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# Resilience Endangered: The Role of Regional Airports in Remote Areas in Sweden

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**Abstract:** This paper examines the role of regional airports in regional and municipal crisis preparedness based on evidence from a case study in Sweden. During the summer of 2018, Sweden experienced some of the most extensive wildfires in modern time. Aerial suppression, for which airports provided the essential preconditions, played an important role in extinguishing these fires. This study includes analyses of public policies that shape the Swedish airport system as well as evidence from interviews and a workshop with stakeholders. The results show that an efficiently operated network of regional airports is critical not only for crisis management but also to ensure important societal services such as health care in sparsely inhabited regions. Moreover, access to quick transportation by air is necessary for the Swedish Prison and Probation Service, tourism industry, public institutions and private businesses. Additionally intensified by effects of both the public debate on flight shame and the COVID-19 pandemic on air-based transportation, the insights arising from this study emphasise that the currently one-sided focus on the number of passengers is an insufficient foundation for the Swedish airport system to construct a resilient base for regional development, crisis management and civil defense.

**Keywords:** critical infrastructure; governance networks; transport; aviation; regional airports; crisis management; emergency response; societal resilience; security



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## 1. Introduction

During the summer of 2018, extensive wildfires in Sweden caused severe damage. Aviation and particularly the regional airports played a major role in fighting the fires. Although these airports are important for the crisis management system, civil protection and regional development, the current Swedish airport system gives little attention to these roles. As shown below, this system primarily aligns with shareholder opinions undervaluing the role of air-based transportation for other societally important functions, i.e., critical infrastructure. Since an airport can be seen as a public utility, their performance should be assessed by their ability to meet the interests of all of their stakeholders [1].

Several airborne activities contribute to the crisis management system, which in turn enhances societal resilience. The suppression of wildfires around the world is an observable example of this; in Sweden (2018), Australia (2020), California (2020), and Southern Europe and Minor Asia (2021), aerial suppression was critical in controlling major wildfires [2–8]. As such, airborne activities for crisis management require infrastructure that ensures reliable operation by providing necessary ground services, including regular maintenance, parking, refuelling or recharging of aircrafts [9].

Aviation has considerable importance to society as a means of transporting people and goods domestically and internationally. The direct effects of employment within the aviation industry impact the economy, as do indirect effects through the establishment of

businesses in the local area. Previous research has therefore often focused on economic impact analyses and the effects of airports on employment and tax revenue in a particular region [10–12]. Air transport ensures a connection to global markets, suppliers and distribution channels. In light of globalised production and distribution processes, disruption to air traffic risks a number of negative consequences for businesses and society, which in turn can adversely impact the economy.

Although aviation is acknowledged as critical infrastructure in Sweden's transport sector [13], the role of regional airports in a resilient society remains understudied. Previous research has analysed the interconnected role of regional airports as a hub of critical infrastructure and has proposed a novel category regarding resilience to economic models [9]. In addition, these resilience effects in economic terms have been further investigated in the Swedish context, for example, with regard to natural hazards, rescue and healthcare services as well as critical infrastructure protection [14]. Research on the 2014 and 2018 wildfires in Sweden has focused on the selection of airports as bases for coordinating air- and land-borne firefighting to minimise losses and crisis management costs [3]. It has been shown that shorter distances to the site result in lower cumulative costs, which can translate to better resilience. In addition, if there are several airports within an appropriate distance, they can complement each other in cases of insufficient capacity or fuel supply and difficult weather conditions [3]. Regarding remote areas, European and Australian studies have demonstrated that regional airports are drivers for regional development and infrastructure for crisis management [15–17].

