

# Exploring the Barriers to Scaling Up Sanitation Enterprises Using Q-Methodology

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**ABSTRACT:** Despite decades of effort, progress in safely managed sanitation—a public sector mandate—is stalling due to limited public funding and poor governance, among other reasons. As a result, public health has suffered and environmental degradation has continued. Social enterprises that use innovative business models to provide on-site sanitation services, also known as sanitation enterprises, are considered an emerging solution. However, sanitation enterprises have not yet successfully replaced public provision at scale. This work explores the barriers that sanitation enterprises encounter in lower- and middle-income countries. Q-Method, a mixed-methods approach that assesses social perspectives on an issue, is used to evaluate major barriers and groups of dominant perception for 19 sanitation enterprises operating across 20 countries. A total of 25 mutually exclusive, collectively exhaustive barriers are identified, ranging from affording capital expenses to navigating political corruption. The results show that most of the identified barriers fall into the financial barrier category, with reaching economies of scale being the greatest obstacle for sanitation enterprises. On the basis of these results, the premise of independent profitability underlying the sanitation enterprise value proposition should be reevaluated. Four enterprise types are proposed and can explain half of the variance among the sanitation enterprises studied. The context of a sanitation enterprise, including its countries of operation, size, customer base, sources of revenue, and section of the sanitation value chain, influences the barriers that the enterprise encounters. This research underscores the crucial role of context in influencing barriers for sanitation enterprises, emphasizing the need for investment and for policy makers to take these contextual dimensions into account.

**KEYWORDS:** *water, sanitation, SDG6, Q-method, sustainability, enterprise, LMICs*



## INTRODUCTION

**Achieving Safely Managed Sanitation.** Sanitation is a human right that is fundamental to living a dignified existence.<sup>1</sup> However, an estimated 43% of the global population does not have access to safely managed sanitation services with a disproportionate number of these people residing in lower- and middle-income countries (LMICs).<sup>2</sup> Although global access to safely managed sanitation increased by 8% between 2015 and 2022, the world is far off track to realize universal access to safely managed sanitation by the end of the decade.<sup>3</sup> It is estimated that 1.4 million deaths in 2019 could have been prevented with access to safe WASH services, with nearly half those deaths being attributable to a lack of access to basic sanitation services.<sup>4,5</sup> In addition to negative health consequences, a lack of safely managed sanitation poses a threat to the environment by contributing to freshwater eutrophication and anthropogenic methane emissions.<sup>6,7</sup>

The rate at which access to safely managed sanitation is increasing would need to more than quadruple to achieve SDG 6.2 by 2030.<sup>3</sup> There are many reasons why the rate of progress has remained substantially lower than necessary to achieve SDG 6.2, including limited funding, rapid urbanization, poor

governance, and climate change.<sup>8–10</sup> Only 14% of nations surveyed in the 2022 GLAAS report indicated having sufficient funds to achieve their sanitation targets, with roughly 1.36% (US\$2.14 billion) of all private finance for official development assistance between 2012 and 2017 being mobilized for the WASH sector.<sup>2,11</sup>

A wide variety of solutions have been proposed to address the slow progress of achieving universal sanitation.<sup>12–14</sup> One solution that is becoming more popular among international development institutions is sanitation enterprises.<sup>15,16</sup> The increased level of attention on small-scale sanitation enterprises is reflective of a larger trend in which the responsibility for sanitation provision is being shifted from the public sector to the private sector.<sup>17,18</sup> This trend of shifting responsibility has been accompanied by advancements in resource recovery

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technologies and business models,<sup>19,20</sup> and the understanding of sanitation as a human-derived resource system.<sup>21</sup> Environmental concerns of nutrient leakage have attracted additional interest in these technologies.<sup>20–22</sup>

The uptake of citywide inclusive sanitation (CWIS) as a new paradigm in the development agenda has amplified the potential for creating a sanitation economy with the involvement of the private sector in various contexts.<sup>23,24</sup> The sanitation economy offers the promise of catalyzing change by tapping into new streams of investment, while CWIS prioritizes the delivery of services through a range of solutions rather than solely focusing on centralized infrastructure.<sup>25,26</sup> Sanitation enterprises combine these concepts by offering the promise of a private, decentralized solution that can deliver sanitation services at relatively low costs to marginalized communities.<sup>27,28</sup> This promise is based on the assumption that enterprises can unlock private finance by being profitable at scale.<sup>29,30</sup>

