



## OPEN ACCESS

## EDITED BY

Maria Elisa Magri,  
Federal University of Santa Catarina, Brazil

## REVIEWED BY

Alison Parker,  
Cranfield University, United Kingdom  
Claire Furlong,  
IHE Delft Institute for Water Education,  
Netherlands  
Björn Vinnerås,  
Swedish University of Agricultural Sciences,  
Sweden

## \*CORRESPONDENCE

Rebecca Ventura,  
✉ rebecca.ventura@colorado.edu  
Amy Javernick-Will,  
✉ amy.javernick@colorado.edu

RECEIVED 28 September 2023

ACCEPTED 06 May 2024

PUBLISHED 21 June 2024

## CITATION

Ventura R, VanRiper F and Javernick-Will A (2024), Characterizing customer attrition mitigation strategies in container-based sanitation (CBS) organizations: the challenge of the public-private continuum. *Front. Environ. Sci.* 12:1304047. doi: 10.3389/fenvs.2024.1304047

## COPYRIGHT

© 2024 Ventura, VanRiper and Javernick-Will. This is an open-access article distributed under the terms of the [Creative Commons Attribution License \(CC BY\)](https://creativecommons.org/licenses/by/4.0/). The use, distribution or reproduction in other forums is permitted, provided the original author(s) and the copyright owner(s) are credited and that the original publication in this journal is cited, in accordance with accepted academic practice. No use, distribution or reproduction is permitted which does not comply with these terms.

# Characterizing customer attrition mitigation strategies in container-based sanitation (CBS) organizations: the challenge of the public-private continuum

Rebecca Ventura<sup>1\*</sup>, Froggi VanRiper<sup>2</sup> and Amy Javernick-Will<sup>1\*</sup>

<sup>1</sup>Department of Civil, Environmental and Architectural Engineering, University of Colorado Boulder, Boulder, CO, United States, <sup>2</sup>Environmental Studies, Washington University in St. Louis, St. Louis, MO, United States

An estimated 3.6 billion people lack safely managed services globally, many of whom live in challenging urban contexts and face multiple barriers to accessing safely managed sanitation. These households need solutions that span the entire sanitation chain, from waste containment to waste treatment and disposal. Container-based sanitation (CBS) is one such solution. CBS organizations provide safely managed sanitation services to subscribers and largely depend on customers subscribing and remaining subscribed to their services. However, these organizations report that they experience high rates of customer attrition, which can make sustaining operations and/or meeting community sanitation goals difficult. Few studies have investigated the strategies being implemented to mitigate this attrition. To address this need, we used an exploratory case study approach, interviewing employees from seven CBS organizations and gathering documentation, to identify the perceived drivers and strategies employed to mitigate attrition. The dominant perceived driver of attrition was economic challenges faced by subscribers, and the most common strategy to mitigate this attrition was developing individual repayment plans. Notably, organizations described attrition mitigation strategies that ranged along a public-private continuum. Strategies carried important tradeoffs, for example, private-leaning strategies often limited cases' ability to service the most economically challenged households while reducing their risk to operational sustainability. Public-leaning strategies often sought to maximize the households serviced through external funding and subsidies; a long-term goal of some respondents. Future research should consider longitudinally studying CBS organizations to better understand their movement along the public-private continuum and how these essential sanitation services could be best supported by public actors.

## KEYWORDS

container-based sanitation, public-private continuum, social enterprise organization, safely managed sanitation, subscriber attrition, SDG 6, non-profit, CWIS

## 1 Introduction

Urban population growth is outpacing recent increases in urban sanitation coverage (United Nations Children's Fund, 2020). Increasing sanitation coverage in high-density urban areas is complicated due to the multiple barriers urban households can face in accessing safely managed sanitation systems, or "improved facilities that are not shared with other households and where excreta are safely disposed of *in situ* or transported and treated offsite" (WHO and UNICEF, 2017). Barriers to decentralized sanitation solutions in these areas can include limited space for new infrastructure (Tamene and Afework, 2021), difficulty affording pit emptying services (Jenkins et al., 2015), and barriers to installing new systems if land ownership is uncertain or disputed (Tilmans et al., 2015).

Container-Based Sanitation (CBS) is one potential sanitation solution to meet the need for safely managed sanitation solutions in these challenging urban settings. CBS is a market-based sanitation solution, defined as "the development of a sanitation market in which the user makes a full or partial monetary contribution toward the purchase, construction, upgrade, and/or maintenance of a toilet from the private sector" (USAID et al., 2018, p. v). CBS organizations operate a unique business model which provides both a compact, portable, sanitation technology (a toilet) and a regular waste collection service for treatment under one subscription-based model. Excreta treatment may be managed by the CBS organization itself or another entity like a municipality or utility (World Bank, 2019). CBS services are uniquely able to provide an indoor, accessible solution requiring no below-ground infrastructure. These characteristics make CBS a vital sanitation solution for dense, space-limited, low-infrastructure peri-urban areas and/or those with disputed land tenure (Russel et al., 2019).

Subscription-based CBS models are centered on customers subscribing to, and remaining subscribed to, their services. However, CBS organizations describe experiencing high rates of customer attrition, which can make sustaining operations difficult. For example, VanRiper et al. (2022a) found that from August 2014 to August 2019, 57% of CBS subscribers in Haiti eventually terminated their subscriptions. The most cited reason for leaving the CBS service was economic challenges; further, those who terminated their subscription due to economic challenges were more likely than other groups to revert to open defecation or non-private sanitation options. UN Sustainable Development Goal (SDG) 6.2 calls for "access to adequate and equitable sanitation and hygiene for all and end open defecation" by 2030; thus, movement down the sanitation ladder, or slippage, is problematic. When attrition from CBS services results in loss of access to safely managed sanitation, mitigation is essential.

While the nature of attrition in CBS services has profound implications for managing sanitation safely, few studies have investigated the drivers of attrition, and we are not aware of any that have explored the strategies CBS organizations have employed to address customer attrition. The strategies organizations choose to implement are influenced by internal values and external, contextual pressures (Moore, 2000; Bradshaw, 2009). In the case of CBS, organizations exist along a continuum, between a public, utility-style provider that ensures sustained sanitation coverage to all households, and a private enterprise, which requires maintaining

private paying customers to remain operationally afloat. We hypothesize attrition mitigation efforts may move CBS organizations in varying directions on the public-private continuum described by Perry and Rainey (1988).

Therefore, this study sought to address the following research questions:

- What do CBS practitioners perceive to be the main drivers of customer attrition in their CBS operations?
- What are CBS organizations' strategies for mitigating attrition across the communities they operate in?
- What are the implications of attrition mitigation strategies on the CBS organizations' operational characteristics?

To investigate these questions, we employed an exploratory case study analysis across seven CBS organizations.

## 2 Background

The JMP sanitation service ladder, used to monitor and measure progress towards SDG 6.2, calls for all to have "access to adequate and equitable sanitation and hygiene" and an end to open defecation by 2030 (WHO and UNICEF, 2017). It contains five rungs, each representing a reduced health risk for the sanitation user or broader community, with the highest rung representing safely managed sanitation.

