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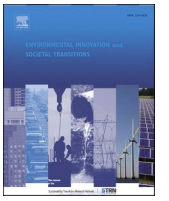

Cross-sector collaboration, nonprofit readiness, and sustainability transitions

Yuhao Ba *, Sreeja Nair, Mohnish Kedia

Lee Kuan Yew School of Public Policy, National University of Singapore, Singapore 259772, Singapore

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ABSTRACT

Cross-sector collaborations—partnerships between organizations from multiple sectors (e.g., the public and nonprofit and voluntary sectors)—are key to sustainability transitions yet remain understudied. In this study, we assess the readiness of nonprofit organizations for engaging in collaborative sustainability efforts. We develop and empirically validate a theoretical framework focusing on three key dimensions of readiness: awareness, capacity, and actions. Using an important yet less-studied empirical context of Singapore, and informed by evidence from thirty-nine in-depth interviews, our findings reveal that nonprofits in Singapore are generally aware of sustainability transition challenges and opportunities and possess important capacities such as organizational agility and digital adaptability. However, proactive actions remain limited, partially due to the predominant role of the state in sustainability action. Our research contributes to understanding the role of nonprofit and voluntary actors in collaborative efforts for sustainability transitions, offering valuable insights for strengthening a collaborative approach to sustainability transitions.

1. Introduction

Sustainability transitions entail long-term, deliberate, and society-wide transformative changes of existing modes of production and consumption towards a more sustainable economy and society (Avelino et al., 2016; Köhler et al., 2019; Markard et al., 2012). The urgency for societal transitions towards sustainability has perhaps never been more pronounced, especially in the aftermath of the COVID-19 pandemic, which clearly revealed the vulnerabilities of our contemporary socio-technical systems (Wells et al., 2020). A significant takeaway from our response to the crisis is the growing recognition of the potential and necessity of a collaborative approach, which seeks to synthesize efforts of the government, businesses, nonprofit and philanthropies, and the public to enable meaningful policy changes. Such an approach aligns with the long-standing insights emphasized by the multi-level, multi-actor perspective of research on governing transitions (see e.g., Ehnert et al., 2018; Geels, 2011; and Hess, 2018) and is arguably a key institutional solution driving sustainability transitions.

Cross-sector collaboration—partnerships between organizations from at least two sectors (e.g., the public and nonprofit and voluntary sectors)—features prominently in the collaborative approach to sustainability transitions (Ordonez-Ponce et al., 2021; van Mierlo and Beers, 2020). In practice, cross-sector collaboration has been increasingly devised as a strategic response to complex societal challenges such as energy transitions (Aisbett et al., 2023; Määttä, 2021) and environmental degradation (Ba, 2022; Mousavi and

* Corresponding author.
E-mail address: yba@nus.edu.sg (Y. Ba).

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Bossink, 2020). As cross-sector collaborations continue to thrive, research on sustainability transitions has likewise dedicated significant efforts, providing valuable insights into crucial areas such as public-private partnerships (see e.g., Pinilla-De La Cruz et al., 2022; Wang and Ma, 2021), coproduction (Chambers et al., 2021; Miller and Wyborn, 2020), and power dynamics and strategic interactions within such arrangements (Bohnsack et al. 2016; Herrfahrdt-Pähle et al., 2020).

While research on cross-sector collaboration within sustainability transitions has been advancing significantly, important gaps still remain. One crucial gap involves the insufficient attention towards actors from the nonprofit and voluntary sector (for exceptions, see Feola and Jaworska, 2019; Watson et al., 2020). Here, based on the literature, we define nonprofit and voluntary actors as "organized, private legal, and self-governing entities that are nonprofit-distributing and voluntary" (Anheier et al., 2020, p. 653). Examples of nonprofit and voluntary actors include charities, foundations, religious organizations, and social clubs. These entities are established to serve public or mutual benefits rather than pursuing profits for owners or investors. They play an important role in addressing societal needs and contributing to community development. The limited attention given to actors from the nonprofit and voluntary sector overlooks their unique advantages in pivotal areas such as raising awareness about environmental and sustainability issues, fostering public engagement and fundraising, and cultivating and sustaining sustainability-friendly behaviors (Delmas et al., 2020). When collaborating with partners from different sectors, nonprofit and voluntary entities are likewise useful in enhancing the accountability and legitimacy of their collaborations. This is particularly the case in collaborations initiated by corporate entities (Ba, 2021). Additionally, due to their close proximity to service end-users and deeper understanding of local contexts, nonprofit and voluntary actors also offer distinctive insights and knowledge regarding community needs, service expectations and experiences. This expertise is especially valuable in addressing justice and equity issues within sustainability transitions (Johnson et al., 2023).

Here, we focus on an important prerequisite of cross-sector collaboration: readiness, and assess systematically the readiness of nonprofit and voluntary actors to engage in collaborative sustainability efforts. Our approach begins with the development of a theoretical framework that identifies three core dimensions of nonprofit readiness: *awareness, capacity*, and *actions*. We then test this framework empirically, using a qualitative exploratory method in the context of Singapore, a city-state situated in Southeast Asia. Our study advances the transitions scholarship by unpacking insights on individual and organizational agency within the nonprofit and voluntary sector, and offers valuable perspectives for scholars, practitioners, and policymakers engaged in fostering a collaborative approach to sustainability transitions.

2. Literature review

Sustainability encompasses the achievement of a durable and harmonious equilibrium of environmental integrity, economic prosperity, and societal well-being (Purvis et al., 2019). The field of sustainability transitions seeks to theorize, evaluate, and promote significant societal transformations aimed at achieving sustainability (Köhler et al., 2019). In doing so, scholars likewise delve into the political and normative foundations of sustainability transitions (see Avelino et al., 2016). The primary focus of analysis is on the "*meso*" level, where socio-technical-ecological systems undergo major reconfigurations that depart from established norms and practices (Magnusson and Werner, 2022). One important area of study revolves around transitions governance (see e.g., Bolton and Hannon 2016; Nieminen et al. 2021; Voß and Bornemann 2011), emphasizing the intricate, multi-level, and multi-actor nature inherent in sustainability transitions (Ba and Galik, 2023). Such an emphasis aligns with the growing momentum of non-state and subnational sustainability initiatives as well as the acknowledged limitations of top-down, nationally-driven approaches in advancing sustainability transitions (see Bohnsack et al. 2016; Broto and Bulkeley 2013; Hale et al. 2021; Törnberg 2018).

