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Shifting from adaptive capacity to transformative capacity: a case study of how Sihanoukville can develop the capacity of urban stakeholders to enable sustainability transformation in sanitation

Fiona Lord, Jason Prior and Monique Retamal

Institute for Sustainable Futures, University of Technology Sydney, Sydney, Australia

ABSTRACT

Cities worldwide are reorienting their governance and planning practices to negate the negative impacts of urbanisation and seize the opportunities that urbanisation creates through developing capacities for urban sustainability transformations. There has been limited research to date on how urban stakeholders can develop their transformative capacities, especially in the lower-income settings of rapidly developing Southeast Asian countries. In this region, Sihanoukville, Cambodia, has recently experienced a major urban construction boom and has become a city of strategic planning focus for the Cambodian government. To support these efforts, our case study of Sihanoukville city investigates how Sihanoukville can develop the capacities needed to enable sustainability transformation of its sanitation sector. We found Sihanoukville had adaptive capacity but required strengthening of a range of key urban transformative capacities. Sihanoukville city could focus initially on strengthening reflexive and learning practices, knowledge partnerships and collective sustainability visions and goals.

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Introduction

Urbanisation is creating major social, economic and environmental challenges, particularly in areas where urban development is occurring rapidly and with limited urban planning (Bai et al. 2017; Webb et al. 2017). Southeast Asia is experiencing rapid urban development, causing increasing pollution, traffic congestion, inequitable access to land and housing and increasing vulnerability to natural disasters (Dahiya 2014; Matsumoto and Daudey 2014; Arfanuzzaman and Dahiya 2019). Cambodia has had Southeast Asia's second-fastest urban growth rate over the last three decades (UN-DESA 2018; World Bank 2018), and the Cambodian government has recognised the need to reorient its cities towards urban sustainability goals through strategic planning (Chan and Lee 2019; NCSD, MoE, PPCH, & GGGI 2019; Chan 2020; NCSD, MoI, & GGGI 2020).

The practices and tools to support sustainability transformation agendas have become an increasing focus for urban planners and scholars, given the impact of rapid urbanisation at multiple scales (e.g. from the contribution of cities to global climate change to the localised impacts of urban development households and communities) (Frantzeskaki et al. 2018). Sustainability transformations involve large-scale societal changes to address major societal and ecological challenges (Linnér and Wibeck 2020) and imply fundamental changes in structural, functional, relational and cognitive aspects of socio-technical-political-ecological systems (Scoones et al. 2020). In cities, urban sustainability transformations involve the transformation of urban systems across scales and sub-systems, reorienting cultures, structures and practices of urban stakeholders towards sustainability (Ernst et al. 2016).

CONTACT Fiona Lord fiona.n.lord@student.uts.edu.au Institute for Sustainable Futures, University of Technology Sydney, Sydney, PO Box 123, Ultimo, NSW 2007, Australia

Global platforms and agreements have also recognised the importance of cities and transforming urban systems to achieve global sustainability goals – especially in Goal 11 of the Sustainable Development Goals (SDGs) for 2030 under the United Nations agreed in 2015. Scholars are developing and testing new models for urban transformative governance and strengthening urban transformative capacities to support cities in their transition towards a more sustainable future, including through transdisciplinary action research (Wolfram 2016; Hölscher et al. 2019; Asadzadeh et al. 2023; Webb et al. 2023; Lord and Prior 2024).

Southeast Asian cities have not yet been a focus for research on urban sustainability transformations, particularly on the role of governance and urban transformative capacities (Wolfram et al. 2019; Lord 2020). Studies in this field in Southeast Asia have focused on how urban resilience and resource efficiency can be integrated into local green growth strategies (Daudey and Matsumoto 2017; Lehmann 2018); the potential for mainstreaming nature-based solutions for climate adaptation (Tun et al. 2024) and on the financing of resilience efforts in vulnerable Southeast Asian cities (Causevic et al. 2021), without a specific focus on urban transformative capacities. In Cambodia, recent research on the capital city, Phnom Penh, has investigated key governance dimensions of urban transformations, including the multi-dimensional aspects of empowerment in the transition of the built environment (Jayaweera et al. 2023) and the political dimensions of resilience in urbanisation processes (Asif et al. 2023).

Sustainability transformations research builds on the need for transformative resilience to climate change and the associated literature on adaptive capacity. Adaptive capacity is the capacity of a system(s) to adjust its characteristics or behaviour in order to expand its coping range under existing climate variability or future climate conditions (Brooks et al. 2004).

Drawing on this scholarly experience, our case study research in Sihanoukville, Cambodia, seeks to identify and build capacities for urban sustainability transformations in the sanitation sector. Sihanoukville was selected because this city has had limited sustainability-focused research, and the challenges of unsustainable urban development patterns are particularly acute. It has experienced a rapid construction boom, insufficient urban planning and public infrastructure investment, severe challenges with law and order, and a low prioritisation of environmental protection. The sanitation sector was selected as a priority for sustainability transformation by Sihanoukville's stakeholders through its sustainable city planning processes (NCSD, MoI, & GGGI 2020). It was chosen as the focus of this study through initial consultations with the city's urban stakeholders from government and non-government sectors.

In the context of these pressing urban sustainability challenges, our research aims to answer the following question: how can urban stakeholders in Sihanoukville develop the capacities needed for urban sustainability transformation of the sanitation sector?

Theoretical framework

Bounded within a practice-oriented transdisciplinary research approach, our research applies scholarly frameworks for evaluating urban sustainability transformations. Sustainability transformations involve deep and often rapid changes in social-ecological-economic- and technical systems, resulting from large-scale political forces, economic forces, social mobilisation, and/or carefully planned interventions (Fazey et al. 2017; Scoones et al. 2020). Within cities, urban sustainability transformations can redirect urban planning and development across sectors and organisations, and radically alter urban outcomes.

Policies and institutions can play a key role in enabling sustainability transformations, as well as infrastructures, cultural discourses and maintenance networks. Social innovations, such as new governance modes and business models, can contribute to large-scale technological change (Olsson et al. 2014). Promising social and technical innovations need to be nurtured and connected to broad institutional responses and resources (Westley et al. 2011).

