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From Vulnerability to Resilience: Critical Infrastructure and Logistics Preparedness in Sweden

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Abstract: This article examines vulnerabilities in Sweden's logistics and infrastructure systems within the total defence framework and considers which lessons from Russia's full-scale invasion of Ukraine may inform efforts to strengthen national resilience. Using qualitative analysis of policy documents, infrastructure disruptions, and Ukraine's wartime experiences, the study conceptualises logistics as a strategic capability linking civilian infrastructure and military operations. The findings identify vulnerabilities in fragmented coordination structures, transport capacity constraints, and insufficient infrastructure repair capability. Ukraine's experience highlights the importance of redundancy, decentralised repair capacity, and adaptive civil-military cooperation for maintaining logistical functionality under conditions of sustained disruption.

Keywords: Total Defence, Critical Infrastructure, Resilience, Ukraine, Lessons Identified, Civil-Military Cooperation

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1. Introduction

Reliable infrastructure and effective logistics are essential to the functioning of modern societies. They enable individuals to manage everyday life and allow businesses to operate and grow (Amin, 2002; Little, 2002; Samli, 2010). Infrastructure systems such as transport networks, energy supply, communication systems, and water services form the physical backbone of economic activity and societal stability (Burns, 2015). More narrowly, critical infrastructure refers to systems whose disruption would have severe societal consequences, including electricity networks, financial systems, healthcare facilities, and communication systems. These elements of infrastructure are highly interdependent, meaning that disruptions in one sector can rapidly cascade into others, amplifying the overall impact on societal resilience (Gallais and Filiol, 2017; Smith and Wilson, 2023).

Infrastructure systems are also central to national security as they enable the movement of goods, personnel, and materiel required for both civilian functioning and military operations (Adl-Zarrabi, 2017; Mammadov, 2018). Military mobility and operational capability depend on the availability and reliability of physical infrastructure, including transport networks and fuel distribution systems (Usewicz, Czekaj, and Bartoszek, 2022; Fixler, Montgomery, and Lane, 2025; Majchút, Belan, and Varecha, 2026). Many components of civilian infrastructure, including roads, railways, ports, and digital networks, therefore possess a dual-use character, serving both civilian and defence-related purposes. The strategic significance of infrastructure is therefore particularly evident in the context of national security and the armed forces.

The importance of resilient supply chains systems has become increasingly evident in recent years. Disruptions ranging from the Fukushima nuclear disaster in 2011 and the COVID-19 pandemic to Russia's full-scale invasion of Ukraine have exposed the vulnerability of global supply chains and the risks associated with insufficient redundancy (Antai and Hellberg, 2024). Without resilient logistics systems, even well-developed infrastructure struggles to sustain societal functionality or military operations under conditions of stress (Lucas et al., 2024).

Effective logistics operations depend on access to domestic and international suppliers, the availability of critical infrastructure, adequate transportation assets such as vehicles, rail wagons, aircraft, and vessels, and qualified personnel capable of managing and operating these resources (Naim et al., 2006; Memedovic et al., 2008; Halaszovich and Kinra, 2020; Rodrigue, 2020; Wang, Wood, and Wang, 2022).

The foundation of national security rests on societal resilience: the capacity to secure critical goods and services, maintain or adapt production, and ensure the distribution of essential supplies during periods of heightened alert or armed conflict (Keck and Sakdapolrak, 2013; Prop. 2024/25:34). In this context, physical infrastructure together with the associated transport capacity, constitutes a fundamental component of national preparedness and forms the backbone of national security systems (Bērziņa, 2018; Wither, 2020).

In Sweden, these issues are increasingly addressed within the framework of *total defence*. Total defence refers to the integrated mobilisation of civilian and military resources to prepare society for major crises or war (Rongved, 2025). It encompasses both military defence and civil preparedness, requiring coordinated action across public authorities, private actors, and civil society (Regeringskansliet, 2022; Regeringskansliet, 2025; MSB, 2025a). Similar approaches exist in neighbouring Nordic and Baltic countries (Wrange, Bengtsson, and Brommesson, 2024; Jordan, 2024), where the concept is referred to, for example, as *comprehensive security* in Finland (Valtonen and Branders, 2020) and *societal security* in Denmark (Roelsgaard Obling, Berndtsson, and Gilje Østensen, 2026). In the broader international literature, related approaches are described using terms as *comprehensive defence*, *whole-of-society defence*, or *total national resilience* (Sundelius and Eldeblad, 2023; Noyes and Humpal, 2025).

Secure supply chains and functioning logistics networks are essential for translating the concept of total defence into operational capability. Without reliable transportation networks and effective logistical coordination, the mobilisation of national resources becomes severely constrained (Burns, 2015; Ganguly, Bhatia, and Flynn, 2018; Radvanovsky and McDougall, 2023). This issue has gained further prominence following Sweden's accession to NATO, which places additional emphasis on infrastructure resilience, civil-military coordination, and logistical interoperability within the alliance (Christie and Berzina, 2022; NATO, 2025a). Infrastructure resilience and supply chain resilience are thus closely intertwined, together forming the foundation of a state's ability to sustain defence operations and maintain societal functionality during crises.

At the same time, recent events in Sweden and its neighbouring countries have underscored the vulnerability of infrastructure systems (Silvast et al., 2021). Natural hazards such as storms, floods, and landslides regularly disrupt transport and energy networks, demonstrating their fragility even under peacetime conditions. While states generally possess the capacity to manage such localised disruptions, the large-scale and systematic destruction of infrastructure observed during Russia's war against Ukraine illustrates a level of disruption for which many European countries are not fully prepared. Attacks on transport networks, energy infrastructure, and logistical hubs have shown how the degradation of infrastructure can rapidly undermine both military operations and civilian resilience (Aebi, Hauri, and Kamberaj, 2024).

This highlights a broader structural challenge: the tension between peacetime efficiency and wartime resilience. Infrastructure and logistics systems in advanced economies are typically optimised for cost-efficiency and streamlined operations under normal conditions, often resulting in limited redundancy and reduced repair and recovery capacity (You et al., 2025). While such arrangements improve efficiency in peacetime, they may simultaneously weaken the ability of infrastructure systems to absorb and recover from large-scale disruptions during crises or armed conflict. The Ukrainian experience provides an important empirical reference for identifying lessons that may be applicable to Sweden and to other countries with similar infrastructural and institutional conditions.

Despite growing policy attention to total defence and societal resilience, relatively limited research has examined the significance of infrastructure and logistics systems for crisis preparedness (Boin and McConnell, 2007; Sundelius and Eldeblad, 2023; Radvanovsky and McDougall, 2023). Existing studies have largely focused on the evolution of total defence concepts and their implications for regional security (Gotkowska, 2021; Grigalashvili, 2023; Angstrom and Ljungkvist, 2024; Rongved, 2025), while comparatively less attention has been devoted to the infrastructure and logistics systems that enable these strategies to function in practice.

Against this background, this article examines the role and vulnerability of physical infrastructure in enabling effective logistics within Sweden's crisis preparedness and total defence framework. The study focuses on identifying vulnerabilities in key logistical and infrastructural systems by analysing both past incidents affecting infrastructure and critical components of logistics capacity, including vehicle availability, driver supply, infrastructure robustness, repair capacity, and civil-military coordination. It examines how these factors influence national resilience under conditions of crisis or armed conflict.

Particular attention is given to lessons derived from Russia's full-scale invasion of Ukraine. The ongoing war provides a rare empirical example of how modern infrastructure systems and logistics networks perform under sustained wartime pressure, revealing both structural vulnerabilities and adaptive practices related to maintaining supply flows, repairing damaged infrastructure, and sustaining societal functionality under extreme conditions.

The research question guiding this study is: How do structural vulnerabilities in Sweden's infrastructure and transport systems shape the functioning of logistics within the total defence system, and what lessons from Ukraine's wartime experience can inform efforts to strengthen resilience and preparedness?

By addressing this question, the study contributes to literature on total defence, infrastructure resilience, and logistics capabilities in national security contexts. It highlights infrastructure repair and recovery as critical yet underexplored strategic capabilities underpinning both societal resilience and military effectiveness. Although the study focuses on Sweden, the findings may also offer insights for other countries with similar conditions.

2. Methodology

This study employs a qualitative research design combining critical event analysis and comparative institutional analysis (Skarbek, 2020; García-Montoya and Mahoney, 2023). The purpose is to examine the role of logistics and infrastructure in Sweden's crisis preparedness within the framework of total defence. The methodological approach is designed to identify vulnerabilities in logistical and infrastructural systems and to analyse how lessons from the Ukrainian wartime experience may inform improvements in resilience and preparedness in countries such as Sweden.

The study focuses on Sweden as the primary analytical case, while developments observed during Russia's full-scale invasion of Ukraine are used as comparative reference points. Rather than constituting a traditional comparative case study, Ukraine serves as an empirical reference illustrating how infrastructure and logistics systems function under conditions of sustained wartime pressure.

The analytical framework builds on three complementary perspectives. First, logistics is conceptualised as a strategic capability rather than merely a supporting function. From this perspective, logistics emerges as a critical enabler of operational endurance, military mobility, and societal resilience during crises. Second, the analysis draws on the concept of total defence, which frames national resilience as a whole-of-society responsibility requiring coordinated civilian and military preparedness. Third, the study draws on the literature on critical infrastructure resilience, which highlights the vulnerability of interconnected infrastructure systems and the risks of cascading disruptions. Within this perspective, particular attention is given to lessons from the Ukrainian experience regarding infrastructure repair and recovery capacity as key components of resilience. By integrating these perspectives, the study analyses logistics as the operational link between civilian infrastructure and military capability within Sweden's total defence system.

Sweden was selected as the primary case because the country is currently undergoing a significant security transformation following the deterioration of the European security environment and its accession to NATO. This shift has brought renewed attention to total defence planning and infrastructure resilience, making Sweden a particularly relevant case for examining how infrastructure and logistics systems are being strengthened under changing security conditions.

Ukraine is included as a comparative reference because the ongoing war provides empirical examples of how infrastructure and logistics systems function under conditions of sustained high-intensity conflict. The Ukrainian experience illustrates how infrastructure degradation and logistical bottlenecks affect both military operations and civilian resilience. At the same time, it demonstrates adaptive practices such as rapid infrastructure repair, decentralised logistics arrangements, and flexible supply solutions aimed at maintaining essential supply flows under extreme conditions. These insights help identify resilience requirements and resilience-building strategies that may also be relevant for Sweden and other countries with similar institutional and infrastructural conditions.

2.1 Data Sources

The empirical material consists primarily of document-based sources. Three types of material were analysed to provide both theoretical grounding and empirical insights.

First, scholarly literature was reviewed to situate the study within existing debates on defence logistics, infrastructure resilience, and total defence. This body of literature provides the conceptual foundation for the analytical framework used in the study.

Second, policy and institutional documents were examined to analyse Sweden's institutional arrangements for total defence, logistics, and infrastructure preparedness. These sources include Swedish government propositions and defence bills, official strategies related to total defence and infrastructure resilience, as well as reports from relevant authorities such as the Swedish Civil Defence and Resilience Agency, the Swedish Armed Forces, and NATO doctrinal and policy documents.

Third, empirical material was analysed to identify how infrastructure and logistics systems perform under conditions of disruption. This material includes analyses of infrastructure disruptions in Sweden caused by natural hazards such as storms, floods, and landslides, as well as publicly available sources documenting wartime infrastructure and logistics challenges in Ukraine. These sources cover the period 2022-2025 and include expert assessments, analytical reports, news media coverage, and peer-reviewed studies addressing wartime logistics, infrastructure resilience, and repair and recovery practices. Sources were selected based on three criteria: their analytical relevance to logistics and infrastructure resilience, their empirical grounding in observed disruptions or wartime developments, and the credibility of the publishing institution or research outlet.

