Climate action as an extreme case of project portfolio management: Navigating global ambitions amid ambiguous sustainability transitions

Satu Teerikangas,[1,2*] Joana Geraldi,[4, 2] Christian Thusen,[5] Katariina Koistinen[1,3]
[1]School of Economics, University of Turku, Finland; satu.teerikangas@utu.fi
[2]Bartlett School of Sustainable Construction, University College London, United Kingdom
[4]Copenhagen Business School, Denmark
[5]Technical University of Denmark
[3]Turku Institute for Advanced Studies, University of Turku
*Correspondence: satu.teerikangas@utu.fi

Abstract

To date, we lack an understanding of how to manage the global transition towards carbon neutrality in a coordinated way. Building on transition management and portfolio management, we examined how actors from ministries, agencies, cities, firms and NGOs across three countries organized their projects to address climate change. Our empirical work based on 30 interviews revealed six organizational challenges: (1) global ambition; (2) national complexity; (3) coordination across project portfolios; (4) governance of project portfolios; (5) continuously changing context; and (6) ownership. Underlining these challenges is the need of connections between climate projects. We propose a novel way of conceiving project portfolio management as an approach to make these connections that coordinates across multiple levels of analysis and loosely connected organizational settings. Going forward, we call for more research on cross-organizational project portfolio management to lead societal transitions.

Keywords: climate change; transition management; project portfolio management

Introduction

Climate change, or even climate collapse, ranks among the greatest challenges that our interconnected ecological, economic and social systems face. Despite this problem's magnitude and urgency, global greenhouse emissions show no signs of decline (UNEP, 2021). The Arctic and sea levels are witnessing change, and extreme weather conditions occur on an increasingly regular basis (WMO, 2020). The dangers from global warming and climate change pose substantial risks for human and other species' survival. For example, without critical actions to reduce the rise in average temperature caused by carbon emissions, many of the planet's species face ecological and social collapse, while extreme weather conditions already are threatening human lives and livelihoods worldwide, from flooding in Europe and wildfires in Australia to drought in North America.

The challenge of climate change is multifaceted and complex, with global dimensions and no one organisation, country or international institution alone that can solve or lead the fight against it. The necessary transition towards carbon neutrality requires multi-level collaboration and coordination of efforts. In this study, we adopted transition management and portfolio management perspectives to connect responses to climate change across analytical levels. For one, transition management aims to enable macro-level change, seeking various niche and meso-level actions to steer such macro-level changes. Furthermore, portfolio management offers a meso-level strategy that connects niche action with macro-level changes to address climate change (see Figure 1). Empirically, we investigated practices and challenges tied to organising for climate action in three countries – Denmark, Finland and the United Kingdom – during the 2015-2016 period. Therefore, our paper examines how countries were addressing climate change around the time of the Paris climate change negotiations.

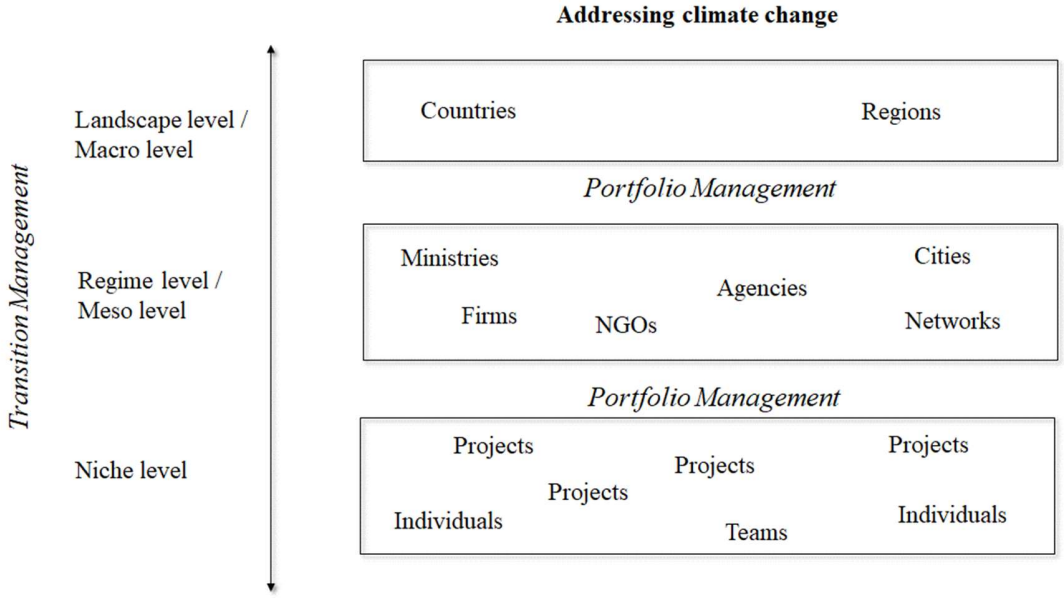

Figure 1. Transition management and portfolio management across levels of analysis

Our paper proceeds as follows. First, we set the theoretical background of the paper via an overview of climate change, followed by a review of the literatures on both transition and portfolio management. We then present our research methods and setting, followed by our findings with respect to the challenges in responding to climate change. Finally, we discuss the implications of our findings for project portfolio management research and practice, while offering directions for future research.

Literature review

Climate change

In this section, we spotlight the global challenge of climate change through an interdisciplinary review of relevant academic literature, providing an idea of the literature at the time of data collection. With the dynamics and definitions of sustainable development remaining subjects of debate, climate change, that is, a temporary or enduring variation in climate (Vijayavenkataraman et al., 2012) has come to be singled out as a major challenge within this wider sphere in recent years. Compared with the broader and somewhat looser context of sustainable development, climate change offers a more focussed and tangible perspective for securing the planet's sustainable future.

The scientific bases of climate change were set by 19th century French, English and Swedish scientists Fourier, Tyndall and Arrhenius in physics and chemistry, respectively. They observed that the atmosphere's chemical composition influences the Earth's temperature (WMO summary report, 2013). Either natural processes or anthropogenic factors can cause climate change (Vijayavenkataraman et al., 2012), which results from excess greenhouse gases in the atmosphere.

Over the past three decades, academic research on climate change's presence and impact has flourished (Moss et al., 2010). Such research – whether published in academic outlets, through the global survey of all climate change research conducted by the Intergovernmental Panel on Climate Change (IPCC, 2021), or in international institutions' reports, e.g., the World Meteorological Organisation (WMO, 2013, 2020) or the UN Environment Programme's Emissions Gap Report (UNEP, 2014, 2021) – proves that human activity is causing global warming, in turn resulting in climatic changes. We now know that since the Industrial Revolution, the amount of greenhouse emissions has rocketed (Vijayavenkataraman et al., 2012). Carbon dioxide (i.e., traceable to fossil fuels such as coal, oil and natural gas) is the largest contributor to climate change, while methane and nitrous oxide also are contributors. The main sources of greenhouse gases are electricity generation, transport, land-use changes and agriculture (World Resources Institute, 2000), with electricity generation and transport growing at the fastest rate.

The urgency of climate change is accepted widely, with 97-98% of active climate change research supporting the evidence (Anderegg et al., 2010). As more scientific evidence becomes

available, the risks related to climate change now appear more serious than initially thought (Stern, 2006; IPCC, 2021). However, despite the problem's urgency, global greenhouse gas emissions remain on the rise, instead of declining (UNEP, 2021). Concurrently, global temperatures continue to rise, polar ice caps and sea levels are witnessing change, while extreme weather conditions occur on an increasingly regular basis (WMO, 2020).

Already in 2007, Mathews argued that to reduce carbon dioxide emissions 70% by 2050, imminent action is needed. He called for 2007-2017 to be a 10-year window for implementing mechanisms that enable such action. If these targets are not reached, the potential exists for global warming and climate change consequences going beyond known limits, thereby threatening human and other species. It appears that for the first time in its history, unless imminent action is taken, humankind is facing a human-made disaster. At the time of this chapter's writing, we have gone beyond this 10-year window.