Our research positioning is normative in that it seeks to support key actors within the urban systems of the city we are studying, Sihanoukville, to orient their urban development planning, systems, processes and outcomes towards ecological sustainability and social justice. With this framing, we selected the conceptual framework of 'Urban Transformative Capacities' (UTC) developed by Wolfram (2016) to guide our research, enabling analysis of the 'transformative capacities' that are needed for urban sustainability transformations. The UTC framework integrates a range of disciplines, including urban planning,

sustainability studies (including on adaptive capacity approaches) and political science to support researchers and practitioners in analysing the capacities underpinning sustainability transformations of cities.

Transformative capacities are the social attributes and capacities that empower individuals and communities to take action and have agency in enabling sustainability transformations (Ziervogel et al. 2016). Transformative capacities allow for systemic change by empowering (and providing for the various needs of) different actors and enabling transitions across scales (Iwaniec et al. 2019). Key capacities are needed for different phases of a transformation, such as the capacities required to promote experimentation and foster a diversity of available ideas in preparation for transformation (Olsson et al. 2014). Key persons and intermediaries can be pivotal in steering transformation processes, providing leadership, building trust and developing visions and sense-making (Folke et al. 2004; Gutiérrez et al. 2011; Westley et al. 2011; Ehnert 2023).

The UTC framework of Wolfram (2016) provides a comprehensive multi-disciplinary analytical tool for evaluating transformative capacities across relevant components of urban sustainability transformations, and has been applied in a range of urban contexts and systems (Wolfram 2019a, 2019b; Wolfram et al. 2019). Existing UTC research applying Wolfram's framework has predominantly been focused on higher-income countries (with few studies in lower-income settings, especially in cities of Southeast Asia). However, recent research has applied this framework in the secondary city of Battambang, Cambodia (Lord et al. 2024).

Wolfram's UTC framework considers what kind of capacity can deliver transformative change towards urban sustainability. The framework maps out 10 interdependent key components of urban transformative capacities and specifies requirements for their development, indicating a baseline and areas of capacity growth (see Table 1).

In reviewing research that applied the UTC framework across a range of cities, Wolfram et al. (2019) emphasised four transformative capacities that underpin urban sustainability transformations:

(1) the need to foster inclusion and empowerment as prerequisites,
(2) the need to strengthen the role of intermediaries and local academia in brokering transformation processes,
(3) the need to reinvent urban planning as a critical level for developing urban transformative capacities, and
(4) the need to foster reflexivity and collective learning through new self-assessment techniques for transformative capacities.

Research design

Through a case study approach (Yin 2009), we partnered with local institutions – the Cambodian Institute for Urban Studies (CIUS) and the

Table 1. Conceptual framework for urban transformative capacity components (extracted from Wolfram 2016).

Component/Capacity development factors	Subcomponents (where applicable)
C1 Inclusive and multiform urban governance	C1.1 Participation and inclusiveness
	C1.2 Diverse governance modes and network forms
	C1.3 Sustained intermediaries and hybridization
C2 Transformative leadership (in the public, private and civil society sectors)	
C3 Empowered and autonomous communities of practice (place-based and/or issue-driven)	C3.1 Addressing social needs and motives
	C3.2 Community empowerment and autonomy
C4 System(s) awareness and memory	C4.1 Baseline analysis and system(s) awareness
	C4.2 Recognition of path dependencies
C5 Urban sustainability foresight	C5.1 Diversity and transdisciplinary co-production of knowledge
	C5.2 Collective vision for radical sustainability changes
	C5.3 Alternative scenarios and future pathways
C6 Diverse community-based experimentation with disruptive solutions	
C7 Innovation embedding and coupling	C7.1 Access to resources for capacity development
	C7.2 Planning and mainstreaming transformative action
	C7.3 Reflexive and supportive regulatory frameworks
C8 Reflexivity and social learning	
C9 Working across human agency levels	
C10 Working across political-administrative levels and geographical scales	

Cambodian Government's National Council for Sustainable Development (NCSD) – to support our qualitative data collection. Our case studies were informed sequentially by an initial set of online semi-structured interviews (22 interviews with 28 participants) between July 2021 and January 2024, followed by an in-person workshop in Sihanoukville with 18 participants (including 3 focus groups of 6 participants) in February 2024, and a further 8 semi-structured interviews with 12 participants held face-to-face and in situ with site visits (e.g. to a wastewater treatment plant, plastic recycling facility, the waste transfer station and the city's landfill site).

Our research participants (in interviews and the workshop/focus groups) were recruited through snowballing and predominantly by our research partners based on the criteria that they had a role in Sihanoukville's urban planning and/or sanitation sector, including:

- Public sector agencies responsible for policy and programme management at national and sub-national levels of government, including environmental management, waste management, urban planning, public works and/or governance and administration
- Private sector organisations involved in the management of the sanitation system
- International development agencies providing technical and/or financial assistance
- Non-government organisations (NGOs) providing technical assistance and/or advocacy
- Academic institutions involved in the sector through research/knowledge partnerships.

Amongst the focus group participants, three were also part of the face-to-face interviews. Therefore, 55 people in total participated in the research process, either as an interviewee and/or focus group participants, including government representatives, international development agencies, NGO representatives, academic institutions and private businesses (see Table 2).

In each interview and focus group, we explained the concepts of urban sustainability transformations and transformative capacities. We structured the questions for the interviews and focus groups around the UTC's 10 transformative capacities. For example, under C1 (inclusive and multiform governance), we asked the following question to participants: '*To what extent do you think there is an opportunity for a range of organisations in the city to participate in the governance (decision-making processes) of the city?*', among other questions. We used our discussion guides flexibly and encouraged the participants to discuss the transformation of Sihanoukville, the city's potential capacity strengths and gaps in the management of sanitation services, and the city's broader planning context. During the workshop, each focus group worked separately in parallel using our discussion guide and reported back to the workshop plenary. A translator supported the interviews and focus groups, as required.

A document review throughout the data collection phase also informed our case studies. We collected and analysed relevant documents to supplement our understanding of the context and issues raised by participants. The documents included national policy documents, planning instruments, regulations, programme documents, reports of international-development-funded projects, local media reports (online) and websites of relevant organisations.

