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No legitimacy: A study of private sector sanitation development in the Global South

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ABSTRACT

What is needed for the private sector to successfully establish itself as a key player in delivering sustainable sanitation in the Global South? The present paper aims to offer some answers to this through the case of Peepoople AB, a company delivering a single-use biodegradable toilet bag in informal settlements. The company aimed to but failed in combining sustainable development of sanitation and financial gain for investors. We suggest that explanations for the failure can be found in the interaction between the company and the development– and aid organisations already involved in sanitation development. Through Strategic Niche Management, we look at whether the company managed to create relevant social networks, expectation dynamics and learning processes. The company gained legitimacy with end users, but failed to gain legitimacy in the development sector as it did not prioritise the kind of learning and competence considered relevant in the sector.

1. Introduction

Nowadays the private sector has been assigned a key role in development, with significant hopes placed on quicker, more efficient and consumer-oriented sustainable development (Bitzer and Glasbergen, 2015; Ghosh and Rajan, 2019; Hall and Lobina, 2006; McEwan et al., 2017). One arena in which the private sector has been given a particularly prominent role is in technology development for the poor (McEwan et al., 2017).

Sanitation has historically been one of the least prioritised areas on the global development agenda due to high capital investment costs, social taboos and the inherent complexity around technology adoption and implementation. Global sanitation statistics make depressing reading, with two billion people still lacking basic sanitation, causing over 400,000 diarrheal deaths annually and a much larger number of non-fatal cases of disease (WHO, 2019). In response to the sanitation challenge, the sector has seen an increased interest in the role of private investment and innovations, particularly for urban informal settlements in the Global South.

Private sector engagement in sanitation development is characterised by solutions that aim to combine human wellbeing and environmental improvements with making a profit (Fejerskov, 2017). The increasing participation of the private sector in sanitation development warrants a closer scrutiny of how the sector integrates with the established development apparatus of large government and intragovernmental organisations and NGOs that have historically dominated the sanitation regime in the Global South. It also raises questions about the kinds of development issues and actors that are either targeted or left out when there is a profit incentive

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(Blowfield and Dolan, 2014; Schurman, 2018).

This paper presents a case in which a new sanitation solution, the Peepoo bag developed by the Swedish company Peepoople AB, aimed to combine profit for investors with development improvements in informal settlements. The Peepoo bag is a single-use biodegradable plastic bag containing a pad of urea that absorbs and breaks down pathogens (Vinnerås et al., 2009). Peepoople AB was founded in 2006 and liquidated in 2016 due to lack of financial viability. The company's most comprehensive engagement was in the Kibera informal settlement in Nairobi, where it for a limited period gave households and schools subsidised access to the bag through donor funding (Kokko, 2019).

Kibera is one of the largest informal settlements in Africa with a likely population of over half a million residents (Schouten and Mathenge, 2010). The settlement is located in hilly terrain, partly on a floodplain and like other informal settlements, it is characterised by government failure to provide effective structural planning and municipal services, including for water and sanitation. In this void of an adequate solution serving all residents, several civil society– and private sector initiatives have emerged providing communal pit-latrines as well as various portable- and in-house sanitation solutions. Many of these have not lasted over time, often due to financial or structural constraints with regard to emptying and removal of waste (van Welie et al., 2019). As an indication of the inadequacy of access to sanitation, figures from 2004, which was the period just preceding the introduction of the Peepoo bag, suggested that 150 people shared one pit latrine in Kibera, resulting in a significantly higher use frequency than they are designed for (Schouten and Mathenge, 2010). Not having access to an adequate toilet solution is a cause of significant stress for Kibera's residents. It also leads to exposure to violence and diarrheal related illnesses (Kokko, 2019).

The Peepoo bag provides a solution to many of the sanitation-related constraints faced by people living in informal settlements. It can be used in the home, but it does not require much space, and it can be used without the need for additional devices, placed over a used tin can, for example. Like other forms of waste that have to be disposed, it needs to be collected and ideally removed from the settlement. However, the sanitizing effect of the urea means that the bag does not contribute to the spread of pathogens and resulting diseases in the same way as other available toilets (Vinnerås et al., 2009).

Previous studies of the Peepoo case have focused on the sanitizing effect of the urea (Vinnerås et al., 2009) and on user perspectives (Kokko and Lagerkvist, 2017; Lagerkvist et al., 2014). This body of work shows that despite initial scepticism among end users, many became positive about using the bag. Women particularly appreciated it for its usefulness in situations when it is difficult to leave the house, such as when caring for small children, at night and during illness. Women with access to the bag also reported that their children were ill less often (Lagerkvist et al., 2014), which is an anticipated result of reduced exposure to pathogens (Vinnerås et al., 2009). However, consumer-oriented research on the Peepoo bag has been unable to explain why, despite the local benefits and appreciation of the bag amongst Kibera's residents, it failed to penetrate the niche as a successful private sector sanitation solution.

Since the failure of Peepoople AB to successfully combine financial gain for investors and development cannot be explained by studying consumers, this paper turns to the activities and relationships that needed to be in place for the company to successfully deliver its sanitation solution to end users, i.e. other actors in the sanitation and development regime. In another publication (Kokko, 2019) we describe the importance of the lack of engagement with Kenyan authorities and experts for the failure of the bag to take hold as a local sanitation solution. In the present paper we instead focus on relationships with the wider set of globally active donor and aid organizations which represent key players in the field of sanitation development in the Global South (Fejerskov, 2017; van Welie et al., 2019) and from which the company needed to secure support and funding. Unsuccessful interaction with these organizations was shown to be of key importance for the failure of the company to deliver its sanitation solution, as will be described.

We place our study in the wider context of the private sector's growing engagement in development (Blowfield and Dolan, 2014; Fejerskov, 2017; Schurman, 2018) and draw on frameworks from the field of sustainability transitions (Schot and Geels, 2008) and strategic niche management (SNM) (Kemp et al., 1998). We focus our analysis on three related processes that the literature has indicated need to be in place for a niche innovation to successfully penetrate a regime:1) expectation dynamics, 2) social network dynamics and 3) learning processes (Geels and Raven, 2006).