2.2 Analytical Methods

The identification of relevant empirical material followed semi-structured search procedures commonly employed in targeted literature reviews (Wattage, 2001; Mauskopf et al., 2013; Narayanan et al., 2017). This approach provided a systematic yet flexible means of examining diverse sources and enabled comparisons between experiences of infrastructure disruptions in Sweden and wartime conditions in Ukraine. The empirical material was analysed using a qualitative thematic approach (Thomas and Harden, 2008; Clarke and Braun, 2017; Christou, 2022). Through an iterative process of coding and interpretation, recurring themes were identified, including infrastructure vulnerability, logistics capacity, repair and recovery capability, and civil–military coordination. These themes were subsequently interpreted in relation to the study's analytical framework, which draws on concepts of total defence, logistics resilience, and critical infrastructure preparedness.

Two complementary analytical approaches are employed in the study. First, critical event analysis is used to examine how major disruptive events reveal structural vulnerabilities in infrastructure and logistics systems. Such events can act as stress tests that expose weaknesses in preparedness arrangements and the functioning of critical infrastructure. In this study, particular attention is given to disruptions caused by natural hazards affecting infrastructure in Sweden, as well as to Russia's full-scale invasion of Ukraine, which providing empirical insights into how infrastructure and logistics systems function under extreme wartime conditions.

Second, comparative institutional analysis is used to examine how changes in the geopolitical environment interact with organisational and infrastructural arrangements to shape Sweden's logistics capacity within the total defence system. By comparing these institutional arrangements with lessons derived from the Ukrainian experience, while accounting for differences in geographical and infrastructural conditions, the analysis identifies structural gaps and vulnerabilities in Swedish preparedness.

Critical event analysis identifies stress points and operational vulnerabilities revealed by disruptive events, while institutional analysis evaluates how existing Swedish preparedness arrangements address, or fail to address, these challenges. This combination strengthens the methodological transparency of the study and clarifies how the empirical material informs the analysis and conclusions presented in the article.

This study has several methodological limitations that should be acknowledged. First, the analysis relies primarily on document-based sources and secondary materials rather than original fieldwork or interviews. While this approach allows for the systematic analysis of a broad range of official documents, academic studies, and analytical reports, it also means that the study depends on the availability and quality of publicly accessible information.

Second, the Ukrainian experience is drawn upon as a source of empirical learning and reflection, rather than as a case intended for strict comparative analysis. Differences in geography, infrastructure systems, and institutional arrangements mean that lessons cannot be transferred directly but must be interpreted cautiously within the Swedish context. Despite these limitations, the combination of critical event analysis and comparative institutional analysis provide a robust basis for identifying vulnerabilities and analysing resilience-related challenges within Sweden's total defence framework.

2.3 The Swedish Case

For more than two centuries, Sweden adhered to a policy of neutrality, which became a defining principle of its foreign policy from the declaration of 1814 until the end of the Cold War (Mironov, 2025). Although Sweden gradually adapted its defence policy throughout the 1990s and early 2000s, it was not until the intensification of regional security threats, culminating in Russia's full-scale invasion of Ukraine in 2022, that Sweden decisively abandoned its long-standing policy of neutrality and applied for NATO membership. Sweden's accession to NATO represents a historic strategic shift in the country's security policy, aligning it more closely with its Nordic neighbours and reorienting defence planning toward collective deterrence, resilience, and allied cooperation (Mironov, 2025).

For Sweden, NATO membership implies not only the strengthening of military capabilities but also the enhancement of civilian infrastructure systems that underpin both societal functions and defence operations. Transport networks must be able to operate under conditions of severe disruption, including those associated with armed conflict. This requires infrastructure systems to be designed and managed with sufficient flexibility, redundancy, and recovery capacity to withstand and adapt to adverse events. Meeting NATO's resilience requirements is therefore not solely a military concern but also a matter of national preparedness and societal security. By strengthening the resilience of critical infrastructure, Sweden enhances its capacity to maintain essential services during crises while simultaneously supporting the Alliance's collective defence objectives (FOI, 2023; MSB, 2025b).

Within the Swedish policy context, NATO membership has broadened the scope of national preparedness by linking domestic resilience more closely to collective defence requirements. In addition to maintaining critical societal functions during crises, Sweden is expected to facilitate the movement and sustainment of Allied forces. Consequently, the resilience and functionality of transport and infrastructure systems have become increasingly important, as they constitute key enablers of military mobility and operational support across Swedish territory (Ekström, 2025). This responsibility reflects the commitment contained in Article 3 of the North Atlantic Treaty, which establishes the general obligation for allies to maintain and develop their individual and collective capacity to resist armed attack (Moloeznik, Willoughby, and Kamps, 2025). To support the implementation of this commitment, NATO has subsequently developed policy guidance on resilience, including the seven baseline requirements for national resilience and civil preparedness (Gerginova, 2023; Cotroneo and Georgescu, 2025). These guidelines emphasise the importance of maintaining critical societal functions and ensuring that infrastructure systems can continue to support both civilian needs and military operations during crises.

Within this evolving strategic landscape, the revitalisation of the Swedish total defence concept has become central to national security policy (IVA, 2024; Regeringskansliet, 2025). The Swedish government has therefore identified critical infrastructure and transport systems as key pillars of total defence, emphasising the need for investments in rail, maritime, air, and road networks, as well as improved redundancy in transport links with the rest of Europe (Prop. 2024/25:34). Such infrastructure not only supports Sweden's societal resilience but also enables NATO operations on Swedish territory, including the rapid movement of allied troops and materiel. Ensuring adequate access to military ports, air bases, and training areas has thus become a strategic priority in the Defence Bill 2025-2030 (Prop. 2024/25:34).

3. Analytical Framework

Societal resilience theory examines the capacity of communities, societies, or nations to absorb, withstand, adapt to, and recover from disruptions, such as natural disasters, pandemics, armed conflict, or economic crises, while maintaining essential societal functions. Societal resilience is a collective, systemic, and multidimensional phenomenon. It emphasises factors such as social cohesion, institutional trust, and shared values that enable societies to sustain stability and adapt under conditions of stress and uncertainty (Eshel and Kimhi, 2016; Struberga, Teperik, and Bankauskaite, 2024).

The framework developed for this study illustrates how logistics functions as the operational linchpin connecting Sweden's total defence concept with the resilience of its critical infrastructure. It builds on three complementary perspectives. First, logistics is conceptualised as a strategic capability that transforms infrastructure into operational functionality by enabling the movement of people, goods, and materiel. Second, the concept of total defence emphasises the integration of civilian and military preparedness as a whole-of-society approach to national security. Third, the literature on critical infrastructure resilience highlights the vulnerability of interconnected infrastructure systems and the risks of cascading disruptions across sectors.

Together, these perspectives provide an analytical lens for examining how infrastructure, logistics systems, and institutional arrangements interact to shape national resilience in situations of crisis or armed conflict.

3.1 Logistics as a Strategic Capability

In defence and security studies, logistics has traditionally been regarded as a support function that enables military operations but does not determine their outcomes. However, both historical experience and contemporary conflicts demonstrate that logistics often plays a decisive role in shaping operational success or failure (Burns, 2015). Logistics determines whether military forces can sustain operations over time, maintain mobility, and ensure the continuous flow of supplies necessary for both combat effectiveness and civilian survival (Smith, 2018; Serrano et al., 2023).

Military logistics is therefore increasingly conceptualised as a strategic capability rather than merely a technical support function. Its central objective is to maintain operational capability at the lowest possible cost while ensuring the continuity of supply under conditions of escalating security threats and potential armed conflict. Contemporary military logistics is also undergoing significant transformation, driven by technological innovation and strategic investments aimed at improving efficiency, safety, and sustainability in logistics operations (Karbovska et al., 2025). The importance of logistics has been particularly evident during Russia's full-scale invasion of Ukraine. The destruction of fuel depots, attacks on transport corridors, and shortages of spare parts have severely affected both military operations and civilian survival. These developments illustrate how logistical systems represent critical vulnerabilities in modern warfare.

Recent research increasingly identifies logistics as a decisive factor in both combat effectiveness and societal resilience. Gherghinoiu (2024) highlights the role of intelligence-driven logistics in enhancing mobility and operational resilience. Sollfrank and Boeke (2024) contrast Russia's rigid logistical structures with NATO's more flexible and multinational logistics systems. The civilian dimension is equally important, since logistics underpins the provision of essential supplies, the movement of people and resources, and the broader functioning of society during crises (Kovács and Falagara Sigala, 2021; Jałowiec and Spychalski, 2025). In a total defence context, civilian logistics systems also support military operations by providing access to transportation networks, infrastructure, services, and critical resources. Consequently, civilian logistics represents a key mechanism through which societal resilience and military sustainment become mutually reinforcing during crises and armed conflict (Hellberg and Antai, 2025). Räkköläinen, Sundblom, and Juutinen (2025) emphasise the importance of redundancy, decentralised preparedness, and civil-military coordination in sustaining essential functions during prolonged crises. Similarly, Stavaras and Drakaki (2023) analyse the challenges of military logistics in situations where combat operations and humanitarian relief must occur simultaneously, underscoring the importance of adaptability and cooperation with civilian actors.

Taken together, these studies reinforce the view that logistics extends beyond transport efficiency to encompass resilience, redundancy, and adaptability under stress (Ganguly, Bhatia, and Flynn, 2018; Radvanovsky and McDougall, 2023). Within NATO terminology, this capability is increasingly referred to as the 'sustainment of operations', emphasising the endurance and continuity of supply required to maintain operational effectiveness over time (NATO, 2025c).

3.2 Total Defence and Civil-Military Integration

The concept of total defence is deeply rooted in the Nordic security tradition and integrates military and civilian preparedness into a comprehensive defence framework. In Sweden and Finland, this model has been revitalised in response to changing security dynamics and NATO membership (Wither, 2020; Gotkowska, 2021; Angstrom and Ljungkvist, 2024).

Total defence is based on the recognition that modern warfare targets not only military capabilities but also the societal systems that sustain them. Supply chains, energy systems, communications infrastructure, and essential services therefore become integral components of national defence (Stiglund, 2021; Weissmann et al., 2021).

At the regional level, security transformations across Northern Europe reinforce the importance of this approach. Finland and Sweden have strengthened their societal resilience and defence preparedness, culminating in NATO accession (Sandö, Rydqvist, and Langlais, 2015; Wither, 2020; Gotkowska, 2021; Grzela and Bieniek, 2022). Denmark has similarly prioritised rapid deployment capabilities and transatlantic cooperation in response to evolving security challenges (Surwillo and Slakaityte, 2025). Germany's *Zeitenwende* policy represents another attempt to strengthen defence capabilities, although implementation has been slowed by institutional and resource constraints (Friede, 2022).

Scholars emphasise that effective total defence requires strong civil-military integration. Civilian infrastructure operators, logistics providers, and government agencies must be embedded within defence planning and crisis management structures (Møller, 2019). Bērziņa (2020) conceptualises total defence as a comprehensive approach to national security that blurs traditional boundaries between civilian and military domains. Similarly, Larsson (2021) argues that the revival of Swedish total defence reflects a broader shift toward societal security, where the resilience of civilian infrastructure is inseparable from national defence. From a European perspective, Rongved (2025) highlights the adaptability of total defence across different historical contexts and emphasises its renewed relevance under contemporary geopolitical conditions.

Sweden’s defence rests on two interdependent pillars: military defence and civilian defence. Together, these constitute the concept of total defence, encompassing the full spectrum of societal activities designed to prepare the country for war and major crises. The underlying principle is that responsibility for defending Sweden and safeguarding its collective security, freedom, and independence is shared across society, ultimately requiring contributions from government institutions, private actors, and the population at large (MSB, 2025a). The effectiveness of total defence therefore depends not only on military capabilities but also on the resilience and preparedness of society as a whole.