Our qualitative data analysis approach applied a triangulation method (Heale and Forbes 2013), drawing on qualitative data from the interviews, focus groups and document review. To support our analysis, we audio-recorded the interviews and the plenary reports of each focus group, and prepared transcripts of these audio-recordings. The workshop/focus group's written outputs were also translated from Khmer into English. Using NVivo analysis software, we coded the transcripts and focus group

Table 2. Number of research participants by category and method (interviews or focus group).[1]

	National Government	Sihanoukville Provincial Government	Sihanoukville Municipality	Commune administration	International development agency	NGO	Academic institution	Private sector	Total
Interviews	11	5	7	0	11	1	1	4	40
Focus groups		7 (−1)	3	3		2		3(−2)	18 (−3)
TOTAL	11	12 (−1)	10	3	11	3	1	7 (−2)	55

discussion notes against the UTC framework (see Table 1) and emerging themes related to urban transformations, urban governance and transformative capacities. Using this analysis, we collated key themes, focusing on how urban stakeholders in Sihanoukville can develop the capacities needed to support the sustainability transformation of the urban sanitation sector (our research question).

Case study context

Cambodia is a smaller and lower-income country in Southeast Asia (population of 16.59 million and a GDP of USD 26.96 billion in 2021), and it has experienced rapid economic growth and urban development over the last two decades. Although its national policy orientation is towards green growth and sustainable city development (Chan 2020), Cambodian cities and towns face several significant sustainability challenges: infrastructure shortfalls, increasing vulnerability to disasters, increasing environmental pollutants, and social inequities associated with a lack of land and housing for the poorer communities (World Bank 2018; NCSD, MoI, & GGGI 2020). Around 25% of Cambodia's population lived in cities in 2023, and this is projected to increase to 30% by 2030 (World Bank 2023), with cities being increasingly important as the country aims to transition from an agricultural-based economy to an industrial economy, expanding its manufacturing sector and foreign investment (World Bank 2018).

Cambodia ranked 150 out of 180 countries on Transparency International's corruption index in 2022. Corruption is embedded in the culture of its governance systems (Ong and Smith 2014). Cambodia's history of civil war and post-conflict fragility has weakened its governance systems (Un and Hughes 2011). Cambodia has received high levels of international aid and technical assistance from international agencies since the end of the civil war in 1991.

Sihanoukville is unique as Cambodia's only city with an international port situated within a multi-purpose special economic zone (SEZ) and is popular for tourism and gambling. It is prioritised for sustainable development under Cambodia's *Sustainable City Strategic Plan 2020–2030 for Seven Secondary Cities* (NCSD, MoI, & GGGI 2020). The city has received an influx of foreign investment in the construction and industrial sectors (World Bank 2018). With a lack of building regulations and law enforcement, it has experienced the collapse of some buildings during their construction (Luo 2023). Sihanoukville has a history of social disorder and international crime.

Sanitation is a priority sector under Sihanoukville's sustainability plan, but the city faces several sustainability challenges in this sector. While management responsibilities for urban sanitation systems were delegated by national authorities to the municipality for solid waste in 2015 and sewerage in 2017, local authorities are currently building their capacities to manage these systems, and there are overlapping roles and responsibilities between different levels of government. Commune councils and the municipality have budget shortfalls for sanitation services and lack human resources. Sihanoukville's municipality became responsible for managing the contract with a private waste collection company (Kampong Som Waste Management Company (KSWM)) in 2017 and, in 2024, introduced new local penalties for illegal waste dumping and started charging residents directly for waste collection services.

Sihanoukville does not have a formal waste segregation system for recycling solid waste but does have a range of informal businesses and waste pickers supporting an ecosystem of recycling. One formal business for plastics recycling was established in Sihanoukville in 2023, Ton-to-Ton, financed initially through the Ocean Bound Plastics credit programme. Sihanoukville's landfill site was upgraded to meet environmental sanitary standards in 2022. The volume of waste being dumped at the landfill daily in February 2024 was almost double the projected volume (from the design) and is, therefore, likely to reduce the landfill's lifespan.

Sihanoukville introduced a 'smart city' planning process in 2021, with the support of international development agencies – Australia and UN-Habitat – to support the city to become a smart, sustainable, and liveable city (UN-Habitat Toscano and Hak 2021). Sanitation became a strategic focus of its smart city planning, and the United Nations Economic and Social Commission for Asia and the Pacific (UN-ESCAP) supported a Smart City Innovation Lab in 2023, which helped the city to pilot waste segregation and reporting through smart applications. Although the pilot was short-term (2 months) and limited to one school and a group of 40 beachside restaurants, it generated some environmental impacts (see Figure 1). In parallel, the United Nations

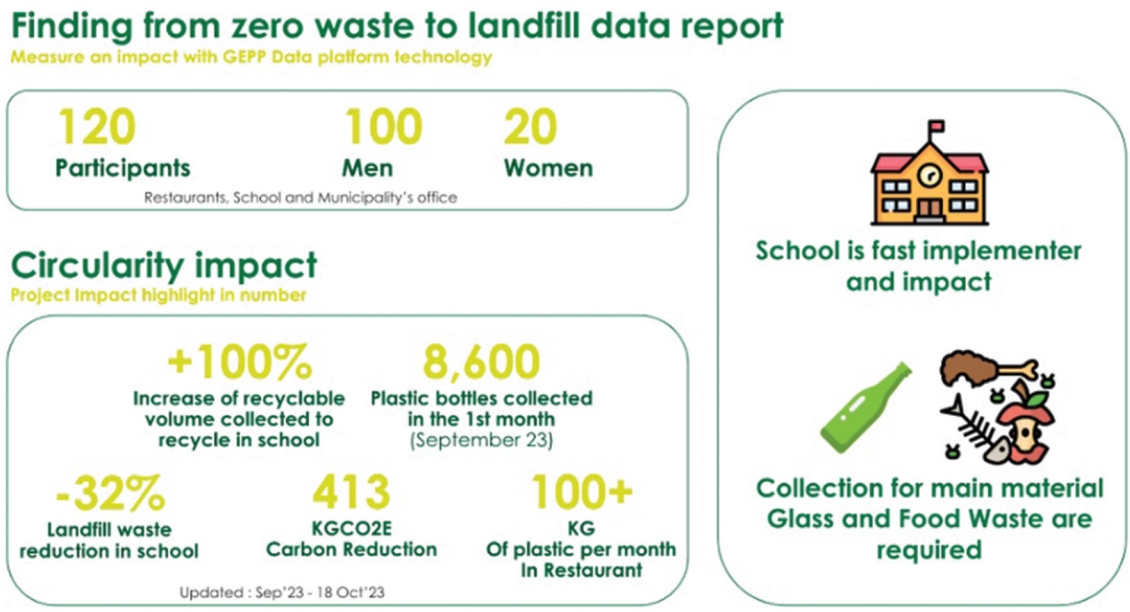

Figure 1. Impacts of ESCAP pilot in Sihanoukville applying technology from the start-up company GEPP sa-ard (source: UN-ESCAP 2023).