Transitions governance can be defined as the system of institutional procedures, structures, and organizations that enable actors to collectively design and shape sustainability transition pathways and outcomes (Turnheim et al., 2015; Hess, 2018; Lemos and Agrawal, 2006). As noted previously, given the intricacy and unpredictability of socio-technical-ecological challenges, stakeholders from various sectors are engaged in transitions governance, resulting in a multitude of cross-sector collaborative arrangements at varying scales (Bohnsack et al. 2016; Mol, 2016). The prominence of cross-sector collaboration in transitions governance stems from the potential to attain a collaborative advantage, which enables actors to leverage synergistic capabilities through joint efforts to achieve outcomes that would be otherwise unachievable for actors within singular sectors (Vangen and Huxham, 2010). The mechanisms through which a collaborative advantage can be attained include: operational efficiency gains through the transfer of best practices, innovation and enhanced decision-making through knowledge sharing and cross-pollination of ideas, augmented transparency and risk-sharing, improved stakeholder representativeness and inclusiveness, and increased responsiveness to complex governance challenges (Doberstein, 2016; Emerson and Nabatchi, 2015; Hansen and Nohria, 2004).

Achieving collective advantage, however, is not always straightforward. In practice, collaborative arrangements in diverse contexts encounter many challenges, such as navigating complex institutions and conflicting interests and priorities (Doberstein, 2016; Vangen and Huxham, 2010), balancing stakeholder inclusion with decision-making costs (Scott et al., 2018), and contending with the tendency towards symbolic decision-making and consensus seeking (Gerlak et al., 2013). These challenges are notably more pronounced for nonprofit and voluntary actors. Compared to their counterparts in the public and private sectors, nonprofit and voluntary actors often encounter inherent disadvantages in collaborative arrangements due to their limited capacities, diffuse interests (owing to their operation on more localized issues), and reliance on fundraising from the other sectors (Fyall, 2016). Additionally, nonprofit and voluntary actors have concerns that participating in collaborative arrangements could escalate operational costs due to heightened coordination and administrative tasks, compromise their autonomy and advocacy capabilities, limit their ability to hold other actors accountable, and potentially affect donation streams (Gazley, 2010).

Given such barriers, assessing the readiness of nonprofit and voluntary actors to partake in cross-sector collaborations becomes imperative to better unlock the potential of a collaborative approach toward sustainability transitions. Here, readiness refers to an

entity's level of being equipped and prepared to engage in sustainability-oriented cross-sector collaborations. It encompasses both capacity and willingness, thereby delineating the objective and perceived readiness levels, respectively (Barletta et al., 2021; Van Cauwenbergh et al., 2022). This aligns with the literature on organizational readiness for change, which describes it as an organization's collective belief in their ability to implement a change (change efficacy) and their shared determination to make it happen (change commitment; Weiner, 2009). In the context of sustainability transitions, scholars further extend the notion of readiness to encompass three critical dimensions. These involve understanding sustainability-related risks and opportunities (*awareness*), having the ability to analyze and convert them into particular planning and management activities (*analytic capacity*), and taking action to address these risks and opportunities (*actions*; Moser and Luers, 2008). Application of readiness as a concept has been gaining traction in the literature, particularly within domains such as production and consumption models around sustainable manufacturing (see Barletta et al., 2021), adoption and mainstreaming of nature-based solutions (see Van Cauwenbergh et al., 2022), and risk and resources management (see Moser and Luers, 2008).

While the research on readiness is advancing, a closer examination reveals two key insights. First, despite its conceptual clarity and parsimoniousness, readiness is profoundly influenced by context. Its alignment relies on an entity's objectives, operations, and its positioning within the wider landscape of transitions governance. Empirical work from various contexts is thus needed to validate and enrich our understandings of readiness. Second, although readiness among actors from various sectors remains generally underexplored, nonprofit and voluntary actors receive notably scant attention. As transitions continue to scale up and accelerate, as previously argued, it is imperative to assess systematically the readiness of nonprofit and voluntary sectors for sustainability-oriented cross-sector collaborations. In doing so, exploring the synergies between transitions studies and public and nonprofit management research holds promise for providing valuable guidance. An important reason lies in the potential for complementary insights enabled by the strength of transitions studies in examining system-level developments and the expertise of public and nonprofit management research in capturing organizational level dynamics.

A luminous strand of research in transitions studies focuses on system-level developments and has yielded significant insights (see e.g., Ehnert et al., 2018; Bohnsack et al. 2016; Bolton and Hannon 2016; and Kanda et al., 2019). The advantage of a system-level focus is that it enables a dynamic and evolutionary perspective on socio-technical changes that integrates the interactions between varied system components such as actors and their activities as well as the influence of the system's institutional and material environments (Bohnsack et al. 2016). Examples of research that has been fostered by such an emphasis include sustainable entrepreneurship and business model innovation (Lüdeke-Freund, 2020), the influence of the multi-level political context on urban sustainability transitions (Ehnert et al., 2018), as well as the impact of historical industrial transitions on local sustainability performance (Ba and Galik, 2023). As this strand of research progresses, recent evaluations, however, have been reflecting on the potential constraints of this largely aggregated approach, prompting a call for increased focus on agency and political dynamics (see Avelino et al., 2016; Bolton and Hannon 2016; and Markard et al., 2012).

The public and nonprofit management literature is advantageously positioned in offering complementary insights at both the organizational and individual levels within sustainability transitions. That is, in addition to its well-established strength in studying organizational and individual level attributes such as capacity, practices, and performance, the public and nonprofit management literature is increasingly equipped to explore more nuanced aspects such as information processing, learning, and preferences (see e.g., Andersen, 2010; Deslatte et al., 2020). Such advantages will help add to the prominence of agency in system-focused transitions research. For instance, building upon the existing research at the crossroads of transitions scholarship and public and nonprofit management, it becomes essential to explore the preferences of actors across sectors concerning transition pathways. This exploration could offer deeper insights into the political and strategic interactions among these actors. Additionally, studying practices and assessing performance in transition efforts would be invaluable for evaluating and benchmarking progress across different domains/subsystems of transitions governance (Boyd and Martin, 2021). The current study, drawing on the synergy between transitions studies and public and nonprofit management research, aims to develop and empirically validate a framework for nonprofit readiness for cross-sector collaborations oriented towards sustainability transitions.

3. A framework of nonprofit readiness

In the context of sustainability transitions, cross-sector collaborations play a pivotal role in facilitating progress via three key mechanisms (Bohnsack et al. 2016; Clarke and Crane, 2018; van Mierlo and Beers, 2020). First, they enable stakeholders to co-create new ideas and knowledge, essential for developing innovative transition pathways. Second, these collaborations are instrumental in making sense of ongoing transitions, cultivating a shared understanding of the evolving sustainability landscape. Lastly, they offer valuable insights into the operation and influence of sustainable solutions, revealing their impact on transition dynamics in the making (Frantzeskaki and Rok, 2018). Despite the promise, formation of cross-sector collaborations is a complex process as commitment and buy-in of all participants are required. Key factors influencing the formation of cross-sector collaborations include the resource profiles of the involved parties, their understandings of the problem at hand and the need for collaboration (i.e., problem definition and collaborative purpose), their anticipations of other stakeholders' willingness to engage, initial leadership, communications, and the political and institutional environment (Bryson et al., 2015).