This paper argues that the perspective of ownership affects societal resilience, particularly in remote areas such as central Sweden. In particular, the study emphasises the importance of a broader stakeholder perspective for critical infrastructure resilience by highlighting a number of stakeholders representing services and functions that depend on airborne transportation. To investigate the role of regional airports in the regional and municipal context of Sweden, the paper leans against stakeholder theory [18,19] and analyses public policies that shape the Swedish airport system as well as evidence from interviews, a workshop and group discussions with concerned stakeholders. The insights from this research will also be relevant to other contexts of sparsely populated regions with a similar remote location. For example, the findings emphasise that the one-sided focus on the number of passengers is an insufficient foundation for the Swedish airport system which, in turn, constitutes the basis for crisis management and civil defence.

Following this introduction, the next section provides the theoretical foundation for this study. The method section describes the methodological proceedings for data collection and analysis. The result section examines not only the role of regional airports for regional development, crisis management and civil protection in more detail but also provides insights into the historical development of the Swedish airport system and the current challenges due to the ongoing COVID-19 pandemic. The paper concludes with a discussion of the implications of the results for research and practice and a summary of the key learnings and needs for further research.

## 2. Theoretical Points of Departure

### *2.1. Resilience and Critical Infrastructure*

Resilience originates from the Latin *resilio*, meaning *leap back* [20] and is often defined as the ability to return to an original status after a temporary disruption e.g., [21]. This does not necessarily imply that society needs to return to the same state as before [22]. Resilience embraces both a set of attitudes on desired actions and the development of new opportunities. The ability to react on singular or unique events constitutes a common way to conceptualise resilience [23]. Resilience can also mean the ability of a society or a system to maintain societal functions (i.e., continue to produce) when it has been subjected to a shock [24].

In particular, resilience contributes to a better understanding of the concepts of risk and vulnerability and their importance for risk management [25]. For example, the ability

to work across organisational and national borders constitutes an important basis for resilience development [26]. Cooperation improves resilience in a crisis since it increases (i) the coordination level, including risk communication, decision-making and policy implementation; (ii) the resource distribution; and (iii) trust-building and social capital [26]. Associated with resilience, the concept of adaptive capacity measures the preparedness of society to react to phenomena such as climate change and its willingness to undertake measures to manage such phenomena [27,28].

As for critical infrastructure resilience, studies show that the involvement of relevant stakeholders in the planning process is a key issue. This includes cooperation, information sharing and discussion, which are key aspects that must be based on trust between the involved stakeholders [29]. One example of a stakeholder-based system to enhance societal resilience is the network of Swedish river groups, which deal with floods and high river flows. Studies of this example stress the importance of appropriate exchange of information and data among the participating actors, such as policy makers, critical infrastructure operators and businesses, in order to maintain the relevance of the strategy [30]. In addition, research has emphasised that the timeframes for actions often differ between involved actors, which must be recognised in the context of critical infrastructure resilience [31].

### *2.2. Stakeholder Theory*

The stakeholder concept is considered an essentially contested concept that shows a degree of definitional variation [32]. In this study, a stakeholder represents a group who can affect or is affected by the achievement of an organisation's objectives [33]. Stakeholders can cover a broad spectrum of interests, such as societal, environmental, economic or geopolitical objectives. These interests have properties, for example beneficial, neutral or conflicting side effect, which can become challenging when multiple stakeholders are concerned, for example in the context of emergency response planning [34]. The role of stakeholders with regard to business and management has been discussed in literature since 1963 [18,35], whereas Freeman [36] as well as Donaldson and Preston [37] have had strong influence on the development of this field. Freeman's work has provided a solid theoretical foundation to the stakeholder concept [19]. Donaldson and Preston [37] have considered three ways to utilise stakeholder theory in analysis, focussing on descriptive/empirical, instrumental or normative aspects. The case study in this paper mainly concentrates on the former to contribute to a broader perspective on the role of regional airports in societal resilience of remote areas.