Previous research shows that the company focused a great deal and spent considerable resources on establishing beneficial expectation dynamics, social network dynamics and learning processes among certain groups of end users in Kibera – largely successfully (Kokko, 2019). However, we will show here that the company failed to establish the same dynamics in relation to more powerful actors currently active in the regime, such as the development agencies operating in the field. We suggest that this is potentially an important reason for its ultimate failure. As such, our study provides an example of how the private sector's increasing involvement in development in general (Blowfield and Dolan, 2014), and in the sanitation sector specifically (Fejerskov, 2017), might play out, and highlights the importance of moving beyond a market focus on consumers to understand the success or failure of private sector sanitation development.

2. Conceptual Framework

In recent years, the field of transition studies has increasingly addressed issues of how to transform societies for increased sustainability (e.g. Shove and Walker, 2010). A cornerstone of these studies is recognition that technologies do not work in isolation, but are interconnected with multiple actors, organisations and users, i.e. they form socio-technical systems (Lawhon and Murphy, 2012). Much of the literature describing socio-technical transitions is derived from high-income countries, although the concept is increasing being applied to low-income areas (e.g. Ramos-Mejía et al., 2018; van Welie et al., 2019).

Transition studies are often framed using a multi-level perspective in which changes in socio-technical systems are understood as being influenced at three levels: landscape, regime and niche (Fig. 1). A niche represents an area of new development and radical innovation (Geels, 2002). New sanitation technologies aimed at serving informal settlements, such as the Peepoo bag, are typical

examples of niche innovations attempting to penetrate the existing sanitation regime (Fejerskov, 2017; Cherunya et al., 2020). In this study, the niche innovation offers a new technology and a new way of organising sanitation delivery – namely through a private business. Regimes are dominant ways of doing things and include the technical infrastructure, users and organisations. In order to succeed, the niche needs to be integrated into the regime or needs to destabilise the regime so that the innovation becomes the new norm (Geels and Schot, 2007). In the absence of functional government support, the local sanitation regime in Kibera is strongly influenced by actors from the development aid sector. The landscape consists of slow-changing trends, e.g. ideologies around what a proper toilet should be, and economic and environmental conditions, which influence the other levels, but is not examined in this paper (however see Kokko, 2019).

Early developmental engagement by former colonial powers in the Global South focused on the transfer of heavy and inflexible technologies (such as irrigation systems) for implementation and adoption by end users without adaptation (i.e. aiming to directly substitute regime technology) (Cherlet, 2014; Kragelund, 2004). In light of the failure of these inflexible technologies to be adopted and bring about sustainable change in the developing world, in the 1990s ideas about technology development shifted to place an emphasis on the need for local adaptation and flexibility in technologies (Fejerskov, 2017). Simultaneously the private sector was given more space to engage in development (Kragelund, 2004).

The idea of flexible technologies allowing for on-site experimentation is the core of the SNM framework (Kemp et al., 1998). The starting point in SNM is that technology adoption is never only about optimising the technology, but is also about social change. It is based on a lesson that it should be possible to change the technology when it is introduced in the social setting, i.e. there is need for local experimentation and adaptation of the technology in the niche to enable successful adoption (Schot and Geels, 2008). In the complex environments of the poor, this room for local adaptation is likely to be particularly important, as indicated by research on the adoption of pro-poor technology more generally (Reece and Sumberg, 2003; Sumberg and Okali, 1997). Innovators, particularly from the private sector, have taken up the idea of local experiments, aiming to develop sanitation solutions for informal settlements. In this context the lack of a comprehensive sanitation solution serving everyone is not only seen as a constraint to be resolved but as an opportunity for niche innovations (Cherunya et al., 2020; Fejerskov, 2017; Montgomery et al., 2017).

The literature related to SNM has investigated which processes and factors determine the successful development of the niche (Schot and Geels, 2008). Key interrelated processes have been defined as being related to 1) expectation dynamics, 2) social network dynamics and 3) learning processes (Geels and Raven, 2006).

Expectation dynamics are related to the visions and claims that different actors associate with the niche innovation (Schot and Geels, 2008). New technologies either have to accommodate different expectations or expectations have to be modified through active engagement with those being targeted by innovation, as well as those having significant influence over its development (Hegger et al., 2007). Substantiated (realistic) and shared expectations will increase the acceptance and legitimacy of the innovation (Schot and Geels, 2008; Bergek et al., 2008; Bork et al., 2015). In this study, we analyse whether expectations for Peepoo among different actors were compatible and whether the necessary legitimacy for the niche innovation was created. Legitimacy is both a matter of social acceptance and compliance with relevant institutions. In line with previous studies on technology legitimacy we here conceptualise legitimacy broadly as "*the perceived consonance of an entity with a socially constructed set of norms, values, beliefs and practices in its context*" (Markard et al., 2016: 331).

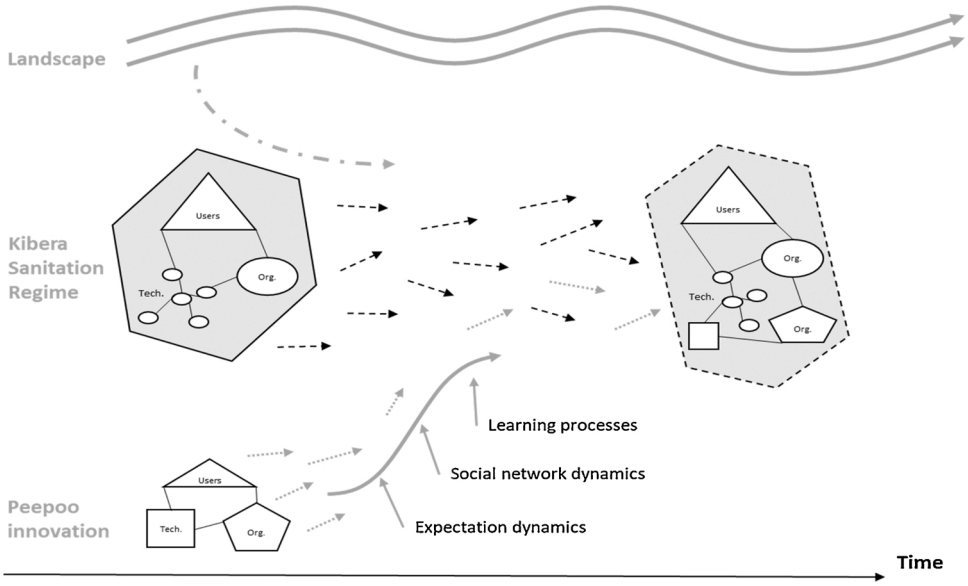

Fig. 1. The concept of socio-technical transitions framing this study. Niche innovations and regimes are formed by users, organisations and technology. Changes in the regime occur through interactions with the niche and the wider landscape. Key dynamics and processes influencing the uptake of a niche innovation are highlighted along the trajectory (adapted from Geels, 2002).