In Sweden, the concept of total defence has been institutionalised through policy and legislation. The Swedish Civil Defence and Resilience Agency define total defence as a collective societal responsibility involving public authorities, private-sector actors, and citizens (MSB, 2025b). The *Swedish Total Defence Bill* 2025-2030 further identifies civil-military integration as a cornerstone of national security policy and emphasises coordinated investments in infrastructure, stockpiling, and crisis preparedness (Prop. 2024/25:34).

The same policy framework identifies six sectors[1] as critical to national resilience, reflecting lessons from Ukraine, where the continued functioning of key societal systems has proven essential during wartime (Reznikova and Korniievskyi, 2024). Sweden's geographical position further underscores the strategic importance of transport infrastructure, which supports both economic activity and the movement of Allied forces across Swedish territory (Prop. 2024/25:34). The Ukrainian experience demonstrates that total defence is more than a doctrinal concept; it is an operational framework that depends on the effective integration of civilian infrastructure and military capabilities (Glebov and Kuzmin, 2025; Wulf et al., 2026).

At the regional level, the changing security environment has reinforced the importance of cooperation among the Nordic and Baltic countries, as well as interoperability within NATO. The ability to reinforce, sustain, and coordinate military operations across national borders has become a central requirement for collective defence in the Baltic Sea region (Møller, 2019; Surwillo and Slakaityte, 2025). At the same time, many of the functions underpinning societal resilience, including energy supply, transportation networks, digital infrastructure, cybersecurity, and emergency management, are highly interconnected across national borders. As a result, disruptions affecting one

[1] The six sectors represent the most critical areas for maintaining societal functionality during crises. These are:

1. **Preparedness sectors** - the key domains required to sustain core societal functions in times of crisis.
2. **Energy** - ensuring secure and continuous energy supply is fundamental.
3. **Critical infrastructure** - protecting electricity grids, communication systems, and transport networks remains a top priority.
4. **Cyber domain** - defending against cyberattacks is essential for safeguarding both national security and critical infrastructure.
5. **Societal functions** - strengthening and better coordinating civil defence capabilities is vital.
6. **Command and control** - improved coordination and leadership within civil defence are necessary to ensure an effective crisis response.

country may quickly generate cascading effects throughout the region (Pescaroli et al., 2018; Wernli et al., 2023).

Enhanced regional cooperation strengthens resilience through information sharing, coordinated contingency planning, resource pooling, and mutual support during crises and armed conflict. Within the NATO framework, Nordic–Baltic cooperation also contributes to collective defence by improving interoperability, protecting critical infrastructure, and supporting the continuity of essential societal functions across the Baltic Sea region (NATO, 2024; International Institute for Strategic Studies, 2026; MSB, 2024a). Consequently, such cooperation has become an increasingly important component of both national preparedness and regional security.

Despite growing political and military integration, however, logistics capabilities across Europe remain largely organised along national lines. This fragmentation continues to constrain interoperability and complicates the coordination of cross-border logistics and sustainment operations, highlighting the gap between strategic ambitions and operational realities (European Defence Agency, 2022).

3.3 Critical Infrastructure Resilience

Critical infrastructure refers to the systems and assets essential for the functioning of society and the economy. Disruptions to these systems can have severe consequences for national security, economic stability, and public safety (U.S. Department of Homeland Security, 2003a).

Although definitions of critical infrastructure vary across jurisdictions, they generally encompass a similar set of core sectors. The European Union identifies eleven essential sectors, including energy, transport, banking, financial market infrastructure, healthcare, water supply, wastewater management, digital infrastructure, public administration, space, and food production and distribution (European Commission, 2025). The United States recognises sixteen critical infrastructure sectors. In addition to those broadly corresponding to the EU framework, the U.S. system includes chemical industries, critical manufacturing, dams, the defence industrial base, emergency services, and nuclear reactors, materials, and waste management facilities (U.S. Department of Homeland Security, 2003a; U.S. Department of Homeland Security, 2003b). Australia adopts a comparable approach, recognising eleven critical infrastructure sectors that largely align with those identified in Europe and North America (Australian Government, 2023).

Despite these differences, a common feature across all frameworks is the strong interdependence between infrastructure sectors. Transport systems depend on energy supply, logistics relies on digital infrastructure and communications systems, and modern economic transactions require functioning financial systems. As a result, disruptions can propagate rapidly across sectors, creating cascading failures that undermine societal resilience.

Scholarly research emphasises the importance of resilience in these interconnected systems. Amin (2002) highlighted the role of resilient infrastructure in maintaining societal stability, while Little (2002) demonstrated how cascading failures in interconnected systems can escalate local disruptions into systemic crises. Rehak, Senovsky, and Slivkova (2018) distinguish between two key dimensions of resilience: technical resilience, referring to the robustness and recoverability of physical systems, and organisational resilience, referring to management structures capable of coordinating restoration efforts during crises. Gheorghe et al. (2006) further emphasised the risks associated with critical energy systems in Europe.

From a systems perspective, critical infrastructures can be understood as complex "systems of systems" requiring governance approaches capable of managing interdependence and complexity (Katina and Keating, 2015). Ganguly, Bhatia, and Flynn (2018) similarly argue that resilience must be embedded both in engineering design and policy frameworks. More recent work emphasises reliability, risk management, and adaptive governance within interconnected infrastructure systems (Schulman and Roe, 2020; Grafius, Varga, and Jude, 2020).

Given that substantial portions of physical infrastructure are shared between military activities and civilian societal functions (Collier and Lakoff, 2020), the transportation of large volumes of personnel, equipment, and supplies presents significant coordination challenges. These difficulties are amplified by the fragmented nature of European transport infrastructure, particularly at border crossings where differences in capacity, standards, and procedures can hinder efficient mobility.

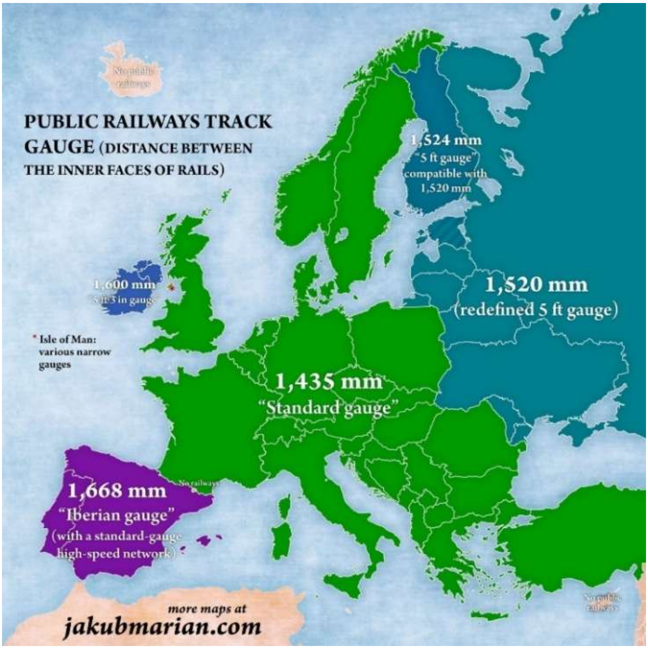

Figure 1: Public railways track gauge. (Source: jakubmarian.com)

A clear example is the railway sector, where differences in track gauge create barriers to cross-border logistics. Western and Central Europe use a standard gauge of 1,435 mm, whereas Ukraine and several post-Soviet states operate a broad-gauge system of 1,520 mm (Marian, n.d.). Differences in track gauge create significant constraints for cross-border rail transport. Because trains cannot operate directly on both gauge systems, bogie exchange is required at the border. During this procedure, trains are lifted and their wheel assemblies replaced to match the receiving railway network. The process is labour-intensive and can take up to two hours per train, creating delays and capacity bottlenecks for both passenger and freight transport. In crisis or wartime situations, such delays can significantly reduce rail transport capacity and complicate the rapid movement of military equipment and critical supplies (de Kemmeter, 2022; Lousada et al., 2024).

The Russia's full-scale invasion of Ukraine has demonstrated how the degradation or disruption of infrastructure systems can significantly affect logistical capacity and operational outcomes. Several studies show that the functioning and resilience of infrastructure and supply networks have played a decisive role in shaping military operations. Skoglund, Listou, and Ekström (2022) demonstrate how Russian logistical failures during the early phases of the invasion significantly undermined operational effectiveness. Similarly, Ti and Kinsey (2023) argue that disruptions in supply chains and transport infrastructure can negate the advantages of superior numbers or advanced weapon systems. Kukkola (2025) further notes that although Russia has attempted to adapt its logistical structures during the invasion, systemic weaknesses, including corruption and excessive centralisation, have limited its ability to overcome initial failures.

From Ukraine's perspective, resilience has depended heavily on adaptive logistics systems and rapid infrastructure repair. Minculete (2025) highlights the importance of flexible distribution networks and close civil-military cooperation in sustaining supply flows during wartime conditions. Similarly, Kushnir, Nagurney, and Konrad (2024) show how Ukraine's logistics system relies on partnerships between government authorities, private industry, and international donors to maintain essential deliveries despite infrastructure disruptions. These adaptive arrangements demonstrate how logistics can evolve into a strategic capability under extreme conditions, enabling continued resistance even in the face of infrastructural damage and resource scarcity (Hellberg and Lindelöf, 2025).

Infrastructure repair capacity is a critical element of resilience because the ability to restore damaged assets directly affects the continuity of both military and civilian operations during conflict. Resilient infrastructure depends not only on protective measures but also on the capacity to absorb disruptions and rapidly recover functionality following an attack. For this reason, repair capabilities are often targeted by adversaries, as delays in restoration can create persistent operational bottlenecks and trigger cascading effects across interconnected transport, energy, and communication networks (Hecht, 2014).

Evidence from Ukraine suggests that resilience is not derived from any single measure but from the combined effects of redundancy, decentralised governance arrangements, and effective repair capabilities. Together, these factors have enabled critical infrastructure systems to continue operating despite sustained attacks and repeated disruptions (Kriachko et al., 2024). Technological and organisational innovations further enhance this adaptive capacity. Modular bridges, mobile power systems, and drone-based damage assessment tools can accelerate restoration efforts and improve situational awareness, while specialised repair units, pre-positioned resources, and contingency plans increase the ability to prioritise and execute reconstruction activities efficiently (Jones, McCabe, and Palmer, 2023; Aebi, Hauri, and Kamberaj, 2024).

Infrastructure resilience should be understood not merely as the ability to withstand disruption, but as the capacity to adapt, recover, and restore essential services under adverse conditions. In the context of prolonged crises or armed conflict, the speed and effectiveness of repair efforts may be as important as the measures designed to prevent damage in the first place.

Ukraine has adopted a phased reconstruction approach that combines emergency repairs, stabilisation measures, and long-term rebuilding efforts (Ugnenko, Shevchenko, and Shevchenko, 2023). In practice, this strategy has involved the rapid installation of temporary bridge structures to restore damaged transport corridors, the deployment of mobile power generation units following attacks on the electricity grid, and the prioritisation of railway repairs to sustain both civilian mobility and military logistics. These measures have enabled critical transport and energy systems to remain operational despite repeated disruptions.

Kosse (2023) argues that the effectiveness of these reconstruction efforts has depended not only on international support but also on the capacity of local authorities and domestic engineering organisations to coordinate and implement repairs under wartime conditions. Local engineering teams have been instrumental in restoring road networks, repairing utility systems, and adapting technical solutions to changing operational requirements. The Ukrainian experience therefore highlights the importance of combining external assistance with strong local capabilities and decision-making structures.

These examples demonstrate that infrastructure resilience in wartime is not solely a technical challenge but also an organisational and institutional one. The ability to mobilise resources, coordinate actors, and execute repairs rapidly has proven as important as the physical infrastructure itself. More broadly, Ukraine's experience illustrates that logistics and infrastructure are not merely supporting functions but fundamental determinants of both military effectiveness and societal survival.