Container-based sanitation was first recognized by the Joint Monitoring Program (JMP) as an improved sanitation solution in 2018 (UNICEF and WHO, 2018), and has been expanding globally since 2009 (World Bank, 2019). CBS organizations provide toilets that store excreta in a removable receptacle and then collect and transport the containerized excreta for treatment at regular intervals (World Bank, 2019; VanRiper et al., 2022c). Many CBS organizations operate as subscription-based services. Most collect containerized excreta from the point of use. Some CBS business models require households to drop off their full container at a collection site (World Bank, 2019) or dispose of collected urine while the organization picks up the solid waste (World Bank, 2019; VanRiper et al., 2022c). CBS services providing household-scale toilets meet safely managed sanitation standards set by JMP (Russel et al., 2019). While CBS organizations work with a variety of subscriber types, including landlords and schools, they most often work directly with individual households (World Bank, 2019). CBS organizations currently operate in at least nine different countries across four continents with over 250,000 users (CBSA, 2024).

Progress towards achieving SDG 6.2 can be hindered by the occurrence of slippage, which occurs when a household moves down the sanitation ladder. Attrition, or the discontinuation of the active business-customer relationship (Optimove, 2023), can lead to slippage when the household moves down the sanitation ladder following the discontinuation of the business-customer relationship. In the context of CBS services, attrition occurs when a household ceases to subscribe to the sanitation service or the CBS organization leaves a service area, resulting in the household losing access to the service (VanRiper et al., 2022b). When attrition results in slippage, it undermines progress toward SDG 6.2. Thus, it is

crucial to identify drivers of such attrition, and the strategies that CBS organizations can employ to mitigate this where possible.

Few studies have identified drivers of customer attrition in CBS services. We are only aware of the study by VanRiper et al. (2022a) that surveyed current and former CBS subscribers in Haiti to identify drivers of attrition. They found that the dominant driver of customer attrition from CBS services was economic challenges, followed by subscribers exiting CBS services after installing their own latrine or flush toilet. Further, dissatisfaction was not identified as a meaningful driver of attrition from CBS services which aligns with other studies that have found low dissatisfaction with CBS in serviced areas (World Bank, 2019; Tidwell et al., 2022). This low dissatisfaction may be due to CBS organizations' practice of collaboratively designing their sanitation systems based on feedback from their customers (e.g., Mijthab et al., 2021; VanRiper, 2021). Indeed, previous literature suggests that CBS services can satisfy subscriber's wants and needs for sanitation (Russel et al., 2019).

Many contextual factors shape CBS operations and attrition dynamics, including the economics of customers, property size and infrastructure, geophysical context, household sanitation history, and regulatory and financial context (VanRiper et al., 2022a). Furthermore, the sector has increasingly recognized the need for approaching urban sanitation as a public service and employing a mix of technology solutions to achieve SDG 6.2 (Schrecongost et al., 2020). CBS services hold an important role in achieving these goals. To our knowledge, scholars have not yet investigated the strategies CBS organizations take to address these drivers and mitigate attrition. Therefore, this study seeks to characterize the strategies that CBS organizations currently employ, plan to enact, or have discontinued, and associate them with identified perceived drivers.

## 2.1 CBS providers as non-profit organizations and social enterprises

Most CBS organizations in this study self-identified as non-profit organizations (NPOs) or social enterprises (SEs). The term NPO is broad and includes diverse types of organizations such as universities, hospitals, and non-governmental organizations (NGOs) (Antonucci, 2017). This diversity makes NPOs challenging to define and no consensus on their defining characteristics has been reached (Knutsen, 2013). Notably, Knutsen and others (e.g., Sanders, 2015; Bromley and Meyer, 2017) argue that while NPOs are not wholly public or private organizations, they may adopt public or private characteristics depending on the organization's context.

There is no international consensus on the definition of SEs (Defourny and Nyssens, 2017); however, SEs are generally understood as organizations that "combine societal goals with an entrepreneurial spirit" (European Commission, 2023). They are sometimes defined as private institutions that conduct services that contribute to social good or the public using a market-based approach or entrepreneurial strategy (OECD, 1999). For this study, SEs are understood as non-profit organizations that address societal needs and achieve "financial returns while fulfilling social, environmental, and/or other developmental goals, mainly poverty alleviation; and working in conditions where formal institutions,

governments, or markets have failed to ensure social justice" (Cho and Sultana, 2015, p. 296). This attempt to balance two objectives causes SEs to exist along a public–private continuum (de Kam, 2005), with the organizations nearer the public pole minimizing cost burden to the customer, and those nearer the private pole focusing on the customer as the main source of operational funding. This internal tension between their mission and the need to maintain financial sustainability is especially relevant to CBS organizations as the service they provide is subject to inherent market failure (Schrecongost et al., 2020).

NPOs rely in large part on funding from donations and grants to sustain operations, often indefinitely (Luke and Chu, 2013). Whereas, SEs generate enough revenue to sustain their operations independently through their business model or through a mix of revenue generating activities and grants (Luke and Chu, 2013; Doherty et al., 2014). CBS organizations often provide sanitation services in locations where a government utility currently does not provide services (Mijthab et al., 2021; VanRiper et al., 2022c) and where individual sanitation users may struggle to afford subsidized costs of safely managed sanitation services (VanRiper et al., 2022a). Therefore, gathering reliable income solely from external sources (e.g., government funds or grants) or full funding from internal subscribers is difficult (World Bank, 2019).

An organization pursuing an attrition mitigation strategy that increases external funding sources, such as grants, donations, and public investment, would move more towards a public organizational model. Conversely, a strategic decision to target reliable customers would focus reliance on internal revenue, moving the organization more towards a private model (Perry and Rainey, 1988). This tension between public- and private-leaning decisions is important to capture as it has real implications for the sustainability and operations of CBS organizations, and for reaching SDG 6.2. Thus, our study considered these financial factors when analyzing how the strategies employed by CBS organizations for customer attrition are influenced by this tension.

## 2.2 Blended finance models with pressure to scale services

CBS organizations often cannot recover all operating costs from their subscription fees and sales of transformed products (World Bank, 2019), requiring them to rely on other sources of revenue, such as external donations, to sustain their operations. This, combined with the recent expansion of CBS services to multiple countries, has drawn attention from the broader Water, Sanitation, and Hygiene (WASH) field and increased inquiry into their financial sustainability as a market-based service for low-income communities (e.g., Tilmans et al., 2015; World Bank, 2019; Mallory et al., 2022). Specifically, blended finance models, which include a combination of internal and external funding, have been a focus of recent work (OECD, 2019; World Bank, 2019). Some analysts critique their dependence on external funding (World Bank, 2019), placing pressure on CBS organizations to achieve a "break-even" or profitable business model.

Simultaneously past studies have emphasized the need for CBS organizations to scale their services as a means of increasing their impact, bringing in more revenue, and demonstrating CBS services' potential as a sanitation solution (EY & WSUP, 2017). While enlarging the customer base may help reduce costs per household served, "profitable" CBS businesses are unlikely in the near future, even with increases in scale and sale of products from transformed excreta (World Bank, 2019). A study of two CBS organizations found that it would be difficult for both organizations to scale without increasing their reliance on external subsidies or gaining institutional support and recognition (Mallory et al., 2022). A separate study found similar results, emphasizing that increased scaling of CBS services will only be possible with subsidies and significant institutional support (Russel et al., 2019). Finally, scaling alone will not relieve the financial pressures of the areas where CBS organizations operate. Therefore, in this study, we seek to understand CBS organizations' experiences with customer attrition, the strategies they employ to address attrition, and the outcomes of those strategies, while considering the contexts in which CBS organizations operate, their service model designs, and operational pressures.

