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# *Does a multi-risk approach help in understanding urban networks? Reflections on entangled dynamics based on two French cities and a Turkish metropolis*

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## INTRODUCTION

The Covid-19 global pandemic powerfully demonstrated the key role networks play during disasters, as both vectors for the propagation of outbreaks and as support for prevention measures. Airports are an emblematic example of this. From the start of the pandemic to date, airports have been the object of numerous measures (the closure of air borders, limits on access, prevention measures such as compulsory mask wearing, thermal cameras, health “passes,” manual temperature taking, etc.). However, these new measures compound with the myriad pre-existing norms and security measures, including: anti-terrorist measures for all airports (magnetic gates, detection of explosive materials, video surveillance, etc.); seismic risk measures for certain airports (evacuation zones at Istanbul airport); and, increasingly, marine flooding risk measures due to the rise in sea levels in coastal areas (Yesudian and Dawson 2021). The consequences of this superposition of measures merits further investigation.

Many disaster studies highlight the key role networks play in the propagation of risks and dysfunctions due to the former’s interdependency (Guilhou et alii. 2006; Boin, McConnell 2007; Galland, 2010; Lhomme, 2015; Touili, 2022). Such approaches tend to perceive networks in generic way in establishing their importance in crisis dynamics. Moreover, their assessment of potential risks is often based on a single-risk model (floods, earthquakes, fires, power failures, terrorist acts, etc.), although work on risks has demonstrated the importance of conceptualizing the latter in a combinatory way (November, 2002, 2008; Lakoff, 2007; Gill, Malamud 2016). Multi-risk approaches, on the other hand, highlight the interactions between several types of risks. This can include **transfer** scenarios (from one risk to another, one population to another, or one territory to another) (Beck, 2001); **sequences** (also called “domino effects”) between several risks; or **hierarchization**, which prioritizes certain risks over others. These three typical forms are by no means representative of all of the possible interactions. Urban networks are exposed to heterogeneous dynamics during disasters or crises.

Although each disaster is unique and varies in form and scale, the dynamics that burden networks and exacerbate these situations are little documented.

As such, it is critical to develop approaches that connect urban networks and combined approaches to risks, that we call “multi-risk” approaches. This article documents the interrelationships between risk dynamics and urban network dynamics. We hypothesize that, by highlighting these interrelationships, we can better understand crisis and disaster situations. Revealing the many ways multi-risk situations and networks can overlap and become entangled is heuristically important for the risk and crisis field.

To this end, we will explore the interrelationships between risks and networks from three angles. The first is that of the moment of the crisis itself. As stated earlier, crises are often revelatory hitherto underdetected dynamics. In consequence, it is critical to observe how actors handle combined dynamics with regard to risks and networks. The second angle is multi-risk perspective. Exploring networks through such approaches sheds light on potentially atypical relationships between local actors. The third angle involves including the multi-scalarity of networks and risks to better highlight the rapprochement (or sticking points) between different scales to better appreciate their interactions.

Empirically speaking, we used a multi-site approach commonly employed in the social sciences (Bocquet, 2019). We analyzed three urban systems in which multi-risk practices and questions emerged: the French agglomerations of Nantes and Le Havre, and the city of Istanbul in Turkey (1). Though the investigations did not focus specifically on the interactions between networks and risks, several convergent examples emerged when we reinterpreted them in light of networks. As the multi-site approach did not call for strict comparison, we have provided an overview of the three case studies to explore multi-risk interactions on a generic object: networks. This allowed us to observe how these “network” objects impact multi-risk analyses and vice versa, by shifting our analytical focus from the institutional/political context to urban systems in dense agglomerations and negotiations between the actors, namely the national government and local actors.

After a short review of the literature on the conceptual diversity of multi-risk approaches and networks as a socio-technical apparatus, we will look at the multi-risk concept as

an operational practice used by urban actors in our three case studies. The third section explores a specific example in each of the three cities to highlight different ways multi-risk reflections can be incorporated into the design and operation of structuring networks and the flows generated by them. The final discussion underscores the added value of analyzing urban networks in a multi-risk perspective with regard to crises, multi-actor relationships and multi-scalarity.

## **MULTI-RISK APPROACHES, NETWORKS AND TERRITORIES**

Multi-risk approaches are relatively recent in literature on risks and disasters, but have become increasingly essential in the field. After exploring multi-risk approaches and proposing a generic definition of networks, we tested these concepts in the three territories and thus revealed the first dynamics and interrelationships.

Multi-risk approaches are in line with disaster and crisis management analyses, and encompass a wide variety of risks, not only “natural” ones. The Sendai Framework for Disaster Risk Reduction (2015-2030) suggests the need to consider different types of risks jointly, but does not specifically discuss their interactions (Gill, Malamud 2016). Such approaches are in line with “all-hazard” approaches, which propose generic responses in anticipation of unforeseen events during crises rather than hazard-specific scenarios (Perry, Lindell 2003; Wise, 2006; Lakoff, 2007). In this respect, it is more accurate to use the term “multi-crisis” approaches than “multi-risk.”

These approaches are akin to operational analysis methods for evaluating risks and their territorial relationships in greater depth with tools that allow for harmonized approaches. The result is a comparison or prioritizing of risks (Komendantova et alii. 2016). Gill and Malamud (2016) suggest going beyond “multi-layer, single hazard” approaches to truly grasp the interactions between different hazards and territories. They lay out three types of relationships: triggering, increased probability and catalysis/impedance. The case of Fukushima is often cited as an almost “ideal type” disaster with cascading effects: an earthquake causes a deadly tsunami that sparks a nuclear disaster. The erraticism and indeterminacy of such disasters that transcend time and space require more horizontal and inclusive crisis management tools.