The Ukrainian experience demonstrates that infrastructure resilience depends not only on protecting critical assets but also on the ability to restore disrupted functions rapidly. This lesson is particularly relevant for Sweden, where highly interconnected transport, energy, and digital systems are vulnerable to cascading effects if key nodes, such as ports, rail hubs, bridges, or control systems, are disrupted through sabotage, cyberattacks, or military action (Prop. 2024/25:34). In such systems, the consequences of damage often extend well beyond the immediate point of attack, affecting military mobility, supply chains, and the delivery of essential services.

Consequently, resilience cannot be achieved through physical protection alone. It also requires the ability to sustain operations under adverse conditions through rapid repair capabilities, alternative transport routes, redundant systems, and effective coordination between civilian and military actors. From this perspective, recovery capacity should be regarded as a core component of transport system resilience. The ability to restore critical infrastructure quickly is essential for maintaining operational continuity, supporting military operations, and ensuring the continued functioning of society during crises and armed conflict.

EU-member states are encouraged to conduct stress tests and risk assessments based on common EU threat scenarios, initially focusing on the energy sector. EU resilience efforts are further reinforced through Protective Security Advisory Missions and deepening cooperation with NATO, including the establishment of the EU-NATO Task Force on Critical Infrastructure Resilience in 2023 (European Commission, 2023).

Taken together, these perspectives highlight the interdependence between logistics systems, critical infrastructure resilience, and the institutional arrangements underpinning total defence. Logistics enables the operational use of infrastructure, total defence provides the organisational framework for integrating civilian and military capabilities, and infrastructure resilience determines the system's ability to withstand and recover from disruption. The following analysis applies this framework to examine vulnerabilities in Sweden's infrastructure and logistics systems and to assess what lessons from the Ukrainian experience may inform efforts to strengthen national resilience and preparedness.

4. Analysis

This section analyses Sweden's logistical vulnerabilities within the framework of total defence and critical infrastructure resilience. The analysis is organised around three dimensions that reflect the analytical framework developed in the previous chapter: logistic capability, critical infrastructure resilience, and civil-military coordination. The Swedish case is first examined through structural characteristics of its logistics system and infrastructure networks. The analysis then considers empirical lessons from infrastructure disruptions in Sweden and compares these findings with ongoing wartime experiences from Ukraine.

4.1 Sweden's Logistical Vulnerabilities in the Total Defence Concept

4.1.1 Vehicle Availability and Driver Supply

Road transport constitutes the backbone of Swedish logistics, carrying approximately 80% of all domestic freight (Trafikanalys, 2024). In 2023, Sweden had more than 700,000 trucks in circulation, including 615,000 light and 85,000 heavy vehicles, representing substantial theoretical transport capacity. The sector is supported by over 13,500 companies, primarily haulage firms, employing more than 65,000 full-time workers (Transportföretagen, 2023). Despite this apparent capacity, two structural constraints limit operational resilience. First, a persistent shortage of qualified drivers restricts the ability to expand transport capacity during crises, large-scale evacuations, or military mobilisation (Sveriges Åkeriföretag, 2023). Although volunteer organisations could potentially supplement professional transport services, the absence of legal and institutional mechanisms for their rapid mobilisation limits their practical usefulness.

Second, the increasing digitalisation of Sweden's vehicle fleet introduces new vulnerabilities (Pernestål et al., 2020; Björklund, Gillström, and Stahre, 2025). Modern transport systems depend heavily on internet connectivity, electronic control systems, and satellite-based navigation. While these technologies improve efficiency under normal conditions, they may become liabilities in contested environments characterised by cyberattacks or electronic warfare. In contrast, Ukraine's transport fleet, which relies more heavily on older and less digitally dependent vehicles (Jacyna-Gołda, Gavkalova, and Salwin, 2026), has demonstrated a degree of operational resilience under wartime conditions (Cherniavskyi et al., 2025). Sweden's technologically advanced fleet may therefore face operational challenges if digital systems are disrupted.

A related concern arises from Sweden's rapid transition toward fossil-free transport systems. Sweden is among the global leaders in decarbonising the transport sector (Fossilfritt Sverige, 2024; BioDriv Öst, 2025). National policies have promoted a gradual transition towards electricity, hydrogen, biogas, and high-blend liquid biofuels. Consequently, public procurement requirements have increased the use of gas-powered buses in many urban transport systems, while several municipalities have restricted diesel-powered vehicles. These changes have implications not only for environmental performance but also for transport resilience and emergency preparedness (Lundström et al., 2019; European Commission, 2026).

This transition may also create new logistical vulnerabilities in crisis situations, particularly when buses and trucks are required for large-scale evacuations or long-distance transport operations. The distribution infrastructure for biogas remains concentrated in major urban areas, while charging infrastructure for heavy electric vehicles is still limited across much of rural Sweden (Trafikverket, 2022). As a result, the operational flexibility and geographical reach of alternative-fuel vehicle fleets may be constrained during emergencies that require rapid and sustained mobility over long distances. These limitations may also reduce the number of vehicles that can be deployed and sustained in transport operations during crises, thereby affecting overall transport capacity and responsiveness.

Similar challenges can be observed in the maritime sector, where ongoing decarbonisation efforts are progressing more rapidly than the development of the fuel supply chains and infrastructure needed to support prolonged emergency operations (van de Ketterij et al., 2024; Tønsberg and Arnfinnsson, 2024). These structural limitations may complicate evacuation planning, crisis logistics, and the movement of personnel and supplies, particularly in regions with limited access to alternative fuel infrastructure.

4.1.2. Fuel Distribution and Contingency Stockpiling

Fuel security remains a critical, yet often overlooked, dimension of transport resilience and national preparedness. Although Sweden has pursued ambitious decarbonisation policies and reduced its reliance on fossil fuels in several sectors, the country continues to depend on imported petroleum products for a range of essential activities, including transportation, agriculture, forestry, manufacturing, backup power generation, and the defence sector (Kaljunen, 2024; Sanctuary et al., 2024; Guarascio, Reljic, and Zezza, 2025). This dependence creates a potential vulnerability because fuel supply underpins the functioning of many other critical infrastructures and societal services.

The experience of Ukraine illustrates how fuel systems can become strategic targets during armed conflict. Attacks on fuel depots, refineries, and distribution networks have disrupted both military operations and civilian logistics, demonstrating the importance of maintaining secure and resilient fuel supply chains under adverse conditions (Kushnir, Nagurney, and Konrad, 2024; Kukkola, 2025). For Sweden, these experiences highlight an important challenge associated with the ongoing energy transition. While electrification and alternative fuels may reduce long-term dependence on imported fossil energy, crisis preparedness still requires reliable access to energy carriers capable of supporting military mobility, emergency services, freight transport, and critical industries during periods of disruption.

From a resilience perspective, reducing dependence on fossil fuels is therefore only part of the solution. Equally important is the ability to ensure continuity of supply through strategic reserves, diversified energy sources, robust distribution networks, and legally established mechanisms for fuel prioritisation and rationing. Without such measures, disruptions to fuel imports or domestic distribution systems could constrain both societal functioning and wartime mobilisation during a prolonged crisis. In this sense, fuel security remains a fundamental prerequisite for both total defence and the resilience of critical infrastructure systems.

4.1.3 Infrastructure Robustness and Redundancy

Sweden possesses an extensive and technologically advanced transport infrastructure encompassing road, rail, maritime, and aviation systems. Recent policy initiatives have increasingly emphasised the strategic importance of transport infrastructure for total defence and national preparedness. Within the road sector, efficiency has been enhanced through the introduction of longer and heavier vehicles, enabling larger transport volumes to be moved with the same number of trucks and drivers (Trafikverket, 2023). To further support both civilian and military transport requirements, the government has initiated programmes to strengthen and upgrade bridges to accommodate higher axle loads.

Rail freight capacity is largely dependent on private operators. The largest freight operator, Green Cargo, transports more than 31 million net tonne-kilometres per day, making it a critical component of Sweden's logistics system (Green Cargo, 2023). Maritime transport also plays an important role in national supply chains and international trade. In 2022, the Swedish-flagged merchant fleet comprised 314 vessels (Trafikanalys, 2023), providing an important, although limited, national maritime transport capability.

Together, these assets constitute key components of Sweden's transport capacity and provide important foundations for both economic activity and total defence. At the same time, their effective utilisation during crises or armed conflict depends on the availability of fuel, infrastructure, vehicles, personnel, and supporting logistics systems.

Recent policy initiatives aimed at rail modernisation and improved European transport connectivity reflect a growing recognition of infrastructure as a critical component of national resilience (Prop. 2024/25:34). At the same time, these developments illustrate an important resilience paradox. Modern transport systems increasingly rely on digitally integrated infrastructure that enhances efficiency, coordination, and capacity utilisation under normal conditions. However, the same interconnectivity can increase systemic vulnerability when disruptions occur.

Railway operations in Sweden are highly dependent on digital signalling systems (Trafikverket, 2026). When signalling failures occur, opportunities for manual operation are limited, causing significant disruptions to train movements. Similarly, the widespread adoption of digital ticketing and payment systems has reduced operational flexibility; when these systems fail, passengers may be unable to purchase tickets or access transport services even when alternative means of payment are available. These examples illustrate how digital integration, while improving efficiency, may also create single points of failure with consequences that extend across multiple parts of the transport system, which is supported by Pernestål et al. (2020) research.

The challenge is compounded by the limited redundancy of many transport corridors. Large parts of Sweden's rail and road networks depend on a small number of critical routes, nodes, and river crossings, leaving few viable alternatives when disruptions occur (Cedergren, Lidell, and Lidell, 2019). The floods in northern Sweden in 2023, which contributed to the derailment of a freight train carrying ammunition near Örnsköldsvik, demonstrate how a local infrastructure failure can generate wider consequences across the transport network. There was more or less no alternative traffic route. In northern Sweden in particular, several key transport corridors rely on a limited number of bridges crossing major rivers, creating potential bottlenecks and increasing the risk of cascading disruptions.

From a resilience perspective, Sweden's transport system therefore reflects a trade-off between efficiency and robustness. High levels of integration and digitalisation improve everyday performance but may also increase exposure to cyberattacks, sabotage, technical failures, and physical disruptions that affect multiple interconnected systems simultaneously. Compared to Ukraine's more fragmented and decentralised infrastructure networks (Jacyna-Gołda, Gavkalova, and Salwin, 2026), Sweden's tightly coupled systems may be more vulnerable to cascading effects when key nodes or control systems are disrupted. While decentralised networks may operate less efficiently under normal conditions, they can offer greater redundancy and adaptability during crises by reducing dependence on individual infrastructure assets and centralised control functions.

Strengthening infrastructure resilience consequently requires more than investments in connectivity and digital technologies. It also demands measures that enhance redundancy, provide alternative routing options, enable degraded-mode operations, and ensure the rapid restoration of critical functions when disruptions occur.

A further challenge concerns infrastructure repair and recovery capabilities, which have emerged as a critical determinant of resilience in contemporary conflicts. The experience from Ukraine demonstrates that the ability to assess damage, mobilise resources, and restore essential infrastructure rapidly may be as important as protecting infrastructure from attack in the first place (Aebi, Hauri, and Kamberaj, 2024; Gunawan and Pane, 2024). Repeated strikes against transport networks, energy facilities, and utility systems have shown that operational continuity depends not only on the robustness of physical infrastructure but also on the availability of skilled personnel, specialised equipment, spare parts, and established organisational arrangements for emergency reconstruction (Kukhtina, 2024).

The Ukrainian experience further illustrates that repair and recovery constitute an ongoing operational function rather than an activity undertaken only after a disruption has occurred. Temporary bridges, mobile power systems, emergency repair teams, and decentralised decision-making structures have enabled critical services to be restored quickly and, in many cases, maintained despite repeated attacks (Poliukh and Hutson, 2025). These observations suggest that recovery capability should be regarded as an integral component of infrastructure resilience rather than a separate support activity.