However, sanitation enterprises have largely not met expectations of providing sanitation services at scale without external government support.<sup>31,32</sup> These enterprises suffer from a poor enabling environment and a variety of barriers that prevent their success.<sup>27,30,33</sup> The development community has spent much of the past decade attempting to devise sanitation enterprise business models that can effectively address the sanitation crisis and hoping that these models can bring sanitation services to harder-to-serve households and communities.<sup>34–36</sup>

**Research Aims.** The aim of our study is to explore the barriers that prevent sanitation enterprises in LMICs from achieving success. For our study, sanitation enterprises are defined as social enterprises that use innovative business models to achieve safely managed sanitation by providing on-site sanitation solutions.<sup>37,38</sup> The success of sanitation enterprises is defined as the ability to provide sanitation products or services to the target population while maintaining financial viability and sustainability.<sup>15</sup>

There has been little research into the barriers that sanitation enterprises experience across LMICs as most existing literature is confined to specific geographies, development aid programs, or types of sanitation technologies.<sup>31,39,40</sup> Similarly, research on examining the influence of geography, regulatory environment, and market segment on barriers has been minimal.<sup>15,41</sup> We are not aware of a study that explicitly explores the differences in barriers between sanitation enterprises based on the contexts in which the enterprises operate.

Our study aims to contribute to the literature on sanitation enterprises by asking the following: (1) What are the most significant barriers reported by sanitation enterprises in LMICs? (2) How do these barriers vary between different sanitation enterprises in different contexts?

## METHODS

**Overview of Q-Method.** Q-Method is a mixed-methods approach that assesses social perspectives on an issue and identifies patterns of opinion using rank-ordering of subjective statements and factor analysis.<sup>42,43</sup> It does not purport to identify the proportions of a population that hold certain views, but it instead can be used to find groups of “shared subjective perspectives within the participant pool”.<sup>44</sup> It can also be used to support policymaking by generating a better understanding of key stakeholder perspectives<sup>45</sup> and has been

applied to a variety of disciplines, including the environmental social sciences on topics ranging from wastewater reuse in Texas to cultural understandings of water in the Murray-Darling Basin.<sup>46–50</sup>

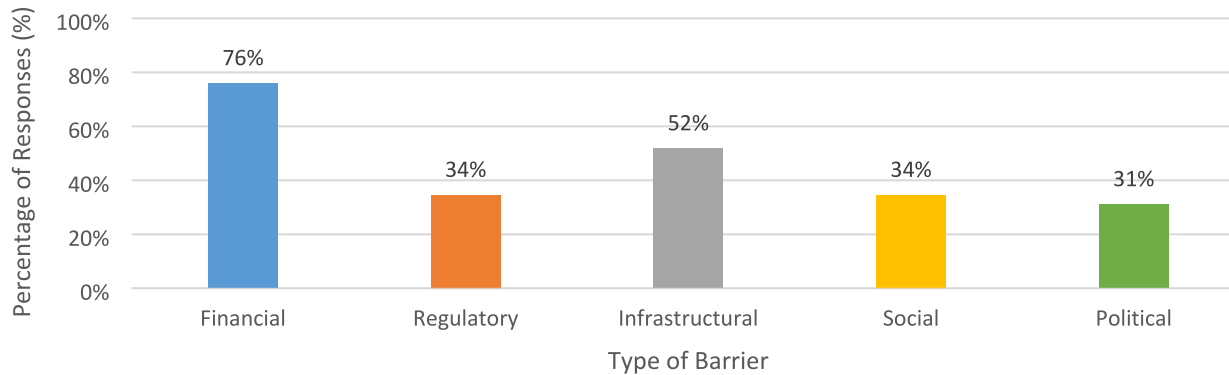
**Study Participants.** The exact number of sanitation enterprises in LMICs is unknown. However, a 2020 global assessment of market-based sanitation development projects identified 49 unique projects in 22 nations across sub-Saharan Africa, south and southeast Asia, and Latin America.<sup>31</sup> Our study identified a total of 48 sanitation enterprises through Internet searches, expert consultations, and literature reviews. Included were private enterprises that provided or aided in the provision of on-site sanitation products or services in LMICs. Large multinational conglomerates (e.g., Suez) were excluded because these entities encounter substantially different challenges and are not typically considered sanitation enterprises in the existing literature.<sup>51</sup>

A total of 36 unique sanitation enterprises with operations across 20 LMICs representing the regions of South America, sub-Saharan Africa, west Asia, south Asia, and southeast Asia participated in our study. Purposive sampling was used to ensure geographic diversity.<sup>52</sup> Thirty-four of the sanitation enterprises participated in the concourse survey, and 19 participated in the Q-sort. All 48 sanitation enterprises identified were contacted for participation in our study, with the final number of participants being reflective of the enterprises’ responsiveness and availability.