Secondly, multi-risk approaches also employ the notion of “systemic risks.” This refers to emerging phenomena that

broadly threaten fundamental societal systems (OECD, 2003). Poised between the analysis of complex systems and risks, the concept refers to the existence of risks that cannot be remediated using classical methods for calculating probability and of collective insurance (Renn, Klinke, 2004). The characteristics used to them are based on two key features: complexity and uncertainty. Risks are complex because reconstructing, modeling or understanding causal chains when multiple, undetermined factors are involved proves challenging (Renn, 2022). Consequently, deterministic approaches such as probability distribution are ineffectual when it comes to anticipating them (Van Asselt, Renn 2011). Like “multi-layer” analyses, systemic analyses highlight the “transboundary” nature of risks. This refers to the blurring of conventional limits and borders (sectoral and territorial) and the ability of risks to cut across distinct areas of society (Schweizer, 2021). Systemic risks are characterized by their non-linear development, threshold effects and tipping points (Renn, 2022). Their unpredictability and irreversible consequences render their management complex. The specificity of systemic risks (“climate change” being a common example) has led some researchers to emphasize the need for “inclusive” approaches (Schweizer, 2021), particularly as regards decision-making processes.

A third, more recent approach is that of “compound,” or combined, risks, which refers to the simultaneous existence of several distinct risks in a single area. This approach aims to show that seemingly unrelated crises can nevertheless strongly interact, often compounding and reinforcing like vulnerabilities. In such cases, the response to these risks must be all the more inclusive and flexible. While the Fukushima accident may seem emblematic of “multi-risk” situation and climate change emblematic of “systemic risks,” it is the Covid-19 pandemic that truly has fueled the development of the “compound risks” concept, especially in thinking about relationships based on the consequences climate change (Phillips, 2020; Kruczkiewicz, 2021).

This abundant semantic and conceptual offering shows the importance of a framework for understanding how risks interact when analyzed in combination. To respond to this issue, we used socio-technical approaches to better comprehend the way in which the definition of risks is built in close connection with their management options.

With regard to urban networks, the socio-technical approach considers how networks materialize in the urban

space and contribute to forging the social, institutional and organizational structures present in them. Using this approach, we can also consider the material, organizational and symbolic conditions of these networks in the urban space. Numerous studies have shown that network dynamics occasion novel reconfigurations of the actors who rely on them, resulting in the rearranging of these urban systems. Notably, we wish to cite a special issue of the *Flux* magazine (guest edited by Sylvie Jaglin and Benjamin Steck (2008)) that explores how flows - which result from interdependencies between components of the global system - require territorial and societal readjustment. The concept of infrastructure therefore offers an interesting critical approach for questioning their networking and societal functioning (Vertesi, 2014; Coutard, Rutherford 2017; Chatzis et alii. 2017; Furlong, 2010; Furlong, 2021). This approach emphasizes the importance of actors and their interdependencies, as well as the underlying issues present. Several researchers have shown that certain features of networks only come to light in the event of a problem (Graham, 2010; November, Gueben-Venière 2017). The concept of critical infrastructure also underscores large-scale failures with a high level of interconnectivity between the actors (November, 2011).

In cities, networks have become denser and increasingly interconnected, to the extent that in the event of a failure, they can paralyze an entire urban system (Reghezza, 2015, 2019; Little 2002, 2010) and propagate risks due to the strong actor interdependency (Lhomme, 2015). Interdependencies and dysfunctions linked to networks have led researchers to use the term “network risk” (Blancher, 1995; Galland, 2003) to describe disaster situations generated by hazards triggered by networks themselves.

We will not linger on the notion of network in this article. Rather, we simply wish to reiterate that the notion of urban networks is useful for shedding light on relationships of connectivity between risks and individuals, organizations and territories.

Let us now explore how multi-risk approaches, which are included in territorial risk analyses, have diversified since the late 1990s. These approaches first consider the spatiality of risks (diffuse, network, localized-territorialised) (Galland, 1998) and go on to highlight the multifaceted relationships between risks and territories. This facilitates an understanding of accumulation, transfer and diffusion phenomena between risks (November, 2011). Thus, it is less a question of acquiring

multi-risk operational analysis tools than of using multi-risk approaches to interpret the relationship dynamics between territory and risks. Finally, our goal is to better understand how the multi-risk question emerges locally.

### THE DIVERSITY OF MULTI-RISK PRACTICES IN URBAN AREAS

Many studies have shown that, because of their density, the risk potential in urban areas is higher than elsewhere (November, 1994; Blancher, 1995; Chaline, Dubois, 1994; Dubois, Chaline, 2002). In urban spaces, certain risks transcend their category type. For this reason, some researchers speak of “hybrid” risks (Reghezza, 2009). Taking only the Ministry of the Environment’s legal definition of “major risks,” the Le Havre conurbation, for instance, has three risk prevention plans (PPR): flooding, technological and coastal. However, certain local authorities took on new responsibilities and risk categories above and beyond the regulatory obligations in force starting in the 1990s (Galepois, 2012). The greater metropolitan areas (2) of both Nantes and Le Havre created new services to explore risks, building knowledge and developing specific tools such as population alert systems, internal emergency coordination platforms, etc. Contrary to the national government’s environmental services, whose definition of regulatory risks is category based (major risks are essentially based on criteria of probabilities), local governments offer an endo-urban, or integrated, definition of risks (Boin, Galepois 2006), following Mathilde Galepois’ concept. In other words, the definition of risks is contingent on urban systems as functional, “just in time” spaces (Galepois, 2010). This definition combines the concept of risk with the “crisis”/civil safety approach applied by the Ministry of the Interior, which is responsible for relief organization and planning. The risks borne are therefore broad, and include both “major risks” co-determined with the national government as well as fires, major road accidents, storms, urban runoff, epidemics, etc.