Social network dynamics relate to coalition building, trust and tensions. This process is important for creating a supportive community around the niche, which will provide the necessary resources, both human and capital. In this context, it is clearly important that the actors involved in the social networks have the capacity and commitment within their organisations to provide the necessary resources (Schot and Geels, 2008; Jacobsson and Bergek, 2011). Resource mobilisation has been identified in other innovation research as a critical function shaping the potential for niche development (Bergek et al., 2008). In this study, we analyse whether the Peepoo innovation and innovator were able to build coalitions and mobilise the necessary resources to successfully establish the new innovation in the niche.

The development of any new technology is intertwined with learning processes related to technology and market development (Kemp et al., 1998). Learning processes relate to the accumulation, adaptation and sharing of knowledge of a new technology by individuals and in networks (Hekkert et al., 2011; Schot and Geels, 2008). Included in learning processes are also the views among actors of what kind of knowledge is needed to successfully penetrate the regime and achieve sustainable sanitation. We pay particular attention to the kind of knowledge that was seen as important among the actors involved for achieving sustainable sanitation. Here we add the concept of epistemic community (Haas, 1992) for conceptualizing how a shared understanding of the Peepoo bag was created within the social network established around the development of the innovation. Epistemic community as a concept helps us emphasize the discursive dimension of the resource mobilization and alliance building in the social network, and the interconnectedness between the factors of social network dynamics and learning processes. Within a social network, actors support and reinforce each other's worldviews, while at the same time resisting challenges to their shared worldview from the outside. The establishment of an epistemic community thus hinders epistemic reflexivity (Rodríguez de Francisco and Boelens, 2015), i.e. the possibility to reflexively scrutinize one's own knowledge claims and the conditions under which they are valid (Bourdieu and Wacquant, 1992) Table 1 summarises how we conceptualise expectation dynamics, social network dynamics and learning processes in this study (Table 1).

Importantly, while much of recent sanitation technology development has focused on adapting technology to its end users, and academic studies and evaluations have similarly focused on the success or failure of adaptation by looking at end users' perspectives (Kokko and Lagerkvist, 2017; Cherunya et al., 2020), the SNM framework, in line with the multilevel perspective in transition studies (Lawhon and Murphy, 2012; Geels, 2011), acknowledges that expectation dynamics, social network dynamics and learning processes not only have to be established successfully with local end users, but also with other actors and institutions that are impacted by or have an impact on the technology and its development and introduction (Schot and Geels, 2008).

3. Material and methods

The study reported here is situated in a larger longitudinal case study on the introduction of the Peepoo bag in Kibera (Kokko, 2019). Interviews drawn on in the present study are listed in Table 2

The interviews were semi-structured with focus on the story of Peepoople AB from the interviewee's perspective, with particular details regarding aspects about which the interviewee was particularly knowledgeable. In addition, important insights about the case are drawn from a stakeholder meeting on sustainable sanitation arranged in January 2018 by the first and second author together with the NGO International Aid Services (IAS) that took over the Peepoo bag after Peepoople AB closed down. The meeting was attended by 31 participants engaged in sanitation and development in Kenya, including several NGOs working with sanitation issues in Kibera, city and county government officials, researchers who had been involved in the development and trials of the Peepoo bag from Sweden and Kenya, and former staff of Peepoople AB.

Lastly, the first author analysed all Peepoople AB's annual reports and additional company information registered with the Swedish Companies Registration Office, such as proof of company registration listing the CEO, chairperson and members of the board, describing the ownership structure and all applications for new share issues, for example. The first author also investigated the academic backgrounds, employment histories and role in the company of all board members and the majority of all employees to identify the kind of knowledge prioritised in the company and how this changed over time. A large number of media posts about the bag, including those re-posted on Peepoople's own website (www.peepoople.com), and in several newspapers and magazines were analysed to get a picture of how the bag was depicted in society at the time.

All the material was coded thematically, with a focus on identifying descriptions of events, thoughts and perspectives from Peepoople staff and other regime actors related to expectation dynamics, social networks and learning processes, as described in the theoretical framework. Quotations from interviews not originally conducted in English have been translated by the first author.

4. Results

In what follows we tell a chronological story of the Peepoo bag and Peepoople AB, with focus on the expectations, social network dynamics, and learning processes that were created during the development and implementation processes. The story is subsequently discussed in the light of literature on private sector in development with the aim of better understanding the key factors of influence for integrating a niche innovation in a sanitation regime in the Global South.

4.1. A social network for the Peepoo bag

The idea of the Peepoo bag came about when an architect visiting an informal settlement in Bombay met a women's group who told him that they did not need help with building houses; what they needed was a sanitation solution. The architect took the problem home

Table 1
Interrelated processes of importance for successful niche innovation (inspired by Geels and Raven, 2006, and Haas, 1992).

Expectation dynamics	Social network dynamics	Learning processes
Visions and claims associated with the innovation. Creation of substantiated and shared expectations.Important for creating legitimacy for the innovation and innovator.	Coalition building, trust and tensions. Creation of a supportive community around the innovation.Important for mobilizing the necessary resources.	Knowledge creation, knowledge sharing and adaptation. Includes views about what kind of knowledge is needed and creation of a shared understanding about the innovation (epistemic community).

Table 2
Interviews drawn on in the analysis.

Period	Data collector	Source	Language	Type of interview	Recording and processing
October 2015	Second author	Architect/ founder	Swedish	Face to face	Voice recorded. Transcribed verbatim
October 2015	Second author	Researcher part of the core team developing the bag	Swedish	Face to face	Voice recorded. Transcribed verbatim
October 2015	Second author	Local manager Peepoople Kenya	English	Face to face	Voice recorded. Transcribed verbatim
January 2018	First author	Five former employees Peepoople AB	Swedish	Face to face, individual interviews	Handwritten notes
January 2018	First author	Scientist part of the core team developing the bag	Swedish	Face to face	Handwritten notes
January 2018	First author	Scientist evaluating the bag in Kibera	English	Face to face	Handwritten notes
January 2018	First author	Former employee Peepoople Kenya	English	Face to face	Handwritten notes
May 2020	First author	Former owner and chair-person Peepoople AB	Swedish	Telephone	Handwritten notes
May 2020	First author	Scientist part of the core team developing the bag	Swedish	Face to face	Handwritten notes

with him and started a process of working out what a modern toilet that could function in these women's local context might look like. Based on the living conditions and monetary constraints characterising the kinds of informal settlements in which these women lived, he concluded that the solution had to be affordable and possible to use in places with limited space. Ideally too, it should not add to the burden on the already constrained waste situation in informal settlements. The idea of a niche innovation of a biodegradable toilet bag emerged in 2005 (Fig. 2).