Responding to the climate change challenge is not a simple or unequivocal matter. First, despite evidence of climate change, disagreement and uncertainty remain about the nature and scale of longer-term consequences, with error margins reported in all studies (Stern, 2006). Despite its significance, the study of climate change is not an exact science. Furthermore, as climate change co-evolves together with the human and societal response to it (Jaroszweski et al., 2010), this response needs to be added to climate change models. This is a difficult undertaking, and few studies to date can include existing mitigation and adaptation strategies in their research designs. The question is: what is the human influence on climate change pathways (Moss et al., 2010)? In essence, responding to climate change entails trying to predict the future, which by definition is unpredictable and unknown. Furthermore, a set of complex cause-and-effect mechanisms is in play, e.g., those causing the damage are not the ones likely to suffer the consequences directly (Chapman, 2007).

Current responses to climate change are driven by international macro-level institutional forces. The Intergovernmental Panel on Climate Change provides a platform for sharing and communicating global findings on climate change. The United Nations Framework on Climate Change initiated at the Rio Earth Summit in 1992 has sought global agreements on greenhouse gas emissions. Despite successive meetings, global protocols, e.g., the Kyoto Protocol 2005, have been lengthy processes that have elicited disappointing outcomes. At the 2010 Cancun Climate Change

Conference, it was agreed that the goal would be to limit global warming to 2 degrees Celsius in the 21st century, compared with the pre-industrial era (UNEP, 2014 synthesis report). To reach this target, carbon neutrality (i.e., net-zero carbon emissions on a global scale) needs to be reached between 2050 and 2070 (UNEP, 2014). Despite these efforts, it can be argued that humankind lacks a coherent, consistent climate change policy to which all countries adhere. Acknowledging that the political will is absent, Mathews (2007) called for refreshing and renewing climate change strategies.

As the problem is global, the response needs to be global as well, which requires international collaboration, collective action and leadership (Stern, 2006). Beyond international institutional action, local bottom-up approaches are needed (Koniadari & Mavrakis, 2007). Yet, approaches that encourage voluntary behavioural change do not have mainstream status (Chapman, 2007). Beyond political will, communication and collaboration are needed across academic disciplines involved in the study of climate change (Moss et al., 2010; Jaroszweski et al., 2010). An integrative perspective is needed, and the assumptions underlying the literature are coming under scrutiny. Already Stern (2006) called for a redefinition of our economic theories to include externalities, which presently are missing from mainstream economic theories, rendering them unable to deal with complex problems such as climate change.

While most extant literature has focussed on technological innovation, underlying behavioural changes (Anable & Boardman, 2005) and societal change (Jaroszweski et al., 2010) also need to be addressed. How can consumption patterns be changed, and how can individuals be incentivised to behave differently (Mathews, 2007)? Beyond an overall, global response, Jaroszweski et al. (2010) called for an enhanced appreciation of climate change's consequences in particular contexts, such as transport and cities (Walsh et al., 2010). The focus in climate change research and policy is increasingly on mitigation and adaptation strategies (Vijayavenkataraman et al., 2012), but the optimal mix of these strategies remains the subject of debate, as does their link to citizen participation (Larsen & Gunnarsson-Östling, 2009). Individual countries need to examine their strategies and policies towards climate change (Mathews, 2007). To appreciate how to manage the transitions towards climate neutrality, we next proceed to the transition management literature, which explicitly focusses on societal sustainability transitions.

Transition management

Transition management (TM) is an approach for governing complex sustainability challenges. TM provides a framework for understanding how local development interventions can be scaled up to change the broader system, and thereby explains how system (i.e., macro-) level change depends on local initiatives (Marquardt, 2015). Accordantly, TM's objective can be perceived as the governance of macro-level changes through meso- and niche-level activities. Therefore, TM includes four different types of activities in the governance of sustainability transitions: strategic; tactical; operational; and reflexive (see Table 1) (Loorbach & Rotmans, 2010), and emphasises the importance of coordination, interaction and learning, which are necessary components for scaling up results from niche experiments (Marquardt, 2015). Moreover, TM involves various system levels, e.g., regions, industries and businesses, the subsystem level and the societal level (Loorbach, 2010). Over the past 15 years, TM has been applied to numerous sustainability questions, policy contexts and geographical scales (Frantzeskaki et al., 2017; Loorbach et al., 2017), which have demonstrated that the approach can support governance of system-level sustainability transitions (Loorbach et al., 2016, Frantzeskaki et al., 2017; Nevens et al., 2013).

Table 26-1. Transition management activities (adapted from Loorbach & Rotmans, 2010).

Activity	*Description*
Strategic	Strategic activities are placed at the societal system level and focus on a long-term horizon related to structuring a complex societal problem and creating alternative futures.
Tactical	Tactical activities lie at the subsystem level and relate to the build-up and breakdown of system structures, including institutions, regulations and physical and financial infrastructures.
Operational	Operational activities relate to short-term and everyday decisions and actions. At this level, actors either recreate system structures or choose to restructure or change them.
Reflexive	Reflexive activities relate to evaluation of the existing situation at the various levels and their interrelation of misfit. Through debate,

	structured evaluation, assessment and research, societal issues are structured, reframed and dealt with continuously.

To succeed, TM requires the capability to deal with uncertainties involved in mitigation and adaptation to climate change (Loorbach & Rotmans, 2010; Voß et al., 2009). TM often is described as manifesting through a cycle of change. Loorbach (2010) defined four main elements of the TM cycle as follows: (1) structure the problem in question and establish and organise the transition arena; (2) develop a transition agenda, envision plans for sustainability and derive the necessary transition paths; (3) establish and carry out transition experiments and mobilise the resulting transition networks; (4) monitor, evaluate and learn lessons from the transition experiments, and based on these, make adjustments in the vision, agenda and coalitions.

It is against this broader research context backdrop and these calls for action that our work on a project portfolio management approach to climate change can complement TM. Despite a wealth of extant research on climate change and sustainability transitions, how to manage the global transition towards carbon neutrality in a coordinated way remains underexamined. Furthermore, we observed that the sustainability transitions and project portfolio literature hitherto have not been connected, i.e., the sustainability transition literature lacks the concept of project portfolios as a means of operationalising coordination towards carbon neutrality. By focussing on a project portfolio approach, we started to address this larger question. We proposed that portfolio management might be a useful tool as it represents the meso-level activities that elicit macro-level strategic changes and can thereby cut across the TM framework's strategic, tactical, operational and reflexive activities and develops reciprocal vertical and horizontal links between them.

Project portfolio management

Project portfolios and their management comprise a widely established strategic practice within organisations. *Project portfolios* are defined broadly as 'a collection of projects, programmes, subsidiary portfolios and operations managed as a group to achieve strategic objectives' (PMI, 2017, p. 3). Portfolios are interesting because they represent actual planned investments in the short and medium term; therefore, portfolios express a firm's actual strategy (Cooper et al., 2001). Project portfolio management is dedicated to managing this collection, horizontally in terms of its coordination through, e.g., allocation of resources and avoiding work duplication, and vertically by bridging a firm's projects and operations toward strategic objectives consistent with its vision,

mission and values (Levine, 2005; PMI, 2017). Specifically, the largely normative literature recognised three project portfolio management goals (Cooper et al., 2001; Dye & Pennypacker, 1999; Geraldi & Arlt, 2015):

- *Strategic alignment:* a vertical link between organisational articulated strategy and its projects and other related activities. However, despite efforts to implement project portfolio management and tools, most firms still experience difficulties linking projects and strategy (Economist Intelligence Unit, 2017).
- *Portfolio balancing:* usually involves a wide range of tools to recognise and evaluate trade-offs in different potential portfolios, as well as choose between such portfolios (Cooper et al., 2001), e.g., balancing risk exposure across the project portfolio by ensuring that projects have different risk exposure levels. Balancing implies that decision makers search for moderation in each trade-off. However, this is not necessarily the case, e.g., a balanced portfolio with moderate risk exposure might not be in line with a firm's strategic objective.
- *Benefits maximisation*: This is related to the use of resources effectively and efficiently. In a commercial context, benefit maximisation often is reduced to maximising profitability across a variety of financial performance indicators (Norrie, 2006).