**Steps of Q-Method.** The first step in our study was generating the concourse, “a selection of subjective statements representing the breadth of the broader domain of subjectivity under study”,<sup>42</sup> using an online survey. The survey was administered to 41 participants representing 34 unique sanitation enterprises and included the following four questions: (1) How would you define operational success for your organization? (2) What is the most significant barrier that prevents your organization from achieving operational success? (3) What type(s) of barriers does your organization encounter? (select all that apply). (4) What steps is your organization taking to overcome these barriers? Our concourse had a total of 150 statements meant to capture all sentiments relating to the barriers that sanitation enterprises encounter in LMICs.

The second step was condensing the 150 statements into the Q-set, or a set of mutually exclusive statements meant to be fully representative of the concourse. The number of statements in the Q-set is typically dictated by a pyramid-shaped distribution of 16, 25, 36, or 49 statements. Sixteen statements were insufficient to capture the full breadth of the concourse, whereas there were not 36 statements that would have been mutually exclusive; therefore, the final Q-set in our study comprised 25 statements, divided into five *a priori* themes drawn from the existing literature. The number of statements under each of the five themes in the concourse was determined using the results of the third online survey question asking enterprises what types of barriers they encountered. Further details on creating the Q-set can be found in the [Supporting Information](#). As the Q-sort is derived directly from the language used in the online survey by the study participants, creating a set of statements that are perfectly mutually exclusive and collectively exhaustive is difficult.

The third step was administering the Q-sort to 19 participants representing 19 unique sanitation enterprises,

Scheme 1. Categories of Barriers Encountered by Sanitation Enterprises<sup>a</sup>

<sup>a</sup>Provided as a percentage of total survey responses to question 8 of the online survey.

asking them to rank-order the Q-set statements onto a predetermined pyramid-shaped distribution. The Q-sort was virtually administered through Microsoft Teams using a software package called Q-Tip ([qtip.geography.wisc.edu](http://qtip.geography.wisc.edu)) developed by researchers at the University of Wisconsin. The condition of instruction given to the participants was to “sort the [25] statements [in the Q-set] based on how significant the barrier described [was] to [their] organization from most significant on the far right [of the pyramid] to least significant on the far left [on the pyramid]” with a forced sorting condition of 1 2 3 4 5 4 3 2 1 as shown in Appendix D. After finishing the Q-sort, the participants were interviewed to understand the reasons behind their sorting. Two of the 19 participants were unable to stay for the follow-up interview.

The fourth and final step was factor analysis, which produces the Q-method’s primary findings by “identifying clusters of participants who have completed their Q-sorts in a similar way to reveal a set of shared viewpoints”.<sup>42,53</sup> We used principal component analysis to identify three extracted factors that had a cumulative explained variance of 47%. One factor was considered bipolar because it had an equal number of positively and negatively strongly correlated participants, and the factor was therefore split into two factors for easier data analysis. The final set of factors represented “idealized worldviews” on the barriers that sanitation enterprises encounter in LMICs. This study used an open-source software package known as KADE ([github.com/shawnbanasick/kade](https://github.com/shawnbanasick/kade)) for factor analysis. Further details of the identification of enterprise types through factor analysis can be found in Appendix B.

## RESULTS

**Major Barriers to Operational Success.** As captured through the online survey, most sanitation enterprises defined operational success as achieving their strategic objectives while remaining commercially solvent. Scheme 1 shows the percentage of respondents who identified each category of barrier as an obstacle to their sanitation enterprise’s success. Financial barriers were the most common category of barrier encountered, with 76% of respondents selecting this category.

Table 1 shows the Q-set with the corresponding *a priori* themes and the average ranking of each barrier by sanitation enterprises from the Q-sorts. The individual barrier that was ranked the most significant by sanitation enterprises was, on average, “the ability to grow to a point where we have reached

economies of scale” (barrier 7), as displayed in Table 1. Fifty-four percent of barriers identified as being among the top three most significant fell within the financial barriers category.

