Amsterdam's Decaying Canal Infrastructure

Urban Development Textual Analysis

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City Introduction:
Amsterdam, capital and principal commercial center of the Netherlands, attracts scores of tourists each year with its beautiful network of canals and well-preserved landmarks. Historically, the Netherland's canals and riverways have played a critical role in the nation's infrastructure and history. Amsterdam's concentric circles of canals were built over five hundred years ago to facilitate defense, irrigation, wastewater removal, and movement of goods (World Heritage Convention, 2010). However, the city's rapid growth and modernization needs to be supported by technologically advanced infrastructure. With 26 percent of land currently below sea level, the city is faced with 125 miles of dilapidated canal walls that are "in danger of collapsing and potentially taking buildings and people with them" (Erdbrink, NY Times). In an era of rapid climate change, Amsterdam must implement a number of redevelopment measures to ensure its long-term future and sustainability.

City Urban Development Profile:
The area of the city is 64 square miles with a population of 1.2 million people, and the metropolitan area is 245 square miles with a population of roughly 2.5 million people. The inner city is divided by its network of canals into some 90 "islands," and the municipality contains approximately 1,300 bridges and viaducts (Britannica). Amsterdam is one of the most densely populated areas of the country, with roughly 3,600 people per mile squared. The Netherlands has a prosperous and open economy, relying heavily on foreign trade. The GDP per capita is $58,240 and the Gini coefficient for income inequality is merely 0.266 (Darmawangsa, Berkeley). Amsterdam is very well connected globally as a leader in international commerce, technology, and digital services. According to the World Bank, the Netherlands has the fifth lowest at-risk-of-poverty ratio with 0.1% of the population living in poverty at $2.15 per day. These quality of life indicators suggest that Amsterdam's issues are deeply rooted in logistics and physical infrastructure, rather than sociopolitical conflicts.

Urban Development Issue: Background and Diagnosis
First built in the 1600s, Amsterdam's canals are slowly crumbling and require extensive redevelopment. From sinkholes appearing on nearby roads to collapsing canal walls to rickety bridges showing their age, the city's iconic features are nearing a breaking point. Recent climate change-related events and infrastructure failures highlight the criticality of immediate action and the need to find solutions. Canal walls near the University of Amsterdam are one extreme example of this, with "sewer pipes dangling and disoriented fish jumping out of the water." At the same time, "sinkholes are appearing in its small streets" and swallowing "antique lamps[post]" (Erdbrink, 2021). In short, the infrastructure is breaking down. The canals and the city sit on top of "millions of wood pilings that serve as foundations" (Erdbrink, 2021). While this wooden infrastructure was once the height of innovative design, today it represents an immense vulnerability for the city. Water has swept under the city's foundation and hollowed out the ground. For an area that is already swampy and unstable, rising sea levels pose a threat to the city's very existence.

The circular ringlets of canals were built for a very different time. The need for modernization was clear at the turn of the 20th century. With a growing population and the need to dedicate more space to the automobile, some of Amsterdam's canals were filled in to create roads (Bicycle Dutch, 2016). However, these roads were built to meet the demands of pedestrian traffic

and horse-drawn vehicles, not the immense weight of modern trucks and motor vehicles. As a result, “wood pilings have shifted, cracked, [and] collapsed under the pressure” (Erdbrink, 2021). Complicating this picture are the layers of modern innovations including electrical and communications cabling. What might have been thought of as only an infrastructure issue has become a concern to the city and society overall. In some ways, by wiping out tourist traffic, Covid-19 restrictions highlighted what the city had been missing. The city reported a slowdown in structural movement and damage during the pandemic. The recent return of downtown traffic in Amsterdam has made clear the urgency of the task at hand.

Amsterdam’s canals also play a critical role in the city’s water pollution management and sanitation systems. Similar to the crumbling canal infrastructure, the city’s aging water networks are also facing hard challenges. Amsterdam’s location adjacent to the river Amstel helps drive circulation patterns in the city (Peters S, Ouboter M, Lugt Kvd, Koop S, Leeuwen K, 2021). The canals help intake water from the Amsterdam-Rhine canal to use in locks around the city while also helping to clean the water from lake Ijsselmeer (Peters S 2021). In the 1850s, the canal system changed from being an open sewage system to a system that relied on wastewater treatment and natural flushing from the North Sea canal (Peters S, 2021). Additionally, in 2005, the targeted removal of “nutrients at minimal chemical input and energy use” improved the canal system’s water quality. These changes greatly improved the water’s quality over time.

