Criticality Analysis: A tool for a world in disruption

Lyvia Nascimento Cirqueira Fischer*

Tanja Schnittfinke**

Bruna Brauer*

Abstract: The article explores the application of the Criticality Analysis methodology, adapted to investigate the impacts of COVID-19 on the livelihoods of marginalized groups in three urban contexts: Cape Town (South Africa), the Ruhr Region (Germany), and São Paulo (Brazil). The research employed participatory criticality assessment to elucidate the cascading effects of mobility disruptions on access to critical urban infrastructures, resulting from disturbances in transportation systems during the pandemic. Through cascading effect representations, the study sought to demonstrate the interdependencies among urban systems and the possible chain reactions triggered by changes in transport, impacting access to essential everyday services such as education, health, social assistance, food, and nutrition.

* Universidade Federal do ABC (UFABC); ** TU Dortmund;

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Introduction

Urban accessibility can be measured by the ease with which people reach places of opportunity. It is a function of both the spatial distribution of places and the organization of urban transport systems, fundamental elements to ensure that individuals can reach their workplaces and access essential services for maintaining their livelihoods (Pereira et al., 2019). Thus, the connectivity of a place results from a complex dynamic combining the geographic distribution of activities and the organization of the transport system.

We know that not everyone has the same conditions of access to places of opportunity. Marginalized social groups, such as women, the elderly, and low-income populations, feel these inequalities more acutely (Pereira et al., 2019). When located in the urban peripheries of the Global South due to a lack of economic and transport opportunities, this reality is even worse during the COVID-19 pandemic. Accessibility problems increased mainly due to the social distancing measures adopted by governments to contain the spread of the coronavirus. In many countries, transport systems were affected, causing potential effects on mobility and people's ability to access critical services.

In São Paulo, as an emergency measure, the Municipal Secretariat for Mobility and Transport established new rules for the execution of public passenger transport services, requiring São Paulo Transportes S/A (SPTrans), together with collective transport concessionaires, to adjust the bus fleet according to new demand (São Paulo, 2020). This mainly harmed those living in low-income areas, usually far from urban centers where goods and services are concentrated.

Systemic Criticality and Cascading Effects

The main negative consequences of a major external event such as the pandemic on livelihoods stem from failures or interruptions in the functioning of Critical Infrastructure (CI), since these infrastructure systems can be understood as interconnected services essential for maintaining society's vital functions.

In this sense, the disruption of a single service has the potential to amplify risks and generate repercussions across the system (Kruse; Schmitt; Greiving, 2021). This is why transport infrastructure can be understood as a critical system, as its disturbance directly and indirectly affects access to other essential infrastructures, such as health, education, and social assistance.

The new transport rules during the pandemic affected spatial mobility, hindering or even preventing people's access to essential services necessary to maintain their livelihoods. To assess the magnitude of these consequences, the Criticality Assessment approach was employed, focusing on the public impact caused by these changes, with emphasis on access to education, health, social assistance, food, and nutrition services.

Criticality measures the degree of importance of an infrastructure, considering the impact that a failure or disruption in this infrastructure would have on the provision of goods and services for society. In this study, criticality analysis sought to demonstrate the weight of the consequences that a disruption or failure in the transport system can have on marginalized groups' access to essential services in a moment of crisis, such as the pandemic. Being highly interconnected systems, failures or disturbances in a single CI can trigger cascading effects, compromising the functioning of multiple essential services (Kruse; Schmitt; Greiving, 2021).

To better understand the effects of mobility restrictions on other interconnected systems, a scheme of cascading effect diagrams was employed to elucidate the impacts of mobility disruptions on health, education, social assistance, food, and nutrition systems, considered fundamental for the security and well-being of marginalized families.

The development of this scheme involved an extensive literature review on CI interdependencies, as well as interviews with specialists representing critical sectors. The information collected was represented in a cascading effect chain structure (Figure 1), to demonstrate the impacts on CI users and workers whose causes originated in changes to the mobility system and in the consequent reactions triggered on respective CIs.