In the evolving landscape of cross-sector collaborations, nonprofit and voluntary actors have seen their roles expand from primarily providing services to becoming active decision-making partners (Calò et al., 2023). Despite this progression, these actors often face challenges in joining collaborations. As noted previously, concerns include their resource limitations and power imbalances compared to other stakeholders, as well as more general issues like the extra costs associated with reallocating resources as well as adapting internal logics, organizational routines, and practices to facilitate collaborative efforts (Frantzeskaki and Rok, 2018). As cross-sector

collaborations continue to proliferate in sustainability transitions, and considering the increasingly significant role played by nonprofit and voluntary actors, it is thus necessary to assess the readiness of these actors in engaging in sustainability-oriented collaborative efforts. Importantly, it is vital to differentiate between readiness and willingness, as the latter characterizes mainly an agent's inclination or positive disposition to undertake a task or engage in an activity (Qian et al., 2021) whereas the former takes a more realistic and comprehensive approach by incorporating capabilities and/or actions (see Barletta et al., 2021; Moser and Luers, 2008; Van Cauwenbergh et al., 2022). Below, we draw on the literature of transitions studies and public and nonprofit management and detail a theory-driven conceptualization of three aspects of readiness: *awareness, capacity*, and *actions*.

3.1. Awareness

In the context of developing cross-sector collaborations that facilitate sustainability transitions, "awareness" is crucial for nonprofits in two key respects. First, it involves an understanding of both the current impacts and risks associated with ongoing transitions and the potential future pathways these transitions may take, especially as they pertain to their organizations. Second, awareness encompasses a comprehensive grasp of the potential costs and benefits associated with engaging in cross-sector collaborations. This includes how such collaborations might contribute to their organizations' operation, mission fulfilment, and resilience (Boyd and Martin, 2021; Bryson et al., 2015; Frantzeskaki and Rok, 2018). Together, these two aspects help define the range of options that a nonprofit can consider for engaging in cross-sector collaborations. Accordingly, awareness refers to the spectrum of perceived incentives and constraints that influence a nonprofit's decision to collaborate with stakeholders from other sectors for sustainability transitions (Gazley, 2010). Importantly, it is essential to emphasize that for nonprofit and voluntary actors, engaging in cross-sector collaborations within the sphere of sustainability transitions indicates a higher entry barrier than in other contexts, as such collaborations often entail a longer process, less defined objectives, more diffused interests and responsibilities, and more complex political dynamics (see e.g., Avelino et al., 2016; Chambers et al., 2021; Clarke and Crane, 2018; and Hess, 2018).

Along this line, it is useful to conceptualize awareness as a dynamic, evolving construct, highlighting that a nonprofit's level of awareness can shift over time through mechanisms such as organizational learning and/or in response to variations in both internal and external factors affecting their organizations (Brown et al., 2021). Key factors that can influence a nonprofit's awareness when considering cross-sector collaborations include the management team's knowledge and perceptions of potential collaborating stakeholders, their professional experience (including experience of prior collaborations) and training, their level of trust, social capital and network, as well as their cultural and political backgrounds. Additionally, the specific mission of their organization, donor expectations, the organization's needs, the prevailing policy environment, and the needs and expectations of the community they serve, may also contribute to shaping this awareness (Gazley, 2010). Moreover, it is worth noting that awareness is also subject to various behavioral biases such as availability bias, deception aversion, escalation of commitment (sunk cost fallacy), optimism bias, and planning fallacy (Alempaki et al., 2023; Flyvbjerg, 2021). Lastly, feedback from other two aspects of readiness—*capacity* and *actions*—likewise can play a role in shaping awareness.

3.2. Capacity

Capacity, generally rooted in a resource-based view of cross-sector collaborations, encompasses the specific skills, resources, and functions that a nonprofit can bring to the table in collaborations. This view highlights the benefits that can arise from cross-sector collaborations, including the sharing of complementary resources (e.g., financial, human, and social capital) as well as the joint management of financial and political uncertainties. Additionally, and perhaps more importantly, the resource-based view emphasizes an organization's competitive advantage/edge, elaborating on how its unique assets can enhance and reinforce its role and influence in cross-sector collaborations (Clarke and MacDonald, 2019). For nonprofit and voluntary organizations, the manifestation of capacity can vary depending on the context. A typical array of capacities include (1) organizational development (e.g., governance, human resources management, financial health); (2) program development (e.g., service delivery, program evaluation), (3) revenue development (e.g., fundraising strategies, donor relations), leadership development (e.g., mission, vision, board composition), and community engagement (e.g., community connections, knowledge of local contexts and service needs; Despard, 2017). More recently, with the increasing prevalence of social, political, and economic uncertainties (e.g., extreme weather events, natural disasters, and financial crises), resilience has likewise been touted as a key nonprofit capacity (Waerder et al., 2022).

In the context of sustainability transitions, capacity can be further connected to another important concept: transformative capacity, which refers to a system's ability to develop new configurations when the existing ones are no longer sustainable (Wolfram, 2016). For nonprofit and voluntary actors, transformative capacity can comprise a series of key elements, including inclusive, diverse, and resilient governance structures; transformative leadership that views individuals as agents of change; transformative strategies that promote empowered and autonomous communities; system awareness and recognition of path dependencies; sustainability foresight that prioritizes transdisciplinary knowledge co-production and collective visions for radical changes; expertise in community-based experimentation; a commitment to innovation; reflexivity and social learning; adaptability to work across various levels of human agency (e.g., individuals, households, and social groups); and flexibility to operate across different geopolitical boundaries (for more details, see Wolfram, 2016). A key premise in cultivating transformative capacity is the necessity for stakeholders to engage in networks characterized by "governed interdependence." Such networks are conductive to integrating the knowledge bases and problem perceptions of varied stakeholders, harmonizing their goals and interests, and fostering the development of transition pathways and reciprocal relationships (Halpin and Daugbjerg, 2008; Wolfram, 2016). Such a premise is closely in line with the core of cross-sector collaborations, in which stakeholder engagement is integral to a collaboration's legitimacy, effectiveness, and impact

(Desai, 2018). Importantly, just like *awareness*, possessing the needed *capacity* is likewise a necessary yet insufficient condition for nonprofit involvement in sustainability-oriented cross-sector collaborations.

