch Government. A circular economy in the Netherlands by 2050: Government-wide programme for a circular economy [Internet]. The Hague: Dutch government; 2016. Available from: https://circulareconomy.europa.eu/platform/sites/default/files/17037circulaireeconomie_en.pdf.
55. Ministry of Infrastructure and Water Management on behalf of other Ministries. Uitvoeringsprogramma circulaire economie 2019–2023 (Execution programme circular economy 2019-2023) [Internet]. The Hague: Dutch government; 2019. Available from: https://www.rijksoverheid.nl/documenten/rapporten/2019/02/08/uitvoeringsprogramma-2019-2023.
56. Kemmis S. What is to be done? The place of action research. Educ Action Res. 2010; 18: 417-427.
57. Wittmayer JM, Schäpke N, van Steenbergen F, Omann I. Making sense of sustainability transitions locally: How action research contributes to addressing societal challenges. Crit Policy Stud. 2014; 8: 465-485.
58. Loorbach D, Rotmans J. The practice of transition management: Examples and lessons from four distinct cases. Futures. 2010; 42: 237-246.
59. Wittmayer JM, Schäpke N. Action, research and participation: Roles of researchers in sustainability transitions. Sustain Sci. 2014; 9: 483-496.
60. United Nations Environment Programme. Global status report for buildings and construction: Towards a zero-emission, efficient and resilient buildings and construction sector. Nairobi: UNEP; 2021.
61. Dong T, Yin S, Zhang N. The interaction mechanism and dynamic evolution of digital green innovation in the integrated green building supply chain. Systems. 2023; 11: 122.
62. Leal Filho W, Perry P, Heim H, Dinis MA, Moda H, Ebhuoma E, et al. An overview of the contribution of the textiles sector to climate change. Front Environ Sci. 2022; 10: 973102.
63. De Aguiar Hugo A, de Nadae J, da Silva Lima R. Can fashion be circular? A literature review on circular economy barriers, drivers, and practices in the fashion industry's productive chain. Sustainability. 2021; 13: 12246.
64. Dris R, Gasperi J, Mirande C, Mandin C, Guerrouache M, Langlois V, et al. A first overview of

textile fibers, including microplastics, in indoor and outdoor environments. Environ Pollut. 2017; 221: 453-458.

65. Dutch Circular Textiles Platform. On the road towards circular textiles: Roadmap for the Dutch textile industry [Internet]. Utrecht: Afval Circulair; 2017. Available from: https://www.afvalcirculair.nl/onderwerpen/linkportaal/publicaties/downloads-0/on-the-road-towards/.
66. Ministry of Infrastructure and Water Management. Beleidsprogramma circulair textiel 2020-2025; Brief over het beleidsprogramma circulair textiel 2020-2025 (Policy program for circular textile 2020-2025; Letter about the policy program for circular textile 2020-2025). The Hague: Dutch government; 2020. Available from: https://www.government.nl/documents/parliamentary-documents/2020/04/14/policy-programme-for-circular-textile-2020-2025.
67. Termeer CJ, Dewulf A. A small wins framework to overcome the evaluation paradox of governing wicked problems. Policy Soc. 2019; 38: 298-314.
68. Cramer J. De kracht van netwerksturing: Tien bouwstenen voor een slimme, groene en gezonde Metropool Amsterdam [Internet]. Amsterdam: Amsterdam Economic Board; 2021. Available from: https://amsterdameconomicboard.com/wp-content/uploads/2022/06/board-publicatie-V41.pdf.
69. Cramer J. Building a circular future: Ten takeaways for global changemakers [Internet]. Amsterdam: Amsterdam Economic Board; 2022. Available from: https://amsterdameconomicboard.com/wp-content/uploads/2022/10/Building-a-Circular-Future-Web-V4.pdf.