Similar concerns have been identified in Sweden. Both the Swedish Armed Forces (MSB, 2022) and Asp (2025) highlight limited repair and restoration capabilities as a significant weakness in national crisis preparedness. Many infrastructure operators are organised and staffed primarily for peacetime efficiency and therefore possess limited surge capacity to manage large-scale or prolonged disruptions. Private operators seldom maintain excess personnel, equipment, or spare parts that can be mobilised rapidly during emergencies (MSB, 2026). This creates a potential mismatch between the scale of infrastructure damage that could occur during a crisis and the resources available to restore functionality.

Recognising these challenges, Swedish authorities have begun to reactivate elements of the civil defence system, including the use of civil conscription (*civilplikt*) to increase the number of trained personnel in critical sectors

(Regeringskansliet, 2026a). Such initiatives reflect a growing recognition that resilience depends not only on robust infrastructure and preventive measures but also on the human, organisational, and technical resources required to repair, maintain, and restore essential systems under crisis and wartime conditions. In this sense, repair and recovery capabilities represent a strategic resource that directly influences both societal resilience and the ability to sustain military and civilian operations during prolonged disruptions.

NATO membership has further increased attention to cross-border infrastructure integration in the Nordic region. Ongoing projects aim to strengthen transport and energy connections between Finland and Sweden and to enhance the protection of communication infrastructure, including undersea cables (Regeringskansliet, 2024a; NATO, 2025b). However, technical challenges remain, including differences in railway gauge standards between Finland and Sweden, which complicate interoperability and highlight the need for long-term infrastructure coordination.

4.1.4 Civil-Military Coordination

Civil–military coordination represents one of the most complex dimensions of Sweden's Total Defence system because responsibility for preparedness and crisis management is distributed across many public and private actors. Sweden's decentralised governance structure grants municipalities and regions considerable autonomy in planning and implementing preparedness measures. While this arrangement can promote local adaptation and flexibility, it also produces variations in preparedness levels, resource availability, and logistical capabilities across the country (Lidström, 2016; Garcia et al., 2024). As a result, the capacity to manage large-scale disruptions may differ significantly between regions, creating challenges when resources must be prioritised and coordinated at the national level.

These challenges become particularly apparent in logistics-intensive crisis situations. The movement of military reinforcements, evacuation operations, emergency fuel distribution, infrastructure repair, and the provision of essential supplies all require the coordinated efforts of the Swedish Armed Forces, the Swedish Civil Defence and Resilience Agency (MCF), municipalities, regional authorities, infrastructure operators, and private logistics providers. In practice, however, these actors operate under different legal mandates, planning horizons, organisational cultures, and decision-making processes. A municipality may prioritise the evacuation of vulnerable populations, while transport operators focus on maintaining commercial services and military authorities prioritise the movement of forces and equipment. During a rapidly evolving crisis, such competing priorities can create tensions regarding the allocation of transport capacity, fuel supplies, repair resources, and access to critical infrastructure.

The challenge is further complicated by the fact that many of the resources required during crises are owned or operated by private actors (MSB, 2026). Transport companies, fuel distributors, port operators, rail freight providers, telecommunications companies, and energy suppliers all perform functions that are essential for both societal continuity and military operations. Yet these organisations are governed by commercial considerations and contractual obligations that may not always align with the requirements of national defence. Effective coordination therefore depends not only on formal authority but also on pre-established relationships, information-sharing mechanisms, and mutual understanding between civilian and military stakeholders.

Experiences from Host Nation Support and Total Defence exercises have repeatedly demonstrated that successful crisis response depends less on the performance of individual organisations and more on the ability to synchronise activities across organisational boundaries (Regeringskansliet, 2024b). Challenges frequently arise regarding information sharing, resource prioritisation, command relationships, and the coordination of activities across local, regional, national, and international levels. Uncertainties concerning responsibility for transport coordination, infrastructure restoration, and civilian support to military operations may delay decision-making and reduce the effectiveness of response efforts.

As Møller (2019) argues, effective total defence requires more than the existence of capable organisations; it requires integrated planning structures, shared situational awareness, and clearly defined coordination mechanisms. From this perspective, the absence of a unified national logistics coordination structure represents a potential vulnerability in Sweden's preparedness system. In a prolonged crisis or wartime scenario, fragmented decision-making could delay resource mobilisation, create competing priorities between actors, and reduce the overall effectiveness of national response efforts. Strengthening national coordination mechanisms, clarifying responsibilities, and developing joint civil–military planning processes may therefore be as important for resilience as investments in physical infrastructure, stockpiles, or transport capacity (Berndtsson, 2025; Victor Tillberg, Berndtsson, and Tillberg, 2025). In this sense, resilience is not only a question of infrastructure and resources but also of governance and the ability to coordinate collective action across organisational and sectoral boundaries.

4.2 Lessons from Sweden: Infrastructure Disruptions

Physical infrastructure systems, particularly within the transport and energy sectors, are exposed to multiple vulnerabilities, ranging from physical attacks and cyberthreats to natural disasters. Sweden is no exception: the country's highly centralised electricity system and tightly interconnected infrastructures mean that disruptions can cascade across sectors, causing simultaneous failures in electricity, water supply, telecommunications, and transport. Hybrid threats, including cyberattacks and sabotage by hostile actors, are considered a major risk, while the public is also encouraged to prepare for disruptions in essential services (Svenskt Näringsliv, 2024; Sveriges Radio, 2025).

Sweden's geography plays a significant role in shaping both civilian and military transportation patterns. The country's elongated north–south orientation, sparse population outside major urban centres, and concentration of economic activity along a limited number of transport corridors make efficient transportation networks essential for maintaining national connectivity. Large volumes of goods, raw materials, and industrial products are transported over considerable distances between production sites, ports, processing facilities, and consumer markets, while many remote communities depend on a small number of road, rail, maritime, and air links for access to essential goods and services. Consequently, transportation infrastructure performs a critical economic and societal function even under normal conditions (Große, 2022).

These geographical characteristics also influence military mobility. The movement of forces, equipment, and supplies often depends on the same transport corridors used for civilian activities, creating shared dependencies on key infrastructure assets. Large-scale freight transport and military movements are particularly constrained by factors such as axle-load limits, bridge capacity, tunnel dimensions, harbour depths, winter conditions, and the availability of specialised transport assets. As a result, both civilian and military mobility rely on a relatively small number of strategically important routes and nodes (Majchút, Belan, and Varecha, 2026).

This concentration creates vulnerabilities. Disruptions affecting critical transport corridors may have consequences that extend far beyond the immediate area of impact, generating cascading effects across supply chains, regional economies, and defence-related transport operations. Several incidents illustrate the importance of these infrastructure dependencies and demonstrate how local disruptions can produce wider economic, societal, and logistical consequences.

4.2.1 The E4/E20 Bridge Collision in Södertälje (2016)

This incident starkly demonstrated Sweden’s vulnerability to infrastructure disruptions, as one-third of the country’s total goods flows, valued approximately EUR 100 billion annually, pass across the bridge. The consequences of a prolonged closure would have been severe: an estimated EUR 15 billion in goods would face significant delays. Beyond freight, the bridge is a vital evacuation route for the regional population in the event of crisis or war. The designated alternative, Mälarbron, is not dimensioned to handle either heavy freight flows or large-scale evacuations in a crisis scenario.

On average, 65,000 vehicles cross Södertäljebron each day, three times the volume of traffic that passes over the Öresund Bridge. The entire Stockholm region, home to more than 2.4 million people, is thus dependent on this single 60-year-old structure for much of its supply security (Bergström, Englen, and Drageryd, 2025).

4.2.2. The Stenungssund Landslide (2023)

In September 2023, a landslide caused the collapse of a section of the E6 motorway at Stenungssund, resulting in the complete closure of one of Sweden's keys north-south transport arteries. Freight and passenger traffic were rerouted to alternative routes such as the E45, which significantly increased travel times and congestion. The economic cost of the disruption was estimated at EUR 140-290 billion, primarily due to extended travel times for freight and passenger flows. The event underscored the vulnerability of Sweden's road network to natural hazards and the substantial societal costs that arise when critical transport corridors are interrupted (WSP, 2023).

4.2.3. The E22 Snowstorm in Skåne (2024)

In January 2024, extreme snowfall paralysed a section of the E22 motorway between Hörby and Kristianstad, stranding more than 1,000 vehicles, some for over 24 hours. Investigations revealed that situational awareness and crisis coordination between authorities were inadequate. While the police and emergency services had partial oversight of the situation, the Swedish Transport Administration failed to assume overall command in a timely manner, resulting in ineffective crisis management. The incident highlights the importance of coordination, communication, and preparedness in managing weather-related disruptions to critical transport routes (Trafikverket, 2024; MSB, 2024b).

4.2.4. Disruptions on the Malmbanan Railway

"Malmbanan", Sweden's most heavily used freight railway, is critical for the transport of iron ore as well as passenger travel along the 500 km stretch between Boden, Riksgränsen, and Narvik in Norway. It is the only railway in

Sweden that permits a 30-ton axle load, enabling trains of up to 8,600 tons and 750 metres in length. Its single-track design, however, makes it highly vulnerable to disruptions, as there are no alternative railways capable of absorbing its freight capacity. Derailments caused by material fatigue (2021), wheel fractures (2023), and a major rockslide (2025) illustrate this fragility, often halting traffic for extended periods and demonstrating the systemic risks of depending on a single corridor for strategically vital exports (SHK, 2023; SHK, 2025; Trafikverket, 2025).

4.2.5. The Västernorrland Floods (2025)

In September 2025, intense rainfall caused extensive damage to transport infrastructure in Västernorrland, resulting in the closure of more than 40 roads, the washout of railway embankments, and the derailment of two freight trains. The disruptions rendered two of Sweden's three principal north–south rail corridors inoperable, severely affecting both freight and passenger transportation. Given Sweden's elongated geography and the concentration of long-distance transport flows along a limited number of corridors, the consequences extended far beyond the affected region.

The event highlighted the dependence of national transport flows on a small number of strategically important routes. With only the "Inlandsbanan" remaining operational, parts of the disrupted freight traffic could be rerouted, demonstrating the importance of maintaining alternative transport corridors. At the same time, the limited capacity of these alternatives constrained the extent to which lost transport capacity could be replaced. The disruptions therefore affected not only local mobility but also freight movements and supply chains serving other parts of the country.

From a resilience perspective, the floods illustrate how geographically concentrated transport networks can create systemic vulnerabilities. When transport flows depend on a limited number of corridors, disruptions affecting key infrastructure assets may generate cascading effects across a much wider geographical area. The case also demonstrates that resilience depends not only on the reliability and protection of individual infrastructure components but equally on the availability of redundancy, alternative routing options, and the capacity to absorb and redistribute traffic when primary corridors become unavailable (MSB, 2025c; Dagens Logistik, 2025).

These events demonstrate that transport infrastructure is far more than a collection of physical assets; it constitutes a fundamental enabler of both societal functioning and military mobility. When critical infrastructure nodes such as bridges, railways, ports, or major highways become unavailable, the consequences extend well beyond the transport sector itself. Disruptions can delay the movement of goods, interrupt industrial production, reduce access to essential services, prevent employees from reaching their workplaces, thereby affecting economic activity and the delivery of public services, hinder emergency response activities, and constrain military reinforcement and mobilisation efforts.

The cases discussed above illustrate how disruptions affecting a limited number of infrastructure assets can generate cascading effects across geographically distant regions. This vulnerability is reinforced by Sweden's reliance on a relatively small number of strategically important transport corridors, where large volumes of civilian and military traffic are concentrated. As a result, local infrastructure failures may rapidly develop into broader societal and logistical challenges.