3.3. Actions

In the context of sustainability transitions, the third critical element of nonprofit readiness for engaging in cross-sector collaborations is *actions*. In practice, *actions* entail overcoming a constellation of external and/or internal obstacles and barriers that can complicate the implementation of a nonprofit organization's plans and strategies to collaborate with stakeholders from other sectors (Moser and Luers, 2008). From a decision-making perspective, drawing on the nonprofit value chain model (Godefroid et al., 2023), cross-sector collaborations can be integrated into every stage of a nonprofit's value creation process. Consequently, barriers need to be addressed at each of these stages. These stages include: (1) Program Design: this stage involves assessing the service context and planning the organization's service programs. (2) Fundraising: In this stage, nonprofits engage in research and analysis, design revenue strategies, and manage donor acquisition and retention. (3) Fund Management: This involves matching financial portfolios to program needs and managing compliance with funding requirements. (4) Program Delivery: The final stage encompasses setting up, implementing, monitoring, and evaluating programs. It also includes ensuring accountability and the successful delivery of services to beneficiaries. For nonprofits to fully leverage the benefits of cross-sector collaborations, they must identify and overcome challenges inherent in each of these value chain stages.

Beyond addressing barriers, proactive measures are also crucial to enable nonprofit participation in sustainability-focused collaborations. These actions should be rooted in a design-oriented approach, which entails a deliberate effort by collaborative participants to examine, learn from, and apply lessons from best practices, as well as past successes and failures, in the development of

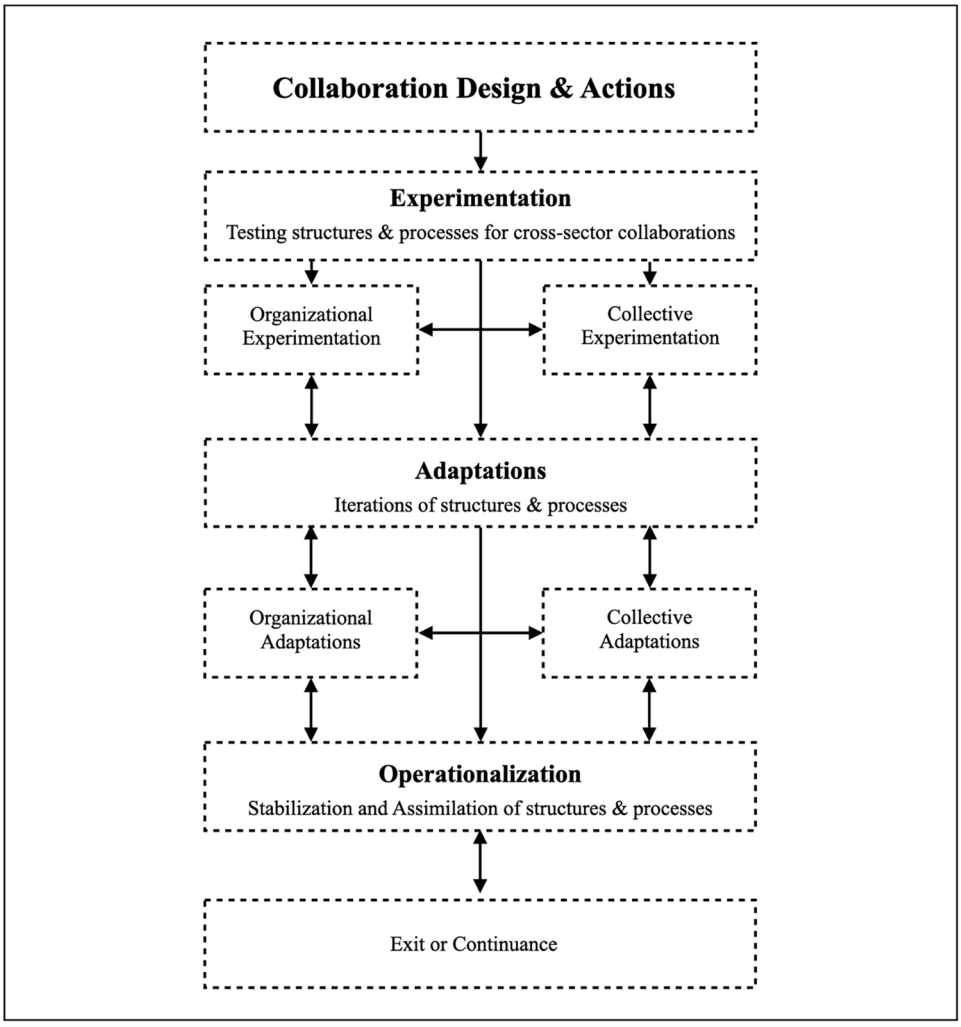

Fig. 1. A Design-Oriented Approach for Actions to Facilitate Sustainability-Focused Cross-Sector Collaborations.
Adapted from Austin & Seitanidi (2012).

sustainability-focused collaborative efforts (Howlett, 2020). A design-oriented approach emphasizes experimentation with both procedural and substantive aspects of collaborative processes (Nair, 2020). Key areas for such experimentation might involve setting clear objectives for the collaboration and defining its structural framework, testing rules and guidelines for cooperation, drafting Memorandums of Understanding to formalize collaborations, proposing leadership roles, and reaching consensus on collaboration management and governance. Along this line, adaptability likewise forms a crucial aspect of action, as it ensures that output of experimentation can be effectively stabilized and assimilated into nonprofit practices and decision-making. At the systemic level, adaptability is also essential for developing and supporting resilient, adaptive transition pathways (Pant et al., 2015). Fig. 1 illustrates this design-oriented approach to fostering sustainability-focused collaborations, applicable at both the micro (individual nonprofits) and *meso* (across collaborative processes) levels. Furthermore, it is crucial to recognize the significance of strategic communications, both internal and external to nonprofit organizations, in the development of sustainability-focused collaborations. Effective strategic communication is key to navigating uncertainties, resolving misunderstandings among stakeholders, and addressing potential power imbalances (Austin and Seitanidi, 2012; Laakso et al., 2021).

3.4. Inter-linkages between the three aspects of readiness

Together, the aforementioned three aspects—*awareness, capacity*, and *actions*—characterize the readiness of nonprofit organizations in engaging in sustainability-oriented cross-sector collaborations. Importantly, the three aspects function in parallel rather than in sequence, each operating with a degree of autonomy. That is, opportunities and barriers to effective cross-sector collaborations may arise in any one of these aspects and it is the strategic alignment of the three aspects that is key to unlock the synergistic value of cross-sector collaborations. This is in line with the multiple streams framework as well as the garbage can model in the policy process literature, which suggest that the confluence of problem, policy, and political streams may lead to a brief window of potential meaningful policy changes (Kingdon, 2011; Zahariadis, 2014). In this case, at the organizational level, it is crucial to identify the specific shortfalls in the three aspects within different organizations. This understanding will facilitate the design of more tailored strategies to enhance each organization's readiness for sustainability-oriented cross-sector collaborations. More broadly, at the sector level, recognizing the distribution of strengths and limitations across various organizations in these three aspects is equally important. This recognition will lay the foundation for more effective pairing of organizations when developing cross-sector collaborative efforts.