In Turkey, the term “risk” (*risk*) has its origins in the Arabic term “*razk*,” which refers to a blessing. However, this term is rarely used in Turkish planning or in risk management tools. Instead, the term for disaster (*afet*) or danger (*tehlike*) is preferred, showing that “risk management” refers directly to the event itself. The idea of risk as a potentiality or that a situation need not become a disaster is relatively recent. The notion of risk has only come into use in the past decade, following

the implementation of the Sendai framework for Disaster Risk Reduction in 2015, when AFAD (*Afet ve Acil Durum Yönetimi Başkanlığı*, Disasters and Emergency Management Presidency) shifted from “crisis management” (*kriz yönetimi*) to “risk management” or “reduction” (*risk yönetimi* or *azaltma*) (3). This explains why the institutions that manage risk and crisis are named according to the disaster. In the Turkish context, one effectively speaks of “disaster risk” (*afet riski*), and not simply “risk.” As risk studies in Turkey think in silos, risk and crisis management institutions nonetheless must manage several categories of risk at the same time. At the government level, one of AFAD’s jobs is producing risk maps (*tehlike haritası*) on specific hazards (earthquakes, floods, and tsunamis), which increase the data from various scientific expertise studies. In Istanbul, the Central Disaster Coordination Directorate (*Afet Koordinasyon Merkezi Müdürlüğü*) is linked to the Istanbul Metropolitan Municipality (*Istanbul Büyükşehir Belediyesi*) and is charged with attenuating threats through risk prevention and planning. This directorate is required to cooperate with the Istanbul Transport Directorate (IETT, *Istanbul Elektrik Tramvay ve Tünel İşletmeleri*) and the office of water management and pipes (ISKI, *Istanbul Su ve Kanalizasyon İdaresi*).

Despite differences in size and radically different local contexts, the advantage of comparing the cases of Le Havre and Nantes with that of Istanbul is the possibility of illustrating the issue of networks based on two conceptions of the multi-risk approach. Three key practices were identified in these urban spaces: 1) a flexible definition of risks, 2) the sharing of management tools, and 3) reflections on the interactions between risks.

In the three urban areas studied, risk actors were found to have a flexible definition of risks. In Nantes and Le Havre, local governments intervene in a variety of “disturbances” in urban operations (collapses of underground cavities, pollution, heat waves, the flu, etc.). In particular, officials in Nantes are summoned for so-called “public safety” missions, for which their emergency and crisis response systems are reused: emergency shelters, local feedback, mobilization and coordination of volunteers, etc. While reluctant to fully embrace a compartmentalized approach (which includes terrorist risks and attacks), they were widely mobilized to help manage the “Covid crisis.” In Istanbul, defining public policies based on potential disasters (*afet*) also elicits a flexible definition of risks. This definition covers broad range of notions and can be subject to interpretation

in the framework of planning or crisis management systems. Some actors take advantage of the intricate nature of the term “risk” to justify their decisions.

Furthermore, these local actors are adopting management practices that aim to transcend segmented regulations and create greater coherence in public action as regards risks. In France, this means similar tools used for different types of risks. This was the case for the concept of “major risks,” and led to the creation of systems based on a similar prevention (Prevention Plans - PPR) and crisis management planning (ORSEC), which offers a common response system for all types of events. Local actors are deepening this logic by comparing these systems and creating measures that are transferrable to several types of risks (global risk mapping, multi-risk alert systems, etc.). The multi-risk approach therefore considers and acts on the “generic” characteristics of risk situations. The principle was similar in Turkey. In urban planning, tools utilize the notion of “disaster reduction” (*afet azaltması*) or “disaster management” (*afet yönetimi*), in which risks are amalgamated, though they are studied separately and more or less in depth depending on the location. Thus, Law No. 6306 of 2012 on the transformation of disaster risk areas and micro-zoning for urban transformation (2018) applies the concept of disaster generically to situations that can be potentially disastrous.

Multi-risk approaches attempt to go beyond mere superposition when different regulations by risk type apply (for example, when different PPRs are implemented in Le Havre). Local actors are particularly attentive to the cohabitation of different regulations and to the conjunction of two or more risks. They are especially interested in “NaTech” risks and the potential impact of flooding on local industries, as well as critical crisis management infrastructure. For Istanbul, the blanket term “disaster” culminates in a uniform response to risk identification in urban areas in the form of urban transformation (*kentsel dönüşüm*).

The multi-risk approach, however, is a way of challenging the implementation of certain projects. Recent publications by scientists, civil society and even the Istanbul Metropolitan Municipality cross-compare risks in order to highlight the incompatibility of certain urban projects (the new Istanbul canal project, for instance) or public policies (urban transformation) with preexisting environmental, social and/or economic issues (Kuzucu et alii. 2021; Görür et alii. 2020).

Implementing these multi-risk approaches nevertheless gives rise to obstacles: while many systems focus on a single risk, the timing of different procedures may not be compatible. More importantly, the recommendations and operating principles emitted by different services can prove contradictory. In France, connecting various risk and crisis management procedures is not an easy task (Rey-Thibault, 2021). Moreover, risk spatialization systems do not aptly reflect the complexity of risks and their spatial interconnections (November, 2019). Similar observations have been made with regard to crisis management. Servane Gueben Venière shows the usefulness of certain cartographic projection tools for linking heterogeneous objects in the space and time of the crisis. This has helped highlight the domino effects of certain dysfunctions (Gueben Venière, 2019). Finally, a point was raised through the prism of the sociology of science (Akrich, 1989) regarding the importance of investigating how actors translate crisis management from disparate experiences and cultures into a common language. With inherent processes and tools that unify actors from different fields (scientists, planners, builders, real estate companies), urban planning and development faces challenges when it comes to designing cities. Nevertheless, managing risks, observing how they unfold and understanding their interrelationships in the urban space can generate controversy due to the potentially divergent interests of the actors involved and their means of action. In Turkey, an examination of seismic risk reduction policies for buildings reveals adjustments within the framework of decision-making aid mapping systems. These adjustments have generated unforeseen risks during the transformation of certain neighborhoods (Gourain, 2021).

Multi-risk approaches applied in urban areas confirm that urban actors have the capacity to conceptualize and plan for unforeseen interactions between multiple risks. How does the management of material networks resonate with networks of actors and risks?