Involved Stakeholders

Amsterdam’s decaying canals are an imminent threat and put many in harm’s way. Stakeholders include Amsterdam’s local residents, tourists, the media, city government, the traffic and transport office, canal engineers, and the national government. Each stakeholder group bears different involvement in the issue and has a unique impact on Amsterdam’s canal infrastructure [refer to Table One].

Stakeholders	Involvement in Issue	Stake	Influence	Position	Impact on Issue
Amsterdam’s Residents (Houseboat Owners)	Bearers of Harm	High	Medium	Supportive	High
Tourists	(1) Bearers of Harm (2) Tourism has negative impact on infrastructure	Medium/ High	High	Supportive	High
Transportation Government Office (Alderman Sharon Dijksma)	Failure of Maintenance	High	High	Reluctant Support	High

Engineers and Project Manager (Albert Jongsma)	Infrastructure Data and Maintenance	High	High	Supportive	High
National Government	Lack of Economic Support, Regulation, Maintenance	High	High	Reluctant Support	High
City Government (Amsterdam's Chief Recourse)	Lack of Economic Support, Regulation, Maintenance	High	High	Reluctant Support	High
Waste Management and Other City Infrastructure	Infrastructure Harm	High	High	Supportive	High
Media	Profile on Public Issue	Low/Mediu	Medium	Supportive	Medium

Table 1: Amsterdam's Urban Development Issue of Historic and Aging Canal Stakeholder Table

Current Interventions

The city's first intervention towards the problem of collapsing canal walls is extensive monitoring. The municipality uses traditional measuring bolts to track structural movements. Additionally, more innovative methods such as the use of satellite data, sonar, and 3D scans also monitor the conditions of Amsterdam's canals and bridges. Specifically, Synthetic Aperture Radar (SAR) satellites use displacement monitoring to track over 200 kilometers of quay walls along the historic inner-city canals. Historical buildings and landmarks are often located near the canals and therefore are vulnerable to construction damage and quay decay. These preventive measures are crucial to preserving the physical and historical assets of the city – many of which are key attractions and landmarks that define Amsterdam (Brokke, 2020).

In addition to preventative measures, the city is also involved in the extremely capital and time-intensive process of rebuilding the collapsed walls. Amsterdam has 1,600 bridges and 200 kilometers of canals that require consistent monitoring and replacement if needed. "In the period up to and including 2023, some 27 bridges will be renovated, approximately 800 meters of quay walls will be renewed, and the replacement of about 3,800 meters of quay walls prepared,totaling costs at around EUR 500 million (Narula, 2021). Divers conduct surveys and environmental scans to determine if the installation of steel support structures is needed to withstand the weight of huge trucks that drive over the quays and bridges. One caveat to this construction is the shutting down of roads, exacerbating the city's traffic congestion. The city needs to account for the large number of houseboats and the limited construction working space on land. To mitigate congestion, Amsterdam has spent 2.8 billion Euros and 15 years building a metro system that allows for efficient and effective public transportation. Additionally, the city's 2030 Mobility Plan aims to introduce new cycle bridges, ferry services, and bicycle parking facilities on both

the underground and street level. Looking to the future, Amsterdam's sources have indicated that completing all the canal repair work will cost upwards of 2.5 billion Euros and take roughly 20 years to complete (Erdbrink, 2021). This allocates EUR 22.5 million each year for canal infrastructure maintenance.

The city also has intervention measures in place to address water pollution and sanitation in the canals. In 2019, the municipality of Amsterdam commissioned a project called The Bubble Barrier to strive for plastic-free waters. This innovative solution was developed to stop plastic from following through canals into the ocean [Figure One]. The bubble curtain is "created by a perforated tube on the bottom of the waterway where the air is pumped through," resulting in a screen of bubbles that blocks plastics and directs underwater plastics upwards to the surface. "The diagonal placement of the bubble curtain in the waterway guides plastic waste to the side" and into a catchment system which allows for easy collection (The Great Bubble Barrier). This inexpensive solution only required five hours to install and can trap up to 86% of the plastic waste that would otherwise flow into the North Sea (Narula, 2021). Amsterdam's water authority empties the catchment system three times a week and sends the waste to a processing facility for sorting and recycling. The Bubble Barrier is an innovative system that emphasizes Amsterdam's commitment to conservation and reducing plastic pollution.