To successfully integrate the niche innovation into the sanitation regime of informal settlements, the architect aimed to gain legitimacy and financial support from dominant actors in the regime at the time, i.e. aid and development agencies and sanitation experts focusing on the Global South. However, this group of people were very sceptical about the toilet bag idea. The fact that the innovation was a simple plastic bag, which the architect saw as a benefit because it replicated a sanitation solution already in use locally[1], was seen as obstructing the work of government and development agencies to eliminate practices of open defecation, and the use of plastic bags for this purpose. There was also a strong idea in the sector that sanitation development involved moving away from bags and having access to something seemingly more permanent, such as a proper toilet with a cabin and a seat. Clearly, there was no shared idea between the architect and actors in this sector about what a successful solution to sanitation in informal settlements would look like, and he failed to convince them of his idea. An important reason for this was that the development sector did not see the architect as a legitimate actor. The architect experienced that he was viewed with disbelief due to his inexperience in the sector and that his ideas were not seen as realistic or substantiated by previous experience:

> They [the aid workers] thought that we were arrogant in saying that we had the solution to one of the world's biggest problems. They were annoyed by us coming and saying that we had the solution.

The clash of cultures between the private sector and the development sector can also be exemplified in the way in which the architect described to us how, when meeting people in aid organizations, he encountered a very different culture to the one he was used to in the private sector. In his view, the culture of the development sector was highly controlling, inflexible and conservative. He was frustrated with the high and strict demands on control over invested money and implementation, the heavy bureaucracy, and the demands for paperwork and check-ups:

> Some people do the assessments, then other people perform an evaluation […]. And then they make an assessment, and then this is evaluated. It just goes round and round like this. It's crazy […] Instead of all these measurements, we could have given –

[1] In the absence of better alternatives, in many informal settlements people make use of plastic bags for defecating. These are often referred to as 'flying toilets'.

Fig. 2. Demonstration picture: how to use the Peepoo bag (downloaded from https://www.flickr.com/photos/gtzecosan/6082543470/ licensed under the Creative Commons Attribution 2.0 Generic license).

because it cost millions – we could have provided sanitation to more and more children instead. I don't need measurements to tell me that this would be better. Right?

While disappointed with the rigidity of the development sector and its apparent lack of appreciation for his idea, the architect instead found support amongst natural scientists and engineers in Sweden working on sanitation with the goal of developing circular and more environmentally sustainable sanitation solutions. These scientists were already performing sanitation experiments with urea in bags, so for them the idea of a toilet bag was both realistic and substantiated by evidence from their research. A supportive social network of the researchers and the architect was thus created building on shared expectations of a biodegradable toilet bag. A double layered bag of biodegradable plastic was developed to hold a mix of urea that would kill pathogens, and in 2006 a listed for-profit company with a social mission was established. Initially the architect/founder was both the CEO and the chairperson of the board, holding over 90 % of the shares. Additional members of the board were the wife of the architect, with a background in design, and one of the sanitation scientists.

4.2. Peepoople – an epistemic community of engineering, business and finance

As a functional version of the bag took shape, and the bag was introduced in trials in Kibera (as will be described later), the Swedish team involved in developing the bag managed to attract a number of private investors. These investors all had backgrounds in business and engineering with focus on markets in the Global North. One of the investors with business experience and an interest in sustainability became the new chair of the board and an external CEO with a background in industrial engineering was appointed.

This development indicates how the niche innovation, while failing to gain legitimacy and support from the development sector, found an alternative pathway opening up: that of the business world and environmentally-conscious investors. Our analysis indicates that a strong epistemic community was formed within the community of investors and board members with the shared general idea that capital accumulation would facilitate a move toward increased sustainability, and more specifically that the Peepoo bag would be able to deliver this. These shared expectations created an important basis for the will to invest in the innovation and as such facilitated the company's rapid growth. The spread of this discursive support outside the core group of investors is also indicated in how the bag and the architect received positive attention in the Swedish and international business and tech-oriented media (e.g. Borrell, 2010; Economist, 2010; Roxvall, 2010), and in how the bag won an award for its sustainable design (Peepoople, 2010).

In 2011, yet new owners from the finance and investment sector joined the company and from 2012 the founder was no longer the largest owner and shareholder. There were now six major owners holding 84 % of the company's shares in all. Apart from the founder and his wife with their backgrounds in architecture and design and one of the sanitation researchers, all the other investors and board members came from the engineering, business and finance sectors.

The number of employees also grew quickly from five in 2011 to its maximum of ten people employed simultaneously in 2012–2014, the majority of whom had backgrounds in engineering and business and were working in technology development or marketing and sales. Of the 15 employees that we could trace, nine had engineering or business backgrounds. Of those in leading positions, all had competence in engineering, business or design. This clearly indicates what that the company valued as relevant knowledge and competence. No one in the board or in a management position had documented experience from working with

sanitation development in the Global South, or more generally with poverty related issues. The only context-specific knowledge that we could find as valued by the company was understanding consumers' preferences in Kibera. For this purpose, researchers of consumer behaviour were hired to study market uptake and consumer preferences. The bag continued to receive significant positive media attention in the Swedish and international media (Alpman, 2013; Borrell, 2010; Economist, 2020) and was awarded an additional sustainability prize (Hagström, 2012).

The investment–will and significant risk taking in the company can be exemplified in the large investments prior to market establishment. In 2011, a seven million euro investment enabled upgrading from small-scale semi-manual to automated production of the bags. Interviews with previous employees and board members testify that the idea was that scaling up production and having bags ready to deliver would substantiate claims of the bag being a realistic and available sanitation solution, which would boost sales. During 2012–2013, the company made additional significant investments funded by the issue of new shares and subscription warrants.