### CASE STUDIES: THREE URBAN NETWORKS FAVORABLE TO MULTI-RISK APPROACHES

#### Le Havre: the vulnerability of electrical networks in an industrial port city

In France, there is no formal framework for addressing the issue of vulnerability of networks and infrastructures (transportation, energy, water, sanitation, etc.) at the infra-urban scale. Most regulations regarding electricity concern transportation

infrastructure, and not low-voltage distribution. At the national level, Enedis, the French electricity distribution grid operator, revisited its operational crisis management capacities through the development of a specific service, Rapid Electricity Intervention Force (FIRE (4)). However, network security is a recent endeavor (Derdevet, 2020). Thus, use of the “risk” concept, as well as risk-based methods and approaches in these urban networks is based on local initiatives.

In Le Havre, the issue of network vulnerability surfaces sporadically through the aggregation of initiatives in collaboration with the inter-municipal risk service, the Major Risks Information Department (DIRM) and Enedis local representatives. Early collaboration between the risk department and Enedis dates back to 2015, when a local power outage resulted in a potentially dangerous industrial incident. The incident involved a company in the industrial port area that lost control of its production processes and risked emitting ammonia fumes. The director of the DIRM was nearly obliged to sound warning sirens to alert the population. As part of the feedback organized by the prefecture’s crisis center, he contacted Enedis’ local representative to propose collaboration. They began by sharing their respective crisis plan models and suggesting means to improve them. The scope of the risk situations discussed was broad, and included storm risks, which potentially could bring down electrical network infrastructures. The FIRE relies on local relays for more effective intervention. The DIRM tried to sensitize and mobilize the municipalities - especially peri-urban ones - to ensure their role as intermediaries. The collaboration also focused on the domino effects on urban infrastructure (sewage and water networks, in particular), to improve temporary energy self-sufficiency capacity in the event of a power outage. Most notable, however, was another major and rapidly emerging local risk – that of marine flooding. As part of a Coastal Risk Prevention Plan (PPRL) prescribed in 2015 for the Le Havre conurbation, the modeling of hundred-year floods was the occasion to consider the vulnerability of certain urban and port infrastructures. After an initial experimental study to assess the susceptibility of a strategic lock in the Grand Port, the local authority began negotiating a work program with Enedis to improve the resilience of existing electrical substations.

In this case, the metropolitan risk service, the DIRM and the local representative of Enedis opted for a relatively generic definition of risks, allowing them to alternate between a “multi-layer” and a systemic approach to risks. From this flexible

definition, local actors are envisaging multiple entry points between the territory and urban electrical networks at different scales (figure 1). Such collaboration has led to greater awareness of the symbiotic relationship between different “disasters” and the multifaceted relationships between risk and urban networks. In Istanbul, we observed a very different dynamic of the multi-risk problematization.

### **Istanbul: When managing citizen evacuation raises issues during a pandemic**

In early 2019, the metropolitan municipality launched the “earthquake parks” (*deprem parkı*) project. This project was created to designate specific parks as civilian evacuation areas in the event of an earthquake in the framework of the local town plan. These parks were also meant to accommodate infrastructure for managing and regulating seismic events (tents for civilians, logistics buildings, drinking water and electricity supply, and a temporary canteen). Topkapı Park on the Golden Horn near the historic center was the first such earthquake park. Deniz Gezmiş Park, which takes its name from an emblematic, far-left Turkish activist, was the second. While these parks have seen certain fixings and fittings (notably in the form of signage), the strategy for their legal conversion is mainly political and rooted in conflicts of interest and use between Recep Tayyip Erdoğan’s central government and opposition mayor Ekrem İmamoğlu, who heads Istanbul’s Metropolitan Municipality. The government’s right to transform the urban space without coordination with the Metropolitan Municipality has pushed the latter to stake a claim to protect its spaces. Public spaces in Turkey, and Istanbul in particular, are often fodder for conflicts of interest between actors due to significant land speculation. In the past, this has led to controversies that were then spearheaded by “spatial justice” associations (*mekânda adalet*). It has also given rise to protest movements. The Taksim Square protests (2011) against the building of a shopping center and the densification of the emblematic square in Istanbul were illustrative in this sense. Since the earthquakes in the Marmara region in 1999, several risk management institutions (AFAD and AKOM) have pleaded for the opening of public spaces as evacuation zones. Yet, the measures implemented by the municipalities in favor of such areas have often failed. Thus, the objectives of opening the Zeytinburnu pilot zone (figure 2) in a neighborhood close to the Golden Horn did not have the expected results due to intense real estate pressure.



**Figure 1: Multi-risk approaches to urban networks in the Havre urban conurbation**



Main hazards considered

Low flood probability (TRI 2016)

Hazards modeled by PPRL (2022)

<0.2m to 0.5m

0.5 to 1.0m

1.0 to 2.0m

Main infrastructure at risk

Dangerous industrial site (Seveso and "High risks")

Locks

Risk management measures for networks

Local "risk correspondants" for storm

Construction works to transform networks

Sources : PPRL PANES, DDTM 76 2022 ;  
TRI du Havre, DDTM 76 2022 ; Plaquette  
PPI, SIRACED-PC 76, 2010 ; ORMES, BD  
ORTHO, IGN 2019

Lexicon:

PPI: Plan particulier d'Intervention /  
Industrial contingency plan

PPRL: Plan de Prévention des risques  
littoraux / Coastal Risk Prevention Plan

TRI: Territoire à Risque d'Inondation/  
Flood-prone cities

Cassandre Rey-Thibault, 2022

Topkapı Park is covered by developers due to its proximity to the historic and touristic center and to the Zeytinburnu district. The same is true for Deniz Gezmiş Park in the Ataşehir district, the home of Istanbul's future financial center in the Asian portion of the city. This second park is unique in that it is located near a dammed watercourse, which poses soil liquefaction issues. As they are close to the fault line, these areas will likely be affected by a strong earthquake in the coming years. These earthquake

parks are geared to the highly specific management of seismic risks. Effectively, the aforementioned facilities, toponyms and communication the municipality has implemented concerning these parks attest to this. Moreover, the civilian evacuation plan was developed conjointly by AKOM, the Istanbul disaster coordination agency, and civil and transport engineers to consider road obstructions linked notably to debris from buildings and potential water and electricity network malfunctions (Figure 2).