Development Programme (UNDP) supported Sihanoukville by installing water filtration systems in 21 schools, plastic reduction campaigns, and installing waste traps in canals (UNDP 2022). Overall, the city has begun experimenting with smart local solutions to reduce plastic consumption and prevent the flow of plastics and other harmful materials into the ocean.

Results

We first provide an overview of the key findings, including an overview of each capacity component (see Table 3). We then discuss the capacity component within the UTC in more detail, before finishing the results section with an overall reflection on the strengths of the capacity components within the UTC, in Sihanoukville's urban sanitation sector.

Key findings – urban transformative capacities in Sihanoukville

Sihanoukville had undergone a recent pivot in its planning and development orientation, triggered by an intervention from the Cambodian Government in 2021 to create land management plans and policies to support the city's becoming a modern industrial city. While urban construction and industrial development in Sihanoukville increased significantly over the last 10 years, the city's land use masterplan was only published in 2021. This coincided with the closing of international borders in Cambodia due to the COVID-19 pandemic and the halting of construction, as well as the migratory workers and international tourists coming to Sihanoukville. Furthermore, at this time, the Cambodian Government established a special committee to support planning for Sihanoukville, directed by the Prime Minister, culminating in the publication of a *Land Management and Land Use Policy for Developing Preah Sihanouk Province as a Multi-Purpose Special Economic Zone 2022–2038* and an additional USD 394 million in budget for urban infrastructure in Sihanoukville allocated from the national government. Cambodia was also the chair of the Association of Southeast Asian Nations (ASEAN) in 2022 and sought to demonstrate that Sihanoukville was a thriving ASEAN port city. Infrastructure investments included the expressway (between Phnom Penh and Sihanoukville), 34 new roads, two wastewater treatment plants, an upgraded landfill and an upgraded international airport, all supporting the redevelopment of its SEZ and deep seaport facilities.

Sihanoukville's pivot was triggered by discontent amongst the Cambodian population with the state of

Table 3. Sihanoukville's urban transformative capacities for transformation of its urban sanitation sector.

Transformative capacity component	Capacity Strengths	Capacity Gaps
C1 – Inclusive and multi-form governance	A transparent inclusive platform (created through social media) enables residents to access the government authorities to discuss their concerns with the sanitation sector and hold authorities accountable address issues.	Planning and governance processes for urban development (including sanitation) have been top-down and not inclusive. Administrators do not yet engage with NGOs, citizens and the private sector in urban planning and decision-making.
C2 – Transformative leadership	High level political leadership is driving the transformation of Sihanoukville province and city, linking the transformation agenda to global and regional agendas on sustainable development.	Transformative leadership appears to be dependent on the political appointments of the day and currently does not consistently embrace joint problem-solving and open processes.
C3 – Empowered and autonomous communities of practice	Intermediary organisations have started to bridge pre-existing gaps between stakeholders (public sector, private sector, NGOs, communities), and facilitated inclusive participation pilot initiatives on waste reduction, segregation and recycling.	There is very limited funding available for communities of practice (or multi-stakeholder partnerships) with limited public sector budgets, and very few partnerships with international development agencies or NGOs.
C4 – System(s) awareness and memory	Partial awareness and recognition of urban systems and path dependencies are evident, through research commissioned to support the city's urban masterplan and sanitation pilots.	Knowledge of the urban system and path dependencies are not widely shared, and specific constraints (such the need for resolving tenure disputes) are not openly acknowledged due to political sensitivities.
C5 – Urban sustainability foresight	A top-down vision for urban renewal, economic diversification, smart and green development of the city and province, has been promoted, conceived as a radical departure from the current state of uncontrolled development.	The vision for the city is currently not a collective vision, as it is primarily a vision of the national government and did not reflect the goals of local authorities or other urban stakeholders.
C6 – Diverse community-based experimentation with disruptive solutions	A few short-term community-based experiments have commenced but are yet to provide disruptive solutions.	There is a lack of skills and resources for development of experiments.
C7 – Innovation embedding and coupling	There is a lack of commitment, skills and experience with scaling-up innovations towards transitioning to a sustainable sanitation sector.	Access to resources for capacity development and embedding of innovations is limited currently to international donor funds, and stakeholders are not yet able to access the resources required (technical, knowledge, financial and time).
C8 – Reflexivity and social learning	Social learning has commenced informally through recognition amongst urban stakeholders that the past practices of uncontrolled urban development led to negative outcomes.	There are currently no systematic processes and limited methodological skillsets for enabling reflexivity (monitoring, assessment, evaluation).
C9 – Working across human agency levels	Public education programs have been piloted to improve sanitation services, linking households, villages and local tiers of government to identify solutions and change behaviours, facilitated by intermediaries (UN agencies).	Public-private-civil society partnerships are rare and there appears to be a low level of trust and engagement by authorities in working with intermediaries to facilitate problem-solving across human agency levels.
C10 – Working across political-administrative levels and geographical scales	Top-down nationally led coordination is driving urban transformations, linking the agenda across geographical scales (city, province, national and regional), especially through infrastructure investments.	There is currently limited experience of bottom-up approaches to coordination of urban planning, and the municipality and lower-tiers of government are reported to have limited capacity and resources to drive any reforms.

Sihanoukville due to a collapse of a building site, disorder and illegal activities and gambling. An interviewee noted the dramatic shift in Sihanoukville: *'From 2015, the Chinese investment started to come to Sihanoukville, and Sihanoukville completely transformed to become like a Chinese city, with so many Chinese signs and casinos, and then up to 2 years ago the roads were also horrible. People were complaining how polluted the city was. Then I went back three weeks ago [in 2021] . . . there is drastic improvement.'* Another interviewee remarked, '*The Governor of Sihanoukville province has a vision to transform Sihanoukville into a globally competitive, prosperous, multi-cultural city. They are going to diversify their investment*.'

