

A STUDY OF CONSIDERATION FOR IMPROVING USER EXPERIENCE OF PORTABLE TOILETS IN THE POST-PANDEMIC ERA

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ABSTRACT

Portable toilets, also known as porta-potties, are a common solution for outdoor events, construction sites, and other places with limited access to toilets. However, hygiene concerns such as bad smells and physical contact have led to negative user experiences, resulting in a reluctance to use them. Primary research conducted in Hong Kong, Taiwan, and China found that many users avoid using them unless necessary, with an average rating of 1.6/5. Despite this, the global demand for portable toilets has increased due to the COVID-19 pandemic. A recent study estimated that the portable toilet market will increase from \$12.61 billion in 2021 to \$20.43 billion by 2028. This suggests that current designs of portable toilets may not consider post-pandemic user behaviours, as they were catered to pre-COVID-19 circumstances. To address these issues, this paper aims to provide a set of design considerations for toilet-related products. The redesign of the interior and exterior features of portable toilets should consider manufacturing, transportation, cleaning, and usage processes. By enhancing the user experience, the goal is to provide everyone with a wonderful toilet experience. This paper provides a valuable resource for academics and designers to refer to when designing toilet-related products.

Keywords: Portable toilet, user experience, post pandemic, innovative design

1 INTRODUCTION

“I want to use the toilet really badly, but there are only portable toilets here”. Portable toilets have been around for decades. Some people believe it is a ‘lifesaver’ product, yet others consider it a “portal to hell”. The unsatisfactory user experience has led to an unfavourable impression of portable toilets among the public. Moreover, since the COVID-19 outbreak, public health awareness has significantly increased. Portable toilets, a place with higher chances of potential breeding grounds for germs and viruses, have prevented people from using them during and after the pandemic. This paper aims to explore the challenges associated with the portable toilet user experience, hoping to increase the acceptability and usability of portable toilets during post-pandemic times.

2 BACKGROUNDS

2.1 The necessity of portable toilets

Portable toilets have been in use for almost 60 years since their invention. They are commonly utilized in urban areas with high population density and high demand for toilets within a short timeframe. While in rural areas, they are considered an effective solution for toilet demands due to the scarcity of water and electricity resources. According to the United Nations, World Toilet Day acknowledges the importance of toilets and highlights the issue of inadequate access to safe toilets for billions of people globally. Portable toilets are a vital part of the solution in providing improved sanitation facilities for those in need. In addition, Sustainable Development Goal 6.2 highlights that portable toilets are essential in achieving the 2030 objective of providing universal access to proper sanitation and hygiene, especially in developing countries where access to public toilets is limited (UN, 2022).

Portable toilets provide benefits not only to humans but also to the environment. The portable toilet industry has significantly impacted the environment and natural resources conservation. Globally, it helps save up to 473 million litres of fresh water daily with thousands of litres of fuel, making it a “green

product” with its materials and functional characteristics (Safe T Fresh, 2023). There is a significant growth in global portable toilet demand. The global portable toilet market was worth USD 11.85 billion in 2020 and is projected to grow to USD 20.43 billion by 2028. The COVID-19 pandemic positively impacted demand for portable toilets across all regions (Market Research Report, 2020). Portable toilets are versatile and flexible, making them ideal for use in construction and manufacturing sites without access to a continuous water supply. The demand for standard and customized self-contained portable restrooms are increasing in construction projects, manufacturing factories, and other commercial or public places.

2.2 Post-pandemic user behaviour change

During the COVID-19 pandemic, public and personal sanitation have become significantly more important to the general public, as the level of sanitation directly affects the public’s health. However, during the post-pandemic periods, there is a change in user behaviour for public area usage. The psychological and emotional impact and consequences have influenced the way people interact with hygiene-related public facilities, which include portable toilets.

Despite the positive impacts that portable toilets have brought to society and the environment, many people find their user experience unsatisfactory and are generally unwilling to use them unless necessary. This phenomenon is seen more severely in the post-pandemic era, with a noticeable change in user behaviour towards portable toilets. Many people are hesitant to use the facilities due to cleanliness and hygiene concerns, which the demand for a more user-friendly and user experience-based portable toilet is needed. With the limited portable toilet variety in the market, design improvements and innovations are required to provide a wider range of options to cater the diverse needs. Therefore, this paper is expected to further investigate the user behaviour changes toward portable toilets by collecting and analysing relevant data, given the limited information currently available on this topic.