Along this line, we highlight several critical elements to our proposed framework. First, we assume bounded rationality at the agent and organizational levels, acknowledging that stakeholders in general lack the ability to process all information relevant to forming collaborations. Second, we recognize the significant role of collaborative entrepreneurs, agents equipped with the necessary skills, resources, and the mindset to drive collaborative efforts forward for strategic purposes (Cairney, 2018). Third, informed by the literature on organizational readiness for change (see e.g., Gigliotti et al., 2019; Weiner, 2009), we highlight the dynamic and evolutionary nature of the three aspects and their interactions within and beyond individual nonprofit organizations. For instance, changes in an organization's ability and/or actions in engaging in sustainability-oriented cross-sector collaborations can influence its members' awareness, thereby impacting the organization's overall level of readiness. Lastly, we acknowledge that while cross-sector collaborations are in general favorable, they can compromise the independence of nonprofit organizations (Baur and Schmitz, 2012). When assessing their readiness, it is thus imperative to give careful consideration to how these collaborations align with a nonprofit organization's mission and operations.

4. Methodology

Empirically, our study adopts an exploratory approach, with a qualitative research design that provides in-depth insights into our proposed framework on nonprofit readiness for collaborative sustainability efforts. In doing so, we focus on nonprofit organizations in Singapore, capturing the perspectives of leaders (e.g., directors and managers) of these organizations. Their firsthand accounts are invaluable in uncovering the routine challenges faced by nonprofits as well as the risks and opportunities that they perceive when it comes to collaborating with participants from other sectors, including the public and private sectors, to advance their sustainability missions.

Our focus on Singapore is driven by the following motivations: First, Singapore leads the effort in Southeast Asia in engaging non-state actors in sustainability transitions (Li et al., 2020; Rock et al., 2009; Yap and Thuzar, 2012). Its emphasis, however, has been on the for-profit sector given the sector's significant carbon footprint and economic influence. As Singapore continues to progress on its sustainability efforts, its nonprofit and voluntary sector must be further engaged to complete and strengthen its collaborative approach. Second, social services in Singapore have long been delivered predominantly by the state. This extensive state involvement has led to Singapore being characterized in several ways. For instance, it is described as an "administrative state," where bureaucracy controls societal direction, and as a "corporate state," where the government dominates society through a complex corporatist structure (see Guo and Zhang, 2014). As a result of this strong state presence, the nonprofit and voluntary sector remains in its early developmental stages. This nascent stage of development underscores the necessity for these actors to collaborate with other sectors to enhance their impact and growth. Third, most of the existing research on sustainability transitions concentrates on Western contexts (Rut and Davies, 2018). Insights from Singapore can offer unique and valuable perspectives for other non-western contexts, especially for Southeast Asia, where Singapore is seen as a leading force in sustainability efforts (see e.g., Rock et al., 2009).

4.1. Design and sampling strategy

Given our qualitative research design, we rely on in-depth semi-structured interviews for data collection. Each interview was designed to capture information on four aspects. This includes: (1) basic information about the interviewee and the organization such as mission, staff, funding sources etc., (2) information about an organization's risks and opportunities in sustainability transitions; (3) an organization's adaptation strategies and experiences; (4) the interviewee's reflection on their organization's outlook and future plans. These sections provided the essential questions based on the literature, and also allowed flexibility for a wider range of reflections.

In total, our study engaged 41 nonprofit organizations. As illustrated in the accompanying figure, a significant portion of our sampled nonprofits operate solely with volunteer staff, which is in line with the trend in the global nonprofit sector (see appendices for details). Additionally, our sample represented a diverse range of organizations in terms of full-time employees, regular volunteers, and part-time staff. This diversity was instrumental in providing a comprehensive view of readiness at various stages of organizational development, and across a spectrum of objectives and operational environments.

Our selection of nonprofit organizations began with two databases: *Lepak Kakis Database* (https://lepakinsg.wordpress.com/lepak-kakisdatabase/) and *Southeast Asian Climate NPOs Repository* (https://www.seaclimatenpos.org/). The two databases are periodically updated and feature organizations actively working on various environmental issues within Singapore and Southeast Asia, respectively. To ensure the relevance and activity of our targeted organizations, we performed preliminary assessments using their social media presence. In parallel, desktop research was conducted to identify additional organizations involved in Singapore's sustainability space. To ensure the representativeness of our sample, we also employed snowball sampling to reach participants who were challenging to access but held crucial insights into our research topic (Robichau and Sandberg, 2022). Ultimately, we sampled 41 participating organizations in our interviews. Please refer to the appendices for more information about our sampled nonprofits.

4.2. Data collection

All interviews were conducted between 4 April to 28 June 2022. The duration of these interviews varied, ranging from twenty-five to one hundred fifteen minutes, with an average length of fifty-five minutes. The structure of each interview was flexible, adapting to the conversational style and responses of the interviewees. We encouraged each participant to share their organization's experiences and contributions in the field of sustainability policy, aiming to gain a comprehensive understanding of their roles and impacts on Singapore's sustainability transitions. To ensure accuracy and ease of analysis, all interviews were recorded and then transcribed using Otter AI. Transcripts were also reviewed by the interviewers to verify their precision. In line with ethical research practices, the identities and designations of all interviewees have been anonymized in our study. Additionally, to confirm the factual accuracy of the information provided, we cross-referenced the interview data with other sources such as the organizations' social media, websites, and/or government registration. All interviews were conducted online to accommodate the needs and schedules of both interviewers and participants.

4.3. Data analysis

A total of thirty-nine interviews were transcribed and coded using NVIVO software; two transcripts were lost due to technical issues. The coding process was informed by the literature and began with four randomly selected transcripts (representing about 10 % of all transcripts). We developed a codebook using this approach, which involved creating an initial set of codes from the literature, coding a transcript, resolving discrepancies among coders, refining the codebook based on discussions, and then proceeding to the next chosen transcript (Campbell et al., 2013). The goal was to achieve consensus on the coding framework among coders, after which each coder independently processed the remaining transcripts. This combination of deductive and inductive analysis aligns with common practices in qualitative research (Sandberg and Robichau, 2022). Based on the codebook, which involves eleven parent codes inclusive of the three aspects of readiness, two coders worked on all the transcripts. Additional parent codes include, for instance, service delivery, resilience, and impact of the pandemic. We assessed inter-coder reliability using the Cohen's Kappa coefficient, calculated via NVIVO. The average Cohen's Kappa was 0.7535, which dropped to 0.6426 when codes with no text assigned by both coders (ineffective codes) were excluded. The overall average agreement percentage was 97.59 %, reducing slightly to 96.51 % when excluding ineffective codes. These metrics indicate a moderate to high level of agreement between the coders, consistent with various interpretations in the literature (O'Connor and Joffe, 2020).