Project portfolio management often manifests within organisations as an attempt to achieve objectives by creating a centralised, dynamic, complex and political decision process in which portfolios of projects, programmes and other activities are updated and revised constantly, and ongoing projects may be accelerated, terminated or continued according to plan (Cooper et al., 2001, p. 3). Yet, one can also conceive project portfolio management as a mode of organizing, which can be abstracted from its usual realms of application and brought into novel contexts. As such, project portfolios are characterized by a prioritization and integration process marked by an ongoing, cyclical and reoccurring monitoring activities that serve as an arena to make sense of current developments and prospect strategic directions (Geraldi et al., 2022). We build on this perspective on project portfolio management to propose climate action as project portfolios.

Climate action as project portfolios

Despite advances in our appreciation of project portfolios, areas still exist in which our understanding is quiescent. Notably, the mainstream project management literature contains no references to the project, programme and portfolio management's relevance to many of the major

issues facing society. Although we now have growing bodies of literature on infrastructure and systems-led change projects and programmes (Sovacool and Geels, 2021; Andreoni et al., 2022), most of this research, for quite understandable reasons, still seems to be focussed on tools and techniques, processes and practices, i.e., means rather than ends. Meanwhile, humanity faces grand challenges, which the project management community is only starting to address (e.g. Marcelino-Sádaba et al., 2015; Morris 2017, Silvius and Schipper, 2018; Koch-Ørvad et al., 2019, Overgaard et al., 2022). This book is itself a good example of such effort. In this chapter, we join this emerging effort and address one of the biggest challenges – climate change – from a project portfolio management perspective. In so doing, we are answering recent calls (Martinsuo, 2013; Martinsuo et al., 2014) for more research on portfolio management in dynamic, uncertain environmental contexts.

Concurrently, upon closer inspection, climate change mitigation and adaptation are executed through projects, programmes and other related activities around strategic objectives, e.g., keeping global temperatures below 2 degrees Celsius. In this regard, we could view climate action as a large project portfolio containing several project portfolios at the organisational, regional and national levels.

Such a perspective requires relaxing two assumptions about project portfolios: portfolio boundaries and management approaches to them. First, a project portfolio usually is associated with an organisation and its strategic direction; therefore, portfolios' boundaries are contained within an organisation. However, a firm ultimately chooses the contours of a portfolio based on which projects and programmes they would like to manage as a collection. Indeed, some organisations choose to organise their projects around several portfolios, while for others, it is more sensible to organise around a single, large project portfolio (Martinsuo & Geraldi, 2020). Thus, the boundaries of project portfolios remain an empirical question (Martinsuo, 2013). Accordingly, we investigated a project portfolio's boundaries for climate action empirically, as well as examined where practitioners have chosen to set and wish to set boundaries for their project portfolios, and at which levels they see a need for coordination and collective climate action.

Second, the literature is dominated by a technocratic view that reduces project portfolio management to the use of a specific set of tools and processes (Cooper et al., 1999; Dye & Pennypacker, 1999; PMI, 2017). Although extant research suggests that certain generic PPM

(project portfolio management) practices could improve portfolio performance (Ghasemzadeh & Archer, 2000; Unger et al., 2012; Teller et al., 2012; Voss & Kock, 2013), PPM has been demonstrated to be highly context-sensitive (Martinsuo, 2013). As such, project practitioners and academics would benefit from a more open understanding of how project portfolios actually are managed in each context. Thus, instead of viewing project portfolio management as a set of pre-established practices, we agree with Martinsuo and Geraldi's (2020) conceptualisation of project portfolios as an organisation, and as such, one that is 'an (evolving and social) entity with semi-permeable boundaries to its context…, [used to] tame the fluctuations and fragmentation caused by the temporality of projects' (Brown and Eisenhardt, 1997), while also connecting the projects with their contexts within and outside the firm, thereby promoting their strategic importance' (p. 443). Thus, akin to the boundaries, management of a project's portfolio is viewed as an empirical question.

Methods

In recognising the lack of theorising on the role of portfolio management in addressing the transition towards carbon neutrality, we adopted an open-ended, exploratory, qualitative approach to our empirical research. Although we were well-versed in extant theorising on both climate change and project, programme and portfolio management, we did not have any preconceptions concerning the empirical findings. In this sense, our research approach was inspired by grounded theory (Glaser & Strauss, 1967), in that we sought to gain a bottom-up, inductive, interviewee-led appreciation of the studied phenomenon.

To appreciate the subject matter across national settings, we undertook a multiple case approach (Yin, 2009; Eisenhardt, 1989). Internationally, our empirical foci comprised the UK, Finland and Denmark, a choice made on practical and theoretical grounds. From a theoretical perspective, we viewed these countries as representing advanced countries in terms of their approach to climate change. Studying them allowed for examining cutting-edge practices and national approaches to address climate change. The choice was influenced further by practical considerations in that our international research team's members resided in these three countries.

Data collection was conducted in two rounds. Interviews were conducted during the January-March 2015 period in the greater London area of the UK, focussing on project portfolio management's role in addressing climate change. During the January-February 2016 period, we conducted the second round of interviews in Finland, Denmark and the UK to gain a wider

perspective of the subject matter from experts across sectors and organisational types. Overall, over 30 interviews were held with ministry-, agency-, city-, firm-, NGO- and network-level experts. More specifically, in Denmark, our interviewees included the UNEP, Orsted (a world leader in offshore windfarms), Novozymes (a world leader in biological solutions), Realdania (a philanthropic organisation supporting the climate agenda), leading climate change researchers and advisors, and the chairman of the Danish Association for Project Management. In Finland, personnel from several ministries, agencies and cities were interviewed. In the UK, interviewees included the chairman of the Association for Project Management, the government's Chief Construction Advisor and the head of the Climate Change Commission.

Our study aimed to examine whether portfolio management can play a role in tackling climate change. The interview questions aimed to increase understanding of how the countries were organised presently in regard to addressing climate change's causes (i.e., climate change mitigation) and consequences (i.e., climate change adaptation), as well as project portfolio management techniques' role in this work.

Interview notes were written up either immediately or within days of the interview. The findings were analysed first at the level of each nation. A workshop was held early February 2016 in Denmark during which researchers shared their findings and made a cross-comparison of their principal results. This single-case and cross-case analytical process led us to understand the kinds of challenges related to addressing climate change, as well as how portfolio management can help address these challenges. Given the interviews' timing, our findings provide an overview of portfolio management in addressing climate change in 2015.

Findings: Challenges in organising a response to climate change

In our interviews, we identified challenges related to how the response to climate change mitigation and adaptation has been generated. We clustered these challenges around six themes illustrated in Figure 2: (1) global non-binding ambition; (2) national complexity; (3) coordination across project portfolios; (4) governance of project portfolios; (5) continuously changing context; and (6) ownership. These are graphically illustrated in Figure 2.

1. Global non-binding ambition

Our interviewees emphasised global climate ambition's relevance. The Paris climate negotiations in December 2015 played a pivotal role in establishing clear, globally shared targets regarding climate change mitigation, during which it was agreed to limit global warming to less

than 2 degrees Celsius, while striving to reach 1.5 degrees. These visionary goals have been translated into annual emissions targets for 2020, 2030 and 2050. Various media have criticised the Paris Agreement for not being legally binding, but our interviewees viewed the agreement from a different perspective. They stressed that 193 countries backed the agreement, in addition to numerous cities, commercial firms and NGOs. Our expert interviewees emphasised that instead of legally binding agreements, the climate negotiations are a learning process for establishing a global understanding among world leaders gradually on the critical nature of climate change. The COP21 global and national goals are believed to create transparency regarding the goals and strategies 'aligning' resources in cities and companies to foster innovation and drive out fossil fuel industries. Thus, the global ambitions are not perceived as specific goals to be achieved, but rather as arenas for negotiation of meaning and directions to inspire action.