Interviews indicated that sanitation enterprises chose the aforementioned barrier 7 as the most significant because reaching economies of scale is necessary for providing affordable services to low-income customers while covering operating expenses. Some enterprises also expressed that demonstrating the possibility of reaching economies of scale is essential for securing investment. Accessing concessional finance (barrier 3) and affording the initial capital cost of their products and/or services (barrier 1) were ranked as the second and third most significant barriers, respectively.

**Contexts and Barriers.** Factor analysis of the Q-sort data from the 19 sanitation enterprises revealed four enterprise types, also known as factors. These four types were able to explain roughly 47% of the variance observed in the Q-sort data, which is in the normal range for Q-method and social science research more generally.<sup>44</sup> Of the 19 sanitation enterprises, 17 enterprises had a statistically significant ( $p < 0.05$ ) correlation of at least 0.4 with one of the four enterprise types. Sixteen of the 17 correlations were positive, and one of the correlations was negative. Interviews and survey results were used to complement the factor analysis to give more depth to the Q-sort data. Table 2 offers a high-level overview of the four enterprise types, while Table 3 provides further background on the contexts of each of the types.

**Type A: The Independent Sanitation Providers.** Type A is defined by small-to-medium-sized enterprises (1–100 full-time employees) that provide sanitation services targeting low-income communities without financial support from the government. The enterprises that fit this type have been in operation for an average of eight years and operate in only one country.

Affording the initial capital expenses of their products and/or services (barrier 1) and covering their operating costs (barrier 2) are the most significant barriers for enterprises that fit Type A. Interviews reveal that enterprises in Type A rely heavily on grants to pay for initial capital expenses, which can create an unreliable dependency on philanthropic goodwill. Covering operating costs was also a significant issue for this group because low-income communities are their target customers and these communities cannot often pay the full costs of service.

**Table 1. Q-Set with *A Priori* Themes and Average Rankings<sup>a</sup>**

barrier number	Q-set statements	average barrier rank
Financial Barriers (33% of total answers)		
1	the ability to afford the initial capital costs of our products and/or services (e.g., construction)	3
2	the ability to maintain our products and/or services and afford the operational costs	4
3	the ability to access concessionary financing (e.g., grants, PPPs, etc.)	2
4	the ability to access low-interest financing (e.g., commercial bank loans, etc.)	14
5	the ability to access equity financing (e.g., venture capital, private equity, etc.)	18
6	the ability to ensure customer payment is made in a reasonable amount of time	15
7	the ability to grow to a point where we have reached economies of scale	1
8	the ability to compete with other market players	20
Regulatory Barriers (15% of total answers)		
9	the ability to be considered a tax-exempt entity	23
10	the ability to secure regulatory permits	21
11	the ability to work in environments with little or no enforcement of fecal sludge regulations	19
12	the ability to legally sell sanitation treatment byproducts (e.g., fertilizer)	12
Infrastructure Barriers (23% of total answers)		
13	the ability to source high-quality materials for our products and/or services	13
14	the ability to gather sufficient data on our customers	16
15	the ability to overcome technological hurdles with our product and/or services	10
16	the ability to hire skilled employees and offer a competitive wage and/or salary	11
17	the ability to adapt to climate extreme events (e.g., droughts, floods, etc.)	24
18	the ability to offer our products and/or services in politically unstable regions	25
Social Barriers (15% of total answers)		
19	the ability to provide low-cost products and/or services to poorer communities	5
20	the ability to serve customers in rural or remote environments	22
21	the ability to overcome social stigmatization and change customer behavior	9
22	the ability to retain customers	7
Political Barriers (14% of total answers)		
23	the ability to collaborate with local sanitation authorities	8
24	the ability to navigate political corruption	17
25	the ability to be recognized as an acceptable form of sanitation provision by the government	6

<sup>a</sup>Condensed concourse as 25 mutually exclusive statements with average rankings of barriers from Q-sorts.

Reaching economies of scale (barrier 7) and providing low-cost products and/or services (barrier 19) are the third and fourth most significant barriers, respectively, which reflect the difficulty of targeting low-income communities. The minimal financial support from governments leaves the long-term financial viability of these enterprises uncertain and informs their ranking of barriers.