Finally, reflecting on our research design, we acknowledge certain limitations. First, our approach of interviewing only one representative from each nonprofit organization may not fully capture the diverse perspectives within these entities. Different roles, such as managers, field workers, and volunteers, can offer varied insights into their organization's readiness for collaborative sustainability efforts in Singapore (Sandberg and Robichau, 2022). For the objectives of our study, however, we aimed to interview individuals who could credibly discuss the organization's history, vision, and future plans. Additionally, given that many of our sampled nonprofits were small organizations, interviewing senior management and leadership was necessary. Nonetheless, we recognize the limitation of our sample and encourage future studies to explore more diverse perspectives from different levels of nonprofit organizations to assess their readiness comprehensively. Second, the predominance of small-sized nonprofits (with fewer than 10 employees) in our sample may reflect the emerging nature of Singapore's sustainability sector and the city-state's scale . However, this aspect could potentially limit the generalizability of our findings. Larger nonprofits, whether in terms of staff size or revenue, may have different perceptions and experiences regarding sustainability transitions. Future studies could broaden our

findings by including a more varied range of nonprofit sizes.

5. Results

In line with our proposed framework of nonprofit readiness for participating in cross-sector collaborations for sustainability transitions, we organize our findings around the three aspects of readiness: *awareness, capacity*, and *actions*.

5.1. Awareness

In our study, we conceptualize *awareness* as the range of perceived incentives and constraints shaping a nonprofit's decision to engage in cross-sector collaborations for sustainability transitions (Gazley, 2010). Specifically, *awareness* encompasses two elements. The first involves understanding both the immediate impacts and risks associated with ongoing transitions and the potential future pathways these transitions may take, especially as they relate to their organizations. In our data, the nonprofit managers shared their recognition of the impacts and risks brought about by the ongoing transitions, often referring to domestic and international climate initiatives as catalysts for growing public awareness of the need for sustainability transitions, and highlighted how these initiatives had contributed to raising their organizations' branding and overall impact. A nonprofit organization leader stated,

> "It's also one of the things that is driving the consciousness now, I think there are different things happening in the world such as COP, but also SG Green Plan. … I think to the mainstream public there is a perceptible shift in government policy and focus, that will also contribute to environmentalism and public consciousness and in that sense, there is some influence as well." (Nonprofit leader of an organization working on fossil-free future, 13 May 2022)

When it came to envisioning future pathways, our interviewees exhibited different levels of understanding about the potential impacts and risks they might face, from their operational approaches to the broader business environment. Many seemed to expect a continuation of the status quo, focusing largely on familiar challenges such as resource shortages and managing funding. These varied understandings suggest a need for targeted efforts to deepen understanding of future pathways, both within and outside the nonprofit and voluntary sectors.

The second element of *awareness* entails an assessment of the potential advantages and drawbacks of cross-sector collaborations with regard to a nonprofit organization's operational success, mission achievement, and overall resilience (Boyd and Martin, 2021; Bryson et al., 2015). In our study we find that, nonprofit managers generally see the value in cross-sector collaborations, recognizing how these partnerships can enhance their service delivery and overall impact. They spoke of the importance of dialogues and partnerships initiated by the government, noting that governmental funding and official support play a vital role in their work. This reliance on government resources aligns with previous research, which highlights the strong dependence of Singapore's nonprofit and voluntary sector on the government, given the country's unique political landscape as a non-liberal electoral democracy (Guo and Zhang, 2014; Huat, 2022).While nonprofit managers appreciated the support they receive, they were also aware of its limitations. One of the non-profit leaders focused on recycling paper items shared their experience of exploring partnerships with private sector companies. While they clearly saw the potential benefits of such collaborations, they also highlighted a significant challenge: the lack of incentives for private entities to get involved. Time and again, they found themselves returning to the same conclusion—the government plays a crucial role in bridging this divide between the business and nonprofit sectors.

> "It's important to understand that corporations are totally not incentivized … unless they have, for example, to fulfill some responsibility. There was an initiative that was funded by the government that says "okay, you need to support green groups." So they were sort of obligated or maybe it just happened that we could be parked under one of their initiatives. Because there are areas that the government or MPs cannot help directly, but corporations can do that, like, for example, recycling companies." (Nonprofit leader of an organization working on recycling paper items, 25 May 2022)

Additionally, as our theoretical framework suggests, there is a concern among nonprofit managers about the potential risks to their organizational autonomy when entering cross-sector collaborations. A common worry was that working closely with larger, more powerful entities could lead to compromises that could shift their mission or influence their operations. For instance, a nonprofit focused on reducing textile waste expressed concerns about becoming a subsidiary of the large entity they had collaborated with. This concern is not unfounded—after all, in Singapore, the businesses they might collaborate with are often large corporations with significant economic impact, while the nonprofit and voluntary sector is still finding its footing.

> "So we've only resolved this by…through personal contacts, we managed to tie up with a bigger initiative, and actually the downside is that we have to become a subsidiary of them for us to share the, their housing with them." (Nonprofit leader of an organization working on reducing textile wastage, 28 June 2022)

5.2. Capacity

In our study, capacity is defined through a resource-based lens focusing on the specific skills, resources, and functional contributions that a nonprofit organization can bring to a collaboration. In the context of sustainability transitions, we further connect capacity to transformative capacity—the ability of a system to adapt and evolve by developing new structures and approaches when existing ones prove unsustainable. Many of our interviewees expressed a common challenge: they feel they lack the capacity to fully

engage in sustainability-focused collaborations. As a result, they emphasized the need for more support, particularly from the public sector, to help their organizations grow and develop. This situation presents a developmental dilemma—on one hand, government assistance is vital for the nonprofit and voluntary sector in Singapore, but on the other, it might also create limitations that hinders independence and growth. This paradox isn't new; it's been observed in other parts of the world (see e.g., Anheier, 2009; Smith, 2008). However, in Singapore, it appears even more pronounced due to the country's unique approach to governance. Known for its developmental paternalism, Singapore's model emphasizes state-led economic growth alongside comprehensive social and economic welfare provisions (Deyo, 2019). This strong state presence, while beneficial in many ways, complicates the balance between supporting nonprofits and empowering them to innovate and expand independently. For instance, a nonprofit working on zero waste and recycling stated,

> "So we do work with the government as well as the corporates to run campaigns, we definitely do not have the resources to run it ourselves so it's a very chicken and egg thing. So when the government funds us then we come in, otherwise we will not be able to do it." (Nonprofit leader of an organization working on zero waste and recycling, 29 May 2022)

Although many nonprofits in our study often mentioned challenges like limited manpower and financial resources, some also demonstrated strengths that can contribute to collaborative sustainability efforts. For instance, a few organizations showed agility and a willingness to embrace digital innovation. A nonprofit working in food sustainability shared how they successfully adapted to the digital format of program delivery, enhancing their online presence to expand their impact and grow their business. This adaptability, they explained, is partly due to their smaller size and the younger, more dynamic management teams—traits that set them apart from their counterparts in the larger public and private sectors.