### 3 Methods

An exploratory case study approach was used to identify CBS service providers' perceived drivers of customer attrition, and characterize the strategies these organizations take (present, planned, and discontinued) to mitigate this attrition. Case study approaches are well suited for investigating a current phenomenon within its real-life context (Yin, 2009). Taking an exploratory case study approach can highlight the similarities and differences in customer attrition and mitigation strategies across each case (e.g., each CBS organization). Cases were selected because they were established organizations providing CBS services, representing a variety of operating contexts and business models. Organizations had to be in operation for at least three years to qualify for the study. To maintain the confidentiality of participants, the locations and names of the CBS organizations are not shared.

Cases were developed using 1) documentation (publicly available and/or provided by participants), 2) semi-structured interviews, and 3) validation of within-case results by participants. Each of these data sources is described below.

#### 3.1 Data collection

Collected documentation included publicly available information, such as CBS organization blog posts and published journal articles, and documents provided by participants. Participant-provided data included information about the CBS organization's service model, descriptive data (e.g., customer base size), and descriptions of customer vetting strategies (e.g., characteristics of the desired customer).

As our primary data source, we interviewed representatives serving in an administrative role at each of the seven CBS organizations using semi-structured questionnaires lasting approximately one hour. Interviews asked participants to describe

(1) the nature of customer attrition they have noted in their work, including the drivers they believe led customers to exit the service and (2) the strategies they have used or are planning to implement to mitigate attrition. Interviewees were also asked to describe their service and service context to allow for comparison of similarities and differences between locations and subscriber bases (e.g., customer characteristics, current rates of attrition, etc.). Informed consent was obtained orally from all participants following IRB protocol #21-0030.

#### 3.2 Data analysis

Qualitative responses regarding attrition drivers and mitigation strategies were analyzed to identify perceived drivers of attrition and current, past, or future attrition mitigation strategies employed by organizations. Collaborative coding was used to validate the categorization of different types of attrition drivers and mitigation strategies. See [Supplementary Material SI-1, SI-2](#) for definitions of strategies and drivers.

Collected documentation was organized by case and information was compiled and scanned for factual descriptions of selected characteristics of the organizations to inform the "General Organization Information" table in [Supplementary Material SI-3](#). To validate findings within each case, interview and document review summaries were sent to each participant for member checking (Birt et al., 2016) (see [Supplementary Material SI-3](#) for the validation sheet template). During the validation phase, participants corrected results by leaving comments. Comments were then reviewed and, as necessary, results were updated. Following validation of within-case results, cases were compared to identify the frequency of perceived drivers and strategies across cases.

Keeping in mind the strategic actions CBS organizations take that may move them towards different ends of the public-private continuum, all identified strategies were then categorized as "private-leaning," "neutral," or "public leaning" based on the continuum as described by Perry and Rainey (1988). Perry and Rainey (1988) defined this continuum using three variables: ownership, funding, and mode of social control. A private enterprise was categorized as an entity that was privately owned, privately funded, and whose mode of social control was the market. While the authors applied this continuum to characterize organizations, we argue that strategies can be characterized using this same continuum because the adoption of strategies can result in changes to the variables that compose the organization's placement along the public-private continuum. Notably, funding and mode of social control can change concurrently with the adoption of one strategy. For example, increased involvement of a government authority in an organization's functions and decision making (social control) could also be tied with increased government funding (funding).

Many attrition mitigation strategies reported by cases in this study adapted at least one of the variables described above (See [Supplementary Material SI-4](#)). A strategy was identified as "public-leaning" if it increased the organization's reliance on external funding sources, increased the influence or decision-making power of public actors (mode of social control), or increased the

ability for economically challenged households to subscribe to the CBS service. Conversely, a strategy was categorized as “private-leaning” if it led the organization to increase reliance on internally generated revenue or increase the influence of the market on strategic decisions. A strategy was categorized as “neutral” if it did not change the amount a household had to pay for the subscription-based service (e.g., did not lower or subsidize the fee), did not change the organization’s reliance on internal or external revenue, and did not change the level of control from public actors.

## 4 Results

Cases discussed fourteen perceived drivers of customer attrition, eighteen current attrition mitigation strategies, including six discontinued strategies and plans to employ ten strategies in the future. Overall, six of the seven cases described at least nine strategies and at least four perceived drivers of customer attrition per organization. Case B reported no measurable attrition and, therefore, did not identify drivers or current strategies for addressing customer attrition. They have achieved a single-payer system, through which the organization partners with a municipality on service provision. The municipality appears to maintain service across users regardless of household ability to pay. Table 1 compares the CBS organizations included in this study by customer type, context, size of their customer base, current attrition rates, and articulated goal for their financial model. Table 2 depicts the five categories of perceived attrition drivers identified in this study and Figure 1 associates strategies employed by the CBS organizations with their targeted attrition driver. Following the tables, each category of drivers and strategies employed by organizations to mitigate attrition are discussed.

All organizations that identified economic challenges as a driver of attrition employed at least one strategy to mitigate this driver.

While five cases identified customers leaving the service area as a driver of customer attrition, only three cases described employing a strategy to mitigate this driver.

### 4.1 Attrition driver I: economic challenges (case A, C, D, E, F, G)

The most common driver of customer attrition identified in six of the seven cases was economic challenges. In four of these cases, participants identified economic challenges as the dominant driver of attrition. Case A surveyed subscribers who have left their service and found that 34% described an inability to pay the subscription fee. The topic of accumulating debt, as it relates to the household’s context, was discussed by three cases (A, D, and E). Case A and E described how recent economic situations, including inflation, have exacerbated issues of affordability. Case D described households struggling to regularly pay due to the unstable nature of their income.

All six cases work with low-income households that face multiple economic barriers, like working in an informal job market, experiencing political unrest, and in some cases, needing to financially prioritize other basic needs, like drinking water. In the six cases that identified economic challenge-driven attrition, government-level sanitation subsidies are not available for individual households. Therefore, when households cannot afford their subscription fees, and no other sanitation subsidies are available, cases described having to make the tough decision to remove subscribers from the service completely or otherwise risk becoming financially unsustainable.

#### 4.1.1 Strategy to address attrition due to economic challenges: increased flexibility with payment (case A, C, E, F, G)

Developing individual repayment plans with subscribers who are behind on payment was a common strategy employed to reduce

TABLE 1 Not all organizations are aware of their current attrition rates and therefore, only those reported are included in this table. Case age describes the number of years each case has been operating CBS services. \*Case B described an attrition rate of 0% based on this study’s definition, however they did note that household-level payment is not regularly collected or documented by the municipal partner.

Case (Age in yrs)	Customer Type	Context Type	Current Attrition Rate (per year)	Customer Base Size (Subscriber Accounts)	Organization Type	Financial Model Goal
Case A (11 years)	Households	Urban	Yes (1.2%/month)	1350	Non-profit Organization	Mixed Public-Private Revenue
Case B (10 years)	Municipality	Urban	0%*	1 municipality (80,000 individuals)	Private Organization	Solely Public Revenue
Case C (12 years)	Landlords, Households, Schools, Churches	Urban	Yes (rate unknown)	4203	Non-Profit Organization	Solely Public Revenue
Case D (13 years)	Households, Landlords	Urban	Yes (2%–3%)	2,300	Non-profit Organization	Mixed Public-Private Revenue
Case E (11 years)	Households	Urban	Yes (1.2%)	3,400	Social Enterprise	Solely Internal Revenue
Case F (8 years)	Households	Urban	Yes (0.34%)	750	Non-profit Organization	Solely Internal Revenue
Case G (4 years)	Households, 1 School	Rural	Yes (1.33%–1.78%)	46	Social Enterprise	Solely Internal Revenue

TABLE 2 Prevalence of reported drivers of subscriber attrition across all cases. The dominant driver of attrition identified by the organization was noted by a bolded X\*. [Supplementary Material S1-1](#) lists all identified drivers.