In the context of aviation, a few studies use the stakeholder perspective to analyse their objectives and the interrelated challenges for airports. For example, ref. [1] has identified the following 15 airport stakeholders: passengers, air carriers, general aviation users, airport organisation, investor holders and bondholders, concessionaires service providers, employees, federal government, local government, communities affected by airport operations, non-government organizations, parking operators and ground transportation providers, and airport suppliers. In addition, another study used this classification in a case study of a Malaysian airport terminal [38]. Departing from this classification, this study started with a generic stakeholder map (see Figure 1) to identify case-specific stakeholders and their stakes.

Stakeholder analysis considers two main elements—the identification and characterisation of the stakeholders, for which a notable number of approaches and perspectives are discussed in literature [32,39]. In the context of this study, the former element seeks to find out who can affect or is affected by the functioning of a regional airport in a remote area. The latter element concerns the relations between stakeholders and their objectives as well as possible cascading effects on indirect stakeholders. The following section outlines the application of the stakeholder approach in this study in more detail.

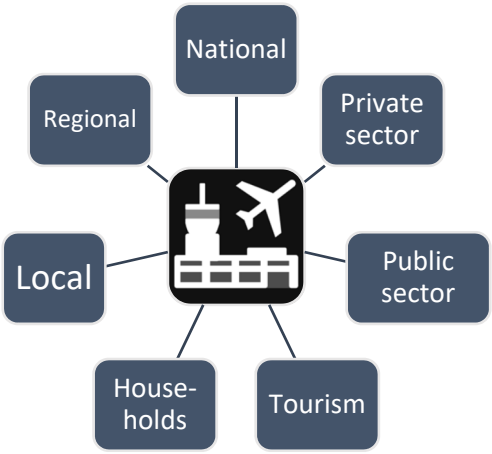


**Figure 1.** Generic airport stakeholder map.

## 3. Materials and Methods

### *3.1. Research Design*

This case study was primarily funded by the Sundsvall and Timrå municipalities within the scope of the partnership agreement with Mid Sweden University. However, the goal was to look beyond the selected case and to problematise the conditions and need for regional airports in a more general sense. The study applied both a local perspective on the area around the airport and a regional perspective to capture the wider impacts, with considerations given to three dimensions: benefits, costs and room for manoeuvre, including power dynamics.

Research designs that use qualitative, semi-qualitative or mixed-method approaches are useful to expand understanding and to enrich insights [40]. Due to this potential, such approaches have the ability to reflect the non-linear interdependencies in the context of critical infrastructure systems [29]. Examples include considering both protection efforts at different levels and resilience effects on interdependent groups or even mitigating a lack of quantitative data [41]. In particular, understanding the needs of depending stakeholders is a precondition for meaningful management of resilience in critical infrastructure and society [29]. Therefore, this study applied a qualitative mixed-method approach [42] for the stakeholder analysis. Data collection included publicly available documents, semi-structured interviews, a workshop and a focus group discussion, which enabled data triangulation [43].

Figure 2 depicts the process of data collection and analysis, which consisted of five steps. Research for conducting this study corresponds to a workload of around six months during a period of two years, representing one 1.0 FTE plus around 0.1 FTE in the same period, accounting for participant effort in being part of this study.

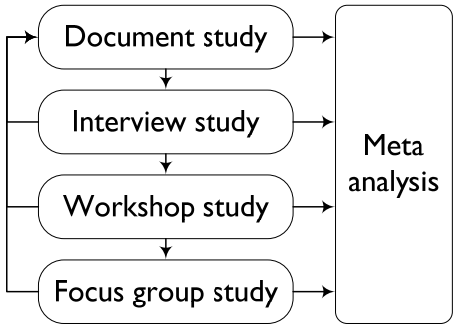


**Figure 2.** Flowchart of the research process.

### *3.2. Data Collection and Analysis Process*

First, a comprehensive document study was used to examine public material and policy documents, such as public inquiries, government bills, official statistics, regulations, rules, statutes, etc. The study was also supplemented by a review of research on the importance of airports for business and society as well as calculation models for assessing public benefits. The analysis sought to understand the particular context of aviation in Sweden and to identify stakeholders that are salient in public policy-making. In addition, the analysis concentrated on how these stakeholders are characterised by public decision making. The results of this step informed the selection of the participants in the subsequent steps of the research process. In particular, this study pursued the ambition to broaden the found perspective that dominated the analysed material.