> "And then even though we might have said at the beginning that no, we don't want to do online workshops, and talks, we found that we ended up doing it and then we found that we actually enjoyed it, or we became quite good at it." (Nonprofit leader of an organization working on food sustainability, 23 June 2022)

Here, it is important to note that, on the demand side, Singapore is a city-state in which citizens have relatively high levels of digital literacy and accessibility. In contexts where these conditions are not met, prioritizing digital transformation is crucial to enable collaborative participants to engage effectively in digital innovation and experimentation (Sareen and Haarstad, 2021). Moreover, some of our interviewees showed sustainability foresight along with evidence of reflexivity and social learning. For example, one organization that focuses on cleanup and outreach programs described how they shifted from merely raising awareness to actively fostering a willingness to take action in response to Singapore's growing concern for sustainability. Yet, despite this progress, the specific strategies for implementing such transitions remained unclear, suggesting a continued need for learning and experimentation.

> "So in late 2020 or early 2021, we felt that awareness was already spread widely, and we don't really need to probe from that anymore. The next question is the willingness right, of which I haven't properly thought of how to generate it yet… why we feel that is important, is that "we love therefore we protect" so that's really the thing that we are trying to drive… so one of the things we are starting to do now is tidal walks and nature walks soon. So we want to show people not just the bad side of what humans have done, but also, through the nature tour, provide more motivation to protect it." (Nonprofit leader of a cleanup and outreach programs, 13 April 2022)

5.3. Actions

In our study, we define *action* as having two key elements: first, overcoming a range of external and internal challenges that can complicate a nonprofit organization's strategy and plans for cross-sector collaborations; and second, adopting proactive measures that are essential for facilitating nonprofit engagement in sustainability collaborations. In our study, we noticed that while there has been some progress in terms of awareness and capacity, action-oriented initiatives to facilitate collaboration between nonprofits and stakeholders from other sectors remain limited. This is not entirely surprising, considering that Singapore's nonprofit and voluntary sector is still in its growth phase. However, amidst these challenges, we did observe a few initiatives from the organizations we interviewed with. Several nonprofits shared how they tapped into their digital capabilities to build networks and dialogues that push collaborative sustainability efforts forward. One example came from an organization focused on beach cleaning and recycling. They used the social media platform, Telegram, to connect with other nonprofits tackling similar challenges. Through these networks, they were able to share insights, provide feedback to the government, and ultimately strengthen their collaborations with government agencies.

> "So for example, another thing that my team and I have done is to create a Telegram group chat for all the Cleanup groups in Singapore. So we've got groups doing amazing work in Singapore but before, we didn't communicate. So these are the leaders in Singapore that have been doing the cleanups and finally, this coming Sunday, we're going to have an in-person meeting." (Nonprofit leader of an organization working on beach cleaning and recycling, 20 May 2022)

Additionally, some organizations also sought to improve their internal management practices by introducing service diversification and structural decentralization to better position themselves within collaborative initiatives at various levels. A nonprofit working on civil clean-up activities described this shift as the "biggest change" they have made in terms of strengthening their participation in sustainability collaborations

> "I think that's probably the biggest change. I think the one that I mentioned earlier, kind of moving to a, to a strategy where we are more decentralized, and I think we are more focused on working with many other groups together to do it, right, rather than a very…yeah, central approach. I think that, that's probably the biggest change." (Nonprofit leader of an organization working on civil cleanup activities, 25 May 2022)

Along this line, our sampled nonprofits also showed both interest and initiative in engaging in relevant policy dialogues and forging stronger connections with corporate entities. An organization dedicated to reef protection shared how they successfully integrated policy participation into their programs, allowing them to have a greater chance to participate in collaborations and become more influential on policymaking.

> "So I think the major shift is from, from the diving service provision to more of the fishing and policy participation work that we're trying to do, and raising awareness about the impact of industry, whether it - whether it is commercial fishing, or fish farming." (Nonprofit leader of an organization working on reef protection, 24 June 2022)

While these initiatives have helped nonprofits engage in Singapore's collaborative sustainability efforts, one crucial area remains underdeveloped: improving their fundraising and financial management. Our interviews revealed that, although nonprofits widely recognize the need for a strong and independent financial foundation, many struggle with long-term financial planning. Instead, they often rely on short-term government grants or contributions from a small pool of donors. Some organizations have experimented with crowdfunding platforms, but these efforts have yet to yield lasting or significant results. This gap is critical, as financial stability is the foundation for sustained nonprofit participation in collaborations and achieving collaborative advantage (Gazley, 2010). In this case, as our theoretical framework suggests, continued adaptation and experimentation are necessary at both the individual organizational level and the broader civil society sector level to improve the financial stability and health of sustainability-focused nonprofits in Singapore. To this end, in our sample, a nonprofit working on water conservation stated,

> "And occasionally we have sponsors and donors who have extra money, who believe in us who came in and support, we went through Giving.SG, which you know, they played an important role also in getting us funding, or helping to get us funding, and write to Tote Board, whoever has got grants you know, and we try and get, you know, every little dollar counts lah. And luckily for us, you know, with some blessings we managed to survive, but our reserves, we ate into part of it. And that's not wise. If we didn't have all this funding and this Bicentennial, I think there was a good chance we could have downscaled or closed, which is a little bit sad, because what we do is a very important part for sustainable Singapore."(Nonprofit leader of an organization working on water conservation, 24 May 2022)

6. Discussions and conclusion

Cross-sector collaboration is increasingly recognized as an important catalyst for sustainability transitions. However, within transitions studies, there is a gap in understanding the roles of agents and organizations, especially within the nonprofit and voluntary sector. Addressing this gap, our research draws on insights from the transitions literature with the public and nonprofit management research to assess nonprofit readiness for engaging in sustainability-oriented cross-sector collaborations. In doing so, we first develop a theoretical framework that delineates nonprofit readiness through three key dimensions: *awareness, capacity*, and *actions*. We then empirically validate our proposed framework by employing a qualitative exploratory approach, focusing on nonprofit organizations in Singapore's sustainability sector. Informed by thirty-nine in-depth interviews with local nonprofit leaders, our study reveals that nonprofits in Singapore are generally aware of the challenges and opportunities brought by ongoing transitions, as well as the values and complexities of cross-sector collaboration. These organizations also show key capacities, such as organizational agility and digital adaptability. However, proactive initiatives remain underdeveloped, in part due to the dominant role the state plays in sustainability action.

Given the lack of proactive actions from nonprofits in Singapore, we expect that a confluence of the three aspects of readiness would be difficult to realize currently at the sectoral level. While a small number of nonprofits might successfully forge cross-sectoral collaborations by aligning these aspects, at the sectoral level, there might be a need for a capable collaborative broker who actively identifies barriers to collaborations, strategically communicates about the opportunities, and brings the involved stakeholders together. Future research opportunities lie in identifying such brokers (e.g., the NEA, an upcoming nonprofit, or a business), studying their potential and highlighting areas for improvement. We speculate that in strong state settings, the state as a broker might have been so far satisfied with informed and capable nonprofits, but might not have realized the full potential from actively removing barriers to cross-collaboration for sustainability transitions. However, as awareness and capability among nonprofits continue to grow, the likelihood of such brokers emerging from within the nonprofit sector may increase.