	Case A	Case B	Case C	Case D	Case E	Case F	Case G
Economic Challenges	<b>X*</b>		<b>X*</b>	<b>X*</b>	X	X	<b>X*</b>
Loss of Access to the Service Area	X		X	X	<b>X*</b>	<b>X*</b>	
Alternative Sanitation Option	X		X	X	X	X	X
Dissatisfaction with Service	X		X	X	X	X	
Other Drivers			X	X	X	X	X

customer attrition rates. Five of six cases that described economic challenges used this strategy. Case A described the difficulty with executing this strategy and acknowledged that while it may help reduce attrition rates it comes with a tradeoff of excessive work for the administrative team.

“We have called people to say if you cannot pay just let us know if there is a way we can work around this with payment arrangements. Maybe just pay one month now and we’ll split the other one or two or three payments and just [do it] on a one-to-one basis . . . this obviously creates some extra work for our team. If you just monetize that . . . that is expensive but is a way in which you can avoid attrition . . . we think that [if] we were more strict with the [payment] policy we would probably have had lost more people.”

Case C, E, F, and G described taking a similar approach by working one-on-one with each subscriber to develop a repayment plan that would work best for each household. Case D used to develop individual repayment plans but stated that they recently discontinued this strategy. Instead, they described changing their messaging around payment to encourage more subscribers to pay the service fee either in small increments over the course of the entire month or in bulk (multiple months at a time) depending on their financial situation. Recognizing that the financial situation of households can vary from week to week, Case D is developing a strategy to encourage their customers to invest in sanitation when they have the financial means to and not just when the monthly payment is due.

#### 4.1.2 Strategy to address attrition due to economic challenges: customer vetting (case C, E, and F)

Conversely, three cases described increasing customer vetting to reduce the likelihood of their subscribers accumulating debt or paying late. Case C described a recent internal study revealing that vetted customers had a 55% higher payment rate. The success of this strategy at the pilot scale led them to apply it across their entire service area. However, this strategy comes with tradeoffs, which Case F mentioned, stating;

“We are aware that we are not considering all the customers [by vetting] but because we are working as a business, we need to really consider those things.”

While Case C, E, and F may experience more financial security by forging a customer base that is more likely to pay consistently and

fully, pursuing this strategy leaves them less likely to service the poorest households in their service area. Case F acknowledged the difficulty of this tradeoff in their interview. This tradeoff has important implications for achieving SDG 6.2 because the poorest households in the service area ultimately will not gain access to safely managed services without financial support. Case D described previously vetting customers based on perceived economic status of the household but have since discontinued this strategy.

#### 4.1.3 Strategy to address attrition due to economic challenges: external subsidy options (case D, E, G)

Case D reported that the identification of economic challenges as a dominant driver of attrition led them to reflect on their core values and goals as an organization, especially as it relates to movement along the public-private continuum. They explained that their organization initially focused on financially “breaking even,” but then chose to pivot to behave more like a public utility to meet their vision of improving sanitation coverage.

“There was a lot more reporting of the different forms of financial burden that led to debt that led to losing the service . . . It began a conversation around how do we consider running a service more as a public service rather than just viewing attrition the way that a social enterprise or a business would, where attrition has to be dealt with or where you’re looking for a better customer for your service to pay for it and stay. The question is “What allows people to stay within that service?” . . . Maybe we’re getting that better customer right [from price increases], but we’re not improving sanitation coverage where we work.”

Ultimately, when faced with households that lacked the financial security needed to maintain subscription fees, Case D decided to expand their methods for securing external subsidies to increase their ability to provide CBS services for the most economically challenged households in their service areas.

#### 4.2 Attrition driver II: loss of access to the service area (case A, C, D, E, F)

The second most common driver of customer attrition, described by five cases, was customers leaving the CBS service area. Case C described examples of subscribers leaving the service

	Economic Challenges	Loss of Access to the Service Area	Alternative Sanitation Option	Dissatisfaction with Service
Develop Individual Repayment Plan	( <b>A*</b> , <b>C*</b> , E, F, <b>G*</b> )			
Customer Vetting	( <b>C*</b> , E, F)			
Minimum 1-year Contracts		(A, <b>E*</b> , <b>F*</b> )		
Conducts Training, Sale, or Follow-up Messaging	( <b>A*</b> , <b>C*</b> , <b>D*</b> , E, F, <b>G*</b> )			(A, C, D, E, F)
Recruiting External Financial Investment	( <b>D*</b> , E, <b>G*</b> )			
Other	( <b>A*</b> , <b>C*</b> , <b>D*</b> , F, <b>A*</b> , <b>C*</b> , <b>D*</b> , E, F, <b>G*</b> )	( <b>E*</b> , <b>F*</b> )		

FIGURE 1

Current strategy areas employed to address each attrition driver (cases employing the strategy are noted by identifying letter code). Blue represents a strategic action that is “private-leaning” and green represents a “public-leaning” action. Black represents strategies that are “neutral”. Bolded letters with an asterisk represent a strategy that was used to address the perceived dominant driver of attrition.

area following the demolition of their home by the city for the construction of other infrastructure (e.g., road, electrical lines). Cases E and F also described the insecure nature of housing and changing jobs leading to the inevitable movement of subscribers. In both cases, subscribers had to move because their lease ended or because they found a job in another area of the city. Case A stated that increasing inflation rates led some households to move to rural areas to reduce their overall cost of living. Case D acknowledged that while customers left their CBS service to move to a different area, they often also constructed an alternative sanitation solution (e.g., a pit latrine) in their new area. They view this positively, emphasizing that customers’ experiences with CBS may lead to “behavior change,” where even after leaving the CBS service, they do not return to their open defecation or unimproved sanitation practices.

The drivers behind subscribers moving outside of the service area are not under the organization’s immediate control. This observation underlines the importance of CBS organizations developing a business model that allows for some customer attrition. Importantly, CBS organizations often operate in areas where they are the main provider of safely managed sanitation services (e.g., Mijthab et al., 2021; VanRiper et al., 2022b). Therefore, customers leaving the service area risk losing access to safely managed sanitation services.

#### 4.2.1 Strategy to address area-driven attrition: 1-year minimum commitment (cases A, E, F)

As noted, cases recognized that some drivers of customer attrition are outside of their control. However, households may also opt to subscribe to CBS services only temporarily while their home or current sanitation technology is under construction or while they are temporarily living in the area for work. This type of attrition was described by three cases (A, E, F), all of which responded by adopting a minimum 1-year subscription period to subscribe to their CBS services.

Only Case F described discontinuing a strategy related to area-driven attrition. Initially, they tried charging an exit fee when subscribers tried to terminate their contract early. However, this led to households exiting without notice, leaving the CBS toilet behind, and ultimately not reducing their attrition rates.