**Figure 2: Deniz Gezmiş Park, Istanbul. Modularity before and during crisis management**

Use of the park before the disaster

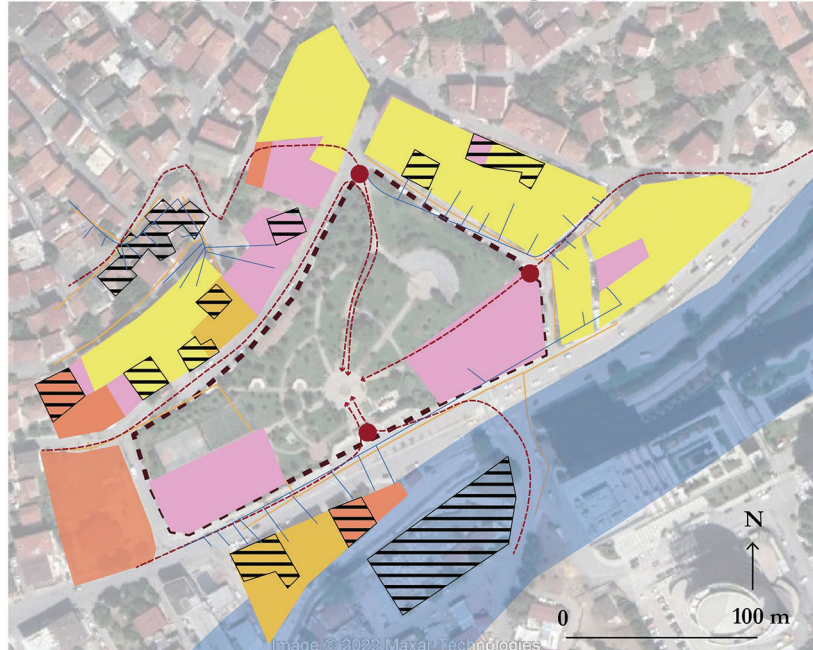


Use of the park after the disaster



- |                          |                    |                               |
|--------------------------|--------------------|-------------------------------|
| East entrance            | Shelter            | Gathering point / pergola     |
| North entrance           | WC                 | Gathering point / park        |
| South entrance           | Shower             | Technology point              |
| West entrance            | Catering point     | Sport zone                    |
| Security point           | Generator          | Education and Awareness point |
| Smart furniture          | Wind turbine       | Children's play area          |
| Logistics transfer point | Health center      | Water deposit                 |
| Training point           | Food delivery area | Orientation board             |

Main invariants organizing the Deniz Gezmiş earthquake parc



Legend

- |  |   |
|--|---|
| <ul style="list-style-type: none"> <li>--- Seismic park perimeter</li> <li>● Park entrance</li> </ul> <p><b>ownership status of the parcels</b></p> <ul style="list-style-type: none"> <li>Ataşehir Municipality</li> <li>Private individual</li> <li>Ataşehir municipality and shared plot</li> <li>Treasury of finance</li> </ul> <p>realization of the map on the right: Youenn Gourain (2022)<br/>Sources of perspectives on the left and data: Urban Transformation Directorate - Istanbul Metropolitan Municipality (2020)</p> | <p><b>Urban Networks</b></p> <ul style="list-style-type: none"> <li>Main gas networks (IGDAŞ)</li> <li>Main drinking water networks (ISKI)</li> </ul> <p><b>Evacuation</b></p> <ul style="list-style-type: none"> <li>distance for an evacuation time of 5 minutes</li> </ul> <p><b>Risks identified by IBB*</b></p> <ul style="list-style-type: none"> <li>Flood zone</li> <li>Risk of building collapse</li> </ul> <p>Gourain, 2023 <span style="float: right;">*IBB: Istanbul Metropolitan Municipality</span></p> |
|--|---|

Realisation: Gourain, 2022 based on documents provided by the Urban Transformation Directorate of the Istanbul Metropolitan Municipality, 2020.

However, the Covid-19 pandemic has brought awareness of new risks (namely health risks) and fostered greater vigilance as regards public spaces and communication channels, with compulsory gauges, social distancing and hygiene devices to limit disease transmission in a dense setting. The fear of a possible cluster during a pandemic thus combined with the pressure of evacuating individuals in the event of an earthquake. The January 2020 earthquake in Izmir demonstrated the incompatibility of managing two concomitant crises, according to reports by the Turkish Medical Association (TTB) who were present on the scene. "Measures such as physical distancing, masks and hygiene rules are disrupted in rescue areas and [during] the

transport of injured persons," (DW, 02/11/2020). Emergency services were effectively forced to juggle between precautions to avoid virus transmission and expeditiously assisting earthquake victims. The example of earthquake parks in Istanbul helps emphasize the need to develop flexible urban systems to manage multiple crises through the prism of multi-risks, hitherto approached as "multi-layers."

### Nantes: Urban networks in flood zones with other risks

As we saw in the case of Le Havre, Enedis has prioritized the integration of storm-related issues. The operator's first "climate

hazard” plan was mainly designed to reduce the vulnerability of overhead power distribution systems during storms. Between 2006 and 2016, the company buried overhead networks, particularly in wooded rural areas. However, the strategy was called into question in light of multi-risk approaches and the issue of climate change (Derdevet, 2020).

At the national scale, the company is reflecting on the resilience of its network and has identified multiple vulnerabilities: in addition to overhead networks’ susceptibility to storms and snowfall, it has also identified underground networks’ vulnerability to high temperatures and transformer stations’ vulnerability to flooding. The latter is being taken more seriously by the inter-municipal risk service for Greater Nantes, which has been concerned about the potential consequences of flooding on urban infrastructure since 2010. After several unsuccessful attempts with the electric company, the service finally obtained a statute for a vulnerability analysis for the PPRi for the Lower Loire. Hence, it was the State that obliged the company to analyze and communicate on its findings regarding vulnerability to flooding. This statute was the fruit of close negotiations with the company. Initially, the State and community services wanted to mandate unilaterally that all electrical substations be protected from flooding. Given the costs of such an operation, the company argued that exposure to water does not necessarily equate to vulnerability; rather, situations must be analyzed on a case-by-case basis. The metropolitan service did not intend to stop there. Once the vulnerability study was complete, it proposed that a working group comprised of all of the urban providers be formed to study the domino effects of their failures in the event of flooding. The true goal is planning operations to reduce the vulnerability of these networks.