By exploring the concept of nonprofit readiness for cross-sector collaborations focusing on sustainability transitions, our study makes several contributions to literature. First, by synthesizing insights from transitions studies with the public and nonprofit management literature, we offer a nuanced understanding of the mechanisms that drive collaborative sustainability efforts at both the individual and organizational levels. While systemic interdependencies and interactions are pivotal for grasping transition dynamics, recognizing the agency of individuals and organizations, as well as the tangible aspects of systems such as capacity and action, is equally crucial in driving effective system changes (see e.g., Bolton and Hannon 2016). Moreover, our investigation of the nonprofit and voluntary sector will add to diversifying the existing literature on transitions that remains predominantly focused on the public and private sectors (see Feola and Jaworska, 2019; Watson et al., 2020). The nonprofit and voluntary sector plays an important role in

raising environmental awareness, mobilizing public engagement, and nurturing sustainable practices (Delmas et al., 2020). In cross-sector collaborations, nonprofits also contribute significantly to enhancing the accountability and legitimacy of joint efforts and offer unique insights about community needs as well as the normative underpinnings of future transitions scenarios (Wolfram, 2016). Last but not least, grounding the empirical context in Singapore injects fresh insights into the transitions literature, which largely centers on Western contexts. Importantly, we believe that the evolving nature of Singapore's nonprofit sector serves as a useful case study, offering insights with broader relevance, particularly in non-liberal regimes where the nonprofit and voluntary sectors remain underdeveloped. These insights add towards understanding the nonprofit and voluntary sector's development trajectory in non-Western contexts and for supporting its growth both regionally and globally.

Our study also raises a few practical considerations. First, it uncovers a developmental paradox within Singapore's nonprofit and voluntary sector, in which government support can act as both a catalyst and a barrier to growth. This paradox reflects a supplementary model of government–nonprofit relations where nonprofits either "compete" with or supplement government efforts in delivering social services. This notion is underpinned by the government failure theory, which suggests that governments may not fully satisfy the heterogeneous demands of citizens, especially those outside the median voter or dominant political coalition, and nonprofits are expected to fill service gaps. Contrarily, the nonprofit literature also underscores a complementary model where resource exchange and contractual relationships enable nonprofits and government agencies to address each other's shortcomings (Cheng, 2019). As Singapore's nonprofit and voluntary sector continues to progress in driving sustainability transitions, there's a growing need to explore new avenues for collaboration with the government. One promising approach could be to adopt a more inclusive strategy that brings in the private sector more effectively, involving not just large corporations but also small businesses. By doing so, nonprofits could reduce their reliance on government support and navigate concerns around autonomy and power imbalances. Moreover, recognizing that the challenges nonprofits face in engaging with sustainability efforts are often shaped by existing contexts and constructions, we believe these barriers can be reconstructed (see Peris-Blanes et al., 2022). For the government, this means facilitating better communication between nonprofits, nonprofit and voluntary actors, and private sector actors. By doing so, it will be possible to map out the strengths and limitations across different organizations, helping to gauge their readiness for sustainability-oriented collaborations. As a result, it will pave the way for more effective and innovative cross-sector partnerships that can drive lasting change.

Second, many of the nonprofits we interviewed revealed a common challenge. They lacked a sustainable financial model and were heavily reliant on government support, partially attributable to their relative newness. This dependency poses a significant risk to their long-term sustainability. To overcome this, these organizations can consider diversifying their revenue streams and increase income from program services. However, navigating this path is not easy, especially when there is limited understanding of future challenges and risks. Therefore, nonprofits in Singapore can benefit from training and resources to develop a better understanding of future challenges and risks. In this case, an anticipatory approach could be embedded in their financial management strategies, ensuring they are better prepared for the long term. On a broader scale, nonprofits need to recognize that cross-sector collaborations are complex, dynamic systems that operate on multiple levels. To effectively engage in these collaborations, nonprofits can adopt a design approach—actively participating in shaping the processes, structures, and outcomes of collaborative initiatives (see Bryson et al., 2015). Specifically, drawing from the literature on cross-sector collaboration, we suggest several strategies. First, nonprofits need to prioritize organizational learning to navigate the complexities of working across sectors (Vogel et al., 2022). Second, they should tailor their communication strategies to align with the unique needs and constraints of potential partners, whether they come from the public, private, or nonprofit and voluntary sectors (Henry et al., 2022). Third, promoting and implementing evidence-based impact assessments through experimentation and benchmarking can help nonprofits measure their progress and refine their approaches. Finally, it is crucial to recognize and address potential power imbalances within collaborations by engaging in advocacy and mobilization efforts (Bryson et al., 2015).

We also acknowledge the limitations of our current study. First, our research is an initial step into understanding the readiness of nonprofits for collaborative sustainability efforts. The proposed framework can be further developed through the inclusion of additional indicators under each aspect and empirical substantiation. In particular, our agent-/manager-level insights can be complemented by organizational attributes as well as socio-technical dynamics to better understand the role of the nonprofit and voluntary sector in sustainability transitions. While our study does point to these factors, additional, and more systematic exploration is suggested to further advance this line of research. It is also important to explore the biases, preferences, and other psychological attributes of agents and managers to gain a behavioral understanding of how different actors contribute to driving sustainability transitions. Second, while our qualitative approach—centered around in-depth interviews—was well-suited for the exploratory nature of our study, there is room for incorporating methods like ethnographic research or computational text analysis to enrich our findings. Ethnographic research, for example, could provide a closer look at routine interactions between collaborative participants, shedding light on power dynamics that might otherwise be overlooked. Computational text analysis, on the other hand, could help us understand cross-sector collaborations on a larger scale by analyzing vast collections of policy and management documents. Nonetheless, our focus on Singapore is intended to ground our theoretical framework and contribute new insights. Our framework is designed to be adaptable to other contexts as it is developed from general theories and principles found in the transitions literature and public and nonprofit management literature.

CRediT authorship contribution statement

Yuhao Ba: Writing – original draft, Visualization, Validation, Supervision, Software, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Sreeja Nair:** Writing – original draft, Visualization, Validation, Supervision, Software, Resources, Project administration, Methodology, Investigation, Funding acquisition,

Formal analysis, Data curation, Conceptualization. **Mohnish Kedia:** Writing – original draft, Methodology, Data curation.

Declaration of competing interest

The authors whose names are listed immediately below certify that they have NO affiliations with or involvement in any organization or entity with any financial interest or non-financial interest in the subject matter or materials discussed in this manuscript.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.eist.2024.100933.

Data availability

The authors do not have permission to share data.

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