#### 4.3 Attrition driver III: alternative sanitation solutions (case A, C, D, E, F, G)

Six cases described subscribers leaving the service because they opted for an alternative sanitation system. One reason why households choose a different system was because they perceived them as less expensive than CBS. For example, Case A reported that subscriber households occasionally opted for a pit latrine instead of continuing with the CBS service because it was cheaper in the long-term. Conversely, Case G described households that left the CBS service because a permanent sanitation technology was perceived as more desirable, despite it being more expensive and unsafely managed. Case G described this driver as being difficult to overcome due to disinclination toward recurrent payments.

“We lost two families because the municipality has built a drainage system which came to their road where they live, and they wanted to make use of the opportunity to connect. So, they invested in a flush toilet and connected to the drainage . . . It’s thousands of dollars for people to buy these systems . . . but the idea that you have to pay every month [for a CBS service] is intimidating.”

CBS subscribers are often price-sensitive and may leave the service to switch to another system that is perceived as less expensive; both Case E and Case A’s experiences highlight this. In some cases, households already had experience with other sanitation system

types (e.g., latrines) and pre-formed perceptions of what is modern (e.g., a porcelain toilet) led them to not choose a CBS toilet.

#### 4.3.1 Strategy to mitigate alternative sanitation-driven attrition: offering other technology solutions (case E)

Only Case E discussed plans to adopt a strategy for mitigating alternative sanitation-driven attrition. Specifically, Case E described experiencing customer attrition when a separate organization began providing a more subsidized sanitation system (a biodigester) in their service area. This led to customers switching to the new sanitation option. In response, Case E is now considering diversifying their services to include additional sanitation technologies like biodigesters.

#### 4.4 Attrition driver IV: dissatisfaction (case A, C, D, E, F)

While most cases mentioned customer attrition due to dissatisfaction with the service, technology, or payment method, they emphasized that it was rare.

##### 4.4.1 Strategy to mitigate dissatisfaction: improving sales strategy, customer relations, and marketing (case A, C, D, E, F)

Case C described changing their organization's team structure in response to early attrition, recognizing that strengthening and building their relationship with subscribers could reduce attrition rates. Specifically, they combined the customer support team, which is responsible for resolving any issues with the toilet or service in the field, with their credit team, which is responsible for collecting payments. In a similar theme, Case E described the importance of a strong customer relationship which the organization practiced by randomly calling customers to check on the quality of the CBS service and having a customer service line where subscribers can call at any time with questions or issues. Similarly, Case A emphasized the importance of training as many household members as possible at the time of installation to reduce the risk of someone leaving the CBS service because they did not understand or get used to using the CBS toilet. In addition to the strong customer service presence, organizations also ensure that customers understand the service when they sign up for the CBS subscription to set and manage expectations.

#### 4.5 When confronted with attrition, cases often adopted public- or private-leaning strategies

In describing customer attrition and the difficulty in maintaining the finances of the CBS organizations, multiple cases described consciously adopting strategies along the public-private continuum (Perry and Rainey, 1988). While all cases in this study are privately owned organizations, all cases that reported experiencing attrition (A, C, D, E, F, G) described taking, or planning to adopt, strategies that changed the nature of their

funding or mode of social control. Importantly, at the time of this study, no cases operated solely at either pole of the public-private continuum. Rather, they operated somewhere in between, and their situation was shaped by the difficult tradeoffs they had to confront when deciding on attrition strategies that both served their target population and allowed them to maintain financial sustainability (Figure 1).

Public-leaning strategies that four cases implemented, or planned to implement included:

- 1) Allow for or increase revenue from external organizations and individuals to provide additional subsidies for household CBS services (Case D, E, G)
- 2) Seeking the government as the sole payer for CBS services (Case C and Case D)

Six cases described adopting some private-leaning strategies, including:

- 1) Adopting customer vetting strategies to predominantly accept CBS subscribers based on ability-to-pay (Case C, E and F).
- 2) Diversifying or plans to diversify business portfolio by offering subscription-based services for different settings (e.g., markets) and thereby increasing internal revenue (Case C, D, E, F, G).

Six cases described adopting strategies that were neutral, including:

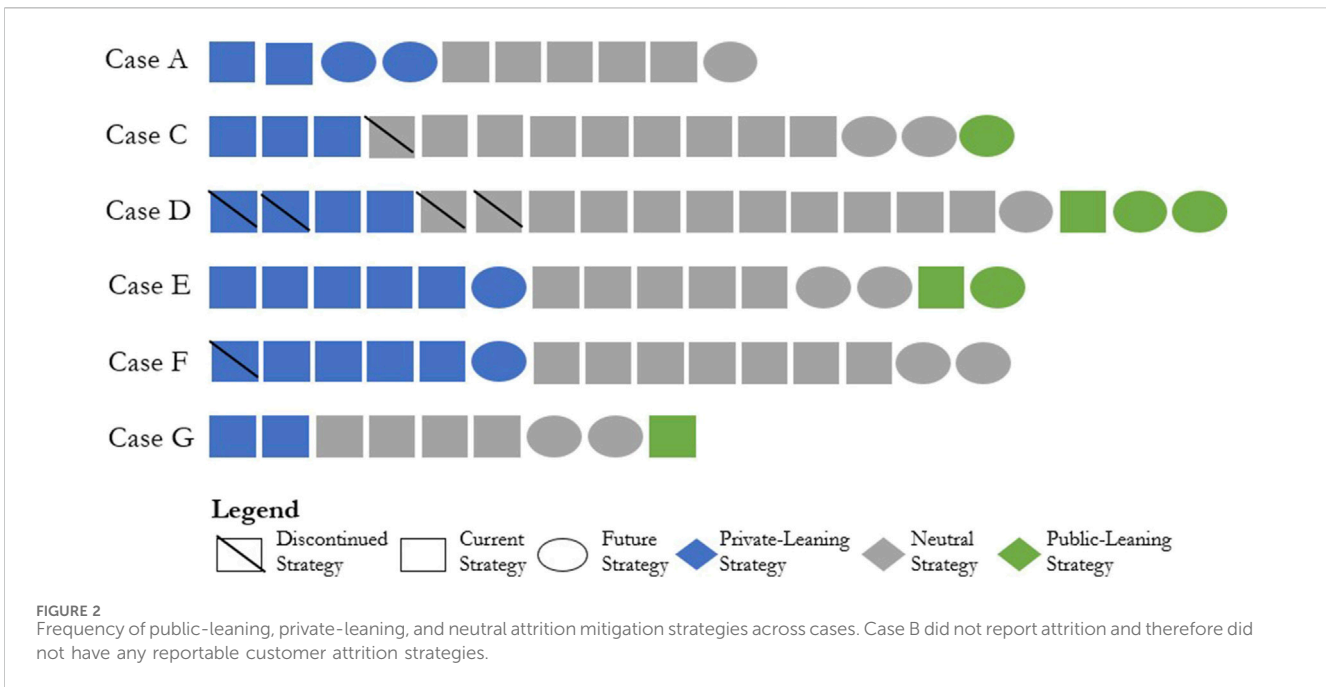
- 1) Developing individual repayment plans for subscribers that are behind on payment (Case A, C, E, F, G)
- 2) Sending customers reminder messages for payment (Case A, C, D, E, F, G)

All reported past, current, and planned attrition mitigation strategies were categorized as private-leaning, public-leaning, or neutral and then organized by case (Figure 2).

Overall, all cases that currently experience customer attrition discussed adopting private-leaning and neutral strategies. Four cases described adopting public-leaning strategies. [Supplementary Material SI-4](#) contains all validated strategies, their categorization as private, neutral, or public-leaning, and notes on the categorization.