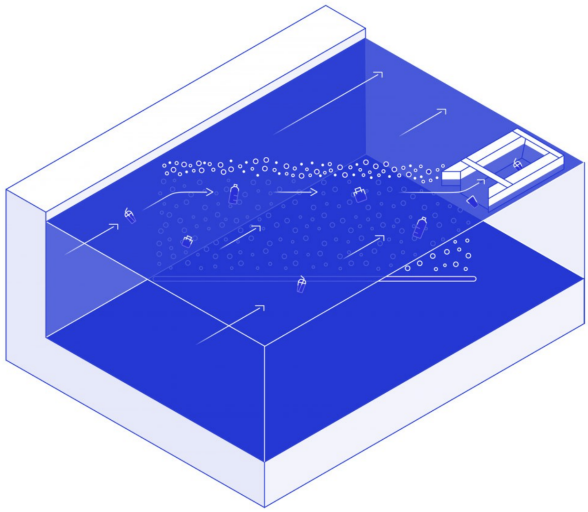

Figure One: Rendering of a Bubble Barrier (Source: Narula, 2021)

Solutions

Solution #1, Stop-Gap: The proposed solution is to maintain today's work and maintenance upkeep to fix the decaying canal infrastructure as urgently needed. Amsterdam government officials and hired engineers have studied the number of bridges and kilometers of canals which need to be replaced. The potential danger in the fix-as-needed approach is that it creates an endless cycle of construction for the city. Amsterdam could continue to undertake these kinds of band-aide infrastructure fixes on an accelerated timeline for the foreseeable future. However, what is needed is a series of long-term modernization projects. Such extensive projects would be more effective but not easy or cheap. However, the reality is that Amsterdam needs to focus on the imminent threats to the canal infrastructure. Over time, to overhaul the entire system, the city must build support for much heavier construction projects, implement new policies, develop

sound urban planning approaches, and engage with the public. Pursuing short-term fixes that will address the immediate threat of decaying infrastructure should be married to a strategy of developing the political will to undertake a longer-term solution. To do this is simple, add funding through the municipal government to ensure the safety and beauty of Amsterdam's residence

Solution #2, Public-Private Partnership: The second proposed solution is a specialized public-private partnership to restructure infrastructure focused on the city's urban renewal and canal maintenance. These partnerships can be cost-effective and responsive policies for cities to rapidly turn an old system into a new, innovative system while ballooning business needs and strategies (OECD, 3). The Dutch Ministry of Economic Affairs has been studying the impact of efficiency related to public-private partnerships and its role in national policy and "for Dutch economic performance in the future" (OECD, 5). The combined public-private cooperation would benefit both increased research for urban planning infrastructure solutions and cost-effective ways to increase funding for canal preservation. Using the United States Infrastructure Bill and Department of Transportation Public-Private Partnerships as an outline, the potential benefit of the specialized partnership program is that the private sector can bring "innovation and capital to address complex problems" affecting the city (Department of Transportation, 2021). Furthermore, the private sector has the ability to take "on additional project risks such as design, construction, finance, and long-term operation" (Department of Transportation, 2021). A newly specialized partnership also has the third benefit of creating jobs for the country and cities' citizens. A partnership with Dutch-based urban planning companies can also boost the local economy. A specialized canal maintenance public-private partnership would benefit the city in the long term by providing funding, encouraging innovative thinking, bolstering the local economy, and safeguarding the city's canals and future.

Solution #3, Comparison Approach: Amsterdam's canals are reminiscent of Venice, the capital of Italy's northern region. A comparison approach between these two cities can provide insights into potential solutions. Venice was historically built on a few hundred small islands in the Venetian Lagoon and currently operates through a patchwork of local streets, canals, and quays (Britannica). Automobiles are banned from the city, so residents and tourists rely on public water buses run by the municipal transport system, private motor-launch taxis, and walking for transportation. In January of 2023, Venice began implementing a fee of €3-10 for day-trippers. Mass tourism results in several negative externalities such as the enormous pressure placed "on the city's sewerage and recycling facilities, as well as on local transport and accommodation" (Eaglecliffe, 2022). Amsterdam currently charges a flat fee of €3 per person, per night on any visitor spending the night in a hotel, in addition to the current 7% room rate. As the city's infrastructure also suffers from overcrowding from visitors, Amsterdam could follow Venice's lead and raise this tax so that tourists shoulder more of the hefty burden related to financing canal redevelopment and construction.

Conclusion

Amsterdam is an innovative urban planned city whose concentric circles of canals make it a historically unique urban environment. Although a key attraction, the canals are also a salient urban development issue. The city's decaying canal infrastructure requires extensive modernization to mitigate risks and safeguard the city's future. Infrastructure constraints affect

many aspects of the city’s physical environment, from collapsing canal walls and bridges to water-borne congestion to water pollution management and clean sanitation systems. Although redevelopment is extremely costly, Amsterdam must act with urgency and recognize the scope of its decaying infrastructure. To ensure the city's future, the local and federal governments must secure funding through new taxation methods and forming public-private partnerships. Now is the time for Amsterdam to modernize and restore its historical canal infrastructure.

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