In addition to setting globally agreed-upon targets, it was decided during the Paris climate negotiations that countries should devise national climate change strategies, a process overseen by the UN. One of the experts mentioned that various incentives will propel this initiative further. For example, the World Bank plans to review various nations' progress toward their goals before deciding to invest in the country, creating an incentive for action. Developing countries are being offered support for this process. In regions such as Europe, a regional body, i.e., the European Union, oversees the implementation of carbon-reduction targets via a two-fold process. The EU oversees carbon emission reductions that are part of the carbon trade agreement, whereas emissions that do not fall within the frame of this agreement are part of national climate strategies. Thus, while commitment to reach ambitious targets exists, the current approach provides flexibility for countries and regions to adjust strategies to their specific needs. All the while, each country bears the burden of developing their own strategies while deciding on the level of ambition to pursue.

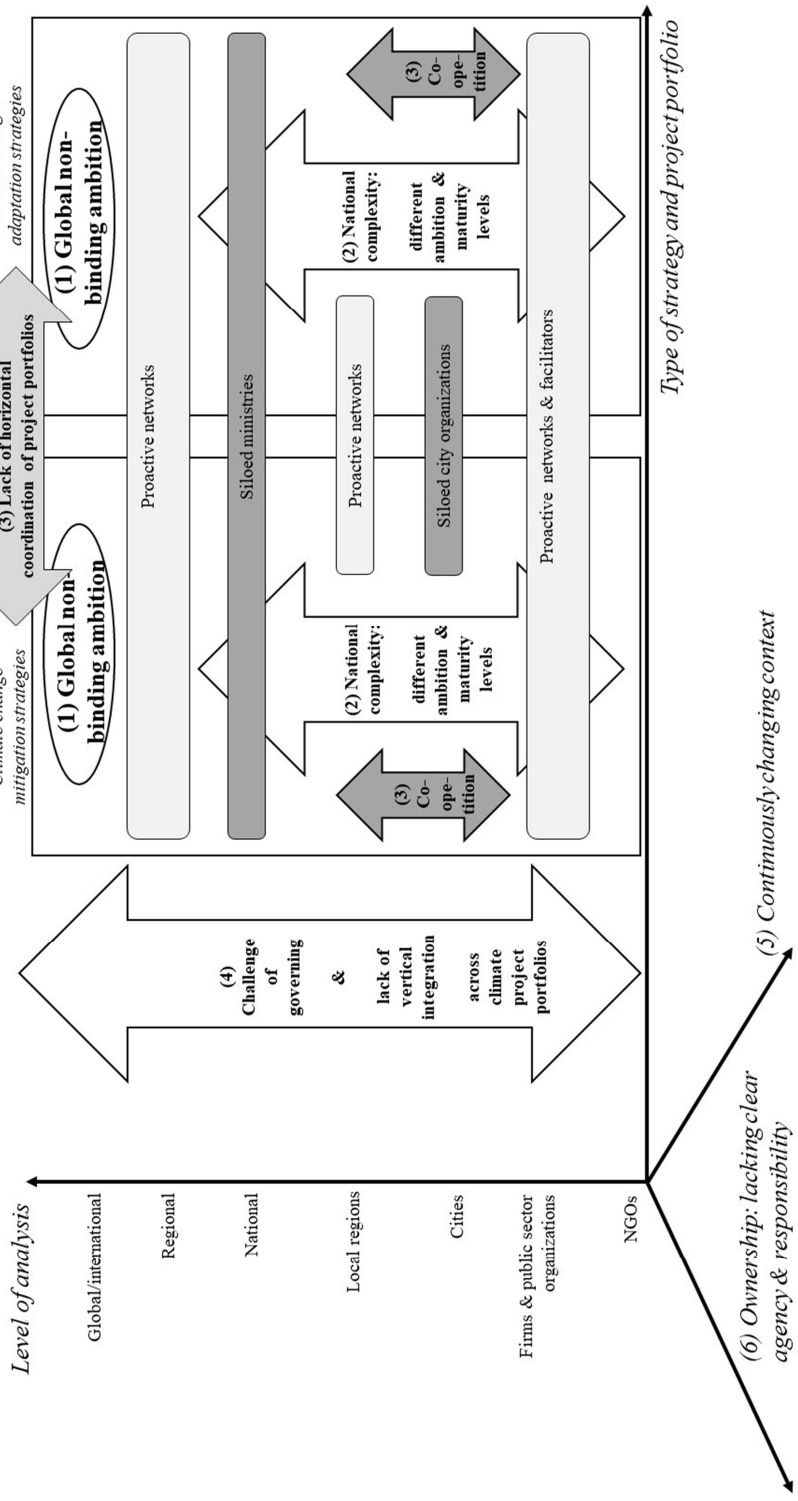

Figure 2. Challenges in organising a response to climate change.

Legend: Theme (3) is marked in dark grey relating to challenges, and in light grey relating to enablers of climate action.

2. National complexity

Despite these ambitious and visionary targets, implementing carbon emissions targets on an international scale is challenging. Climate change project portfolios' sheer complexity was apparent throughout the interviews, as these portfolios operate at national, regional/city and firm levels, with no central coordination of efforts.

First, each country is expected to formulate two kinds of climate strategies: (1) climate change strategies to reduce carbon emissions and, thus, mitigate climate change, and (2) climate change adaptation strategies to nationally adjust to the ongoing process of climate change and global warming. While climate change strategies have been in place as early as the 1990s and early 2000s, depending on the country, adaptation strategies are more recent. Finland was the first country in the world to devise a climate change adaptation strategy in 2006. Countries are at different stages of maturity regarding development and implementation of climate change mitigation and adaptation strategies. According to the UNEP interviewee, 'every country is different and, thus, the plans must be designed for each country'. No 'one-size-fits-all' solution to climate change exists, but actors within and across countries potentially have much to learn, possibly in the form of bilateral collaboration, UN-based knowledge platforms (UNEP), technology transfer (e.g. case Orsted), etc.

In addition to the national level, both climate change mitigation and adaptation strategies are being devised at the local level, i.e., among regions, cities and towns. These local strategies need to be defined in line with the globally negotiated agreement. Every city, region and industry per nation have different levels of maturity and ambition in their climate change mitigation and adaptation strategies. In examining countries more closely, variations can be found across cities and regions' responses. Certain cities aim to do more than what is required of them from international agreements. However, such leading cities climate-wise are not necessarily well-known capital cities. While Copenhagen is aiming to be carbon neutral by 2025 (though this now appears over-ambitious, according to estimates in 2022), smaller towns such as Sønderborg or Växjö are aiming for 2029 and 2030 respectively. In Finland, Lahti, the eighth-largest city, was the first city in the country to devise a climate change strategy in the 1990s and aims for carbon neutrality by 2025. All the while, these strategic targets shift when cities and countries notice that they are not able to meet their initial targets. Moreover, the calculations behind each target are

amenable to critique, depending on the metrics and data used. This makes comparative analyses difficult.

As for commercial firms, across the EU, the need to decrease carbon emissions has become accepted as a hygiene factor when it can be achieved via operational cost reductions and increased efficiency. However, there appears to be less appetite for truly engaging with climate change. Firms' engagement with carbon reductions depends on industry, e.g., sectors such as energy that are affected directly have been first-movers, whereas less-affected sectors, including construction, have lagged others. Large multinational firms have taken leading positions, e.g., the Finnish elevator company Kone. For such firms, this is an opportunity to strengthen their brand image. Other leading examples include Denmark's Orsted, which wants to use 50% biomass in its power plants by 2020, and Novozymes, which seeks to cut 100 million tons of CO2 a year through customers applying their enzymes.