Second, five semi-structured interviews were conducted with representatives of airport operations, the tourism sector, emergency preparedness and rescue federations, industry and non-governmental organisations. The interviews, which were conducted at the regular workplaces of the representatives, lasted one hour on average and were recorded and transcribed. A questionnaire guided the semi-structured interviews. The objective was to identify further stakeholders and to enable an analysis of stakeholder needs as well as interrelations among stakeholder groups. The analysis of the collected material focused on the expressed benefits and challenges relative to regional airports and air-based transportation as well as the perceived cascading consequences of possible changes. The latter included participant concerns with regard to the daily business of their own and that of their customers. The insight from this step informed the selection of the participants in the following step.

Third, a four-stage workshop was held with 14 representatives from the municipalities of Sundsvall and Timrå, the Medelpad Rescue Services Association, Region Västernorrland, Sundsvall-Timrå Airport, High Coast Airport, the tourism sector and the Swedish Cellulose Company (SCA). The workshop focused on the importance of regional airports to society. It followed the stakeholder analysis approach and aimed to identify further stakeholders as well as characterise the identified stakeholders and their relationships. Initially, participants were asked to consider their own operations and highlight which of the services provided by the airport operations they regularly used and what benefits those services offered for their operations and customers. To consistently structure the feedback, we used the model in Figure 3 as a structural framework.

Subsequent discussions, held in small groups, focused on different forms of perceived and possible limitations (e.g., limited access to opportunities due to an airport's range of services), alternative modes of transport and the interconnected consequences for various operations and customers. Following a short joint discussion about the insights gained during this initial stage, in the second stage of the workshop, we shifted from the specific operations to more general societal aspects. Participants were divided into small groups to discuss benefits, conflicts, alternative solutions and future developments. To acquire comprehensive and less-biased insights as well as provide participants with the opportunity to learn of the perspectives from other operations, we changed the group composition in the second stage. This helped minimise undesired effects such as groupthink. The third stage of the workshop aimed to create a common understanding of the issues raised by holding joint discussions about the role of airports in society. Aspects that were described included the conditions and functions, from a user perspective, relevant to the operations of regional airports which are important to society. In addition, potential variations to the identified key factors were discussed alongside possible consequences for society. Finally, participants shared their thoughts about ongoing and future developments.


**Figure 3.** Framework for structuring discussion at the workshop.

Fourth, a focus group interview with seven representatives from several regional airports and the Voluntary Flying Corps and SRF, a cooperation body of all Swedish regional airports, completed the empirical evidence of this study. The group interview, which lasted 1.5 h and was recorded and transcribed, focused on both the challenges that emerged in connection with the COVID-19 pandemic and the role of regional airports as critical infrastructure for regional development, crisis management and civil defence. The focus group improved the previously developed findings with particularly urgent stakeholder needs that emerged alongside the societal adaption to governmental regulations even beyond the Swedish context. The analysis concentrated on emerging issues to complete the analysis of stakeholders in the context of airborne transportation in remote areas.

Lastly, the meta-analysis step included evidence and results from each step and synthesised the findings and insights presented in the sections that follow.

## 4. Results

### *4.1. The Development of Aviation in Sweden*

Constructed in 1903, Wright Flyer 1 is often regarded as the first successful aircraft. Following the Wright brothers' success, aviation spread rapidly throughout the industrialised world, including Sweden. In 1910, the Swedish Flying Baron, Carl Cederström, took off in his airplane as Sweden's first pilot [44,45]. From 22–24 July 1911, the Baron visited Östersund and Sundsvall in central Sweden. In both cities, temporary airports had been constructed close to what today are the two campuses of Mid Sweden University [46,47]. International commercial aviation is generally said to have begun in February 1919, when regular flights were launched in Germany between Berlin and Weimar [48]. In Sweden, regular commercial flights began on a trial basis in 1920 between Malmö and Warnemünde in Germany. The Swedish Air Transport Committee of 1921 recommended that the government avoid intervening in air transport matters, leaving the municipalities to finance the building and operation of aerodromes [49].