3 RESEARCH METHODS

Surveys and interviews with portable toilet users can provide valuable information on their experience, preferences, and suggestions for improvement. This could include questions about cleanliness, odour, ventilation, and other factors that affect the user experience. Based on preliminary research, user satisfaction and usability with portable toilets can be improved through design. To further understand the necessary form and function of portable toilet components to be most effective for user experience, primary research in the form of surveys and interviews was conducted via online methods.

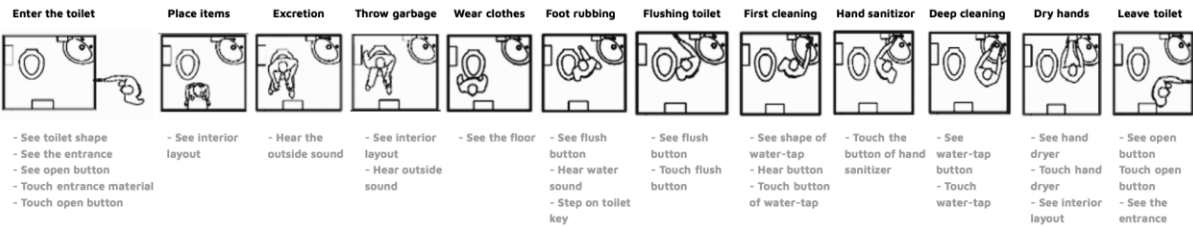
207 surveys were collected mainly focused on individuals who have used portable toilets in the past, which are mainly in China, Hong Kong, and Taiwan. Questions from different categories, such as design preferences, cleanliness concerns, and accessibility features, were made into multiple-choice questions for easier and more specified responses. 12 interviews were conducted, ages ranging from 21 to 65, with a mix of frequent and occasional portable toilet users. The interview questions were focused on understanding the user experience, including common pain points and desired improvements. Questions were open-ended to allow users to express their ideas and opinions freely, with a focus on stimulating innovative ideas that were not thought of during the survey.

4 RESULTS

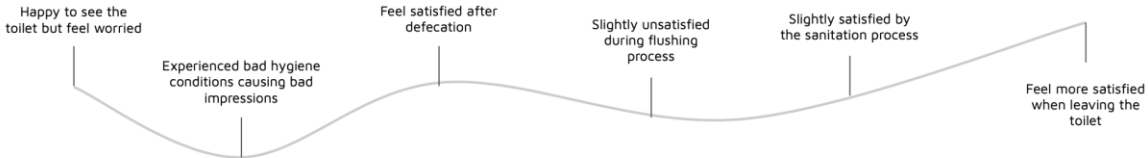
According to the survey findings, there is a clear indication of the low frequency of portable toilet usage, with 61.7% using it once per few years, followed by 19.6% using it once per year. The overall experience was bad (43.9%) with neutral (35.5%) and very bad (17.8%). The usage frequency of portable toilets is most influenced by cleanliness (65.4%) and smell (21.5%). Regular cleaning is necessary to increase hygiene and reduce unpleasant odours. Although the design features may not directly impact these factors, they can influence user behaviour and promote the care and preservation of the facilities. By asking users about the most difficult and unsatisfying aspects of using portable toilets, it can be determined which facilities require redesigning to enhance user experience. Respondents reported that flushing the toilet, washing hands, and using the toilet was equally difficult. However, when asked which process was most unsatisfactory, using the toilet was the most common response, highlighting the need for toilet improvements. The overall scoring for current portable toilets is 1.6/5. The factors of space, cleanliness, smell, appearance, and brightness are rated, and the results indicate that smell and cleanliness have negative experiences, while appearance is the least controversial. Understanding these user feedback trends can influence the design criteria for the design process.

According to interview results, the design pain points outcomes require basic and reflective improvements to enhance the user experience. Basic requirements focus on the practical functionality of internal facilities, while reflective requirements focus on the sense of cleanliness and security during usage, including surface height and material. At a visceral level, users of portable toilets rely on their senses of sight, hearing, smell, and touch to gather information about the environment. The appearance of the portable toilet has a significant impact on users' behaviour, as it is their first impression of the product. At the emotional level, users' feelings and experiences are strongly influenced by the tasks they perform in the portable toilet. Research shows that there is a "W" shaped emotional response curve, with users feeling the most satisfied when leaving the toilet and the least satisfied when encountering poor hygiene conditions at the beginning of their experience (as shown in figure 1).