Sihanoukville has been undergoing a two-track transformation process. On the first track, a major transformation occurred with the cities' infrastructure (new roads, expressways, wastewater treatment

facilities, sewerage network, sanitary landfill, etc.). The USD 394 million in budget for Sihanoukville, allocated from the national government, had been invested in new urban infrastructure, aligned to the Prime Minister's vision under the Cambodian government's new *Land Management and Land Use Policy for Developing Preah Sihanouk Province as a Multi-Purpose Special Economic Zone 2022–2038*. On the second track, our research showed that the transformation of its governance and institutions (or human systems) to manage the sanitation sector (and broader urban planning) was lagging.

Our research findings, summarised in Table 3 below, outline how each of the capacities in the UTC framework were generally weak in Sihanoukville, holding back the overall sustainability transformation of the city. There was a perception of significant improvements being made to the city with the new/rehabilitated infrastructure investments; however, these assets were not yet supported by the governance capacities and structures needed to sustain an urban sustainability transformation. New infrastructure investments appeared to provide a technological fix to deeper social, institutional and planning challenges in Sihanoukville.

The case study also demonstrated a lack of alignment between national policy priorities and local-level objectives. At the national level, the government had emphasised the importance of sustainability stewardship (aligned to the UTC framework), particularly in the context of its National Green Growth Policy, Carbon Neutrality Strategy and Circular Economy Strategy and Action Plan. These strategies emphasise the importance of waste reduction, reuse of materials, product recycling and carbon emissions reduction. At a local level, Sihanoukville's municipality had limited knowledge of, and or prioritisation of these national policy objectives, and were focused on economic development, public order and cleanliness in the sanitation sector. At a local level, this limited understanding of, and prioritisation of, the opportunities for urban sustainability transformation, led to weaker UTC capacities (as summarised in Table 3).

In the following sections, we elaborate on our findings related to the UTC framework.

Capacities 1 to 3 – governance, leadership and communities of practice

Transformative urban governance capacities were absent in Sihanoukville, because of the top-down governance structures and bureaucratic institutional culture. Lower tiers of government, from the provincial level downwards, had limited flexibility in policy, planning and programme management, and needed to adhere closely to the directives of the national government. Interviewees noted that local strategic planning was limited, because initiatives and operations were managed based on directives from the national government and in response to challenges raised locally to the provincial governor or city mayor. One government official noted:

> All the decision makers are at the national government. They set up the policy for the municipality, and for the provincial level, to practice the policy . . . . They [municipalities] have to talk to the national government. They need to get it [plans, program partnerships etc] approved and supported by the national government, to enable their success.

While Sihanoukville municipality had followed the directives of the national government in taking responsibility for solid waste management and wastewater treatment, in recent years, they were yet to be fully autonomous in their management role, with the provincial government retaining some responsibilities and lacked clarity in their future roles. For example, the provincial government managed the wastewater treatment plant operations in 2024, but there was no clear plan for their ongoing management or budget source for future years.

Due to the top-down government management processes, the municipality perceived its role in engaging with the community and businesses as unidirectional and did not perceive a need for inclusive and participatory approaches, such as through multi-stakeholder partnerships or communities of practice. When asked about whether there were opportunities for urban stakeholders, such as NGOs, businesses, or international agencies, to participate in sanitation planning, one focus group reported, '*The Municipal authority has plans to instruct and direct the working groups to widely disseminate the collection schedule, to arrange the collection routes, to organise the waste collection fee, and to promote the related regulation and to implement penalties/law enforcement*.'

Therefore, the government's focus on stakeholder engagement was primarily on informing and educating the community about their responsibilities in sanitation management.

Intermediaries, such as NGOs and international development agencies, have had limited involvement in the governance of Sihanoukville but were starting to become involved with a few pilot projects and short-term planning initiatives. Compared with other Cambodian cities, Sihanoukville had few donor-funded projects and limited technical assistance from outside organisations (e.g. universities), limiting their access to external resources and new knowledge.

While there were no formal partnerships with businesses and NGOs reforming the sanitation sector, an informal collaboration existed between the municipality and the ecosystem of informal recycling businesses in Sihanoukville. These businesses were supported informally through scheduled access to the landfill site, access to land adjacent to the landfill for waste segregation and access to accommodation for some informal waste pickers. While the city authorities did not articulate a vision or goals towards a circular economy or recycling, they acknowledged and informally supported a local marketplace for readily recyclable products.

Interviewees perceived that higher-level leadership was committed to the transformation of Sihanoukville. However, this had not yet been translated into local-level transformative leadership and corresponding local institutional reforms. One explanation for this was the limited knowledge and awareness of sustainability and how to enact changes. When asked about the extent of transformative leadership towards sustainability in the city, one focus group remarked: 'A strength of Preah Sihanouk is the high commitment from leaders such as provincial and municipal governors. Though, it lacks skills and human resources.'

Leaders were perceived as being more transparent (than historically) in their community engagement. Transparency had increased because of the recent processes of finalising and publishing Sihanoukville's land-use masterplan (in 2021) and through their use of social media platforms to communicate with the public. Sihanoukville's authorities perceived that residents could raise their concerns through these platforms. Moreover, the authorities were mostly focused on their day-to-day work in responding to the issues raised by community members and businesses, and they perceived minimal time left for strategic planning.

In summary, we found that governance capacities and leadership were not oriented towards an urban sustainability transformation, predominantly due to the top-down bureaucratic institutions and culture persisting and the limited knowledge of local governing authorities. New partnerships and governance practices were emerging, providing an opening for potential future transformative governance reforms, and allowing the co-production of knowledge.

Capacities 4 to 7 – systems awareness, sustainability foresight, experimentation and innovation

Systems awareness had improved at a provincial scale through the top-down processes of multi-sector development planning, under a nationally managed Coastal Development Committee for Sihanoukville, culminating in the publication of a *Land Management and Land Use Policy for Developing Preah Sihanouk Province as a Multi-Purpose Special Economic Zone (SEZ) 2022–2038*. However, this planning process did not actively engage local decision-makers and stakeholders in undertaking multi-sector baseline analysis and policy development, enhancing knowledge primarily of national officials. The policy and plans were yet to be translated into practical knowledge and a shared understanding of the issues. While the national government had promoted a vision for urban renewal, economic diversification and smart and green development of the city and province, this vision was not fully shared by local authorities and local urban stakeholders (e.g. the waste collection company).