4.3. The social network faces obstacles

The bag was now well-established in the business world as an up-and-coming, promising sanitation solution (e.g. Dagens PS., 2013). However in order for its use to be scaled up from the trials in Kibera, and to become accessible more broadly, the bag still had to be embraced as a legitimate solution by humanitarian and development organisations. The company's development strategy was based on the assumption that organisations working with emergency relief and in refugee camps would embrace the product, which would get sales off the ground. Sales to these organisations were expected to generate sufficient financial gain to enable selling the bag at a subsidised price to users in non-emergency situations, such as urban informal settlements. For this purpose, Peepoople sales staff travelled the world twice a month to promote the bag to these humanitarian organisations. The bag would indeed provide a suitable sanitation solution in such contexts with a minimal need for infrastructure apart from distribution and collection. It would significantly reduce the spread of pathogens and would also ease the burden on the local environment. However, our interviews revealed that the sales staff recruited by Peepoople had been hired for their ability to sell lifestyle products to prosperous consumers in the Global North, with the idea that this kind of sales competence was generaliseable. Clearly, this was not the case. Our interviews revealed a significant clash of cultures between the sales staff, with their well-dressed appearance and aggressive marketing style, and the humanitarian workers being targeted. This can be exemplified by how one of the scientists we interviewed described to us how (s)he had recently met a worker from one of the large humanitarian organisations who had been approached by the Peepoo sales staff and had rejected the Peepoo bag. When the scientist explained the benefits of the bag in the refugee context, the aid worker responded: '*Oh, so the bag actually works!?*' which was not at all her impression after meeting the Swedish sales staff. This is one example of how Peepoople failed to build trust and thereby legitimacy in the development and humanitarian sector. A major reason for this was that the development workers did not see the sales staff as competent or trustworthy. It is also an example of how the epistemic community created within Peepoople, with ideas about generalisability of business and marketing competence, and the lack of attention to context, was important for the company's failure to make an adequate analysis of its market.

We also notice that the company's attention at this time was primarily to secure sales to please the new owners who had invested large sums of money on the back of a promise of a successful product. As such, our interviews report on an environment where the push to sell the bags 'at all cost' was prioritized over delivering sustainable sanitation. In the words of a former employee: '*We felt like we weren't working for the product anymore; we were working to please the investors*'.

4.4. Creating a social network, legitimacy and learning with end users

In parallel with the company's growth in Sweden, trials started in 2008 in the large informal settlement of Kibera in Nairobi, Kenya, in which 30 households were invited to test the first trial bags. An NGO was also established, Peepoople Kenya, which was to be the sister organization of the for-profit venture in Sweden. The idea was that delivering the bag through a local NGO, would make it easier to create legitimacy for the product in Kibera, which would facilitate its adoption and spread. The local staff was employed for three months at a time to allow flexibility for the organization.

The Peepoo bag was being trialled in Kibera because the architect had a contact there who knew a local pastor who was persuaded of the benefits of the sanitation bag. Local elders were also engaged early on in the process to ensure legitimacy for the product (Kokko, 2019). Many people were initially reluctant to adopt the bag, for similar reasons to those that initially made the development sector sceptical. The bag was not seen as a real toilet, some felt that it was too small or undignified, and many were reluctant to pay for it. To overcome people's reluctance to adopt the bag, Peepoople Kenya organized street shows in the form of theatre and music, as well as 'plot parties' where the bag was demonstrated and residents were educated about hygiene. These investments, and the fact that Peepoople managed to gain support from local elders, and the locally trusted pastor were important for creating legitimacy for the bag in the local community. The activities, together with the school programme described below, also helped build shared and appropriate knowledge about the bag and about the importance of hygienic sanitation and hand-washing.

The bags were subsequently introduced for sale to households in parts of Kibera through door to door sales by female sales staff employed by Peepoople. Subsequently sales were scaled up to local kiosks. The bags were purchased for 3 KSH per bag (equal to about 0.02 USD and covering just 7 % of the bag's total costs). Despite this seemingly low cost, the price was an important disincentive for resource-constrained households. At its peak, Peepoo sales reached 1000 individual users in Kibera.

The Peepoople school programme attracted more donor funding than household sales, and was thus possible to scale up. At its peak in 2015, 100 schools covering over 17,000 children had daily access to Peepoo bags. Through the school programme children were trained in sanitation and hand-washing combined with positive reinforcement of correct behaviour, for example through competitions,

with the underlying purpose of encouraging behavioural change. The idea behind involving schools was also that children would get used to the Peepoo bags and would expect similar access to sanitation at home, as well as educate their families about the bag's benefits. Thus, the idea was that it would lead to shared knowledge of the bag's benefits and a demand for better access to sanitation.

Our analysis indicates that it was not lack of appreciation for the product amongst consumers that limited the upscaling of Peepoo in Kibera, but rather the company's failure to meet the consumers' economic constraints and find sufficient funding to produce the bag. We also note that the trials in Kibera and the establishment of the local NGO were based on comparatively small and time-limited investments, completely dependent on donor funding.

It is clear that Peepoople AB realized that they needed to understand their consumers and create legitimacy and demand for their product. At the same time the more limited investment of money in establishing the product in Kibera as compared with the money spent on establishing and promoting the company and product in Sweden, indicates that the company failed to acknowledge the time and resources needed to produce a lasting effect in the local context.

4.5. Efforts to learn about the development sector come too late

The fast growth and large investments made between 2011 and 2013 became difficult to sustain when the anticipated large market did not materialize, in particular, as a result of the failure to sell large quantities of bags to humanitarian relief programmes. As a response to this, new shares were released and new owners joined with the hope of keeping the company afloat. In 2014 the company had seven major owners who together owned 86 % of the shares.

One of the new owners who joined in 2014 took over as chair of the board and CEO. He was critical of the quick upscaling and aimed to achieve slower growth and to gain legitimacy in in the development sector. At this stage it was clear that the company would not succeed in combining private gains with development aid, but nevertheless the company continued to attract positive media attention (e.g. Jejland, 2015). The firm started collaborating with International Aid Services (IAS), a small Swedish aid organization with lengthy experience of delivering water and sanitation in Africa. A plan was developed to give the product and brand to IAS. In 2015 the first person with documented experience of development work joined the board. These events indicate an acknowledgement within the company for the first time of a need for experience from the development sector to gain the needed trust and legitimacy in that sector, but this shift in focus came too late. In 2015, the Swedish company wound up due to its lack of viability, and in 2016 the Peepoople brand and product were transferred free of charge to IAS. Production was substantially scaled down and relocated to Kenya, and some of the local Peepoople staff were employed by IAS in Kenya (IAS, 2016). Despite having returned to cheaper, semi-manual production of the bag, now located in Kenya, the cost of producing one bag is higher than a price that consumers in Kibera are willing or able to pay. This has been repeatedly emphasized as a problem that needs to be overcome by the new owners, indicating widespread belief in the need for a fully market-based solution to achieve sustainable sanitation in informal settlements. Table 3 summarises the key events in the chronological story told in sections 4.1 to 4.5 of the Peepoo bag and Peepoople AB (Table 3). With this chain of events

Table 3
Time table over key events in Peepoople's history.