At the same time, the cases highlight the importance of redundancy and recovery capability. The ability to reroute freight traffic via the "Inlandsbanan" during the Västernorrland floods demonstrated how alternative transport capacity can mitigate disruption and maintain essential flows when primary routes become unavailable. Similarly, experiences from Ukraine show that the capacity to repair and restore damaged infrastructure rapidly can be as important as measures designed to prevent disruption in the first place.

From a Total Defence perspective, the central lesson is that resilience depends not only on protecting infrastructure from disruption but also on ensuring that alternative routes, reserve capacity, and effective recovery mechanisms are available when failures occur. Investments in infrastructure robustness must therefore be complemented by resilient logistics systems capable of absorbing shocks, adapting to changing conditions, and sustaining critical civilian and military functions during crises and armed conflict. In this sense, resilience is not solely a property of infrastructure but of the broader socio-technical system that enables mobility, supply, and national preparedness.

4.3 Lessons from Ukraine

Russia's full-scale invasion of Ukraine provides a unique empirical perspective on how infrastructure and logistics systems function under conditions of sustained high-intensity conflict. Since 2022, Ukraine has experienced extensive destruction of transport infrastructure, energy systems, and communication networks. Despite these attacks, Ukrainian authorities and civil society actors have demonstrated considerable adaptive capacity in restoring critical systems and maintaining supply flows (Armanios, Christensen, and Tymoshenko, 2023). This resilience has relied on decentralised decision-making, strong civil-military cooperation, and the mobilisation of local innovation (Hellberg and Lindelöf, 2025). At the same time, wartime experience confirms that adversaries deliberately target repair capabilities to prolong operational disruption and weaken systemic resilience (Kruglashov, 2025; Reznikova, 2025).

4.3.1 Transport Capacity and Personnel

Ukraine's logistics capacity is experiencing severe strain due to a shortage of both vehicles and qualified drivers, with the freight transportation market lacking approximately 30,000 to 40,000 drivers as of mid-2025. Civilian vehicles and personnel have frequently been mobilised to support both military and humanitarian logistics operations (Lebedeva and Shkuropadska, 2024; Almeida and Mehndiratta, 2026).

A similar structural constraint exists in Sweden. Although the national vehicle fleet is large, shortages of professional drivers limit surge capacity in crisis situations. In addition, Sweden lacks well-developed mechanisms for mobilising civilian transport resources during emergencies. The Ukrainian experience illustrates how civilian transport assets can become critical logistical resources during wartime, highlighting the importance of training programmes and legal frameworks enabling rapid civilian mobilisation (Sveriges Åkeriföretag, 2023; Trafikanalys, 2024).

4.3.2. Fuel Security and Supply Chains

Fuel security has emerged as a critical vulnerability in Ukraine’s logistics system. Repeated attacks on fuel depots and distribution infrastructure forced Ukrainian authorities to adopt dispersed storage systems, flexible resupply arrangements, and increased reliance on international assistance (Aebi, Hauri, and Kamberaj, 2024). The war in Ukraine has created a paradox for electric transport: fuel shortages have accelerated the adoption of electric vehicles (EVs), while repeated attacks on the power grid have simultaneously strained the electricity infrastructure needed to charge them. Despite sustained Russian strikes against Ukraine’s energy system, EV imports have increased markedly, with registrations rising by approximately 300 percent compared to 2021 levels (UBN, 2024; Olkhova et al., 2025; Melnyk et al., 2025).

Sweden faces different but related vulnerabilities. Although Sweden generates nearly all of its electricity from non-fossil sources (hydro, nuclear, and wind), roughly two-thirds of the country's total energy consumption relies on petroleum products, primarily for transportation and industrial processes. Because Sweden lacks domestic crude oil reserves, it remains heavily dependent on imports from countries like the US and Norway (Gilliver, 2026). In the event of supply chain disruption, Sweden’s transport system could face significant operational constraints. Ukraine’s experience illustrates the importance of strategic stockpiles, diversified supply routes, and legally defined mechanisms for fuel prioritisation and rationing (Kriachko et al., 2024; Antai and Hellberg, 2024).

4.3.3. Infrastructure Resilience Under Sustained Attack

Ukraine’s experience provides important insights into the relationship between infrastructure design and resilience under conditions of sustained attack. Since 2022, transport and energy networks have been repeatedly targeted through strikes against rail junctions, bridges, fuel depots, power generation facilities, and electricity transmission systems. Despite the scale and frequency of these attacks, infrastructure systems have continued to function sufficiently to support both military operations and essential societal activities. A key explanation is that resilience has depended not only on preventing damage but also on the ability to adapt and recover when disruptions occur (Aebi, Hauri, and Kamberaj, 2024; Rabinovych et al., 2024).

Ukraine's wartime conditions have accelerated technological and organisational innovation in infrastructure repair and recovery. Faced with persistent attacks on critical infrastructure and constrained access to resources, Ukrainian authorities and engineering organisations have adopted new approaches to damage assessment, repair, and reconstruction. Technologies such as drone-based infrastructure inspections have improved situational awareness and enabled the rapid identification of damaged assets, while additive manufacturing and locally developed engineering solutions have reduced dependence on external supply chains and shortened repair times (Stanislavyk and Kovalenko, 2024; Dodu, 2024).

Transport flows have frequently been rerouted through alternative rail lines, roads, and border crossings, while temporary bridges, mobile power generation units, and emergency repair solutions have been employed to restore critical functionality (Marzęda-Młynarska and Kięczkowska, 2026). The availability of alternative routes, combined with decentralised operational structures and rapid repair capabilities, has reduced dependence on individual infrastructure nodes and limited the extent to which local disruptions translate into system-wide failures.

This experience highlights an important trade-off in infrastructure planning. Highly integrated and technologically advanced systems often deliver superior efficiency under normal conditions but may become increasingly vulnerable when critical nodes or control systems fail. By contrast, Ukraine demonstrates how redundancy, decentralisation, and the ability to operate under degraded conditions can significantly enhance resilience during crises and armed conflict (Aebi, Hauri, and Kamberaj, 2024; Gunawan and Pane, 2024; Kukhtina, 2024). The key lesson is therefore that infrastructure resilience should not be assessed solely in terms of protection and reliability, but also in terms of adaptability, recoverability, and the capacity to maintain essential functions despite disruption.

From a Swedish Total Defence perspective, these observations raise important questions regarding the balance between efficiency and resilience. Sweden's transport system is highly integrated and dependent on a limited number of strategically important corridors, bridges, ports, and digital control systems. While this structure supports efficient transport flows under normal conditions, it may also increase vulnerability to sabotage, cyberattacks, natural hazards, or military action. Compared with Ukraine's more dispersed and decentralised infrastructure networks, Sweden's tightly coupled systems may be more susceptible to cascading effects when key assets are disrupted. The Ukrainian experience therefore suggests that investments in infrastructure protection should be complemented by measures that strengthen redundancy, alternative routing options, repair and recovery capabilities, and the ability to sustain operations under degraded conditions.

In contrast, Sweden's transport networks are more tightly integrated and digitally managed. These characteristics enhance efficiency in peacetime but also increase vulnerability to cascading failures during crises. Highly interconnected systems may be more susceptible to cyberattacks and may require specialised expertise and equipment for repair. The floods near Örnsköldsvik, illustrate the fragility of integrated transport networks under extreme conditions. Ukraine's experience suggests that redundancy and repair capacity play a critical role in maintaining infrastructure functionality under sustained disruption (Grafius, Varga, and Jude, 2020; Prop. 2024/25:34).

Ukraine's infrastructure repair practices also demonstrate how resilience can be strengthened through rapid mobilisation and decentralised decision-making. Local communities, engineers, and emergency services have restored damaged transport, energy, and communication networks through improvisation, modular repair techniques, and close civil-military cooperation (Armanios, Christensen, and Tymoshenko, 2023; Jones, McCabe, and Palmer, 2023). Redundancy planning and phased reconstruction strategies have enabled the continued functioning of essential services despite sustained attacks (Ugnenko, Shevchenko, and Shevchenko, 2023; Aebi, Hauri, and Kamberaj, 2024). Empowering local authorities and incorporating security considerations into reconstruction planning have proven particularly effective (Kosse, 2023).

4.3.4. Civil-Military Adaptation

Perhaps the most significant lesson from Ukraine concerns the adaptability of civil-military logistics cooperation. Civilian actors, including local authorities, volunteer organisations, and private companies, have played central roles in maintaining essential supply flows during wartime conditions (Minculete, 2025; Trif and Dumitrașcu, 2025).

In Sweden, coordination structures remain fragmented and responsibilities across institutions are not always clearly defined (Oscarsson et al., 2025; Försvarsmakten, 2026). Challenges may arise when decisions concerning transport prioritisation, fuel allocation, infrastructure repair, emergency healthcare, or support to military operations require coordination among municipalities, regional authorities, government agencies, private infrastructure operators, and the Swedish Armed Forces. During a major crisis or wartime scenario, uncertainty regarding mandates and decision-making authority may delay the mobilisation of resources and complicate the synchronisation of civilian and military activities.

The Ukrainian experience illustrates the importance of institutional flexibility and rapid cross-sector coordination under conditions of extreme pressure (Danylenko and Zagorodsky, 2025). The restoration of damaged transport infrastructure has often required close cooperation between military units, local authorities, infrastructure operators, engineering organisations, and private contractors (Aebi, Hauri, and Kamberaj, 2024; Poliukh and Hutson, 2025). Similarly, the prioritisation of transport capacity for military reinforcements, humanitarian assistance, and civilian evacuations has necessitated rapid coordination across organisational and administrative boundaries. Fuel and energy resources have also been reallocated to support critical functions, while local authorities have played a central role in coordinating emergency response and reconstruction efforts (Pimenow et al., 2025).

These experiences demonstrate that logistical resilience depends not only on physical infrastructure and technical capabilities but also on governance arrangements that enable rapid collective action. The ability to coordinate decisions, share information, and mobilise resources across organisational boundaries may be as important as the availability of transport assets, fuel, or infrastructure itself. For Sweden, the key lesson is that resilience requires not only robust infrastructure and well-equipped organisations but also clearly defined responsibilities, integrated planning processes, and mechanisms that enable civilian and military actors to act jointly under conditions of uncertainty and time pressure (Møller, 2019; Wither, 2020; Hellberg and Lindelöf, 2025).

5. Discussion

The analysis highlights the central role of logistics and infrastructure in shaping the effectiveness of Sweden's Total Defence system. Interpreted through the three analytical perspectives developed in the framework, logistics as a strategic capability, Total Defence as a civil-military system, and critical infrastructure resilience, three interrelated challenges emerge.

First, Sweden's preparedness depends on effective coordination among public authorities, private infrastructure operators, logistics providers, and military organisations. However, responsibilities and decision-making structures remain distributed across multiple actors, creating the potential for delays and coordination challenges during rapidly evolving crises. Second, many critical transport and supply functions depend on a limited number of infrastructure assets, transport corridors, and supporting systems. As demonstrated by the Västernorrland floods and other infrastructure disruptions, failures affecting key nodes can generate cascading effects across geographically distant regions and multiple sectors of society. Third, several preparedness arrangements have been designed to maximise efficiency and cost-effectiveness under peacetime conditions. While these characteristics contribute to high levels of performance during normal operations, they may also reduce resilience by limiting redundancy, reserve capacity, repair resources, and the ability to operate under degraded conditions.

Taken together, these findings point to a broader challenge within Swedish preparedness policy: balancing the efficiency benefits of highly integrated and technologically advanced systems with the resilience requirements associated with major crises, infrastructure disruptions, and large-scale military mobilisation. The Ukrainian experience suggests that resilience depends not only on robust infrastructure but also on redundancy, adaptability, recovery capacity, and institutional mechanisms capable of coordinating rapid responses under conditions of uncertainty. From a Total Defence perspective, preparedness should therefore be understood not merely as the protection of critical assets, but as the ability of the broader logistics and infrastructure system to sustain essential societal and military functions despite disruption.