Concurrently, several non-commercial actors are working in support of the climate change agenda, e.g., NGOs, local and international networks, and academia. NGOs' goals are not connected directly to specific CO2 reductions. Instead, they seek to create impact, e.g., through capacity building. This is the case with UNEP as it facilitates the development of climate plans and actions in developing countries. Others encourage the sharing of best practices, e.g., Denmark's Realdania, which is investing in networks connecting major cities worldwide (C40.org). Some seek to engage consumers, e.g., 350.org, or attract investors, e.g., *The Guardian* newspaper's anti-fossil campaign 'Keep it in the ground'.

To sum up, climate change project portfolios exist separately for mitigation and adaptation, and separately at national, regional, industrial and organisational levels, each at a varying maturity stage. Furthermore, organisations, depending on their form of ownership, have adopted different stances towards climate change.

3. Coordination across project portfolios

Faced with such complexities, we were surprised to observe a lack of explicit, formal connections between these numerous project portfolios. Coordination presently occurs to some extent at each level of analysis, i.e., national activities are coordinated, and each city coordinates its activities. Nevertheless, even coordination of activities at the national level (i.e., between relevant ministries and agencies) and at city levels (i.e., between relevant departments and agencies) is complicated, as it involves coordination across several local organisations,

departments and units, whether at ministry, agency or city levels. Interviewees involved in coordinating roles were aghast at the sheer complexity of this work.

Furthermore, the interviewees lamented the lack of national oversight and coordination of climate change activities cutting across institutional borders. We observed a lack of horizontal coordination of climate change project portfolios. Within each country, climate change mitigation and adaptation strategies are developed, handled and implemented concurrently, but activities within one organisation often impact the other. As a result, duplication or unintended consequences might be observed. Similarly, vertical integration is missing; thus, no explicit connections exist between mitigation (or adaptation) strategies at the national, regional or firm levels. Although regions are affected by national regulations and can apply for funding for investment or research projects, few explicit ties exist between national, regional and city-level climate strategies. Furthermore, countries lack coordination regarding regional actors. City-level interviewees observed that the attitude between regions is marked more by competition than cooperation, i.e., each region and city must pave its own way for climate change. As for firms, they found the field to be complex, given that several ministries and governmental agencies fed them numerous conflicting policies and regulations.

Amid the lack of formal coordination mechanisms, informal integrative mechanisms have emerged. Several local and international networks connecting firms, cities, regions or towns have been initiated to facilitate the climate change agenda. Active European cities are involved in numerous local and international peer networks. For example, the EU Covenant of Mayors brings together climate-active European cities, with other networks connecting, e.g., Nordic or Baltic cities. In Finland, a climate-active network of small towns has been established to facilitate and speed up climate work. Thus, coordination occurs informally via peer networks, in which a city or town can be involved in several, or even dozens, of such networks simultaneously depending on their proactiveness and ambition. Peer networks also mark industry players (e.g., the World Business Council for Sustainable Development, comprising more than 200 international companies, or the Climate Leadership Council). These networks are international and national, and play a role in sharing best practices, establishing benchmarks, enhancing reputation and image, and lobbying governments and the European Union. However, these informal networks' efforts remain unconnected in that little to no coordination exists between them.

To sum up, what emerges from this overview is a dualistic picture. On one hand, there is a story of strategic alignment. Climate change is becoming politically accepted. Since the Paris Agreement in 2015, it has been expressed in terms of ambitious globally agreed-upon targets translated into climate strategies at national, regional and city levels across countries. The vision has been set, and the political discourse is gradually coming around. On the other hand, when examining climate strategy development and execution, the storyline becomes more erratic. Not only are there discrepancies between countries in their approaches and ambitions towards climate neutrality, but despite the myriad climate strategies and subsequent activities at national, regional, city and firm levels within each country, oversight is lacking as regards nations' climate change activities. Comparing this situation to managing a company – the target has been set, yet the implementation is occurring in country- and city-level silos, with no global or national oversight of the activities taking place. While this might seem overly complicated to tackle, when our planet's future is at stake, it would seem that coordinative action is required.

4. Governance of project portfolios

We identified explicit project portfolios for both climate change mitigation and adaptation at national and city levels in the studied countries. Faced with the ambitious carbon reduction targets set by UN frame agreements, such as the 2015 Paris Agreement, countries and cities have responded by devising climate mitigation and adaptation strategies that have elicited portfolios of short-, medium- and long-term activities. The climate change mitigation debate is a politically sensitive one, given that it requires action to reduce carbon emissions, while climate change adaptation is a more practical, execution-oriented activity concerning what needs to be done for countries and cities to be prepared for climate-change induced extreme weather events.

However, at the firm level, other than for energy firms and infrastructure operators, no explicit climate change strategies were identified at the time of the interviews. Instead, climate change has been integrated into the strategy development process. Nevertheless, firms tend to have well-established models for project portfolio management, including the design and execution of projects connected to existing strategy processes, as well as a deliberate choice of which projects to initiate. Thus, when climate change is strategically relevant, firms seem to be better able to move to prioritised action.

Having identified climate change portfolios' as being situated at national, city and firm levels of analysis, we then sought to make sense of the complex process of governing these

portfolios. We found little evidence of project, programme and portfolio management techniques being used in this exercise, with firm-level climate change portfolios being managed in seemingly traditional, linear, causal ways based on lists of activities, schedules, deadlines, documents and reports. Furthermore, little evidence was found of agility or flexibility in the portfolio strategies and project plans.

We identified the following issues in managing climate change-related project portfolios. First, considering that several players are involved, the question of portfolio ownership and governance is raised. In the Finnish case, we found evidence of a central coordination mechanism at the national level. Tackling climate change was already part of the 2014-2018 government strategic agenda, whereby a central ministerial agency tracks progress. One ministry oversees the development and execution of climate change mitigation strategies, while another is in charge of adaptation strategies. For both strategies, openly published inter-ministerial organisational charts detail governance models for climate strategy development and execution. Concurrently, at the city level, a programme management function that has oversight over the project portfolios across numerous departments appears to be missing. In cities, municipal governments endorse climate strategies, while responsibility for planning and execution rests on the city's environmental department. However, the silo-based functional organisation structures were viewed as slowing down progress on tackling a systemic challenge such as climate change. Considering the lack of inter-departmental processes and working groups, the legwork must be done through networking, negotiating and convincing between departments.

Second, the governance of climate change project portfolios challenges existing organisational structures, particularly for public organisations nationally and regionally. Climate change is a holistic, systemic phenomenon affected by several actors and systems, in turn affecting numerous related systems. Thus, managing climate change portfolios requires alignment between the numerous players, but the public organisations involved in addressing climate change remain organised in traditional ways. In the UK, the siloed ministerial agendas were lamented in comparison with Germany or Sweden. In Finland and Denmark, some degree of ministerial cooperation takes place, though many obstacles and silos remain. Given these countries' small size, several interviewees hailed their willingness to engage in at least some inter-ministerial cooperation.

Third, even when central coordination mechanisms have been identified, the practice of devising and monitoring climate change project portfolios is an immensely complicated task. Interviewees pondered questions that included the following: Who should be involved in strategy development? How can citizens become involved in a meaningful way? How can numerous interrelated agendas be combined in a way that makes sense? Does anyone understand the true challenges involved? Who has ownership?

Fourth, varying degrees of maturity regarding portfolio governance were identified. In particular, the interviewees were looking for forms of reporting on these large numbers of interdependent projects, monitoring them as well as visualising their progress and interrelationships. A common attempt to coordinate efforts was through measurements, e.g., one interviewee pondered, 'If you can't measure, you can't manage'. However, this turned out to be a major challenge, as the interviewee struggled to resolve core foundational measurement problems, e.g., how do you measure progress on climate change? Are there appropriate indicators? Are the measures valid? How should progress be reported? How should action be taken based on the measures? Some organisations, particularly those related to institutions such as the UN, have used reporting and monitoring mechanisms extensively, but the interviewees reported a high level of frustration, as the control mechanisms were not helpful in guiding actions and motives, but rather were bureaucratic and added limited value (for them). However, several interviewees identified third party actors' role in ensuring accurate reporting of progress, e.g., PwC's work on climate services (Novozymes) and the World Bank's review of progress before making investments (UNEP). More recently, developments in ESG reporting are also supportive.