A 1934 investigation on aviation emphasised the role of municipalities in establishing airports [50]. Even if construction costs could be divided between a municipality and the state, the municipalities should have primary responsibility since all airports—excluding Bromma, Bulltofta and Torslanda—were only intended for domestic flights. However,

during the troubled 1930s, the state's attitude towards owning airports changed, and a public investigation recommended state ownership, except for Bromma and Torslanda, which were considered to have the right conditions for municipal ownership [51]. In addition, the responsibility for air traffic control was transferred from municipal to state control starting in 1939 [49].

The number of airports in Sweden grew considerably throughout the 1950s and 1960s. Again, ownership was a subject of discussion, and in 1967, the government proposed allowing municipalities to own airports [52]. It is worth noting the distinction between primary and secondary airports; the former refers to state-owned airports with regular flights and the latter to airports constructed and operated by municipalities or privately owned airports. Airports that do not operate regular flights shall not be managed by the state, the government proposed [52]. Since 1 January 2007, the state has owned 16 airports: Arlanda, Bromma, Jönköping, Karlstad, Kiruna, Landvetter, Luleå, Malmö, Ronneby, Skellefteå, Sundsvall, Umeå, Visby, Ängelholm, Östersund and Örnsköldsvik. These airports constitute a minority of the total number of airports in the country. A comparison with other Nordic countries shows that most airports operating regular flights in these countries are state-owned. The Norwegian government, for example, chose to nationalise the majority of what were previously municipally-owned airports [53]. However, the outcome of the comparison was that the state ownership of airports in Sweden was further constrained, a structure that remains in place today.

Commissioned by the government in 2006, a special investigator conducted a public inquiry into the structuring and categorisation of Swedish airports to review the Swedish airport system. The aims were to provide suggestions for future airport infrastructure, review the methods of funding and ensure good interregional accessibility in accordance with transportation policy goals wherein interaction with other modes of transport should be highlighted [53].

The review has proposed a system with three airport categories: nationally strategic, regionally strategic and other. However, only two of these categories are clearly defined. First, one of two criteria must be met to classify an airport as nationally strategic: passenger volume or the benefit of the airport. Passenger volume is based on a total volume exceeding 750,000 passengers, while the benefit criterion is based on the actual number of passengers in relation to the potential number of passengers and interpreted as the population of the region. If an airport only meets the benefit criterion, a minimum annual level of passengers is set to 50,000. Second, the 'other' category applies the distance to Stockholm-Arlanda airport as a single criterion. If an airport is located within a distance corresponding to a maximum of a two-hour journey by car or public transport, the airport would fall into this category. If none of the mentioned criteria are met, the airport automatically enters the remaining category of regionally strategic airports. The inquiry demonstrated that only nine airports were nationally strategic, while 27 were classified as regionally strategic and four as other. Today, 33 municipality-owned and -operated airports, defined as regional strategic, are joining SRF (https://www.flygplatser.se/ [accessed on 22 November 2021]). In addition, 10 airports, defined as nationally strategic, are jointly owned and operated by a state-owned enterprise (https://www.swedavia.com/about-swedavia/role-and-mission/ [accessed on 22 November 2021]).

In 2009, the Swedish Transport Agency drafted a proposal for how accessibility to airports could be improved for stakeholders who conduct essential operations for emergency preparedness or other societal functions, such as rescue helicopters, airborne medical transports, police helicopters and coastguard planes. The proposal further included the needs of stakeholders who participate in rescue missions, particularly during times when airports are closed for regular business. This proposal identified 10 airports equally spread throughout the country [54]. In 2014, another evaluation suggested adding three airports to the emergency airport network and strengthening cross-border collaboration [55], but no appreciable advancements have been reported since.