Most importantly, the issue of maintaining networks is particularly relevant at a time when renewal projects in flood-prone areas are taking shape in these agglomerations. Several neighborhoods vulnerable to 100-year or 1000-year floods have effectively been targeted for development projects to make them denser and create new urban centers through the construction of new residential neighborhoods (the Chantenay district, Nantes Island hospital center, and Pirmil-les-Isles district, for instance). The federal government only authorized the redevelopment of these neighborhoods on the condition that they function “in a way as to reduce vulnerability to flood risk in order to increase the territory’s resilience to this risk” (regulation of the PPRi the Lower Loire). The operationalizing of this

resilience notably occurs through the designing of networks that “remain operational during flood periods.” The document even encourages the deployment of overhead networks. Network “resilience” therefore means different things to different actors. Enedis’ strategy effectively consists in not protecting the low-voltage distribution network from flooding, but rather in equipping it with warning devices that cut off the network in the flooded area as a precautionary measure. On the other hand, key infrastructures can be waterproofed, thus limiting potential damage and ensuring their rapid reactivation once the flood risk has subsided. Again, the multi-risk approach is based principally on the superposition of different layers of hazard (multi-layer) whose possible interactions are well thought out. While overhead installation of distribution networks is possible in new built areas, the issue becomes more complex in a context of urban redevelopment with preexisting networks.

Above all, the resilience of a neighborhood’s electrical network presupposes the resilience of the entire urban electrical infrastructure, and the transportation network in particular. This is far from being the case, as the vulnerability study at the urban scale is not yet broken down into operations to reduce vulnerability. In this situation, Enedis can encourage measures geared towards the creation of electricity autonomy in the flood-prone neighborhood (as it already does for sensitive equipment such as industrial operators). This can be done using specific resources such as generators, or through decentralized productions such as photovoltaic panels, which can operate independently. The Nantes conurbation seemingly has not envisaged such a scenario. Adapting the electrical network for the event of potential flooding therefore is not simple and challenges the systematic burying of network distribution lines.

## DISCUSSION

How do multi-risk approaches change the analysis of the links between urban networks and disasters in these three cases? While crisis management underscores the need to consider multiple combinations between multi-layered, interrelated systemic risks, the inclusion of risks in networks allows for consideration of multi-risk thinking through the prism of the actors and over diverse time frames.

- Crisis can be key opportunities for highlighting the multi-risk dimensions of networks. The challenge for actors is to include them in a long-term operational framework.

Whereas the pandemic brought out the multi-risk dimension of the network of parks in Istanbul, it was a potential ammonia leak that incited collaboration around the vulnerability of the networks in Le Havre. The initial power outage resulted from a voluntary interruption by Enedis resulting from high temperatures that disrupted the national grid. This led to a local crisis around the control of toxic industrial processes and, potentially, the immediate confinement of the population. From this first multi-risk experience (corresponding to a cascade diagram where vulnerability of the electrical network appears systemic), local actors conceptualized a multi-risk vision of the network by associating other dimensions (flooding, storms, etc.). In addition to simply identifying cascading effects, they also attempted to develop a more transversal understanding of risks.

Nevertheless, the example of Nantes shows that multi-risk issues can arise outside of specific scenarios that constitute “crises” for local actors. The choice between overhead and underground systems in flood zones emerges when the urban electricity network is challenged by divergent conceptualizations of risks.

A comparison of the case studies shows that, while multi-risk dimensions exist in urban planning, their coexistence can be fraught with tension. At times, they are even obliged to compete within the framework of spatial planning, with the final project being comprised between them. The choice between overhead and underground electrical networks in Nantes could engender different forms of vulnerability depending on the phenomena or space, and results in different risk layouts. The same is true of earthquake parks in Istanbul, for which the urban planner from the urban transformation department of the Istanbul Metropolitan Municipality acknowledges not having counted on the risk of a pandemic. Effectively, the shelters turned out to be undersized with respect to social distancing (*sosyal mesafe*). Here, the underlying issue of creating an open public space guided the program and project design. It turns out that seismic risk prevention (*deprem odaklı riski azlması*) carried more weight than health risk when defending the project to the Turkish Ministry of Urban Planning and the Environment.

The inclusion of multi-risk management in operational systems runs up against several obstacles. In Istanbul, the conversion of the first two public spaces into earthquake parks (Deniz Gezmiş Park and Topkapı Park) went smoothly, with the installation of modular infrastructure for the evacuation of residents. Their design incorporated modulation and flexibility capacities

to quickly accommodate for higher densities, manage relief and provide support for disaster victims for periods of several weeks. This spatial flexibility was scalable in terms of the flows of people and uses in the event of disruption. Yet, the Ministry of the Environment and Urban Planning regularly pushes back attempts to include earthquake parks in the local urban plan (*imar planı*) due to conflicts of interest and use around certain parcels because of speculation. Blockages also make these evacuation spaces vulnerable to urban transformation processes, as they are still public land reserves for the central government, which promotes their sale to developers. Similarly, Enedis dedicated its efforts almost exclusively to storm risks for some time: nowadays, it can more easily integrate other types of hazards into its operational crisis management systems (FIRE, local correspondents, etc.) than in the materiality of the network itself.

While crises can be opportunities for underlining the multi-risk scenarios in which networks are entangled, they rely on other mechanisms and dynamics to make them sustainable.

- Exploring the network from a multi-risk perspective reveals new networks of unexpected actors

The inherent nature of networks’ development allows for alliances with new actors with different practices. These practices add other risk dimensions to network design. Certain networks that were not designed using multi-risk logic can nonetheless generate alliances capable of highlighting new dimensions. The case of Le Havre is an obvious example of multiple actors being brought together through the electricity and multi-risk network association (elected officials, agents of small municipalities, network operator companies who are dependent on the electricity supply, ports, etc.). In the case of Istanbul, reflection on earthquake parks comes from working groups that unite various scientific actors (geophysical engineers, geomaticians, etc.), urban planning, and disaster management organizations (*afet yönetimi*), including AFAD at the national level and AKOM at the metropolitan level.