5.1 Logistics as a Strategic Capability

The analysis confirms that logistics is not merely a supporting function but a strategic capability that underpins both military operations and societal continuity. The findings demonstrate that the effectiveness of Sweden’s Total Defence system depends not only on military capabilities but also on the resilience of the civilian logistics networks that sustain transportation, energy supply, infrastructure maintenance, and the provision of essential goods and services. While Sweden possesses substantial logistics capacity in terms of infrastructure, transport assets, and technological capabilities, the analysis identifies several structural weaknesses that may limit performance during crises and armed conflict.

First, logistical planning and resource management remain fragmented across multiple institutions and levels of governance. The absence of a unified national coordination structure complicates rapid decision-making and may delay the mobilisation of resources during large-scale disruptions. This fragmentation reflects the broader institutional complexity of the Total Defence system and creates a risk that competing priorities, overlapping responsibilities, and unclear mandates could reduce the effectiveness of national response efforts.

Second, vulnerabilities exist in both transport capacity and personnel availability. Despite the size of Sweden's vehicle fleet, the availability of qualified drivers represents a significant constraint on the ability to expand transport operations rapidly during emergencies. The analysis further indicates that logistics capacity cannot be assessed solely in terms of vehicles and infrastructure; it also depends on access to skilled personnel capable of operating, maintaining, and coordinating transport systems under demanding conditions. At the same time, the increasing digitalisation of vehicle fleets and transport management systems introduces new operational dependencies on communication networks and electronic control systems. While these technologies improve efficiency under normal conditions, they may reduce reliability in contested environments characterised by cyberattacks or electronic warfare.

Third, Sweden's reliance on imported fuel and limited strategic reserves represents a potential bottleneck in crisis situations. The Ukrainian experience illustrates how disruptions in fuel storage and distribution networks can rapidly undermine both military operations and civilian supply chains (Kushnir, Nagurney, and Konrad, 2024; Kukkola, 2025). Without expanded contingency stockpiles and clearly defined rationing mechanisms, prolonged supply disruptions could significantly constrain Sweden's logistical capacity.

Taken together, these vulnerabilities suggest that Sweden's logistics system contains potential single points of failure. As Burns (2015) emphasises, logistics must be managed simultaneously at the strategic, operational, and tactical levels, since weaknesses at one level can have consequences throughout the entire system. In comparison, the Ukrainian experience demonstrates how disruptions to logistics networks can rapidly affect both military operations and civilian livelihoods. Attacks on transport infrastructure, energy systems, and supply chains have shown that logistical resilience is essential not only for sustaining military manoeuvres but also for ensuring access to food, fuel, healthcare, and other critical services. These observations underline the importance of viewing logistics as a comprehensive societal capability rather than solely a military support function.

5.2 Total Defence and the Civil-Military Nexus

The concept of total defence emphasises that national security depends on coordinated action across civilian and military sectors. Sweden's institutional framework recognises this principle, yet the analysis indicates that coordination mechanisms remain unevenly developed.

The decentralised structure of Swedish governance allows municipalities and regions considerable autonomy in crisis preparedness. While this can promote local adaptability, it also produces variations in readiness and fragmented logistical capacities across the country. Unclear mandates, overlapping responsibilities, and limited surge capacity further complicate coordination among civilian authorities, private logistics providers, and the armed forces.

In contrast, Ukraine's wartime experience demonstrates the importance of adaptive civil-military cooperation. Civilian transport providers, municipal authorities, volunteer organisations, and private companies have played critical roles in sustaining logistics systems under conditions of extreme disruption. These actors have often compensated for gaps in formal logistics structures by rapidly mobilising resources and improvising operational solutions.

This comparison highlights the importance of institutional flexibility as a core component of resilience within Total Defence systems. The Ukrainian experience demonstrates that the capacity to adapt rapidly to changing circumstances depends not only on physical resources but also on governance arrangements and organisational coordination. Throughout the conflict, the repair of damaged infrastructure, the prioritisation of transport capacity, the redistribution of energy resources, and the provision of logistical support have required close cooperation among military organisations, government agencies, local authorities, infrastructure operators, and private firms. Such cooperation has enabled the rapid mobilisation of resources, accelerated decision-making, and the restoration of critical functions despite sustained disruption.

These experiences suggest that effective civil–military integration requires more than clearly defined responsibilities. It also depends on legal frameworks that enable rapid action, shared situational awareness, established coordination mechanisms, and the authority to make and implement decisions under crisis conditions. In this sense, resilience is as much a matter of governance and institutional capacity as it is of infrastructure and material resources.

For Sweden, these observations raise important questions regarding the ability to coordinate action across a highly decentralised system involving numerous public and private actors. While significant progress has been made in rebuilding the Total Defence system, challenges remain in areas such as logistics prioritisation, infrastructure restoration, resource allocation, and the coordination of civilian support to military operations. As Møller (2019) and Wither (2020) argue, strong institutional linkages between civilian infrastructure operators and defence authorities are essential for sustaining resilience. Such linkages facilitate the rapid mobilisation and coordination of resources required to maintain critical societal functions, support military operations, and ensure continuity during crises and armed conflict.

5.3 Critical Infrastructure Resilience

The analysis highlights the importance of infrastructure resilience within Sweden's Total Defence system. Sweden's transport and energy networks are characterised by a high degree of interdependence, relying on digital control systems, centralised traffic management, and a limited number of critical transport corridors to support the efficient movement of people, goods, and services. Under normal conditions, these arrangements contribute to high levels of operational efficiency and reliability. However, the same characteristics can create vulnerabilities during crises by increasing dependence on critical nodes, digital systems, and interconnected infrastructure networks.

For example, disruptions to digital signalling systems can significantly reduce rail capacity because opportunities for manual operation are limited, while failures in digital payment, communication, or control systems can affect access to transport services and reduce operational flexibility. Similarly, the concentration of north–south transport flows on a small number of rail corridors, bridges, ports, and major highways means that disruptions affecting a limited number of infrastructure assets can have consequences across large parts of the country. The Västernorrland floods in 2025, which rendered two of Sweden's three principal north–south rail routes inoperable, illustrate how local infrastructure failures can generate national logistical consequences and disrupt both economic activity and societal functions.

In contrast, the Ukrainian experience demonstrates the value of redundancy, decentralisation, and alternative routing options in maintaining transport flows under adverse conditions. The ability to reroute traffic, operate under degraded conditions, and restore damaged infrastructure rapidly has enabled critical functions to continue despite repeated attacks on transport and energy systems. This suggests that resilience is determined not only by the quality and reliability of individual infrastructure assets but also by the availability of alternatives and the capacity to adapt when disruptions occur.

Consequently, improving resilience requires more than continued investments in infrastructure modernisation and efficiency. It also requires measures that enhance redundancy, provide alternative routing options, support degraded-mode operations, and strengthen repair and recovery capabilities. From a Total Defence perspective, the challenge is therefore to balance efficiency with resilience, ensuring that critical infrastructure systems remain capable of supporting both societal functions and military operations under conditions of disruption, crisis, and armed conflict.

Several infrastructure disruptions in Sweden illustrate how quickly cascading effects can spread across interconnected systems. Events such as floods, landslides, or severe weather have demonstrated that damage to individual infrastructure nodes can significantly disrupt national logistics flows. These incidents reveal the risks associated with tightly coupled systems that lack sufficient redundancy.

Ukraine's wartime experience provides an important contrast to the Swedish case and illustrates that the resilience of critical infrastructure depends on more than technological sophistication or asset quality. Despite repeated attacks on transport and energy networks, Ukraine has maintained a considerable degree of operational continuity through the rapid mobilisation of engineering resources, the use of modular repair solutions, and decentralised decision-making structures that enable local actors to respond quickly to emerging disruptions (Armanios, Christensen, and Tymoshenko, 2023; Jones, McCabe, and Palmer, 2023). In practice, damaged rail links have been bypassed through alternative routes, temporary bridge structures have restored critical transport connections, and emergency repair teams have re-established essential infrastructure functions within short timeframes.

These examples demonstrate that the ability to adapt, improvise, and recover may be as important as the ability to prevent disruption. Infrastructure resilience therefore emerges not solely from robust physical assets but from the interaction between technical systems, organisational arrangements, and human capabilities. The Ukrainian experience suggests that redundancy, decentralised decision-making, repair capacity, and the ability to operate under degraded conditions are critical factors in sustaining both military operations and essential societal functions during prolonged crises. Phased reconstruction strategies and redundancy planning have contributed to maintaining essential services during sustained attacks (Ugnenko, Shevchenko, and Shevchenko, 2023; Aebi, Hauri, and Kamberaj, 2024).

This observation is particularly relevant for Sweden, where infrastructure planning has traditionally prioritised efficiency, reliability, and technological integration. While these characteristics contribute to strong performance under normal conditions, they may also increase dependence on critical nodes, digital systems, and tightly coupled transport corridors. The Ukrainian case therefore highlights the importance of complementing infrastructure modernisation with measures that strengthen adaptability and recovery. From a Total Defence perspective, resilience should be understood not only as the ability to withstand disruption but also as the capacity to maintain essential functions, reallocate resources, and restore critical capabilities when disruptions inevitably occur.

The infrastructure resilience literature emphasises similar principles. Amin (2002), Katina and Keating (2015), and Grafius, Varga, and Jude (2020) highlight the importance of redundancy, adaptability, and cross-sector coordination in managing complex infrastructure systems. These insights suggest that strengthening infrastructure resilience requires attention not only to physical assets but also to the institutional capacity required to restore functionality after disruption.

5.4 NATO Integration and Regional Security

Sweden's accession to NATO has altered the role of national transport infrastructure. Beyond supporting domestic mobility and economic activity, Swedish roads, railways, ports, airports, and logistics hubs have become critical enablers of Allied reinforcement and military mobility (Regeringskansliet, 2026b). As a rear area, staging nation, and transit corridor within NATO, Sweden may be required to receive, sustain, and move substantial volumes of personnel, vehicles, equipment, ammunition, fuel, and supplies across its territory. These responsibilities place demands on transport systems that extend beyond those associated with normal domestic transportation (FOI, 2026).

Effective military mobility depends not only on the ability to move large volumes rapidly but also on whether infrastructure meets NATO requirements regarding load-bearing capacity, throughput, interoperability, and operational functionality. Roads, bridges, railways, ports, and airfields must be capable of accommodating heavy military equipment and sustained transport flows, while customs procedures, border-crossing arrangements, and other administrative processes must be sufficiently streamlined to avoid delays (FOI, 2026). The analysis show that parts of Sweden's transport system is primarily designed to meet domestic requirements and therefore require further adaptation to support large-scale military movements and Allied reinforcement operations.

Several critical transport corridors remain vulnerable because alternative routes are limited or absent, meaning that a single disruption may have disproportionate consequences for both civilian logistics and military mobility. Consequently, fulfilling Sweden's role within NATO will require targeted investments in infrastructure capacity and resilience. Such measures include reinforcing bridges and other critical assets to accommodate heavier military vehicles, improving railway loading facilities and intermodal terminals, expanding port capacity, increasing access to staging and storage areas, and developing alternative road and rail routes capable of maintaining transport flows when primary corridors are disrupted. While these investments may not always align with traditional civilian infrastructure priorities, they are increasingly necessary to meet NATO military mobility requirements and ensure the rapid movement of Allied forces through Swedish territory (FOI, 2026).