A lack of sustainability knowledge amongst local leaders in Sihanoukville also translated into a limited urban vision for sanitation, with the primary focus for the leadership team being on the adequacy of the municipal waste collection system. When asked about whether the city had a vision to introduce recycling (e.g. of plastics, glass, paper and/or organics), a Municipal representative noted:

> In the contract [between the municipality and the waste collection company] there is no article to enforce separation or recycling. This is more the responsibility of the citizens to separate waste. Companies have contacted the municipality to work on recycling but there is not any progress so far.

Research commissioned by the municipality, funded by UN-ESCAP, supported the trial of waste

segregation and plastics recycling through a Smart City Innovation Lab in 2023 (see Figure 1 above). This research increased the municipality's knowledge of the cities' waste profile and the opportunities for locally enhancing the circular economy. However, without any local strategic planning processes for the sanitation sector, the research has not been used to support the development of transformative sustainability goals or actions.

Stakeholders interviewed demonstrated their knowledge of path dependencies – notably, the current barriers to behaviour change to shift the communities' approach to waste management and the limited resources available (financial and technical) to support a transformation. Alternative scenarios or pathways were not considered, with most stakeholders perceiving the status quo as the only viable pathway under the circumstances.

A range of reasons were provided by interviewees on why the city was not planning on introducing a formal waste recycling system. The city's waste management company said, '*[Recycling] is impossible because of the mixing of waste; there is also no incentives for the private companies on recycling . . . I will follow the government instruction, if the government requests the waste to be separated, then I can manage the separate waste streams accordingly*.' On the other hand, the Municipality noted, '*[Recycling] is difficult to introduce, as the people do not separate the waste. The responsibility is more from the waste generation source. . . I have requested to the school and to public educational institutions to integrate the waste separation into the study program for the children*.' And one focus group reported also, '*People will not participate if there is no law enforcement or door to door promotion*.' Hence, the barriers highlighted included: limited policy directives, and the need for sustainability education, law enforcement and awareness raising initiatives supporting system change.

Sihanoukville city has very few examples of disruptive community-based experimentation or innovation embedding strategies with a sustainability goal in the sanitation sector. In addition to the Smart City Innovation Lab pilot, the city had one formally registered recycling business, Ton-to-Ton, supporting waste collection and recycling in the cities' poorer communities through an innovative sustainable financing model, using the Ocean Bound Plastics (OBP) credit programme (credit payment per verified tonne of plastic reduction). Ton-to-Ton had the potential to significantly scale up its operations if the market for the sale of the OBP credits were to increase. Ton-to-Ton was also diversifying its income base, receiving finance through providing study tours at its facility, selling recycled plastic products and receiving grants from international development agencies. Its operations depended on the local authorities' goodwill and support, although no formal contract or arrangements were made between the parties.

This company noted in our interview:

> We need interventions from the local authorities, to expand to new communities; we need to go through the municipality to access the communities (through the Sangkat and village chief); they know the area better than us, and we need their support.

Interviewees primarily perceived the barriers to there being any diversity in community-based experimentation and innovation included: (a) lack of technical knowledge and experience amongst authorities responsible for the sector; (b) lack of financial resources; and (c) lack of incentives or regulatory frameworks that promote sustainable practices within the city.

Some interviewees noted that they had the opportunity to see innovative practices in other Cambodian cities and cities across Southeast Asia (through training programmes and study tours) but suggested that these practices could not be implemented in Sihanoukville, due to local constraints. Access to resources for capacity development was generally limited to higher-ranking officials and short-term training rather than systemic or targeted education. International development agencies had not established a local technical advisory footprint. Universities or other knowledge institutions had not established research partnerships or collaborative projects to address sustainability challenges in Sihanoukville.

Capacities 8 to 10 – social learning, working across human agency levels and across scales

Management systems and structures existed for working across agencies (household-community-village-commune-municipality) and scales (site-neighbourhood-district-city) through administrative governance structures, primarily used to disseminate information from the top of the governance structures. Some interviewees noted that a key capacity

strength in Sihanoukville was their ability work across human agency levels and alignment in policy orientation and objectives (directed from the top). One focus group reported:

> The decision-making of all leaders is in the same standard. This means that leaders have same targets and always have same objectives or provide same answers. Also, leaders integrated the waste management into Safe Sangkat/Village Policy.

Knowledge sharing connections were made between Sihanoukville officials and other cities' officials formally and informally. In addition to study tours and training programmes offered by international development agencies, the city was commercially connected to other cities across Asia involved in its land-use planning processes, and design of SEZs and commercial developments. Sihanoukville was also closely linked to the national authorities because of the strategic focus of the national government on the city and province for reform and transformation. Cambodia's ASEAN Chairmanship in 2022 was a major driver for Cambodia's Prime Minister's strategic focus on Sihanoukville, as the city is a designated ASEAN Green City.

While Sihanoukville did not have formal reflexive monitoring and learning processes, it demonstrated experience in adaptive and responsive management of its waste collection services. One of focus group highlighted that a key strength of its approach has been the ability to scale up the services with the rapid increase in waste resulting from fast-paced urbanisation and an increase in migratory workers associated. This focus group reported:

> We have adaptive capacity, whereby every institution can adapt following the city development for all circumstances. We have experienced the fast city development from very messy situations.

The city's bureaucratic culture would need to be modified to deepen the cities' learning and skills in reflexivity towards transformative knowledge development. The decision-making and engagement structures currently limit the potential for diversity in thinking and opportunities for mentoring and knowledge sharing. One interviewee noted, for example, *'The administration officer doesn't have much to do. For example, at the monthly meetings of the administration, the governor presents, and there is no opportunity for the officials in the administration to participate.'* Another interviewee highlighted, '*Another structural issue is that when civil servants retire from the government civil service, they lose all their power. They do not then transfer their knowledge and experience to the next generation*.' Hence, the lack of autonomy of lower ranking officials and limited knowledge transfer from senior (retiring) officials, were perceived as preventing organisational learning and development.