In recent years, both the debate on 'flygskam' and the COVID-19 pandemic have affected aviation. In 2018, the term flygskam, coined in Sweden, described the phenomenon of travelers feeling guilty about using flights over train trips and the consequent increase in greenhouse gas emissions [56–58]. However, before the flight-shaming movement was able to become mainstream, global restrictions to air travel as a result of the pandemic and the associated cancellation of a considerable number of flights globally occurred. In Sweden, the number of passengers decreased drastically by 71% and 76% for domestic and international flights, respectively, in 2020 compared with 2019 [59].

### *4.2. Perspectives from Regional Airports*

Although several inquiries indicate the importance of airports to society and emergency preparedness, most are regional airports financed, owned and operated by municipalities and regions. This means that if the airport generates a deficit, the owners must contribute funds to maintain the business. While regional airports receive grants from the Swedish state, the amount allocated varies. One of the airports receiving the least in grants is Sundsvall-Timrå Airport (SDL); this is despite its maintaining an emergency preparedness mode. Because of the government decision on the structuring of airports in the country, SDL was transferred to municipal control in 2013, which included both the ownership of the fixed infrastructure assets, such as the terminal, runway and hangars, and operation of air-based transportation. Sundsvall municipality currently owns 84% of the airport, while Timrå municipality holds a 16% share.

After the restructuring, the relationship between the state-owned Swedavia and regional airports was strained, hampering the management of shared issues relating to aviation, such as the climate impact, cost pressure and skills supply. Currently, a certain degree of collaboration with Swedavia has been resumed to strengthen efforts through various means, including strategic procurements or the exchange of personnel and experiences.

The perspectives highlighted by the airport representatives included the fixed infrastructure and operation of an airport and its role in society. First, the representatives emphasised that the fixed infrastructure requires considerable effort from owners to maintain a proper service to both passengers and all types of air transport vehicles. Among other aspects, it includes the maintenance of not only the runway and terminal but also the infrastructure for air traffic control and assets for fuel supply in accordance with recent regulations. However, such efforts challenge the economic situation of small communities in the sparsely populated regions of Sweden. The operations include all types of ground-handling services. For example, aircrafts are prepared in terms of heating, refuelling and catering. In addition, airports provide terminal services, such as checking in freight and passengers, and security controls, which include the provision of basic support functions such as lighting, signage, water and sewerage, travel information, security equipment and information and communication technologies.

Second, apart from regular air-based transportation, SDL offers round-the-clock preparedness, meaning the airport can operate within one hour for ambulance transport. In addition to planned charter flights with destinations such as Gran Canarias or Turkey, charter transport may also require ad-hoc service, for example, in connection with transports to and from the prison in Saltvik. The latter involves expanded security measures related to the movement of prisoners and their ground transports.

SDL also fulfils an important function in the handling of airplanes and helicopters used by the armed forces and in monitoring and extinguishing forest fires, such as those which occurred during the summer of 2018. In this function, SDL provides organisational services in the form of a premises and technical equipment for directing regional emergency management initiatives, which requires the readiness of appropriate staff on site. It is widely acknowledged that extreme weather can cause societal disruption, such as that observed during Hurricane Gudrun (2005) and Per (2007), which caused large-scale power outages in Sweden due to utility poles being blown over and damage to substations from

fallen trees. In these instances, cargo planes and helicopters can transport task forces, equipment and materials close to the problem area to facilitate quick restoration of the power supply. Apart from typical ground services, the maintenance of vehicles can be challenging during emergencies because they require comprehensive regular service, which in turn requires workshop capacity and the availability of skilled personnel.