A final challenge associated with governance is setting up projects that connect ideas and resources. Some organisations (particularly companies) have well-established models for project design and execution connected to existing strategy processes, deliberately deciding what projects to initiate based on carefully developed business cases on potential investments. However, several interviewees mentioned having a lack of resources (mostly economic) to initiate needed projects.

5. Continuously changing context

Climate change strategy development and execution occur amid an increasingly uncertain environment, which has a bearing on climate change project portfolios that need to be able to adjust to such (potentially radical and rapid) changes.

The ability to plan amid uncertainty becomes critical, particularly when devising medium- and long-term climate change strategies, i.e., strategies for 2030, 2050 and beyond. At the time of the interviews, the interviewees agreed that planning for 2020 targets was well under way and relatively easy, given that the target was only a few years away, by relying on existing technologies and picking 'low-hanging fruit'. For example, Orsted was ahead of the plan for 2020, along with the rest of Denmark. At the time of the interviews, Denmark was on the path to over-fulfilling its EU obligations, after asserting that renewable energy should cover at least 30% of energy use by 2020. According to IEA, the share of renewable energy in Denmark was 43% in 2020. However, in considering planning as a way to meet 2030 or 2050 targets, the interviewees agreed that the work becomes more complicated given the number of developments that can occur in the next decades. This has been illustrated in the years 2020-2022 via a global pandemic, the shifting geo-political and energetical balance in Europe combined with economic instability and high inflation rates. Thus, the question of planning for an unknown future was raised. Furthermore, technological innovations might change the landscape in which plans are made; for example, innovations in clean technologies might radicalise vehicle transport and the energy sector. Such changes will impact climate change strategies and long-term climate project portfolios. Finally, planning for the long term in one sector also is impacted by progress in other sectors. For example, Denmark will not be able to meet its 2050 target without fundamental contributions from the transport and farming sectors, which currently are lagging far behind energy sector progress.

Concurrently, climate change's ongoing effects are affecting the very work conducted on climate change, i.e., while preparing their climate change mitigation and adaptation strategies, climate changes' effects are influencing societies. The warming climate and increasing occurrence of extreme weather events are shaping the climate change adaptation agenda on an ongoing basis. Simultaneously, related and indirect effects – e.g., population relocation, as seen in the refugee crisis in Europe – are increasing in magnitude, thereby placing political decision-makers in increasingly challenging positions as they are called upon on numerous fronts.

Aside from the uncertainty related to the goals, dynamic effects between actors and initiatives complicate the measurement of progress. Changes in countries' political landscape, e.g., through increased taxation or environmental regulations, create incentives for companies to move activities from one country to another. This is one of the reasons for many European countries' solid performance with regard to carbon targets, e.g., Finland and Denmark, with emissions from

the most carbon-heavy industries having been outsourced to less environmentally regulated countries. These are some of the effects that make measuring climate change difficult. Simultaneously, this also highlights the importance of common standards worldwide, e.g., through trade agreements.

6. Ownership

A central challenge related to addressing climate change within and across nations relates to ownership, or the lack thereof. We focus on two types of owners next.

As climate change strategies are devised at the international and national levels, the responsibility rests on political decision-makers. Given that they tend to be driven by a mix of personal, career and partisan political interests, climate change is on the agenda only insofar as it benefits an individual politician's re-election. This was raised in particular with respect to international climate negotiations, national debates and climate negotiations in major cities where political debates are active. Concurrently, in smaller towns and cities, it seemed that politicians were less vocal in their opposition and more open in their decision-making. This distinction was observed during the interviews, i.e., local city-level interviewees were much more open about their concerns in their work, whereas national-level civil servants were much less willing to admit to any failure or challenge in their work.

A key question related to a country's stance with respect to climate change relates to courage in decision-making. Differences exist in degrees of courage towards environment-related decision-making across the countries studied. This was observed markedly when comparing the Finnish and Danish interviews. In Denmark, bold political decisions' role in shaping future practices was emphasised. Through tough regulation during the oil crises in the late 1970s, Denmark created a context for innovation in energy production and consumption that over time led to the development of leading global companies in areas such as insulation, wind energy and energy infrastructure. However, in the Finnish context, such incentives have been lacking. As a result, the nation's renewable energy and cleantech sectors have been lagging. Whereas interviewees hailed Danish decision-makers' boldness in the 1970s, they lamented Finland's lack of action. To sum up, the approach to climate change mitigation and adaptation is viewed as governmental and regional decision-makers' responsibility.

Paralleling key decision-makers, individual consumers' role matters as well. Succeeding with regard to climate change will require changes in individual actors' daily behaviours as

consumer-citizens. As one senior civil servant put it, 'If we all made three decisions – shorter showers, less fossil-related travel and no meat – we would be making strides forward'. The reason for the seeming inertia or apathy amid the consumer base was attributed to climate change and global warming being perceived as overly large, abstract and far-off challenges for any individual to grasp or affect by changing one's behaviours. As one of the expert interviewees noted, 'People and organisations aren't motivated if they can't see the benefits – what's in it for me?' This seems to be at the heart of the challenge of making individuals change their daily habits. However, individuals presently are incentivised by their employers. Yet, in the case of corporate employees, where the focus is on corporate profitability, financial incentives toward employees will paradoxically result in higher spending, consumption, travel, thereby downplaying the climate mitigation agenda. Furthermore, the interviewees observed that citizen engagement depends on a country's political culture. In democratic countries with a strong socialist tradition, citizens' stance is that the state takes care of their needs, including education and health, and addresses the nation's large challenges. This might explain why climate agency in the Finnish context seemed to be characterised by apparent inertia.

This is where the vicious cycle begins: Until sufficient numbers of individuals change their habits, large-scale shifts will not occur, and yet, active engagement among individual consumers, end-users, citizens and commuters currently remains scant. The governmental, regional and company-level interviewees seemed surprised when asked about consumers and citizens' role in addressing the climate. In the Finnish context, they admitted that consumers and citizens' role has been neglected in their communication and engagement. Ministries were considering how to involve citizens in formulating strategies, and cities were considering how to engage with citizens regarding travel and housing questions. Firms concluded that they need not act unless consumers want more climate-friendly products and services. Simultaneously, several actors are propelling matters, be it with respect to clean-tech investing or facilitating city or corporate peer networks, while many are changing their travel and eating habits. It is as though a silent, gradual revolution was emerging without coordination. We term this *bottom-up change* in support of a better world.

To sum up, it seems that most players are engaged in a game of hide-and-seek, with few daring to take on visible, courageous and ambitious climate agendas. Governments expect industry to be more proactive in spurring climate work further, and firms are hoping for governments to provide long-term planning and incentives for clean technology. Firms also are expecting

consumers to make a difference, while consumers are expecting the government and firms to take action. Some effective actors exist, and many networks have been created, but we still lack coordination across these actors and networks.

Discussion

Climate change has the potential to elicit catastrophic consequences for the survival of the human species and requires immediate action, but despite improvements, our current global efforts remain limited. Drawing on a combination of transition and portfolio management literature, this chapter examined the challenges for climate change mitigation and adaptation across different levels of analysis in three countries – the UK, Denmark and Finland – that are among the leading countries in the fight against climate change. Our empirical work, conducted during the 2015-2016 period, revealed six challenges related to the horizontal and vertical coordination of actions related to climate mitigation and adaptation (see Figure 2). Although set in a historical context, our findings offer insights into the implications for how project portfolio management could be adapted to address climate change and/or related sustainability challenges, e.g., the biodiversity crisis.