Furthermore, for a culture of openness to learning and reflexivity to be supported, Sihanoukville's urban stakeholders would need a more unified vision for urban sustainability transformation, and an attitude of openness and curiosity towards sustainability stewardship and social justice. Local officials are particularly resource-constrained because of the prioritisation of other issues (above sustainability goals) and perceived lack of interest (according to interviewees providing them with technical support). An interviewee from the municipality noted, for example, '*The responsible office is only 3 staff. They have not only the waste management functions, but also, they have responsibility for wastewater management … and they are also responsible for public order, which is a very busy responsibility. How can three people address all of this*?' On the other hand, one interviewee from an international development agency remarked, '*Sometime when I work with them [officials], and then you feel like they know everything. They don't acknowledge that they should learn more, but they think they already know things*.' Therefore, the limited organisational interest of the authorities in learning and reflexivity appeared to stem from both resource constraints and attitudes.

In partnership with Sihanoukville's local authorities, UN agencies piloted new approaches to build local capacities and identify ways to change behaviours in wastewater management through public participation. These campaigns aimed to create the communities' awareness of the sanitation system and explain why it is important to manage wastewater effectively. However, with residents and businesses having the responsibility to pay for connecting their buildings to the sewerage network under the existing policy, this participation process was yet to have an impact, as the cost of connecting was prohibitive, as one official highlighted:

> Cost of connections from the households to the sewerage network is around $2,000–$3,000 and for some households it reaches to $5,000 – this is why the connection is few.

Why were capacities weak overall?

Based on the UTC framework analysis above, we can extrapolate that Sihanoukville city's transformative capacities were generally weak for several reasons: (a) limited experience and knowledge of sustainability risks and opportunities and the potential sustainability solutions/measures; (b) a lack of partnerships with technical advisory experience and finance; (c) a culture of caution and top-down bureaucratic governance, with few opportunities for non-government actors to participate in urban governance; and (d) a prioritisation of immediate responsibilities (e.g. public order). Underpinning these factors was a lack of collective vision for sustainability or social justice, and a socio-political environment of endemic corruption.

> There is no opportunity and incentives [for local officials], and there is no proper system. They all know that if they go back to their homeland [i.e. Sihanoukville] that they will fall into the corruption trap and they have to really find ways to make money from the public services. International development agency

Furthermore, there appeared to be a disinterest among donors in partnering with Sihanoukville authorities for fear of failure (or potential waste of scarce international development resources).

> They [a donor] had been considering doing some work there [Sihanoukville], but their view was to not really to touch it … because of the challenges … centralised decision-making makes things tricky, and their level of capacity makes working with counterparts challenging. International development agency

Investment in reformative infrastructure had been drawn from the national budget as a showpiece but without the backing of investment in human resources, local policies and local strategic planning. In this environment, there were few opportunities for niche sustainability innovations to be fostered and connected, or local leaders to flourish. The municipality had become accustomed to being highly responsive and 'putting out fires' locally, adapting to the requirements of national authorities, and did not have autonomy or flexibility. National-level prioritisation of a circular economy, sustainable consumption and production, sustainable cities and climate change adaptation have not yet been translated into local priorities.

Discussion

The Sihanoukville case study highlighted some political constraints to achieving urban sustainability transformations and developing transformative capacities. Aligned with the research of Meadowcroft (2011), we found that the transformation context of Sihanoukville was highly influenced by political factors and subject to contestation and struggle (Meadowcroft 2011). We found that politics and power can have an underpinning role in preventing a sustainability transformation process, similar to the findings of Geels (2014). In these circumstances, a sustainability transformation requires destabilisation and decline of existing (unsustainable) regimes, including empowerment and disempowerment strategies (Geels 2014; Avelino 2017; Scoones et al. 2020). In the context of Sihanoukville, the empowerment strategy directed by the top tier of governance (the Prime Minister), which guided the urban transformation through planning directives and infrastructure investment, at the time of the research, was yet to dismantle resistance regimes at a provincial scale (i.e. vested interests).

Bottom-up approaches to sustainability transformation would likely need to be implemented in Sihanoukville to dismantle these resistance regimes, in addition to the top-down model (Scoones et al. 2020). Bottom-up strategies could include mobilising actors, resources and institutions locally towards collective actions and fostering human agency, values and innovation towards a regime shift (Stirling 2015). For example, it can leverage the agency of Sihanoukville's business entrepreneurs and non-government organisations, as well as its investors (in construction or industry), to foster, promote and finance more sustainable models of urban sanitation. The less powerful actors in Sihanoukville delivering grassroots reforms can seek the windows of opportunity or 'fuzzy action moments' where the agendas of the top-level governance actors and the local civic movements align, ideally and dismantle the unsustainable patterns of planning and sanitation management (Patterson et al. 2021).

The case study also showed that certain capacities are foundational to the development of other capacities. Sihanoukville and other similar lower-income cities could also benefit from a 'building block' approach to developing transformative capacities.

Empirical research has shown that, in many cases, the transformative capacity of 'reflexivity and social learning (C8)' is an enabler for developing other transformative capacities (Castán Broto et al. 2018; Wolfram 2019a). Like these other cases, the development of Sihanoukville city's capacity for reflexivity and social learning (C8), is likely to support the development of its capacity for systems awareness and memory (C4), and in turn, aid the development of a collective vision for urban sustainability (C5.2). Developing a collective vision for urban sustainability (C5.2) would also support the development of a range of other transformative capacities (transformative leadership (C2), communities of practice (C3) and diverse community-based experimentation (C6)).

To support the development of Sihanoukville's foundational capacity for reflexivity and social learning (C8), the co-design of a reflective knowledge partnership with a university and/or development agency could enable Sihanoukville to strengthen other transformative capacities (Keeler et al. 2019, 2022). Furthermore, focusing initially on transformative visioning and goal setting (C5.2) would strengthen the sectoral planning processes by providing a clear direction, and potentially encourage alignment between local and national policy settings and management practices (Webb et al. 2023). Further, key interventions that would support urban stakeholders to develop the capacities needed for urban sustainability transformations are: (A) ensure resources are available through key intermediaries; (B) strengthen multi-level governance; (C) implement pilots (and learn from failure and success); (D) strengthen strategic planning and management for city-wide reorientation.