**Type B: The Small Business Reusers.** Type B is defined by small-to-medium-sized enterprises that provide reuse and disposal products and services in competitive markets. The enterprises that fit this type vary in terms of their countries of

**Table 2. Overview of the Enterprise Types<sup>a</sup>**

	context description	most significant barriers
Type A (factor 1)	independent sanitation providers	capital and operational costs (barriers 1 and 2) and economies of scale (barrier 7)
Type B (factor 2a)	small business reusers	customer data (barrier 14) and social acceptance (barriers 21 and 24)
Type C (factor 2b)	big business treatment providers	capital costs (barrier 1) and government inadequacy (barriers 6 and 24)
Type D (factor 3)	public provision partners	economies of scale (barriers 7 and 2) and concessionary finance (barrier 3)

<sup>a</sup>Provided as a summary of survey results and extracted factors from the Q-sorts (see Appendix B).

operation and their customer base. However, all enterprises receive revenue primarily from customers and not from government subsidies.

Gathering sufficient customer data (barrier 14) is the most significant barrier for enterprises that fit Type B. Interviews reveal that enterprises in Type B are most concerned about customer data, because better understanding their customers is central to marketing efforts and customer segmentation. Enterprises that provide reuse and disposal products and/or services often compete with less expensive sanitation services that provide basic but not safely managed sanitation services and thus must convince households to pay for a more expensive option.

Overcoming social stigmatization and changing customer behavior (barrier 21) and being recognized as an acceptable form of sanitation provision by the government (barrier 25) are the second and third most significant barriers, respectively, which confirm the difficulty of competing with centralized sanitation services. Operating costs (barrier 2) are also a major challenge for this group of enterprises because a significant portion of their target market is low-income communities, and these enterprises do not receive financial support from the government.

**Type C: The Big Business Treatment Providers.** Type C is defined by medium-to-large-sized enterprises (100–250 full-time employees) that provide treatment products and/or services targeting large, institutional customers. The enterprises that fit this type receive revenues from both customer payment and government subsidies, and all those in our study that operate in India.

Affording the initial capital expenses of their products and/or services (barrier 1) is the most significant barrier for enterprises that fit Type C. Interviews reveal that enterprises in Type C have relatively high capital costs, because their customer base consists of institutional customers who demand premium products and/or services. The institutional customers are often regional or local governments, which helps explain that the second and third most significant barriers are receiving payment in a reasonable amount of time (barrier 6) and navigating political corruption (barrier 24), respectively. Nepotism and unreliable payment are common themes that emerged across all interviews when governments were the primary customer base.

The difficulty of working with governments and the scarce number of public contracts available are some of the reasons why enterprises that fit Type C list access concessionary (barrier 3) and low-interest finance (barrier 4) as the fourth

Table 3. Context of the Enterprise Types<sup>a</sup>

	years in operation	country of operation	no. of customers	no. of employees	value chain	sources of funding	target customer	barriers	title of respondent
Type A (n = 7)	6–11 years	single country (different)	mix	1–100 employees	mix	customers and grants	low-income communities	financial	mix
Type B (n = 3)	mix	multiple countries	mix	1–100 employees	reuse and disposal	customers	mix	social	CEOs
Type C (n = 2)	6–11 years	single country (india)	1–1000 customers	10 to >251 employees	treatment	customers and government	large customers (e.g., cities)	mix	mix
Type D (n = 4)	mix	multiple countries	mix	mix	whole sanitation value chain	government	low-income communities	mix	founders

<sup>a</sup>Provided as details of survey results to questions 1–7 along extracted factors (see Appendix C).

and fifth most significant barriers, respectively. Enterprises that fit Type C are looking for alternative sources of financing to cover their initial capital costs.

**Type D: The Public Provision Partners.** Type D is defined as enterprises that provide whole sanitation value chain products and/or services targeting low-income communities while receiving financial support from governments. The enterprises that fit Type D vary in terms of the number of years of operation, operating locations, and size.

Reaching economies of scale (barrier 7) and covering operational costs (barrier 2) are the most significant barriers for enterprises that fit Type D. Interviews reveal that enterprises in Type D do not receive government support sufficient for full cost recovery and still must reach economies of scale to provide products and/or services that low-income communities can afford. The difficulty of achieving full cost recovery even with government support helps explain why accessing concessionary finance (barrier 3) as an additional funding source is the third most significant barrier for this group.

These enterprises also believed that reaching economies of scale is contingent on local sanitation authority buy-in and support, which is a reason that collaborating with local authorities (barrier 23) is ranked as the fifth most significant barrier. Receiving customer payments within a reasonable amount of time (barrier 6) is ranked as the fourth most significant barrier. This is largely because enterprises that fit Type D are often substitutes for public provision.