Year	Key events
2005	The idea of a biodegradable toilet bag emerges after the architect has discussed sanitation with women in an informal settlement in Bombay.
2006	After failing to get support from the development sector the architect meets with sanitation researchers. The architect, his wife and sanitation researchers create a stock-listed company with a social mission- Peepoople AB.
2007	
2008	First trials are made in Kibera because the architect had contacts there. New investors and owners enter the company.
2009	The architect is replaced as chair of the board. A new CEO with experience from the packaging industry is recruited. Competence dominating the company: engineering, business and finance from Global North.
2010	The architect wins a price in sustainable design for the Peepoo bag. A local office opens in Kibera to facilitate local production, marketing and distribution. Additional owners enter the company. The company has five employees.
2011	A large investment is made in equipment to speed up production. Donor funding secured for three years to expand from trial-distribution in Kibera. The architect is no longer the largest shareholder. The company now has ten employees.
2012	Competence dominating the company: engineering, business and finance from Global North. Scientists in business are engaged to study consumer's preferences in KIbera. Additional significant investments are made in production and marketing. The bag is awarded a Swedish sustainability prize.
2013	
2014	The company's investments in production and marketing has not led to anticipated purchases. New shares are released with a hope to keep the company afloat. A new owner becomes chair of the board and is critical of the high risk taking and quick upscaling. Contact is established with the NGO IAS. The school programme Kibera peaks with 100 schools having free access to the bag. Continued positive media attention in Sweden.
2015	The first board member with experience from the Global South enters. The company is closed down due to lack of viability.
2016	Peepoople brand and product is transferred to IAS.

in mind, the next section discusses what we see as some of the likely reasons for the failure of the Peepoo bag as a niche innovation and as a sanitation business venture in informal settlements.

5. Discussion and conclusions

This study contributes evidence to the field of socio-technical transitions about an innovation introduced in a low-income setting. The findings exemplify how niche-regime interactions are as much about the use of technology as they are about human social relations. Despite being a business failure, and as such also a failure of private sector involvement in development, the technology in itself offered benefits that were acknowledged by its end users. The bag was clearly appreciated by many of the individuals who had access to it for a period of time. For many, the bag led to improved health in term of absence of diseases, privacy, a feeling of cleanliness and hygiene, and increased sanitation access, in particular for many women, the elderly, the sick and children (Kokko and Lagerkvist, 2017; Lagerkvist et al., 2014). This emphasizes that it is not only the suitability of the technology to the user context per se that is important for its success, but the wider social and political context as well .

The study confirms that processes such as expectation dynamics, social network dynamics and learning processes are useful concepts for visualizing actor dynamics that are crucial to creating acceptance and adoption of new innovations. However, as pointed out by Schot and Geels (2008), this study also shows that attention needs to be paid to the scale and context in which the actors are active, and the associated power that they have to create change. For example, while the Swedish capital-strong investors had significant resources to invest to launch the product, they did not have the necessary networks or competence to create legitimacy for the product amongst powerful actors in the development sector. Likewise, despite the company's success in creating legitimacy for its innovation among consumers, these consumers had limited purchasing- and political power, and the company underestimated the resources needed to build trust and legitimacy among other, more resourceful actors affecting local context.

The study points to the power of the discursive dimension of interaction between actors. To highlight the importance of this dimension we found it useful to add the concept of epistemic community (Haas, 1992). This helped us conceptualize the importance of the shared vision in the social network, and associated high expectations, both within the company and in the business and tech-oriented media, of a sustainable sanitation solution combining private gain with environmental improvements. This epistemic community was found to be an important basis for securing the initial financial resources in the company. The large investments coupled with high risk-taking exemplify what Fejerskov (2017) identifies as the new experimental focus of private sector involvement in sanitation technology for the Global South, in which large sums of money and considerable risks are seen as positive for stimulating novel thinking and creativity.

However, the case also shows how an epistemic community can become destructive, as it hinders epistemic reflexivity (Rodríguez de Francisco and Boelens, 2015) preventing alternative perspectives and negative feedback to enter, thus obstructing important technology adaptation through learning. The knowledge valued by the company for obtaining success was strongly oriented to the kind of competence needed in other tech enterprises that aim to combine environmental benefits and financial gain (Fejerskov, 2017), namely engineering and business competence (see also Richey and Ponte, 2014). This, perhaps signifies a broader misconception within the epistemic community of philanthrocapitalist ventures in the Global South (Fejerskov, 2017), that generic competences in engineering and business are sufficient, ignoring the need for context specific competence. This case indicates that the epistemic community of business and engineering competence from the Global North created an important basis for experimentation and risk taking early in the process, but that at some point in time this epistemic community needs to open up and allow itself to be challenged by alternative perspectives. In the present case it is clear that this happened too late.

The case also exemplifies how the tech culture of experimentation based on significant freedom and large investments clashed with a development aid culture involving considerable bureaucracy and conservatism. Fejerskov (2017) highlights this wish for a quick impact as typical of philanthrocapitalist tech ventures, and emphasizes that this is frequently accompanied by an avoidance of the slow and bureaucratic processes often associated with the involvement of state actors, as also suggested by Montgomery et al. (2017). While circumventing established actors in the development sector might have been important for the successful and rapid development of the niche innovation at an early stage (including the forming of the supportive epistemic community), it was impossible to continue without them if the innovation was to be established in the existing regime. The lack of appreciation of knowledge outside the tech- and business world led to a legitimacy crisis between the company and the development workers. This is noteworthy since the development sector has during the past decades welcomed private sector engagement to make development aid more efficient and consumer-oriented (e.g. Shurman, 2018). Our case suggests that despite this general tendency to embrace of the private sector in contemporary development discourses, this perspective might not have fully trickled down the development hierarchy to those employed in large humanitarian organizations.