In Istanbul, three other levels of alliances were more original in the context of this project. To begin, earthquake parks were the initiative of Tayfun Kahraman, who recently headed the urban transformation directorate of the Istanbul Municipality under the new opposition party mayor, Ekrem İmamoğlu. They quickly showed their willingness to involve civil society in the designing of development and risk management systems. This was particularly the case for associations of first responders in

the event of an earthquake. The second is an alliance with other private organizations mobilized to finance the establishment of earthquake parks selected by the municipality based on more “holistic” criteria. As such, the new mayor has supported the joint-stock company Istanbul İmar A.Ş, which conducts urban development projects, to follow indications of risk prevention and to serve the population. Requests for support from private companies is a way for the project initiators to legitimize the inclusion of parks in the local plan via infrastructures: “The inclusion [of parks] is not easy because the budget is almost finished. He [Tayfun Karaman] called upon our people in Turkey. [...] We are trying to set up the shelter zones [...] and then we will write the rules. They won’t be able to do anything anymore. We’ll put up the flag: these are shelter areas, you can’t touch them anymore,” (interview with D., urban planner at the Urban Transformation Directorate of the Istanbul Metropolitan Municipality, 02/11/2020). Finally, the district municipalities (*ilçe belediyesi*) welcomed the foundation of these parks as a means of creating links between the inhabitants and disaster education associations, where other official spaces have been less successful.

The multi-risk approach allows for the involvement of more actors, which in turn makes possible the implementation of the partners’ network to ensure the sustainability of their spatial inclusion in urban networks.

- The multi-scalarity of networks at the local level allows for the creation of operational links between risk and crisis, and between risk prevention and crisis management more generally.

“When small projects can become big without changing the nature of the project, we call that design feature “scalability,” [...] “Scalable projects are those that can expand without changing.” (Tsing 2012). Defined at multiple scales both locally and generically, urban networks seem eminently scalable. Blackouts and general power outages notably demonstrate scalar interconnections within the network.

However, exploring the multi-risk dimension of urban networks nuances this understanding. The creation of earthquake parks in Istanbul or the protection of sensitive electrical infrastructure (electrical substations, locks) against flooding in Le Havre and Nantes are local measures that sometimes are extended to the agglomeration at large. Seven earthquake parks have been created by the Istanbul municipality but have yet to be included in the local plan (as of May 2022). The

protection of electrical infrastructure in Le Havre was forged around a few strategic sites (a lock and the town hall) but the measure is far from being widespread. Risks do not take the same form from one space to the next because of the many translations they undergo through actors’ management of them (November 2002). While the case studies essentially focused on the micro scale, shifting them into the macro scale raises the following question: can these measures and projects be considered as levers to facilitate crisis management at the scale of global agglomerations? The cases provide contrasting answers. Ultimately, it is by anticipating urban crises (earthquakes, major flooding, etc.) that urban networks transform their capacity to manage one or more risks simultaneously. In this sense, networks contribute to the “territorializing” of crisis management and can perpetuate this tendency over time, and thus aid in the shift from “crisis” to “risk.”

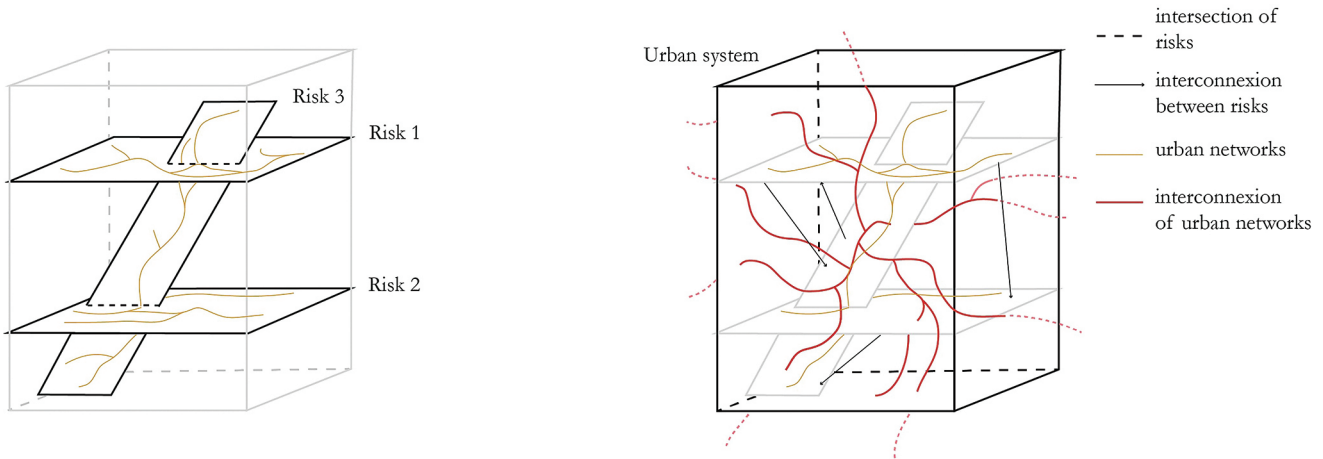
However, it turns out that these ad-hoc facilities, even when seen through the multi-risk prism, cannot extend their reasoning to entire agglomerations. The earthquake parks of Istanbul cannot realistically shelter millions of inhabitants in the event of a strong earthquake. On the other hand, the myriad forms of action and risks undoubtedly require a multitude of scenarios that are sufficiently flexible to take into account the potential interactions between risks that are still largely unknown.