**Intertype Differences.** There are differences among all four enterprise types, which further reveal the sentiments held by the enterprises in each group. Table 4 shows the barriers that are most significantly different between types and the types' corresponding correlations.

The statements that are ranked the most differently across the four enterprise types are the ability to afford initial capital costs (barrier 1) and the ability to receive customer payment in a reasonable amount of time (barrier 6). Barrier 1 was ranked as the most significant barrier for Types A and C but as relatively insignificant for Types B and D. Barrier 6 was ranked as relatively significant for Types C and D but as very insignificant for Types A and B.

The statements that are ranked the most similarly, with average and below-average significance across the four types, are the ability to work in environments with little enforcement of fecal sludge regulations (barrier 11) and the ability to adapt to climate change (barrier 17), respectively.

## DISCUSSION

**Major Barriers to Success.** The most common type of barrier identified by sanitation enterprises was the financial

barrier (Scheme 1). This tendency is mirrored in the existing literature with issues such as affording capital costs and unlocking affordable private finance being dominant.<sup>31–33,41,54</sup>

The prominence of financial barriers in our study and the existing literature can be, at least partially, explained by the nature of the sanitation enterprise value proposition. Sanitation enterprises are often viewed as a second-best solution to poor sanitation where other interventions have failed.<sup>18,55</sup> A common reason for the prior lack of success is funding, and the commercialization of the sanitation value chain is thought to fill this gap.<sup>12,56</sup> However, the profitability of sanitation enterprises funded exclusively from customer revenues alone, without additional subsidies from the government, hereafter termed independent profitability, has not been widely observed to date.<sup>31,57</sup> Difficulties in the private sector's ability to capture the positive externalities of safely managed sanitation such as improved public health and environmental protection make independent profitability difficult.<sup>58</sup>

The single barrier that was ranked as the most significant by sanitation enterprises was the ability to reach economies of scale. This barrier was also reflected in the existing literature on the topic.<sup>15,29,33,54</sup> Nonetheless, there is not a universal definition of economies of scale in the context of sanitation.<sup>59</sup> In our study, sanitation enterprises used the phrase to express their ability to serve sufficient customers so that fixed costs were no longer a barrier. The one justification that appeared across almost all sources and interviews is that economies of scale are critical for reaching low-income customers. Scale spreads fixed expenses and allows sanitation enterprises to offer a more affordable product or service to their customers.<sup>60</sup>

The second and third most significant barriers reported by sanitation enterprises were accessing concessional finance and covering capital costs, respectively (Table 1). These two barriers were also considered major barriers to success for sanitation enterprises in the existing literature.<sup>29,31,33,41,54</sup> However, the existing literature on this topic often lacked the nuance to differentiate among concessionary, low-interest, and equity financing. Nonetheless, the focus on unlocking affordable private finance was clear in multiple international financial institution reports and academic studies.<sup>29,31</sup> The issue of affording capital costs also appeared throughout the literature.<sup>31,41</sup> Accessing concessional finance and covering capital costs are both part of a larger issue of being able to expand while remaining financially solvent.

There was generally a strong alignment between the barriers discussed in the literature and those reported by sanitation enterprises. However, there were two barriers that featured prominently in the existing literature on the topic but were not reported by sanitation enterprises in our study. A narrative that development aid has created an expectation of free sanitation

Table 4. Barriers Ranked Most Significantly Different among Types and Correlations between Enterprise Types<sup>a</sup>

Type A (significant barriers)	Type B (insignificant barriers)	Type C (insignificant barriers)	Type D (insignificant barriers)
n/a	capital costs (barrier 1) and alternative sources of financing (barriers 4, 3, and 5) $\rho = -0.047$	government support (barriers 9 and 25) and reaching low-income communities (barriers 19, 2, and 7) $\rho = 0.119$	capital costs (barrier 1) and alternative sources of financing (barriers 5 and 4) $\rho = 0.254$
market competition (barriers 14 and 8) and political instability (barrier 20) Pearson correlation ( $\rho$ ) = $-0.047$	n/a	market competition (barriers 14 and 8) and social acceptance (barriers 25 and 21) $\rho = -0.525$	market competition (barriers 14 and 8) and serving rural populations (barrier 20) and market competition (barriers 14 and 8) $\rho = 0.077$
customer payment (barrier 6) and political corruption (barrier 24) $\rho = 0.119$	customer payment (barrier 6), capital costs (barrier 1), and political corruption (barrier 24) $\rho = -0.525$	n/a	capital costs (barrier 1) and political corruption (barrier 24) $\rho = -0.017$
customer payment (barrier 6) and sanitation authority collaboration (barriers 12 and 23) $\rho = 0.254$	customer payment (barrier 6) and economies of scale (barrier 7) $\rho = 0.077$	economies of scale (barrier 7) and operational costs (barrier 2) $\rho = -0.017$	n/a