While Peepoople AB clearly failed to gain legitimacy for their innovation in the development sector, they had more success in the local user context in which trials took place. This also indicates that the company prioritized creating a market for its product through engaging with its consumers, a documented strategy used by the private sector in general (Rashid and Rahman, 2009; Blowfield and Dolan, 2014; Richey and Ponte, 2014). Indeed, successful development and implementation of niche innovations, requires legitimacy amongst its consumers (Hegger et al., 2007). This is equally important for ensuring democratic technology development (Montgomery et al., 2017; Roma and Jeffrey, 2010) and as such the focus on consumer preferences can be seen as an important improvement from the top-down technology interventions that characterized development programmes in the past (Cherlet, 2014). Our study, however, points out that this is not enough. To integrate niche innovations from the private sector in sanitation regimes, they also need to build social networks with powerful actors in the regime in order to create legitimacy and shared understandings of development. These actors include established international development organizations and actors from local political and economic institutions (Joshi

et al., 2011; Kokko, 2019). Two examples from the present case highlight how the Peepoo bag as a sustainable sanitation solution and its associated supportive epistemic community circumvented or failed to sufficiently appreciate and engage in the wider structures and processes that lead to unsustainable sanitation. Firstly, the poor humanitarian conditions with e.g. very limited space and lack of access to clean water and toilets, faced by women in informal settlements was taken by the architect as the starting point which the innovation needed to fit into. Clearly, it might be difficult for a technological innovation in isolation to solve structural societal challenges- but as noted here, technology is always part of a wider set of practices. In this case the company spent significant resources on promoting its toilet solution to its consumers. The company could have chosen to also lobby for more just access to sanitation.

Secondly, and in relation to above, the company and other actors in support of the bag were of the idea that the end user must pay for the bag for it to be a sustainable solution. This perspective assumes a status quo in terms of the lack of responsibility that local political actors have taken so far in providing safe and affordable sanitation to all citizens in Kibera. It also fails to appreciate that sanitary systems both in the Global North as well as in formal settlements in the Global South, including in Nairobi, depend upon public investment in sewage infrastructure and/or other forms of subsidised access to safe sanitation. At a more general level, research has repeatedly shown that societies cannot become sustainable through a focus on consumers alone, since consumer power is not enough for creating the systemic change needed. This is particularly the case in contexts of the poor where consumers per definition have extremely low purchasing power. Here our study contributes to the evidence that market-based sanitation solutions alone are therefore unlikely to deliver sustainable sanitation for all (Fejerskov, 2017; Montgomery et al., 2017).

On a concluding note, despite the challenges we have drawn attention to with regard to private sector in development, it can be noted that when the board of Peepoople AB realised that they had failed in combining profit-making with sustainable sanitation development, they chose to transfer the brand free of charge to an NGO. Despite a considerable personal economic loss, the architect did not necessarily view the whole experience as a failure:

> Even if it costs 400 million or 500 million. Even if it turns out in the end that it didn't work out, there is still a value in all these failures […] It doesn't matter what you fail at, because failures also have potential. Because you can build on it. If you get that, then very little money is wasted. The goal behind it has to be a good one.

This indicates that the failures to create development outcomes through the private sector does not have to do with lack of will. The present case rather suggests that established discourses guiding private sector engagement in development, steering which knowledge that is prioritised, and leading to a narrow focus on consumers, are more important in hindering the private sector from contributing positively to improving poor people's lives.

Declaration of Competing Interest

The authors report no declarations of interest.

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References

Alpman, M., 2013. Peepoople: Engångstoalett räddningen för miljarder i nöd Ny teknik [on-line] https://www.nyteknik.se/startup/33-listan/peepoople-engangstoalett-raddningen-for-miljarder-i-nod-6404101 (published 2013-04-16 accessed 2020-05-29).
Bergek, A., Jacobsson, S., Sandén, B.A., 2008. 'Legitimation' and 'development of positive externalities': two key processes in the formation phase of technological innovation systems. Technol. Anal. Strateg. Manag. 20, 575–592.
Bitzer, V., Glasbergen, P., 2015. Business–NGO partnerships in global value chains: part of the solution or part of the problem of sustainable change? Curr. Opin. Environ. Sustain. 12, 35–40.
Blowfield, M., Dolan, C.S., 2014. Business as a development agent: evidence of possibility and improbability. Third World Q. 35, 22–42.
Bork, S., Schoormans, J.P., Silvester, S., et al., 2015. How actors can influence the legitimation of new consumer product categories: a theoretical framework. Environ. Innov. Soc. Transit. 16, 38–50.
Borrell, B., 2010. Ten innovations in global health. Scientific American, fall edition.
Bourdieu, P., Wacquant, L.J.D., 1992. An Invitation to Reflexive Sociology. University of Chicago Press.
Cherlet, J., 2014. Epistemic and technological determinism in development aid. Sci. Technol. Human Values 39, 773–794.
Cherunya, P.C., Ahlborg, H., Truffer, B., 2020. Anchoring innovations in oscillating domestic spaces: why sanitation service offerings fail in informal settlements. Res. Policy 49, 103841.
Dagens PS, 2013. Finanskändisar satsar miljoner på toelett [on-line] https://www.dagensP.S.e/entreprenor/finanskandisar-satsar-miljoner-pa-toalett/ (published 2013-02-27, accessed 2020-06-01). Dagens PS, Stockholm.
Economist, 2010. Enough is not Enough, it Must also be Clean, the Economist May 20 2010.
Fejerskov, A.M., 2017. The new technopolitics of development and the global south as a laboratory of technological experimentation. Sci. Technol. Human Values 42, 947–968.
Geels, F.W., 2002. Technological transitions as evolutionary reconfiguration processes: a multi-level perspective and a case-study. Res. Policy 31, 1257–1274.
Geels, F.W., 2011. The multi-level perspective on sustainability transitions: responses to seven criticisms. Environ. Innov. Soc. Transit. 1, 24–40.
Geels, F., Raven, R., 2006. Non-linearity and expectations in niche-development trajectories: ups and downs in Dutch biogas development (1973–2003). Technol. Anal. Strateg. Manag. 18, 375–392.
Geels, F., Schot, J., 2007. Typology of sociotechnical transition pathways. Res. Policy 36, 399–417.
Ghosh, S., Rajan, J., 2019. The business case for SDGs: an analysis of inclusive business models in emerging economies. Int. J. Sustain. Dev. World Ecol. 26, 344–353.
Haas, P.M., 1992. Introduction: epistemic communities and international policy coordination. Int. Organ. 46, 1–35.