Finally, multi-risk analyses themselves can be enriched by introducing urban networks. While “multi-layer” and “systemic” approaches to risks - forms that we have identified in our case studies - view their interrelationships differently, both can benefit by adding a distinct perspective on networks. Whereas “multi-layer” approaches struggle to identify the interconnections between different risks in the same territory, networks offer an element of continuity and flow. Similarly, while systemic risks are difficult to grasp, using urban networks as a jumping off point allows us to explore the interactions and interconnections between several risks simultaneously (figure 3).

## CONCLUSION

Exploring the relationships between risks in the context of urban networks shed light on several aspects of the dynamics between networks and disasters. To begin, we observed that risks seem to be more entangled than not. This entanglement reflects complex situations that are challenging for actors to manage, especially given that crisis management can contradict the means used to manage a simultaneous crisis in the same space.

**Figure 3: The role of networks in multi-risk analyses**



**multi-layer approach** : the urban networks show continuity and circulation

**Systemic approach** : urban networks highlight new interconnections

Gourain, Rey-Thibault, November, 2023

Source : Gourain, Rey-Thibault, November 2023

Thus, risk management often seems to struggle to fit into socio-technical networks such as urban plans. Moreover, integrating multi-risk logic in the long term is difficult due to actors' recalcitrance, conflicts of interest, or even incompatibility between the measures taken to respond to risks. This entanglement is also multi-scalar given that certain crises, such as blackouts, are revelators of scalar interconnections. Within these interconnections, unexpected actors and unforeseen risks appear as they circulate through physical networks and in those generated by the assumption of risks. What plays out in these

dynamics is an operational rapprochement between risk prevention and crisis management that is difficult to implement.

Our analysis has demonstrated the importance of context, actors and spaces in their ability and willingness to take into account multiple risks. The generic dimension of networks has allowed us to compare three radically different cases. However, their spatial dimensions reflect much more complex situations that require actors to adapt in the time and space context. In such cases, the density of networks can trigger a broader crisis, as the Covid-19 pandemic has taught us.

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## NOTES

(1) These fields are explored in greater depth as part of two longitudinal thesis surveys through semi-structured interviews and observations with urban risk and crisis management actors. 80 interviews were conducted in Istanbul from August 2019 to August 2021; 27 interviews in Nantes from July 2018 to May 2020, and; 45 in Le Havre from July 2018 to May 2020.

(2) Because of the large high number of French *communes*, the latter are strongly encouraged to collaborate “intercommunally,” which includes the corresponding larger urban areas. These *intercommunes* constitute a specific type of local government that is independent and complementary to communes.

(3) In this respect, see Vice-Minister of the Interior Ismail Catakh’s 2018 statement: “The global goal is to develop a strategy for reducing risks and disaster by 2020. As a country, Turkey has a disaster management strategy document (TAYSB). We are working on the Turkish disaster risk reduction plan (TARAP) and local disaster risk reduction plans (IRAP).” (own translation) (<https://www.afad.gov.tr/bm-afet-risklerin-in-azaltil-masi-kuresel-platformunda-turkiye-ust-duzeyde-tems-il-edildi>)

(4) French acronym for “Force d’Intervention Rapide Electricité,”

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**Cassandra Rey-Thibault, Youenn Gourain, Valérie November – Does a multi-risk approach help in understanding urban networks? Reflections on entangled dynamics based on two French cities and a Turkish metropolis**

The Covid-19 global pandemic powerfully demonstrated the key role networks play during disasters, as both vectors for the propagation of outbreaks and as support for prevention measures. This article links urban networks with a combined approach to risks, which we will call **multi-risk approaches**. In particular, it aims to examine the interrelations between risk dynamics and urban network dynamics based on three urban systems in which multi-hazard practices and issues emerge: the French cities of Nantes and Le Havre, and the Turkish metropolis of Istanbul. The exploratory analysis highlights three notable findings: firstly, that crisis episodes can be excellent revelators of the multi-risk dimensions of networks; for actors, the challenge is including them in a long-term operational framework. Secondly, the multi-risk perspective reveals new and often unexpected networks of actors. Thirdly, the multi-scalarity of networks at the local level will likely allow for the creation of operational links between risk and crisis, and between risk prevention and crisis management more generally. We therefore conclude that the hybridization of network dynamics with those of risks reveals the existence of “entangled” risks that merit further exploration.

Key words: Socio-technical approaches; local actors; crises; multi-risk practices; urban networks; entangled risks

**Cassandra Rey-Thibault, Youenn Gourain, Valérie November – Une approche multirisque aide-t-elle à comprendre les réseaux urbains ? Réflexions sur des dynamiques enchevêtrées à partir de deux agglomérations françaises et une métropole turque**

*La pandémie mondiale de la Covid-19 a agi comme un puissant démonstrateur du rôle central des réseaux dans les catastrophes, à la fois comme vecteurs de diffusion de la crise, et comme supports de mesures de prévention. Cet article propose une réflexion qui articule réseaux urbains et approche combinée des risques (que l'on peut synthétiser par approches multirisques). Il vise en particulier à examiner les interrelations entre dynamiques de risques et dynamiques de réseaux urbains, en s'appuyant sur trois systèmes urbains, dans lesquels émergent des pratiques et des questionnements multirisques : les agglomérations françaises de Nantes et du Havre, et la métropole d'Istanbul, en Turquie. L'analyse exploratoire fait ressortir trois résultats : premièrement que les épisodes de crise peuvent constituer des moments privilégiés pour faire apparaître les dimensions multirisques des réseaux. L'enjeu pour les acteurs est alors de les inscrire dans un cadre opérationnel et sur le long terme. Deuxièmement, la perspective multirisque donne à voir de nouveaux réseaux d'acteurs insoupçonnés. Troisièmement, la multi-scalarité des réseaux à l'échelle locale est susceptible de créer des liens opérationnels entre risque et crise, entre prévention des risques et gestion de crise globalement. Nous concluons ainsi que le croisement des dynamiques des réseaux à celles des risques fait apparaître l'existence de risques « enchevêtrés », qui méritent d'être approfondis.*

*Mots-clés : approches socio-techniques, acteurs locaux, crises, pratiques multirisques, réseaux urbains, risques enchevêtrés*