While all cases currently employ several neutral strategies, many cases responded specifically to economic challenge-driven attrition by adopting private-leaning or public-leaning strategies. For example, Cases C, E, and F adopted customer vetting (a private-leaning strategy) based on the ability to pay after recognizing attrition due to household economic challenges. Similarly, Case F and Case G described goals to internally generate all revenue and decrease reliance on external funding. Conversely, Case D described goals of increasing reliance on external funding sources (a public-leaning strategy). Case A was the only organization that described plans to change its CBS toilet design and payment collection method to reduce their subscription fee cost and therefore ease attrition due to economic challenges. Specifically, they described changing their payment method to reduce bank transaction fees and





opting for a fan system (rather than sawdust cover) as it was expected to be lower cost.

### 4.6 The tension between mission and financial sustainability has led to pivot points in organizational strategy

In describing customer attrition and the difficulty in maintaining the finances of the CBS organizations, multiple participants described a “pivot point” where they consciously adopted strategies towards one pole of the public–private continuum. Case D described pivoting twice in response to economic challenge-driven attrition. They first pivoted towards the private-leaning strategy of looking for the “better customer” and considered increasing customer vetting based on ability to pay; however, they since pivoted away to focus on debt management and increasing subsidies to support CBS coverage. Their priority shifted from “breaking even” to servicing all households regardless of their ability to pay:

“I would say we are in the transition from debt is the problem and we need customers who can pay, to debt is a problem [and] we need to help our customers pay. So I will say we spent many years in the ‘our customers are the problem for not paying’ type of strategies versus ‘it’s a problem that people can’t afford the service’... so our teams target people in areas where we already have customers along our service routes but we don’t want to target select away from people who need the toilet.”

Similarly, Case B discussed hitting a pivot point a few years ago when they wanted to increase the scale of their services. This led them to partner with local governments, in order to reach whole communities with CBS service.

“What we realize is as an organization, if we really wanted to reach everybody and scale and to not have to sell to each individual household, we needed to partner with the mandate holder, which is the local government and water utility. So, we could solve a problem at the city level, not just at the individual household level. And we’ve been on that journey of seeing more water utilities and local government as our customers.”

Notably, contextual factors appear to drive the long-term financial model of CBS providers and influence the pivoting along the public-private continuum. Further, while CBS organizations adopt strategies across the public-private continuum, organizations described varying aspirations ranging across a fully public-funded financial model, an exclusively internal revenue finance model, and a blended finance model (Table 1).

Cases B and C favor a future in which the government provides full support for their service delivery. The aspiration to provide sanitation for all and recognition of economic challenges faced by their subscribers leads them to acknowledge the need for subsidies and government support for the services. Case C described aspirations for having the government as the main payer.

However, Case G described how subscribers’ mistrust of the national government due to perceived corrupt behaviors, combined with disinclination to commit to subscription-based services, led this organization to take strategic choices towards increasing internal revenue generation and to consider offering bulk payment options where households can pay for multiple months of service at a time rather than only 1 month at a time. While Case G currently receives some funding from the government, they described aspirations to internally generate all revenue in the future. Due to their operational environment,

this organization worked to differentiate itself from the government in their marketing strategies.

## 5 Discussion

Most participants described economic challenges as their dominant driver of attrition, which aligns with previous research on CBS services. For example, [VanRiper et al. \(2022a\)](#) found that economic challenges, like difficulty affording the cost or avoiding debt, were the most cited factor for ending their contract with CBS service providers.

Economic challenges across cases demonstrate the difficulty CBS providers face in sustaining safely managed sanitation services for financially vulnerable households. All CBS organizations captured in this study that described experiencing attrition, provide a subsidized subscription fee, yet many of them still experience attrition due to household economic challenges. Recent scholarship has described similar cases of market failure in the provision of sanitation services using a private enterprise model ([Trémolet, 2013](#); [Cairns-Smith et al., 2014](#); [Schrecongost et al., 2020](#)). Most recently the Citywide Inclusive Sanitation approach, which includes increased government intervention and the organization of urban sanitation services as a public service, has been proposed as a means of overcoming this observed market failure ([Schrecongost et al., 2020](#)). All but one case captured in this study described operating with nominal public funding or logistical support, and therefore described needing to develop strategies that do not involve significant government involvement to mitigate attrition driven by economic challenges.

While the customer vetting and 1-year minimum strategies increase the likelihood of a CBS organization having a more consistent customer base and the ability to better plan financially, it comes with the tradeoff of not serving more transient households with safely managed sanitation or allowing for the provision of interim sanitation during construction.

The participants' descriptions of attrition rarely being driven by dissatisfaction aligns with previous literature which has described high CBS subscriber satisfaction rates ([World Bank, 2019](#); [VanRiper et al., 2022a](#); [Tidwell et al., 2022](#)). Reports of customer attrition from moving outside of a CBS service area also aligns with a prior study in Haiti, which identified this driver as the third most common reason for a household to leave a CBS service ([VanRiper et al., 2022a](#)).

It is important to recognize that CBS organizations often operate in areas where 1) there is a significant lack of institutional support from local or national governments to subsidize sanitation costs and 2) subscribers often lack sufficient income to pay for all their basic needs, including sanitation, consistently. Combined with the pressure to scale and internally recover operational costs, CBS organizations are placed in a difficult position; one that requires them to behave like a public utility and a private business simultaneously. This was repeatedly described by cases as they discussed the economic challenges their customers faced and their development of strategies to help reduce that financial barrier to sustained CBS use.

Multiple cases adopted strategies that lay along the public-private continuum where, after recognizing the economic

challenges households faced and simultaneously feeling the external pressure to develop break-even financials, organizations pivoted towards more private-leaning or more public-leaning operations. Additionally, most cases described feeling a tension between maintaining financial sustainability and pursuing their organizational mission of serving all households that need safely managed sanitation. The tradeoff of employing private-leaning strategies is that cases are less likely to service transient households, households under construction, or those facing economic hardship. Only two organizations described goals to achieve exclusively external funding finance models. This presence of simultaneously aspiring for increased public support of service provision and strategic plans for blended or internally generated revenue highlights the challenges these organizations face when trying to operate in place of a public utility and in a challenging context.

Interestingly, some cases aspired for increased public investment in service provision yet also adopted private-leaning strategies. This implies that in the absence of public support mechanisms, CBS organizations may need to default to business practices that reduce the accessibility of their services to those most in need of them. This misalignment of aspirations and strategies also suggests that organizations may need to adopt more private-leaning strategies before being able to pivot towards more public-leaning operations. Future research should investigate this phenomenon further, including what implications this type of movement along the public-private continuum has toward sanitation provision and the sustainability of sanitation organization operations. Furthermore, while this study focuses on the current operations of seven cases, future work should consider studying CBS organizations longitudinally to better understand the nature of this movement and corresponding attrition rates over time. This information could help the WASH sector better support sanitation service providers and aid in the eventual transfer of non-profit-led sanitation work to local or national public entities.

While slippage represents regression in progress toward SDG 6, attrition does not always equate to movement down the sanitation ladder. Some cases noted that not all attrition is bad, sometimes calling it "natural". This perspective appears to shape CBS organizations' attrition goals and mitigation strategies by seeking to address drivers of attrition that led households to move down the sanitation ladder and the drivers that they felt they could influence directly.