Hagström, M., 2012. Änglamarkspriset till engångstoaletten Peepoo. Kooperative Förbundet KF, Solna [on-line] https://kf.se/uppslagsverk/anglamarkspriset-till-engangstoaletten-peepoo/ (accessed 2020-06-05).
Hall, D., Lobina, E., 2006. Profitability and the poor: corporate strategies, innovation and sustainability. Geoforum 38, 772–785.
Hegger, D.L., Van Vliet, J., Van Vliet, B.J., 2007. Niche management and its contribution to regime change: the case of innovation in sanitation. Technol. Anal. Strateg. Manag. 19, 729–746.
Hekkert, M., Negro, S., Heimeriks, G., et al., 2011. Technological Innovation System Analysis: a Manual for Analysts. Utrecht University, Utrecht.
IAS, 2016. Press Release IAS Becomes the New Owner of the Peepoople Brand [on-line] http://www.mynewsdesk.com/se/pressreleases/ias-becomes-the-new-owner-of-the-peepoople-brand-1636899 (published 2016-10-18, accessed 2020-05-29).
Jejland, C.J., 2015. Säker toalett med fiffig påse Dagens Industri [on-line] https://www.di.se/di/artiklar/2015/11/17/saker-toalett-med-fiffig-pase/ published 2015-11-16 accessed 2020-05-29.
Joshi, D., Fawcett, B., Mannan, F., 2011. Health, hygiene and appropriate sanitation: experiences and perceptions of the urban poor. Environ. Urban. 23, 91–111.
Kemp, R., Schot, J., Hoogma, R., 1998. Regime shifts to sustainability through processes of niche formation: the approach of strategic niche management. Technol. Anal. Strateg. Manag. 10, 175–198.
Kokko, S., 2019. Transforming society through multilevel dynamics. Swedish University of Agricultural Sciences, Uppsala.
Kokko, S., Lagerkvist, C.J., 2017. Using Zaltman Metaphor Elicitation Technique to Map Beneficiaries' Experiences and Values: A Case Example From the Sanitation Sector. American Journal of Evaluation 38 (2).
Kragelund, P., 2004. The embedded recipient and the disembedded donor: private-sector development aid in Ghana. Forum for Development Studies. Taylor & Francis, pp. 307–335.
Lagerkvist, C.J., Kokko, S., Karanja, N., 2014. Health in perspective: framing motivational factors for personal sanitation in urban slums in Nairobi, Kenya, using anchored best–worst scaling. Journal of Water Sanitation and Hygiene for Development 4 (1).
Lawhon, M., Murphy, J.T., 2012. Socio-technical regimes and sustainability transitions Insights from political ecology. Prog. Hum. Geogr. 36, 354–378.
Markard, J., Wirth, S., Truffer, B., 2016. Institutional dynamics and technology legitimacy–A framework and a case study on biogas technology. Res. Policy 45 (1), 330–344.
McEwan, C., Mawdsley, E., Banks, G., et al., 2017. Enrolling the private sector in community development: magic bullet or sleight of hand? Dev. Change 48, 28–53.
Montgomery, C.M., Kingori, P., Sariola, S., et al., 2017. Critique and Complicity: STS and global health. Sci. Technol. Stud. 30, 2–12.
Peepoople, A.B., 2010. Prestigefyllda Design S Till Den Innovativa Peepoo-toaletten Presemeddelande [on-line] https://www.mynewsdesk.com/se/pressreleases/prestigefyllt-designpris-till-den-innovativa-peepoo-toaletten-421886 (published 2010-06-08, accessed 2020-05-29).
Ramos-Mejía, M., Franco-Garcia, M.-L., Jauregui-Becker, J.M., 2018. Sustainability transitions in the developing world: challenges of socio-technical transformations unfolding in contexts of poverty. Environ. Sci. Policy 84, 217–223.
Rashid, A.T., Rahman, M., 2009. Making profit to solve development problems: the case of Telenor AS and the Village Phone Programme in Bangladesh. J. Mark. Manag. 25, 1049–1060.
Reece, J.D., Sumberg, J., 2003. More clients, less resources: toward a new conceptual framework for agricultural research in marginal areas. Technovation 23, 409–421.
Richey, L.A., Ponte, S., 2014. New actors and alliances in development. Third World Q. 35, 1–21.
Rodríguez de Francisco, J.C., Boelens, R., 2015. Payment for Environmental Services: mobilising an epistemic community to construct dominant policy. Env. Polit. 24, 481–500.
Roma, E., Jeffrey, P., 2010. Evaluation of community participation in the implementation of community-based sanitation systems: a case study from Indonesia. Water Sci. Technol. 62, 1028–1036.
Roxvall, A., 2010. Bajs- en livsviktigt skitsak. SVD [on-line] https://www.svd.se/en-livsviktig-skitsak (published 2010-09-13 accessed 2020-05-29).
Schot, J., Geels, F.W., 2008. Strategic niche management and sustainable innovation journeys: theory, findings, research agenda, and policy. Technol. Anal. Strateg. Manag. 20, 537–554.
Schouten, M.A.C., Mathenge, R.W., 2010. Communal sanitation alternatives for slums: A case study of Kibera, Kenya. Phys. Chem. Earth Parts A/b/c 35 (13), 815–822.
Schurman, R., 2018. Micro (soft) managing a 'green revolution'for Africa: the new donor culture and international agricultural development. World Dev. 112, 180–192.
Shove, E., Walker, G., 2010. Governing transitions in the sustainability of everyday life. Res. Policy 39, 471–476.
Sumberg, J., Okali, C., 1997. Farmers' Experiments: Creating Local Knowledge. Lynne Rienner Publishers Inc.
van Welie, M.J., Truffer, B., Yap, X.-S., 2019. Towards sustainable urban basic services in low-income countries: a Technological Innovation System analysis of sanitation value chains in Nairobi. Environ. Innov. Soc. Transit. 33, 196–214.
Vinnerås, B., Hedenkvist, M., Nordin, A., et al., 2009. Peepoo bag: self-sanitising single use biodegradable toilet. Water Sci. Technol. 59, 1743–1749.
WHO, 2019. Sanitation [on-line] https://www.who.int/news-room/fact-sheets/detail/sanitation (accessed 2020-05-29).