BEHAVIOR LEVEL



VISCERAL LEVEL



EMOTION LEVEL

Figure 1. Behaviour, visceral, and emotional level change

The user journey map identifies pain points at different stages of portable toilet use. At the early stage, users may have difficulty finding and identifying available toilets. During usage, dirty surroundings and insufficient space cause hygiene concerns and discomfort. The interior and exterior designs may also feel unstable and insecure. After usage, users may feel rushed and experience psychological distress (as shown in figure 2).

PAIN POINTS

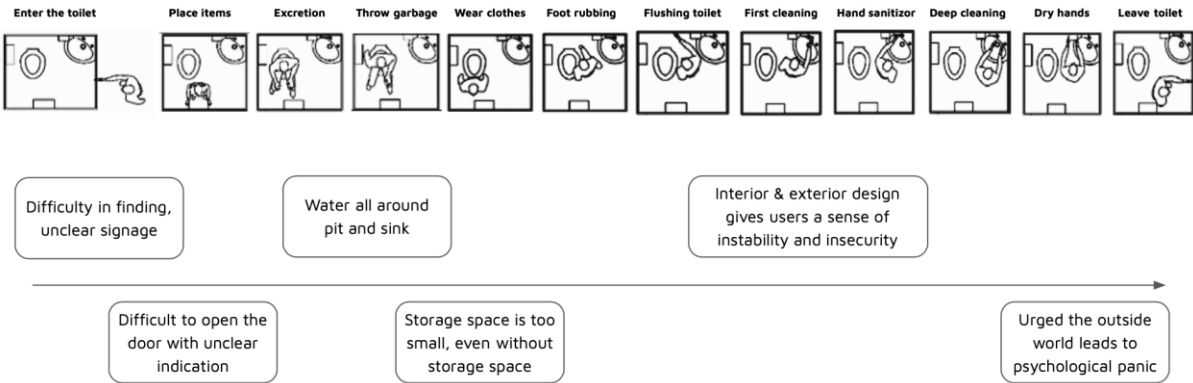


Figure 2. Pain points throughout the process

To further develop the design criteria for the portable toilet concept, brief market research was conducted to identify areas for improvement in current products. The purpose was to identify similarities and differences between these products and to integrate desirable features into a new portable toilet design (as shown in figure 3).

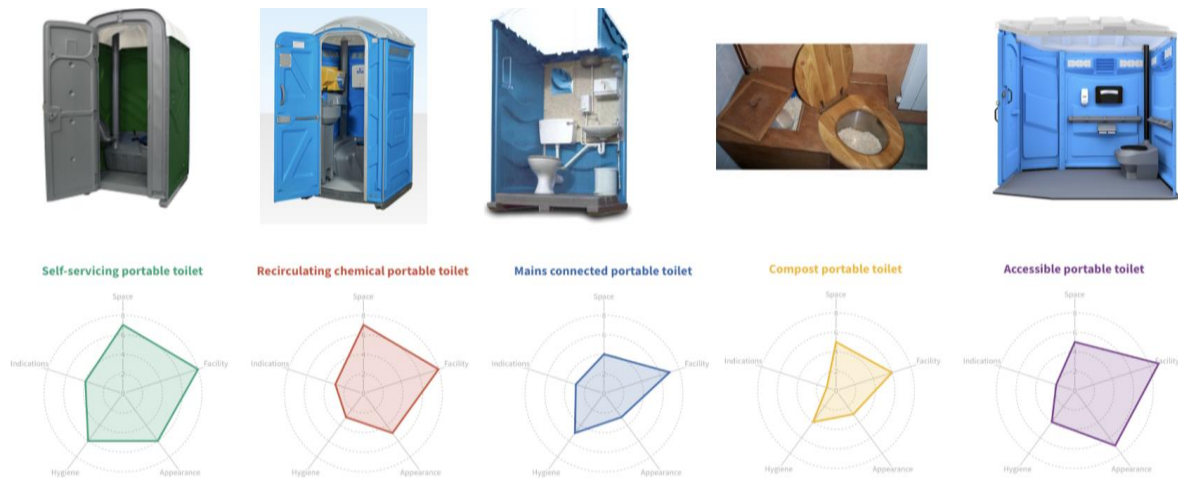


Figure 3. Existing portable toilets marketing comparison

Self-servicing portable toilet: This type of portable toilet is designed for easy and convenient cleaning and maintenance. It typically features a waste tank that can be easily removed and emptied by the user, eliminating the need for professional cleaning services. However, the capacity of the waste tank may be limited, making this option less suitable for high-traffic locations.