We focused on project portfolio management in the context of actual or proposed projects and programmes, that were designed to mitigate climate change's effects. We find that research on project portfolios as a mode of organizing to address climate change remains scant. At the level of individual projects or programmes, portfolio management efforts exist, yet at the meta-level – across international, governmental and private-sector bodies – and between or across projects and programmes, less evidence of an effective, coordinated response mechanism exists. Concurrently, the role and character of decision-making with respect to the prioritisation and coordination of initiatives (e.g., projects and programmes) to reduce carbon emissions and climate change are critical. These initiatives span public and private sectors within international and local domains. The scale is immense, whether adjusting to or mitigating climate change's effects: Infrastructure and industrial and housing sectors are obvious foci, while others are less obvious, though still very important, e.g., agriculture. Thus, one soon can have a portfolio, or portfolios, of quite staggering size and complexity. This is the context against which a project portfolio approach to climate change could lead to fruitful results.

Contribution to project portfolio management

Considering climate action from a project portfolio management perspective is interesting theoretically because it is an extreme case that revolves around ambiguous global ambition that can be obtained only collectively, yet its size and proportion make coordination of such global collective action challenging, if not impossible. It therefore requires innovative solutions that can draw on project portfolio mode of organizing, but go beyond its current common practices. Taken together, the identified challenges call for an alternative way of conceiving project portfolio management that 1) leans more towards coordination mechanisms in a market, instead of a hierarchy, in which cooperation takes place through loose networks of partly competing actors, rather than established structures managing interfaces and interdependencies; 2) does not use goals to define a desired result, but rather a mission-oriented approach (Mazzucato, 2021) that opens arenas to negotiate destinations, make compromises and develop a shared understanding of common directions enabled by useful ambiguity; and 3) calls for distributed leadership and ownership over clear establishment of ownership and responsibility as drivers for action. Table 2 provides an overview of these potential opportunities with which to reconsider project portfolio management.

To sum up, we started the chapter with a conservative view of project portfolio management based on a centralised and hierarchical decision-making process that draws on an overview of projects, a clear objective and decisive power to drive action. Such project portfolio management is logical and deterministic, like a chess game. Different actions and possibilities are complex and difficult to calculate, but can be calculated by bright strategic minds.

We know that such a view of project portfolio management represents senior management's desires, but not necessarily organisational realities (Blichfeldt & Eskerod, 2008; Martinsuo, 2013; Globocnik & Salomo, 2015). The climate change context further challenges this image of controllability due to its loose boundaries and management approaches. Our empirical investigation unveiled challenges that cannot be accommodated by current technocratic views of project portfolio management.

Table 26-2. Rethinking portfolio management for climate change

Identified challenges	**Common response in project portfolio**	**Potential alternative approach to project portfolio**
Inefficient use of resources: National complexity and difficulties creating overviews required to govern and coordinate resources horizontally and vertically (Challenges 2, 3 and 4).	Literature in portfolio suggests *hierarchical control* based on stable processes and structures (Ghasemzadeh & Archer, 2000; Unger et al., 2012; Teller et al., 2012; Voss & Kock, 2013) that create an overview of existing portfolios to establish a link between strategy and projects (Geraldi & Arlt, 2015; Killen et al., 2020).	*Market coopetition*, in which interface management and integration are driven by agency at micro- and meso-levels through, e.g., development of networks and use of competition to foster improvements.
Lack of strategic focus: Despite a common ambition, goals are ambiguous and open to multiple interpretations and enactment in practice, which dilute efforts and fuel disagreements (Challenge 1).	The literature widely agrees that development of *clear objectives* is required to achieve objectives. As such, ambiguity should be avoided.	Clear and binding goals are unrealistic, as countries that actually require such goals create both goals and reinforcing processes. However, our data suggest that development of goals entails arenas of learning and negotiation that enable collective action (Grint, 2005). Therefore, goals are an ambiguous ambition, not a clear target. A mission-orientation could be a pragmatic approach in this regard (Mazzucato, 2021)
Inaction: Ownership is distributed, leading to lack of action (Challenge 6).	Establishment of clear ownership and distribution of responsibility across organisations, preferably binding to specific objectives and sanctions in which these objectives are not achieved.	Global problems are no one's problems, but also everyone's problems. Assigning specific owners to parts of the problem is difficult, particularly as potential owners are not prepared to take on liabilities associated with such goal ownership. Thus, ownership is not going to solve the problem of inaction. Alternative drivers of collective action are required.
Turbulence makes the development of a sound project portfolio even more difficult, as the science, politics and practices related to climate change are in constant change.	Akin to financial portfolios, risk calculations and regular updates enable informed choices about the future.	Alternative views on change and turbulence have been addressed in the literature, viewing the project portfolio as a dynamic capability of the firm (e.g., Petit, 2012; Martinsuo et al., 2014). Such approaches are welcomed in climate change portfolios, with one caveat: Its distributed nature makes actions, e.g., sense and seize opportunities, inherently distributed and not coordinated.

Based on these challenges, we envision alternative contours for project portfolio management that abandon hierarchical controls and instead place faith in market coordination mechanisms that thrive through cooperation and competition, and do not require hierarchical coordination, but instead *also* use agency-driven networks. These networks are heterogenous in nature, with some driven by hierarchical control systems, as is the case within some organisations that we investigated. Others are connected more loosely and draw on project managers and other agents finding like-minded initiatives and coordinating efforts. Global goals exist, but must be ambiguous to hold a diversity of views, yet they still instigate collective action because their very definition encompasses arenas of negotiation and learning. These diverse and loosely connected global institutions have legitimacy, but no cohesive authority. Moreover, adaptation is ongoing and decentralised, based on actors sensing other actors' actions, rather than based on a centralised hierarchical system.

Future studies could examine this alternative form of managing project portfolios within contexts such as addressing biodiversity loss, as well as in the context of other societal challenges, e.g., the global response to COVID-19 and other global challenges. More theorising also is required to establish a stronger link between project portfolio management and other knowledge areas, e.g., transition management. In closing, we call for more research on how grand challenges challenge existing theories and frameworks.

References

Anable, J., & Boardman, B. (2005). Transport and CO2. UKERC Publications.

Anderegg, W. L., Prall, J. W., Harold, J., & Schneider, S. H. (2010). Expert credibility in climate change. *Proceedings of the National Academy of Sciences of the United States*, *107*(27), 12107–12109.

Andreoni, A., Creamer, K., Mazzucato, M., & Steyn, G. (2022). How can South Africa advance a new energy paradigm? A mission-oriented approach to megaprojects. *Oxford Review of Economic Policy*, *38*(2), 237-259.

Blichfeldt, B. S., & Eskerod, P. (2008). Project portfolio management–There's more to it than what management enacts. *International Journal of Project Management*, *26*(4), 357-365.

Brown, S. L., & Eisenhardt, K. M. (1997). The art of continuous change: Linking complexity theory and time-paced evolution in relentlessly shifting organisations. *Administrative Science Quarterly*, *42*(1), 1–34.

Chapman, L. (2007). Transport and climate change: A review. *Journal of Transport Geography, 15*(5), 354–367.

Cooper, R., Edgett, S., & Kleinschmidt, E. (2001). Portfolio management for new product development: Results of an industry practices study. *R and D Management, 31*(4), 361–380.

Cooper, R. G., Edgett, S. J., & Kleinschmidt, E. J. (1999). New product portfolio management: Practices and performance. *Journal of Product Innovation Management, 16*, 333–351.

Dye, L., & Pennypacker, J. (Eds.) (1999). Project portfolio management: Selecting and prioritising projects for competitive advantage. Centre for Business Practices.

Economist Intelligence Unit (2017). Closing the gap: Designing and delivering a strategy that works. https://www.brightline.org/resources/eiu-report/

Eisenhardt, K. M. (1989). Building theories from case study research. *Academy of Management Review*, *14*(4), 532–550.

Frantzeskaki, N., Castán Broto, V., Coenen, L., & Loorbach, D. (Eds.) (2017). *Urban sustainability transitions.* Routledge.