<sup>a</sup>Provided as a summary of the differences in enterprise types from factor analysis.

products or services, reducing willingness to pay for services provided on a commercial basis, also exists.<sup>29,33,61</sup> On the contrary, there is a substantial amount of evidence that shows that the willingness to pay for sanitation is relatively high.<sup>62–64</sup> This can explain why this barrier was found in the existing literature but was not expressed by any participants in our study. The second barrier found only in the literature was a deficiency of business skills within sanitation enterprises.<sup>33,54</sup> Sanitation enterprises did not mention an inadequacy of their own skills, but some did note the difficulty in hiring skilled employees. A reason for this discrepancy could be that sanitation enterprises are less critical of themselves and more critical of the enabling environments in which they are operating. Additionally, inadequate revenue may prevent sanitation enterprises from being able to hire employees with business skills that are in high demand.

The overwhelming prominence of financial barriers being reported by sanitation enterprises may indicate that there is something fundamentally missing or misconceived about the sanitation enterprise business model. Sanitation enterprises clearly need an influx of financial resources to help cover their capital and operating expenses, while fueling expansion. There are increasing calls for private sector finance to fill this gap.<sup>41</sup> However, private finance usually requires a positive rate of return on investment, and the independent profitability of sanitation enterprises has yet to be widely observed.<sup>57,65</sup> Without independent profitability, sanitation enterprises will not be able to access private finance and will instead need to rely on governments or aid organizations for financial support.

**Context and Barriers.** The link between the contexts of the sanitation enterprises and the barriers that the enterprises deem most significant is clear. Context influences the barriers that sanitation enterprises encounter and therefore their enterprise type. The four enterprise types, which were each characterized by a unique context, could account for ~50% of the variation in enterprise barriers, with almost 90% of the enterprises having a statistically significant relationship with one of the enterprise types.

The four enterprise types are not adequately reflected in the existing literature on sanitation enterprises and mark an improvement in our understanding of the topic. The existing literature mostly still relies on assumptions regarding the context of sanitation enterprises even if not explicitly stated.<sup>29,32</sup> The underlying premise in the preponderance of literature is that sanitation enterprises most resemble the independent sanitation enterprises identified as Type A (see Table 2). These enterprises are relatively small entities serving low-income communities and receiving revenue primarily from their customers and grants. The most significant barriers that this group of enterprises encounters include covering their capital and operational expenses while achieving economies of scale. These barriers are also the ones most frequently mentioned in the existing literature.<sup>29,31–33,41</sup> There is a distinct under-representation of Types B–D in the existing literature, which can pose issues for policymakers and development institutions.

Appreciating the differences not only in the context but also in the operation models highlighted in the four enterprise types is key for policymakers crafting initiatives geared at enabling sanitation enterprise success: Understanding context and these enterprise types is essential for policymakers.<sup>66,67</sup> Blunt policy instruments that do not account for these contexts are likely to be ineffective. It would be a waste of limited resources to

approach problems that sanitation enterprises encounter from a unipolar viewpoint. Policymakers can benefit from considering the elements of context displayed in Table 3, including the sanitation enterprise region of operation, size, value chain segment, source of funding, customer base, and other elements not yet explored in our study. A mismatch between the beliefs of policymakers and the reality of sanitation enterprises can lead to ineffective policy and investment. For example, interviews with sanitation experts revealed that they considered the ability to be recognized as an acceptable form of sanitation provision (barrier 25) as the most significant barrier for sanitation enterprises, whereas this barrier was not ranked within the top five by sanitation enterprises.

**Recommendations.** We should reevaluate the premise of independent profitability underlying the sanitation enterprise value proposition. Sanitation enterprises are considered a solution to providing safely managed sanitation where past efforts have been ineffective.<sup>18,31</sup> One of the central assumptions of this claim is that enterprises can help fill the funding gap through resource recovery and other forms of commercialization.<sup>12,56</sup> This idea is deeply tied to the concept of the sanitation economy and, in part, CWIS.<sup>8,11,23</sup> However, the proposition that sanitation enterprises can be independently profitable at scale has yet to be widely observed.<sup>31,57</sup> Additionally, our study demonstrates that financial barriers are the key barriers preventing sanitation enterprise success. There needs to be a reevaluation of the sanitation enterprise value proposition that reconsiders the role of the government subsidy. Aside from the rights-based argument, public provision of sanitation is often considered to be most appropriate because of the private sector's inability to capture the wider benefits of improved public health and the reduced environment impact that sanitation brings to society.<sup>3</sup> While innovations within the sanitation value chain may create value in other ways, they do not financially capture these positive externalities of universal sanitation and thus do not alter the fundamental argument for the public provision of sanitation services.