This work highlights the occurrence of market failure in the provision of safely managed sanitation services and emphasizes the need for increased public financial support and subsidies for those that cannot afford to pay. While CBS organizations tend to operate in peri-urban or urban environments, the need for government involvement and subsidies remains. The influence of, and need for, local or national government support was repeatedly discussed by cases when describing current and future strategic goals for addressing customer attrition driven by economic challenges. These strategies highlight the difficulty CBS service providers experience providing continuous access to improved sanitation for subscribers that face financial insecurity and live in a context that lacks significant government involvement and investment.

## 6 Limitations

Participants may not be aware of all drivers that cause their subscribers to terminate a CBS service. Furthermore, while participants discussed trends they saw across their service area, it is possible that households may leave a CBS service for more than one reason, but only the perceived dominant driver was known and discussed by the study participants. Similarly, participants may not be aware of every strategy their organization has taken to mitigate attrition rates over time, or bias may have influenced their responses. Participant organizations independently calculated their respective attrition rates using data that they collected internally. Different methods may have been used to calculate attrition rates, which may limit the ability to compare reported attrition rates across studies.

Finally, while this study captured seven CBS organizations that operated in diverse contexts spanning multiple countries, continents, and political and regulatory environments, their experiences may not be shared by all CBS organizations operating globally. Thus, results from this study may not be generalizable to all CBS service providers or contexts.

## 7 Conclusion

Cases described fourteen perceived drivers of customer attrition, eighteen current attrition mitigation strategies, and plans to employ ten strategies in the future. Attrition mitigation strategies fell along a public-private continuum, moving organizational practices closer to a public service model or a private business model. CBS organizations attributed the dominant driver of attrition to household economic challenges, and most commonly attempted to mitigate this attrition by generating individual repayment plans to help households reduce debts owed for the CBS service. When confronted with economic challenge-driven attrition, CBS organizations also adopted new private-leaning strategies, such as increasing customer vetting for their ability to pay, or public leaning-strategies, such as increasing government support and subsidizing the service. CBS organizations clearly feel tension between serving those who need sanitation access but cannot afford subscription fees and maintaining a financially sustainable business model.

The second most common driver of attrition discussed by cases was attributed to subscribers losing access to the CBS service area. Cases identified various reasons for why subscribers would leave the service area, including economic factors, to pursue a different job, or being forced to leave due to government construction or demolition. In general, cases adopted strategies that would reduce the number of temporary subscribers that intended to stay for less than 1 year to ensure financial viability of the organization. This strategy exerted pressure towards the private pole of the public-private continuum.

Furthermore, contextual factors such as the level of financial investment from government entities, local and international inflation rates, and household perceptions of subscription-based services and governmental groups, shaped CBS providers' strategic decisions. Specifically, without significant financial contributions from the government when attempting to service households that

face economic challenges, CBS providers often sought private-leaning attrition mitigation strategies. Nonetheless, multiple CBS providers expressed hope for increased financial support from local or national governments. Results from this study demonstrate that to provide safely managed sanitation services to the most economically challenged and transient households within CBS service areas, there is a need for increased subsidies to cover operating costs or otherwise subsidize household subscription fees.

No previous studies have identified drivers of customer attrition across multiple CBS organizations nor have any previous studies identified the strategies CBS providers take to address identified drivers of attrition. By taking a case analysis approach trends in customer attrition drivers and mitigation strategies were identified, and the tradeoffs CBS providers experience when designing and implementing strategies to address customer attrition were discussed.

## Data availability statement

The datasets presented in this article are not readily available because participants in this study, and their corresponding organizations, are part of a small network of container-based sanitation organizations that operate globally. Organizations may be easily identifiable from interview files and validation sheets. Therefore to ensure participant privacy, this data has not been made publicly available. However, we have included multiple participant quotes in the manuscript to describe themes that arose during analysis. Requests to access the datasets should be directed to RV, [rebecca.ventura@colorado.edu](mailto:rebecca.ventura@colorado.edu).

## Ethics statement

The studies involving human participants was approved by the University of Colorado Boulder's Institutional Review Board (IRB). The studies were conducted in accordance with local legislation and institutional requirements. The ethics committee/institutional review board waived the requirement of written informed consent. Informed consent was obtained orally from all participants.

## Author contributions

RV: Writing—original draft, Writing—review and editing, Conceptualization, Data curation, Formal Analysis, Methodology, Validation, Visualization. FV: Writing—review and editing, Conceptualization, Formal Analysis, Methodology, Supervision, Visualization. AJ-W: Conceptualization, Formal Analysis, Methodology, Project administration, Resources, Supervision, Writing—review and editing.

## Funding

The author(s) declare that financial support was received for the research, authorship, and/or publication of this article. Publication of this article was funded by the University of Colorado Boulder Libraries Open Access Fund.

## Acknowledgments

We graciously thank our study participants for taking the time to share their experiences and perspectives in our pursuit of this research study. We would also like to thank the Graduate Assistantship in Areas of National Need (GAANN) Fellowship for supporting the first author's graduate studies.

## Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

## References

- Antonucci, G. (2017). "Definition of nonprofit organization," in *Global encyclopedia of public administration, public policy, and governance*. Editor A. Farazmand (Cham: Springer). doi:10.1007/978-3-319-31816-5\_3043-1
- Birt, L., Scott, S., Cavers, D., Campbell, C., and Fiona, W. (2016). Member checking: a tool to enhance trustworthiness or merely a nod to validation? *Qual. Health Res.* 26 (13), 1802–1811. doi:10.1177/1049732316654870
- Bradshaw, P. (2009). A contingency approach to nonprofit governance: a contingency approach to nonprofit governance. *Nonprofit Manag. Leadersh.* 20 (1), 61–81. doi:10.1002/nml.241
- Bromley, P., and Meyer, J. W. (2017). "They are all organizations": the cultural roots of blurring between the nonprofit, business, and government sectors. *Adm. Soc.* 49 (7), 939–966. doi:10.1177/0095399714548268
- Cairns-Smith, S., Hill, H., and Nazarenko, E. (2014). Urban Sanitation: why a portfolio of solutions is needed. Available at: [https://web-assets.bcg.com/img-src/December\\_2014\\_Sanitation\\_WORKING\\_PAPER\\_FINAL\\_tcm9-79574.pdf](https://web-assets.bcg.com/img-src/December_2014_Sanitation_WORKING_PAPER_FINAL_tcm9-79574.pdf).
- CBSA (2024). About us. Container based sanitation alliance. Available at: <https://cbsa.global/about-us>.
- Cho, S., and Sultana, R. (2015). Journey from NGO to sustainable social enterprise: acceleratory organizational factors of BRAC. *Asian Soc. Work Policy Rev.* 9 (3), 296. doi:10.1111/aswp.12069
- Defourny, J., and Nyssens, M. (2017). Fundamentals for an international typology of social enterprise models. *VOLUNTAS Int. J. Voluntary Nonprofit Organ.* 28 (6), 2469–2497. doi:10.1007/s11266-017-9884-7
- de Kam, G. (2005). "Social enterprise in the Dutch property market," in *GaP working paper No. 3* (Nijmegen: Radboud University Nijmegen).
- Doherty, B., Haugh, H., and Lyon, F. (2014). Social enterprises as hybrid organizations: a review and research agenda. *Int. J. Manag. Rev.* 16 (4), 417–436. doi:10.1111/ijmr.12028
- European Commission (2023). Social enterprises. Available at: [https://single-market-economy.ec.europa.eu/sectors/proximity-and-social-economy/social-economy-eu/social-enterprises\\_en](https://single-market-economy.ec.europa.eu/sectors/proximity-and-social-economy/social-economy-eu/social-enterprises_en) (Accessed April 18, 2023).
- EY and WSUP (2017) *The World can't wait for sewers*. Available at: [https://assets.ey.com/content/dam/ey-sites/ey-com/en\\_gl/topics/corporate-social-responsibility/ey-wsup-the-world-cant-wait-for-sewers.pdf](https://assets.ey.com/content/dam/ey-sites/ey-com/en_gl/topics/corporate-social-responsibility/ey-wsup-the-world-cant-wait-for-sewers.pdf).
- Jenkins, M., Cumming, O., and Cairncross, S. (2015). Pit latrine emptying behavior and demand for sanitation services in dar Es salaam, Tanzania. *Int. J. Environ. Res. Public Health* 12 (3), 2588–2611. doi:10.3390/ijerph120302588
- Knutsen, W. Lu (2013). Value as a self-sustaining mechanism: why some nonprofit organizations are different from and similar to private and public organizations. *Nonprofit Voluntary Sect. Q.* 42 (5), 985–1005. doi:10.1177/0899764012457244
- Luke, B., and Chu, V. (2013). Social enterprise versus social entrepreneurship: an examination of the 'why' and 'how' in pursuing social change. *Int. Small Bus. J. Res. Entrepreneursh.* 31 (7), 764–784. doi:10.1177/0266242612462598
- Malena, C. (1995). Working with NGOs: a practical guide to operational collaboration between the World Bank and nongovernmental organizations. Operations policy department. Available at: <https://documents1.worldbank.org/curated/en/814581468739240860/pdf/multi-page.pdf>.
- Mallory, A., Mdee, A., Agol, D., Hyde-Smith, L., Kiogora, D., Riungu, J., et al. (2022). The potential for scaling up container-based sanitation in informal settlements in Kenya. *J. Int. Dev.* 34 (7), 1347–1361. doi:10.1002/jid.3639
- Mijthab, M., Anisie, R., and Crespo, O. (2021). Mosan: combining circularity and participatory design to address sanitation in low-income communities. *Circular Econ. Sustain.* 1 (3), 1165–1191. doi:10.1007/s43615-021-00118-w
- Moore, M. H. (2000). Managing for value: organizational strategy in for-profit, nonprofit, and governmental organizations. *Nonprofit Voluntary Sect. Q.* 29 (1\_Suppl. 1), 183–204. doi:10.1177/089976400773746391
- OECD (1999). *Social enterprises*. Paris, France: OECD.
- OECD (2019). "Making blended finance work for SDG 6: unlocking commercial finance for water and sanitation," in *OECD studies on water* (Paris, France: OECD). doi:10.1787/5efc8950-en
- Optimove (2023). What is customer attrition & customer attrition rate. Customer attrition. Available at: <https://www.optimove.com/resources/learning-center/customer-attrition>.
- Perry, J. L., and Rainey, H. G. (1988). The public-private distinction in organization theory: a critique and research strategy. *Acad. Manag. Rev.* 13, 182–201. doi:10.5465/amr.1988.4306858
- Russel, K. C., Hughes, K., Roach, M., Auerbach, D., Foote, A., Kramer, S., et al. (2019). Taking container-based sanitation to scale: opportunities and challenges. *Front. Environ. Sci.* 7, 190. doi:10.3389/fenvs.2019.00190
- Sanders, M. L. (2015). Being nonprofit-like in a market economy: understanding the mission-market tension in nonprofit organizing. *Nonprofit Voluntary Sect. Q.* 44 (2), 205–222. doi:10.1177/0899764013508606
- Schrecongost, A., Pedi, D., Rosenboom, J. W., Shrestha, R., and Ban, R. (2020). Citywide inclusive sanitation: a public service approach for reaching the urban sanitation SDGs. *Front. Environ. Sci.* 8, 19. doi:10.3389/fenvs.2020.00019
- Tamene, A., and Afework, A. (2021). Exploring barriers to the adoption and utilization of improved latrine facilities in rural Ethiopia: an Integrated Behavioral Model for Water, Sanitation and Hygiene (IBM-WASH) approach. *PLOS ONE* 16 (1), e0245289. doi:10.1371/journal.pone.0245289
- Tidwell, J. B., Nyarko, K. B., Ross, I., Dwumfour-Asare, B., and Scott, P. (2022). Evaluation of user experiences for the Clean Team Ghana container-based sanitation service in Kumasi, Ghana. *J. Water, Sanitation Hyg. Dev.* 12 (3), 336–346. doi:10.2166/washdev.2022.013
- Tilmans, S., Russel, K., Sklar, R., Page, L., Kramer, S., and Davis, J. (2015). Container-based sanitation: assessing costs and effectiveness of excreta management in Cap Haitien, Haiti. *Haiti. Environ. Urbanization* 27 (1), 89–104. doi:10.1177/0956247815572746
- Trémolet, S. (2013). Sanitation economics: understanding why sanitation markets fail and how they can improve. *Waterlines* 32 (4), 273–285. doi:10.3362/1756-3488.2013.029
- UNICEF and WHO (2018). *Core questions on water, sanitation and hygiene for household surveys*. New York, NY, USA: United Nations Children's Fund and World Health Organization.
- United Nations Children's Fund (2020). *Snapshot of global and regional urban water sanitation and hygiene inequalities*. New York, NY, USA: UNICEF.
- USAID (2018). "Scaling market-based sanitation: desk review on market-based rural sanitation development programs," in *Washington, DC: USAID water, sanitation, and hygiene partnerships and learning for sustainability (WASHPaLS) Project*. (Washington, D.C., United States: USAID).

## Publisher's note

All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

## Supplementary material

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fenvs.2024.1304047/full#supplementary-material>

VanRiper, F. (2021). *The viability of container-based sanitation as a tool for sanitation coverage in urban Haiti*. Doctoral Dissertation. Corvallis, OR: Oregon State University. OSU Scholars Archive.

VanRiper, F., Russel, K. C., Cramer, L. A., Tillias, D., Laporte, J., Lloyd, E., et al. (2022a). Container-based sanitation services and attrition: an examination of drivers and implications. *Front. Environ. Sci.* 9, 817142. doi:10.3389/fenvs.2021.817142

VanRiper, F., Russel, K. C., Tillias, D., Cramer, L., Laporte, J., Lloyd, E., et al. (2022b). The sanitation arc: an alternative examination of WASH behavior change. *J. Water, Sanitation Hyg. Dev.* 12 (1), 90–101. doi:10.2166/washdev.2021.162

VanRiper, F., Russel, K. C., Tillias, D., Tilt, J., and Laporte, J. (2022c). Container-based sanitation in urban Haiti: how can it improve human rights as a component of citywide inclusive sanitation? *H2Open J.* 5 (1), 135–152. doi:10.2166/h2oj.2022.037

WHO and UNICEF (2017). *Progress on drinking water, sanitation and hygiene: 2017 update and SDG baseline*. Geneva: WHO and UNICEF.

World Bank (2019). *Evaluating the potential of container-based sanitation*. Available at: <https://www.worldbank.org/en/topic/water/publication/evaluating-the-potential-of-container-based-sanitation>.

Yin, R. K. (2009). “Case study research design and methods,” in *Applied social research methods series* (Thousand Oaks, California, United States: SAGE Publications, Inc).