The need for such improvements is further reinforced by the growing integration of Nordic and Baltic defence planning. Military mobility in Northern Europe depends not only on national infrastructure but also on interoperable transport networks and coordinated logistics arrangements across Allied states. Administrative procedures, including customs clearance and border-crossing arrangements, are equally important, as bureaucratic delays can undermine operational responsiveness even when physical infrastructure is available (Olsen, 2020; Blessing et al., 2021). From this perspective, regional resilience depends on the ability of Nordic and Baltic countries to complement one another through coordinated planning, interoperable systems, and mutually supporting transport and logistics networks (Vasiliauskas, 2025; Surwillo and Slakaityte, 2025). Cross-border cooperation can provide alternative transport routes, access to additional ports and logistics hubs, shared situational awareness, and opportunities to redistribute resources when disruptions occur. Such arrangements reduce dependence on individual infrastructure assets and increase the region's ability to absorb, adapt to, and recover from disruptions.

At the same time, common threats such as cyberattacks, sabotage, and attacks against critical infrastructure underscore the importance of harmonised procedures, coordinated contingency planning, and shared resilience measures across the Nordic-Baltic region. Regional cooperation strengthens resilience not because countries share identical vulnerabilities, but because integrated planning, interoperable systems, and complementary capabilities create greater redundancy, flexibility, and recovery capacity than any nation could achieve independently (Surwillo and Slakaityte, 2025). In this sense, NATO integration and Nordic-Baltic cooperation should be viewed not only as military necessities but also as important mechanisms for enhancing the resilience of critical infrastructure and sustaining both societal and defence functions during crises and armed conflict (Sandö, Rydqvist and Langlais, 2015; Angstrom and Ljungkvist, 2024; Surwillo and Slakaityte, 2025).

5.5. Implications from the Ukrainian Experience

Ukraine's wartime experience demonstrates that resilience depends not only on material resources but also on institutional adaptability, local initiative, and innovative engineering solutions. Several aspects of Ukraine's response to infrastructure disruption and logistical challenges offer insights that are particularly relevant when considering Sweden's preparedness within a total defence framework.

A central lesson concerns the importance of decentralised repair capacity. In Ukraine, local authorities, engineering units, and emergency services have played a decisive role in restoring damaged infrastructure. Rapid repair has often depended on local decision-making authority and the availability of technical resources at the regional level. In Sweden, infrastructure repair capabilities are relatively centralised and are largely performed by private contractors, which may, particularly in the short term, slow response times during large-scale disruptions. Expanding regional engineering capacity and strengthening local crisis management capabilities could therefore improve infrastructure resilience. Sweden already possesses institutional mechanisms that could support such efforts. Civilian conscripts, assigned wartime roles through the Swedish Defence Recruitment Agency (*Plikt- och prövningsverket*), are currently mobilised primarily within the electricity supply sector and municipal emergency services. Expanding these arrangements to additional infrastructure sectors could strengthen national repair capacity.

A second insight concerns the importance of effective civil-military cooperation. In Ukraine, collaboration between civilian engineers, infrastructure operators, and military units has enabled the rapid restoration of transport networks and energy systems even under conditions of ongoing attacks. This experience highlights the operational significance of integrating civilian infrastructure operators into defence planning processes. Within Sweden's total defence system, closer coordination between the armed forces and critical infrastructure operators, such as energy providers, telecommunications companies, and transport authorities, could improve preparedness. Joint exercises and shared contingency protocols may strengthen institutional coordination and facilitate more rapid responses during crises.

Infrastructure redundancy and modular solutions represent another key lesson. Ukraine has relied extensively on temporary bridges, mobile power systems, and redundant communication networks to maintain logistical functionality after infrastructure damage. These solutions have enabled supply flows to continue even when critical nodes have been destroyed. For Sweden, increasing the availability of mobile infrastructure capabilities may enhance resilience in geographically remote regions and along strategic transport corridors linking ports, railways, and military installations.

Ukraine's wartime conditions have also stimulated rapid technological innovation. Drone-based infrastructure assessments, additive printing, and locally produced engineering solutions have reduced repair times and improved situational awareness during reconstruction efforts. This experience illustrates how crisis environments can accelerate technological adaptation. Sweden could strengthen its capacity for rapid innovation by establishing mechanisms that facilitate collaboration between public authorities, small and medium-sized enterprises, universities, and research institutes during crises.

Societal participation has likewise played an important role in Ukraine's resilience. Volunteer networks, local communities, and civil society organisations have contributed directly to logistics operations, infrastructure repair, and the distribution of humanitarian supplies. Sweden already has a strong tradition of civil preparedness but expanding technical training for civilian in areas such as logistics support, infrastructure repair, and communication resilience could further enhance societal preparedness.

Finally, Ukraine's reconstruction efforts illustrate the principle of "security by design." Infrastructure rebuilding has increasingly incorporated resilience considerations, including redundancy, protective measures, and system-level security improvements. Applying similar principles in Sweden could strengthen the resilience of future infrastructure investments. Integrating cyber protection, electromagnetic pulse (EMP) protection, and backup systems into infrastructure design standards may reduce vulnerability to both physical and hybrid threats.

Taken together, these lessons highlight that resilience is not solely a function of infrastructure investment but also depends on institutional flexibility, technological adaptability, and the mobilisation of societal resources.

5.6 Limits to the Transferability of Wartime Lessons

While Ukraine's wartime experience provides valuable insights into infrastructure resilience and adaptive logistics under conditions of sustained conflict, the applicability of these lessons to Sweden must be considered with caution. The two countries differ significantly in terms of geography, institutional arrangements, and security context. Ukraine's logistics system has developed under conditions of large-scale territorial warfare and extensive infrastructure destruction, whereas Sweden operates within a comparatively stable institutional environment and benefits from membership in the European Union and NATO.

Geographical conditions also differ substantially. Ukraine's transport networks are designed to support large-scale land operations across extensive continental terrain, while Sweden's elongated geography, lower population density, and reliance on maritime and cross-border trade create different logistical challenges. Unlike Ukraine, which shares a long land border with Russia, Sweden is not a direct neighbour to Russia and instead possesses an extensive coastline and strong maritime orientation. Consequently, the security and resilience of ports, sea lines of communication, and maritime logistics play a particularly important role in Sweden's infrastructure preparedness.

Moreover, Sweden's infrastructure systems are generally more technologically advanced and digitally integrated, which improves efficiency under normal conditions but may introduce different vulnerabilities compared to Ukraine's more decentralised networks.

Institutionally, Sweden's integration into European and transatlantic security structures also shapes its logistical environment. Access to allied support, coordinated supply chains, and shared infrastructure planning within NATO and the EU provides strategic advantages that Ukraine has had to compensate for through domestic adaptation and international assistance.

Consequently, the Ukrainian experience should not be interpreted as a direct model for Swedish preparedness. Rather, it serves as an empirical reference illustrating how infrastructure systems and logistics networks behave under extreme stress. The relevance of these lessons therefore lies less in their direct transferability and more in the broader insights they provide into resilience, redundancy, repair capacity, and civil-military coordination under conditions of large-scale disruption.

6. Conclusion

The findings suggest that Sweden's logistical preparedness faces several interconnected challenges that may affect the functioning of Total Defence during major crises or armed conflict. Rather than arising from a single vulnerability, these challenges stem from dependencies on a limited number of critical infrastructure assets, transport corridors, energy supplies, and organisational arrangements. The analysis demonstrates that disruptions affecting key transport routes can have consequences far beyond the immediate area of impact. The Västernorrland floods in 2025, which rendered two of Sweden's three principal north-south rail corridors inoperable, illustrate how disruptions to a small number of infrastructure assets can affect freight transport, passenger mobility, access to workplaces and essential services, and the movement of critical supplies across large parts of the country. Similarly, the dependence of many transport operations on digital signalling, communication, and payment systems highlights how failures in supporting systems can reduce operational flexibility and create cascading effects across interconnected infrastructure networks.

The analysis also identifies several structural preparedness challenges. First, coordination responsibilities remain distributed across multiple public and private actors, potentially complicating the prioritisation of transport capacity, infrastructure repairs, fuel distribution, and resource allocation during crises. Second, Sweden's transport system relies heavily on a limited number of strategically important corridors and infrastructure nodes, creating vulnerabilities when alternative routes are unavailable. Third, dependence on imported fuels and international supply chains for critical goods may constrain both societal functions and military operations during prolonged disruptions. Finally, limited repair and recovery capacity may delay the restoration of essential infrastructure following major incidents, cyberattacks, sabotage, or armed conflict.

The Ukrainian experience demonstrates that resilience depends not only on robust infrastructure but also on redundancy, repair capacity, decentralised decision-making, strategic reserves, and institutional mechanisms capable of coordinating rapid responses under degraded conditions. The ability to reroute transport flows, mobilise repair resources, restore damaged infrastructure, and coordinate actions across organisational boundaries has proven essential for maintaining both military effectiveness and societal continuity. For Sweden, these lessons suggest that strengthening Total Defence requires investments not only in infrastructure protection but also in alternative transport routes, recovery capabilities, fuel security, and effective civil–military coordination. Resilience ultimately depends not on the absence of disruption, but on the capacity of the logistics system to adapt, recover, and sustain critical societal and military functions when disruption occurs. The findings show that Sweden's logistical preparedness contains several interconnected vulnerabilities that may undermine the functioning of total defence during major crises or armed conflict. Three structural weaknesses stand out. First, logistical planning and coordination remain fragmented across multiple institutions and levels of governance, potentially slowing crisis response and complicating national mobilisation. Second, transport capacity is constrained by shortages of qualified drivers and by increasing dependence on digitally integrated vehicle systems that may be vulnerable to cyber disruption. Third, Sweden's limited strategic reserves of fuel, spare parts, and critical goods create dependencies on international supply chains that could be disrupted during prolonged crises.

A further vulnerability concerns the limited national capacity to repair critical infrastructure. As highlighted by e.g. the Swedish Armed Forces, Sweden lacks sufficiently developed repair capabilities for infrastructure and logistical assets. In crisis situations, disruptions to repair capacity can significantly prolong infrastructure downtime and reduce the operational effectiveness of both military and civilian logistics systems.

Ukraine's wartime experience provides an important empirical reference for understanding resilience under conditions of sustained infrastructure disruption. The Ukrainian case demonstrates that logistical resilience depends not only on material resources but also on redundancy, institutional flexibility, and rapid infrastructure repair capability. Decentralised decision-making, adaptive logistics systems, and strong civil-military cooperation have enabled Ukrainian authorities to maintain supply flows despite extensive infrastructure destruction.

For Sweden, these insights highlight the strategic importance of logistics within the total defence system. Infrastructure and logistics networks must not only support efficient peacetime operations but also remain functional under conditions of disruption and conflict. Sweden's NATO membership further reinforces these requirements. The ability to host and support allied operations requires infrastructure capable of accommodating heavy military transport and ensuring the rapid movement of forces across Swedish territory. In several cases, existing infrastructure does not fully meet NATO standards regarding weight limits, clearance dimensions, and interoperability, creating potential bottlenecks for reinforcement logistics.

The study therefore identifies a central tension in Sweden's preparedness system: the balance between peacetime efficiency and wartime resilience. Highly integrated infrastructure systems and just-in-time logistics increase efficiency under normal conditions but may also increase vulnerability to disruption. Strengthening national preparedness therefore requires a shift toward resilience-oriented logistics planning that emphasises redundancy, strategic stockpiling, and repair capability.

More broadly, the findings highlight that the ability to sustain supply chains, restore damaged infrastructure, and coordinate civil-military logistics networks plays a decisive role in determining whether societies can maintain functionality during prolonged crises or armed conflict.

Several areas warrant further investigation. First, comparative studies of Nordic countries could clarify how NATO integration is reshaping logistics planning and infrastructure resilience across the region. Second, empirical assessments of private-sector preparedness would improve understanding of the practical challenges associated with civil-military cooperation within Sweden's total defence system. Third, scenario-based modelling of infrastructure disruptions and supply chain failures could help quantify the potential consequences of logistical breakdowns and support the development of more targeted preparedness strategies.

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