Policymakers and financiers should more thoroughly consider the role of context in shaping experience and enabling sanitation enterprise success. Not all sanitation enterprises encounter the same barriers, and the significance of a specific barrier may differ greatly between enterprises depending on the context. Understanding the dependency of barriers on context is essential for effective policymaking and resource allocation.<sup>68</sup> Our study identified four distinct enterprise types from a group of 19 sanitation enterprises. There are likely other enterprise types that represent sanitation enterprises not included in our study. Policymakers and financiers should endeavor to understand the difference between sanitation enterprises and the role that the context plays in those differences.

**Limitations.** There are three primary limitations to our study. First, Q-method studies suffer from researcher bias as they rely heavily upon the subjective knowledge and interpretation of a researcher for study design and analysis.<sup>44</sup> Second, the participant pool was composed entirely of sanitation enterprises that were currently in operation and agreed to take part in this study. Survivorship bias may have skewed the results. Including enterprises that had recently failed or needed to temporarily stop operations in the participant pool may have yielded different results and

emphasized different barriers.<sup>69</sup> Third, the participant pool size for the Q-sorts lacked certain types of diversity and was smaller than the average. On the basis of a 2021 meta-analysis, the average size of the participant pool in Q-method studies for the Q-sort is 42 participants,<sup>44</sup> whereas the participant size in our study was only 19 participants. However, 19 participants are likely sufficient for a representative sample given the relatively small number of sanitation enterprises currently in operation.

## CONCLUSION

We have reached two main conclusions. First, the main type of barrier that sanitation enterprises encounter is financial, specifically the ability to reach economies of scale. The prevalence of financial barriers is mirrored in the existing literature on the topic and is potentially indicative of issues with the sanitation enterprise value proposition. Sanitation enterprises are conceived as a solution for providing safely managed sanitation where past efforts have failed due to reasons such as insufficient funding. Enterprises are expected to fill this funding gap by commercializing the sanitation value chain, achieving independent profitability, and unlocking private finance. However, this underlying assumption of the sanitation enterprise value proposition remains unsubstantiated. The role of government subsidies in the success of sanitation enterprises needs to be carefully accounted for. Otherwise, sanitation enterprises will not be successful, and the negative human health and environmental impacts associated with a lack of safely managed sanitation will continue.

Second, the context of sanitation enterprises strongly shaped the perceptions of enterprises and their understanding of the most and least significant barriers. Our study identified four distinct enterprise types influenced by context. All enterprise types differed in their understanding of barriers deemed most and least significant. The existing literature on the topic fails to capture the variety of sanitation enterprise experiences and often assumes that all sanitation enterprises resemble only one of these enterprise types, independent sanitation providers. Understanding this relationship between barriers and context is essential for decision-making and enabling sanitation enterprises to achieve success.

## ASSOCIATED CONTENT

### Supporting Information

The Supporting Information is available free of charge at <https://pubs.acs.org/doi/10.1021/acsestwater.4c00274>.

Creating the Q-set (Appendix A), identification of enterprise types using factor analysis (Appendix B), online survey (Appendix C), completed Q-sort distribution shape (Appendix D), and additional references (PDF)

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## Author Contributions

CRedit: **William Wallock** conceptualization, formal analysis, writing-original draft, writing-review & editing; **Abishek Sankara Narayan** conceptualization, supervision, writing-review & editing; **Patrick Thomson** conceptualization, project administration, supervision, writing-review & editing.

## Notes

The authors declare no competing financial interest.

Oxford's Central University Research Ethics Committee (CUREC) approved our research project (SOGE C1B 23 2). All ethical guidelines were followed throughout our study.

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## ADDITIONAL NOTE

"Sustainability is defined here by USAID as "the likelihood that an enterprise remains viable over an extended period of time ... and continues operating without external, non-market-based support". Other aspects of sustainability, including environmental and social elements, are not explicitly included in this definition.

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