Transformative capacities could also be strengthened in Sihanoukville through collaborative knowledge partnerships that recognise the inherent value of informal circular economies. In rapidly developing cities in Asia, where informal waste recycling systems often co-exist with the municipal waste service, there is an opportunity to harness the existing informal local practices to achieve a more sustainable system (De Bercegol et al. 2017). Sihanoukville's authorities had already informally worked with the informal waste collectors, by providing them with resources (e.g. housing, electricity, access to the landfill site). Therefore, there is an opportunity to build on this as part of its waste management plan and provide capacity building and support to the informal waste collectors, potentially through skilling up community-based waste banks and improving labour conditions, as in the case of Surabaya, Indonesia (De Bercegol et al. 2017). Surabaya transformed the urban waste sector through direct technical assistance from Kitakyushu city, Japan, implementing the Takakura Home Composting method, demonstrating how city-to-city cooperation can strengthen transformative capacities through household and village-scale support (Kurniawan et al. 2013). Similarly, Sihanoukville could learn from the progress made by the ASEAN-designated sustainable city, Battambang, Cambodia, potentially through a mediated city-to-city partnership (Lord and Prior 2024).

There is an opportunity for research into urban transformative capacities, especially in Southeast Asia, to gain insights from similar studies into adaptive capacities. As noted in the introduction, adaptive capacities are needed for transformative climate resilience. They can be defined as the capacity of a system(s) to adjust its characteristics or behaviour, in order to expand its coping range under existing climate variability or future climate conditions (Brooks et al. 2004). Previous research on adaptive capacities in Southeast Asian cities highlights elements of governance and planning systems that are constrained, and are preventing transformative resilience. Marks and Pulliat (2022), for example, found that the centralisation of power in governance systems has undermined urban resilience in secondary cities of Southeast Asia, causing a misalignment of incentive structures, and the resulting uneven distribution of urban climate risks. Nunn et al. (2021) demonstrate through case studies in the Asia-Pacific region that adaptative capacity has been constrained by path dependency, especially due to limited forward planning in relation to climate risks, favouring of short-term incremental interventions, the limited capacities of national governments to translate policies of resilience-building at the community level, and a lack of resources to invest in long-term solutions. Similar constraints were evident in the case of Sihanoukville, with the city's centralisation of governance power and limited strategic planning towards sustainability goals.

Our research applying the UTC framework in Sihanoukville had practical benefits for the urban stakeholders. We found that the stakeholders participating developed an awareness of transformative capacities, particularly in focus groups and

workshops, where they discussed the extent to the transformative capacities were evident in Sihanoukville and how they could be enhanced. The workshops and interviews also provided opportunities for reflection and discussion on key barriers and opportunities to developing transformative capacities, advancing collective knowledge of the urban systems and pathways to sustainability transformations. We shared our analysis of Sihanoukville against the UTC framework with the intermediary (an international development agency) that co-facilitated the workshop (as a workshop report) to support their capacity development programmes and use it as a baseline for future reference.

Research limitations and opportunities for further research

The practical benefits of our research for urban stakeholders were limited by its short-term nature. To support the development of urban transformative capacities in Sihanoukville (and/or other capacity-constrained cities), a longer-term transdisciplinary research initiative could be co-designed, focusing on UTC analysis and capacity development oriented towards the cities' urban transformation goals, aligned to the transdisciplinary research practices of Mitchell et al. (2015). Moreover, a longer-term collaborative research program could potentially help address the underlying capacity constraints – particularly capacities 1 to 3 – which likely stem from deeper systemic and structural issues, embedded in the local political-economy and governance cultures. Using additional frameworks of political governance analysis to ascertain the root-cause or structural issues would assist (Kooiman 1999; Kooiman and Jentoft 2009; Lord and Prior 2024) as well as frameworks for capacitating urban governance and planning systems to drive transformations (Asadzadeh et al. 2023; Webb et al. 2023).

With a single case study city in Cambodia, we were not able to ascertain the extent to which these research findings in Sihanoukville stem from the specific conditions of the city, the country or the region, for example, and/or whether there would be any commonalities between cities of a similar size and/or level of economic development, in other countries or regions. There is an opportunity to expand empirical research and cross-case analysis to ascertain the commonalities and differences underpinning the UTC analysis, including any specific social-cultural, economic or political dimensions underpinning capacities in Southeast Asia.

Conclusion

Our transdisciplinary case study in Sihanoukville applied Wolfram's UTC framework to understand how the city could strengthen its capacities to transform the sanitation sector. Transformative capacities allow for systemic change and empower communities and individuals to take action towards a collective vision of sustainability transformation. We found that Sihanoukville had recently experienced an economic and infrastructure transformation (with major investments in wastewater treatment and waste management infrastructure) but was yet to develop local governance capacities and planning structures needed to sustain an urban sustainability transformation. Applying the UTC framework in Sihanoukville enabled us to identify key capacity focus areas for strengthening towards a sustainability transformation. An initial key focus would be establishing local reflexive and learning practices, knowledge partnerships and transformation visions and goals. Underpinning these early building blocks should be a focus on the analysis of power structures and potential socio-political barriers preventing regime shifts and identifying if existing unsustainable structures need to be dismantled and decline. Further, the learning processes for transformation of the sector have the potential to build on existing collaborations between the city's formal and informal waste recycling sectors and harness the existing adaptive capacity of local urban stakeholders.

Note

1. A negative (-) sign indicates that the there was a participant(s) who was in both the focus groups and interviews, to avoid double counting the participants.

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Notes on contributors

Fiona Lord is a PhD candidate at the Institute for Sustainable Futures, University of Technology Sydney. Her research focuses on governance and transformative capacities for sustainable city transformations in cities of Cambodia.

Jason Prior is Professor of Planning, Health and Environment at the Institute for Sustainable Futures, University of Technology Sydney. As an architect, planner, and geographer, Jason's research program focuses on the environment, planning, and human and planetary health.

Monique Retamal is a Research Director and Program Lead for Resource Stewardship at the Institute for Sustainable Futures, University of Technology, Sydney. She specialises in sustainable systems of consumption and production in the Asia-Pacific region. Her research is currently focused on circular supply chains and environmental governance for plastics and textiles.

Authors' contributions

FL: Conceptualisation, Investigation, Methodology, Data curation, Writing – original draft, Formal analysis, Writing – review & editing. JP: Conceptualization, Supervision, Writing – review & editing. MR: Conceptualization, Supervision, Writing – review & editing.

Availability of data and materials

The datasets presented in this article are not readily available because full interview transcripts were obtained confidentially by the researchers. Requests to access the datasets should be directed to the lead author (Fiona.N.Lord@student.uts.edu.au).

Ethics

The authors confirm that approval was provided for this research through the UTS Human Research Ethics Committee, University of Technology Sydney (approval ETH21–8505). Research participants provided informed verbal and/or written consent to participate in this research project.

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