Recirculating chemical portable toilet: This type of portable toilet uses a chemical solution to break down waste and neutralize odours. The solution is recirculated to minimize water usage, making this option more environmentally friendly than traditional portable toilets. However, users may find the chemical smell unpleasant, and the tanks require periodic pumping and professional cleaning.

Mains-connected portable toilet: This type of portable toilet is connected to a mains water supply and sewage system, making it similar to traditional restroom facilities in terms of functionality and convenience. This option is well-suited for long-term use in a fixed location but may not be practical for temporary events or remote locations.

Compost portable toilet: This type of portable toilet uses a composting process to break down waste and convert it into nutrient-rich compost material. This option is environmentally friendly, as it eliminates the need for chemical solutions and reduces water usage. However, the composting process requires a certain amount of time to complete, making this option less suitable for high-traffic locations.

Accessible portable toilet: This type of portable toilet is designed to meet the needs of individuals with disabilities or mobility issues. It typically features a larger interior space, grab bars, and other accessibility features to ensure user safety and comfort. However, this option may be more expensive and less widely available than other types of portable toilets. Overall, the choice of portable toilets will depend on the specific needs and constraints of the location and user population. Factors such as usage frequency, environmental impact, and accessibility requirements will influence the selection of the most appropriate option.

5 CONCEPT DESIGN DISCUSSIONS

Based on the research findings, four key design criteria have been identified to enhance user experience and promote sustainability. These include a contactless experience to address users' concerns about physical contact, improved ventilation and odour control, easy cleaning and maintenance through interior and exterior design improvements and a self-sustaining solution that minimizes energy consumption and environmental impact. The final portable toilet design consists of various components, including a toilet, urinal, water sink, water tank, light, solar panel, and rotatable doors.

To enhance the user experience and enable a contactless toilet experience, a weight-actuated sliding door can be installed on the portable toilet. This means that the door will automatically open and close based on the weight of the user, eliminating the need to touch the door handle. Additionally, a footstep mechanism can be used for flushing or dispensing water, eliminating the need to touch any buttons or handles. Striped walls would be added to the exterior of the portable toilet to improve ventilation. This technique, known as architectural ventilation, uses natural winds to increase airflow and reduce odours. Additionally, keeping the inside of the toilet as dry as possible, can help reduce odours and prevent bacteria growth.

To make the portable toilet easier to clean and maintain, blind spots can be reduced by designing the interior with smooth curves and eliminating any corners or crevices that can trap dirt or bacteria. The textured floor can be replaced with a non-slip material for easier cleaning. Additionally, the exterior of the toilet would be designed with smooth curves and minimal crevices to make cleaning and maintenance easier.



Figure 4. Prototypes of the portable toilet design



Figure 5. Final portable toilet design

To reduce energy usage and make the portable toilet more environmentally friendly, a light-transmitting ceiling would be installed to allow for natural light during the day. To reduce the electricity needed at night, solar panels would be installed to provide lighting at night. This allows a self-sustaining portable toilet solution that can be used in remote locations without access to traditional power sources. These features can help improve the user experience, reduce the spread of germs, enhance ventilation and smell, make cleaning and maintenance easier, and reduce energy usage. They can be incorporated into existing portable toilet designs or used to create new, innovative solutions for portable sanitation (refer to figure 4 and 5).

6 CONCLUSIONS

In conclusion, portable toilets are essential for providing proper sanitation facilities for those in need and contribute to environmental conservation. However, the negative user experience and cleanliness concerns have resulted in a lower frequency of use, particularly during the post-pandemic period. To increase the acceptability and usability of portable toilets, design improvements, and innovations are needed. Our primary research, including surveys and interviews, indicates that cleanliness, smell, and physical contact are the most significant factors influencing portable toilet usage frequency, and redesign is necessary to increase hygiene and reduce unpleasant odours. Moreover, by incorporating design features that promote care and preservation of the facilities, user behaviour towards portable toilets can be positively influenced. These findings enabled an in-depth development of a user-friendly and innovative portable toilet redesign, to further improve user experience and promote sustainable solutions. As this paper aims to examine design considerations for toilet-related products, its goal is to

provide a comprehensive set of considerations that can be referenced by others for academic purposes when designing such products.

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