Chapter 7
A Cybernetic Analysis of Urban Mobility Through the Viable System Model:
Designing City Mobility Systems With Citizen Self-Management

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ABSTRACT

Urban mobility systems are complex, dynamic, and critical for sustainable city development. This chapter applies Stafford Beer's Viable System Model (VSM), a framework from organizational cybernetics, to the design of urban mobility. The VSM outlines five essential functions (Systems 1–5) that enable complex systems to remain viable amid internal and external challenges. We propose a theoretical model where government, private, and citizen-led mobility services operate as semi-autonomous units within a coordinated meta-system. Emphasis is placed on integrating citizen participation and self-managed initiatives into the system's governance structure, in line with emerging smart city paradigms. Through a conceptual case study, we illustrate how cybernetic principles—such as distributed control, feedback loops, and recursive structures—can enhance responsiveness, resilience, and legitimacy. The result is a mobility system that is not only efficient but also adaptive, learning, and co-governed, aligning with the needs and values of the communities it serves.

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INTRODUCTION

Modern cities face numerous challenges in the realm of urban mobility. As populations grow and transportation needs become more complex, city mobility systems must handle challenges such as congestion, pollution, inequitable access to transit, and rapidly changing technology and travel patterns. Traditional top-down planning has often struggled to keep pace with these challenges (Chen et al., 2025). In response, there is growing interest in *cybernetic* and systems-based approaches to analyze and improve urban mobility (Geherson et al., 2021). Cybernetics – the science of communication and control in complex systems (Wiener, 1948/2019) – provides concepts like feedback loops and adaptive control that are highly relevant for understanding a city's transportation network as an integrated, self-regulating system.

One promising framework from management cybernetics is Stafford Beer's **Viable System Model (VSM)**, which conceptualizes the essential organizational structure and functions needed for complex systems to maintain viability (Beer, 1981). Originally developed to diagnose and design effective organizations, the VSM has been applied beyond businesses (Gallego et al., 2018), including in government (Murphy & Regenold, 2023) and community contexts (Espinosa & Martinez, 2025). The core idea is that any system capable of independent existence (i.e., a *viable* system) requires a set of interrelated subsystems responsible for operational work, coordination, control, intelligence, and policy/identity (Beer, 1979, 1985). In an urban mobility context, the VSM can serve as a theoretical lens to identify these functions and ensure that the mobility system can survive, adapt, and evolve amid internal and external pressures.

Another trend in contemporary urbanism is the push toward **participatory governance** and citizen centered design of services (Oregi et al., 2025). Smart city paradigms emphasize that technological solutions alone are insufficient – human and social capital and participatory governance are equally crucial to achieving sustainability and high quality of life (Pira, 2021) . In mobility planning, this translates into engaging citizens not just as users but as co-creators of mobility solutions. Across the world, we see emerging examples of citizen-driven mobility initiatives: community-organized ride-sharing and car-pooling networks (Hosford et al., 2021), volunteer-run shuttle services for the elderly (Freund et al., 202), "walking bus" groups for school children (Johnson et al., 2024), and more . These bottom-up initiatives often arise to fill gaps that public transit or market solutions fail to address, and they exemplify **citizen self-management** in mobility. Incorporating such initiatives into the formal urban mobility system can enhance adaptability and local relevance, but doing so requires a governance model that can accommodate distributed autonomy while maintaining overall coherence – a challenge well-suited to a cybernetic approach.

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