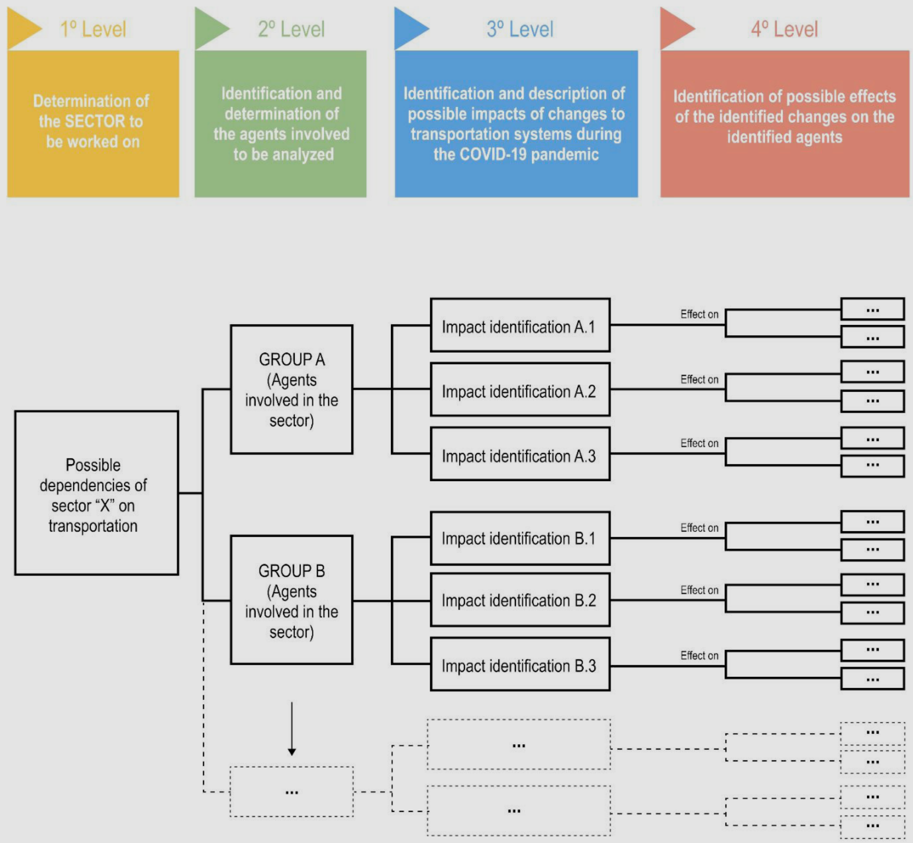

Figure 1. Example of cascading effect structure
Source: prepared by Bruna Brauer, August 2024.

The analyses showed that during the pandemic, the social assistance sector, an essential infrastructure to ensure the security of vulnerable populations, especially in times of crisis, was severely affected (Fischer et al., 2025). In the Brazilian context, for example, this service was interrupted on trains and in São Paulo stations that offered assistance to victims of sexual harassment.

The reflections also make it clear that transport measures have great political relevance in the school context. They can affect not only the learning process but also the guarantee of food security. In this sense, going to school ensures not only the continuity of studies but also meets the nutritional needs of children and young people living in extreme vulnerability, many of whom depend on school meals for their daily food.

In São Paulo, for example, one of the first transport measures of the pandemic was the suspension of free fare quotas and half-fares for students. Even if schools remained open, such a measure would directly affect not only the teaching and learning of marginalized children and young people but also their food and nutrition, since schools play an essential role in social protection.

These examples highlight the profound impacts of disruptions in critical infrastructure sectors on the livelihoods of marginalized groups. Seemingly isolated changes in transport systems produce broad effects on everyday life (Schnittfinke et al., 2024). Public transportation plays a fundamental role in access to health, food, education, and social assistance services. When these systems are impacted - including as a result of political decisions -, it is marginalized groups that disproportionately face the greatest consequences in their daily lives.

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