Geraldi, J., & Arlt, M. (2015). Visuals Matter! Designing and using effective visual representations to support project and portfolio decisions. Project Management Institute.

Geraldi, J., Teerikangas, S., & Birollo, G. (2022). Project, program and portfolio management as modes of organizing: Theorising at the intersection between mergers and acquisitions and project studies. *International Journal of Project Management*, *40*(4), 439-453.

Ghasemzadeh, F., & Archer, N. P. (2000). Project portfolio selection through decision support. *Decision Support Systems, 29*(1), 73–88.

Glaser, B. J., & Strauss, A. L. (1967). *The discovery of grounded theory*. Aldine Publishing.

Globocnik, D., & Salomo, S. (2015). Do formal management practices impact the emergence of bootlegging behaviour? *Journal of Product Innovation Management*, *32*(4), 505–521.

Grint, K. (2005). Problems, problems, problems: The social construction of 'leadership'. *Human Relations*, *58*(11), 1467–1494.

Jaroszweski, D., Chapman, L., & Petts, J. (2010). Assessing the potential impact of climate change on transportation: The need for an interdisciplinary approach. *Journal of Transport Geography*, *18*(2), 331-335.

Killen, C. P., Geraldi, J., & Kock, A. (2020). The role of decision makers' use of visualisations in project portfolio decision making. *International Journal of Project Management*, *38*(5), 267–277.

Koch-Ørvad, N., Thuesen, C., Koch, C., & Berker, T. (2019). Transforming ecosystems: Facilitating sustainable innovations through the lineage of exploratory projects. *Project management journal*, *50*(5), 602-616.

Konidari, P. & Mavrakis, D. (2007). A multi-criteria evaluation method for climate change mitigation policy instruments. *Energy Policy*, *35(12)*, 6235-6257.

Larsen, K., & Gunnarsson-Östling, U. (2009). Climate change scenarios and citizen-participation: Mitigation and adaptation perspectives in constructing sustainable futures. *Habitat International*, *33*(3), 260–266.

Levine, H. A. (2005). *Project portfolio management* (1st ed.). John Wiley & Sons.

Loorbach, D. (2010). Transition Management for Sustainable Development: A Prescriptive,

Complexity-Based Governance Framework. *Governance, 23*(1), 161–183.
Loorbach, D., Frantzeskaki, N., & Avelino, F. (2017). Sustainability Transitions Research: Transforming Science and Practice for Societal Change. *Annual Review of Environment and Resources, 42,* 599–626.
Loorbach, D., & Rotmans, J. (2010). The practice of transition management: Examples and lessons from four distinct cases. *Futures, 42*(3), 237–246.
Loorbach, D., Wittmayer, J. M., Shiroyama, H., Fujino, J., & Mizuguchi, S. (Eds.) (2016). *Governance of urban sustainability transitions: European and Asian experiences* (Vol. 1). Springer.
Marcelino-Sádaba, S., Pérez-Ezcurdia, A., and González-Jaen, L. F. 2015. "Using Project Management as a way to sustainability. From a comprehensive review to a framework definition". *J. Clean. Prod.*, 99, 1–16.
Marquardt, J. (2015). How transition management can inform development aid. *Journal of Environmental Innovation and Societal Transition, 14*, 182–185.
Martinsuo, M., & Geraldi, J. (2020). Management of project portfolios: Relationships of project portfolios with their contexts. *International Journal of Project Management, 38*(7), 441–453.
Martinsuo, M. (2013). Project portfolio management in practice and in context. *International Journal of Project Management*, *31*, 794–803.
Martinsuo, M., Korhonen, T., & Laine, T. (2014). Identifying, framing and managing uncertainties in project portfolios. *International Journal of Project Management*, *32*(5), 732–746.
Mathews, J. (2007). Seven steps to curb global warming. *Energy Policy, 35,* 4247–4529.
Mazzucato, M. (2021). *Mission economy: A moonshot guide to changing capitalism*. Penguin UK.
Morris, P. W. G. G. (2017). Climate Change and what the Project Management Profession should be doing about it - a UK perspective, Association for Project Management.
Moss, R. H., Jae A., Edmonds, J. A., Hibbard, K. A., Manning, M. R., Rose, S. K., van Vuuren D.P., Carter, T. R., Emori, S., Kainuma, M., Kram, T., Meehl, G. A., Mitchell, J. F. B., Nakicenovic, N., Riahi, K., Smith, D. J., Stouffer, R. J., Thomson, A. M., Weyant, J. P., &Wilbanks, T. J. (2010). The next generation of scenarios for climate change research and assessment. *Nature, 463*(11), 747–756.
Nevens, F., Frantzeskaki, N., Gorissen, L., & Loorbach, D. (2013). Urban transition labs: Co-creating transformative action for sustainable cities. *Journal of Cleaner Production, 50*, 111–122.
Norrie, J. L. (2006). Improving results of project portfolio management in the public sector using a balanced scorecard approach. *Doctor of Project Management thesis, School of Property, Construction and Project Management, RMIT, University of Melbourne, Melbourne.*
Overgård, N. B., Jensen, L. B., & Thuesen, C. (2022). Strategies to Benchmark Sustainability Performance within a Project-Based Organization in the Building Industry: A Case Study in Denmark. *Journal of Architectural Engineering*, *28*(3),
Petit, Y. (2012). Project portfolios in dynamic environments: Organising for uncertainty. *International Journal of Project Management*, *30*(5), 539–553.

Project Management Institute (PMI). (2017). *A guide to the project management body of knowledge - PMBOK Guide* (6th ed.). PMI.

Silvius, G., and Schipper, R. 2018. "Four Strategic Postures for Sustainability in the Project-Based Organization". In *Green Production strategies for Sustainability* (pp. 259–280).

Sovacool, B. K., & Geels, F. W. (2021). Megaprojects: Examining their governance and sociotechnical transitions dynamics. *Environmental Innovation and Societal Transitions*, *41*, 89–92. https://doi.org/10.1016/j.eist.2021.10.002

Stern, N. (2006). What is the economics of climate change? *World Economics, 7*(2), 1–10.

Teller, J., Unger, B. N., Kock, A., & Gemünden, H. G. (2012). Formalisation of project portfolio management: The moderating role of portfolio complexity. *International Journal of Project Management, 30,* 596–607.

Unger, B. N., Gemünden, H. G., & Aubry, M. (2012). The three roles of a project portfolio management office: Their impact on portfolio management execution and success. *International Journal of Project Management, 30,* 608–620.

Vijayavenkataraman, S., Iniyan, S., & Goic, R. (2012). A review of climate change mitigation and adaptation. *Renewable and Sustainable Energy Reviews, 16*, 878–897.

Voß, J. P., Smith, A., & Grin, J. (2009). Designing long-term policy: Rethinking transition management. *Policy Sciences, 42*(4), 275–302. http://doi.org/10.1007/s11077-009-9103-5.

Voss, M., & Kock, A. (2013). Impact of relationship value on project portfolio success—investigating the moderating effects of portfolio characteristics and external turbulence. *International Journal of Project Management, 31*, 847–861.

Walsh, C. L., Dawson, R. J., Hall, J. W., Barr, W. L., Batty, M., Bristow, A. L., Carney, S., Dagoumas, A. S., Ford, A. C., Harpham, C., Tight, M. R., Watters, H., Zanni, A. M. (2010). Assessment of climate change mitigation and adaptation in cities. *Proceedings of the Institution of Civil Engineers, 164*(DP2), 75–84.

World Meteorological Organisation. (2013). A summary of current climate change findings and figures. *A WMO information note*, March 1-8.

World Meteorological Organisation (WMO) (2020). State of the Global Climate 2020 (WMO-No. 1264), https://library.wmo.int/index.php?lvl=notice_display&id=21880#.YcQ5dmjMJaR

Yin, R. K. (2009). *Case study research: Design and methods* (Vol. 5). Sage.