It should also be noted that SDL holds an important position in air traffic control, as Saab Digital Air Traffic Solutions, which provides flight inspection and air traffic control services, uses the premises. In addition to SDL, air traffic at Örnsköldsvik, Linköping and Scandinavian Mountain airports is currently controlled remotely from these premises.

Overall, cooperation between airports in the country has developed in recent years to create both knowledge exchange and opportunities for strategic cooperation.

### *4.3. Perspectives from the Swedish Voluntary Air Corps*

The work of voluntary organisations within the scope of society's emergency preparedness seldom receives proper attention in media or government reports. For example, in Sweden, the unusually hot and dry summer of 2018 led to 88 fires in one day throughout the country. This triggered extensive public discussions about the management of the efforts. The Swedish Civil Contingencies Agency final report concluded wildfire-monitoring flights were a valuable means that detected over 500 fires and assisted with directing emergency forces [60].

One voluntary organisation, the Swedish Voluntary Air Corps (FFK), flew 5500 h in connection with the forest fires, compared to about 1100 h during a rainy summer and roughly 1500 h during a normal summer. The cost of an undetected fire is estimated to far exceed the costs of the entire fire monitoring service by air. The costs of the FFK arise mainly from aircraft operation, as the pilots and scouts operating the aircraft receive no reimbursement. The challenges in 2018, however, indicated several problems with emergency preparedness and the reimbursement system, both for the airports and the airborne task forces [61].

One problem is the increasing age of available aircraft. Most aircraft used by the FFK are over 60 years old and, despite regular maintenance, are showing signs of wear and will eventually need to be retired from service. Furthermore, the aircraft require technical service, but the number of workshops and mechanics who can service these older models is declining, resulting in rising costs or unavailability of service during crises. The effects of this scarcity became obvious in the summer of 2018, when mechanics had to work through the night and (like many others in this situation) during their holidays to maintain the firefighting efforts. The need for servicing, which usually occurs every one or two months, had to be conducted after just a few days. To further complicate matters, due to rising fuel prices and costs for reservoir maintenance, an increasing number of airports have chosen not to keep stocks of the type of fuel that these aircraft require, highlighting a notable lack of fuel service. This significantly reduces emergency preparedness, especially in northern Sweden, where there is a considerable average distance between airports. Having to fly or drive to another airport to refuel a plane is unsustainable both in terms of environmental impact and the pilot's flight time and safety. Moreover, it jeopardises the time advantage. Finally, the study results highlighted concerns regarding the overestimation of the capacity of voluntary efforts and this resource being taken for granted. The 2018 fires revealed various problems that could impair volunteering in future crises, such as limited expertise and a lack of reasonable reimbursement to volunteers for their time, including compensation for travel costs to and from the airport and other overhead costs. In addition, voluntary efforts can be affected by the private and professional lives of participants and by their ability to maintain their skills, such as flight certificates. Promoting a vibrant landscape of voluntary organisations therefore requires significant commitment, from both voluntary organisations and public and private stakeholders, at the local, regional and national levels. Such insights from previous crises are relevant and can be recognised when comparing April 2018, during which 16 monitoring flights were performed, and April 2019, during

which 165 such missions were flown and 25 fires were detected as well as stopped in time, due to extended monitoring efforts.

### *4.4. Perspectives from Public Sector Organisations*

The *security* sector plays an important role in society. Services frequently operate without much public attention, including correctional care, emergency preparedness, rescue operations, the police and the judiciary. Interest increases when a major event occurs or the media reports on events such as forest fires or road accidents that caused serious damage. To manage such emergencies, rapid transport is critical for moving casualties to hospitals and deploying reinforcements. In rescue missions, helicopters are frequently used to enable swift transportation of emergency teams to the incident.

At SDL, helicopters from the police, healthcare system and maritime administration receive ground service such as refuelling. However, Västernorrland is one of the counties in Sweden with the fewest publicly owned helicopters. Instead, transport capacity is sourced from the surrounding counties. This severe lack of capacity was shown to be problematic due to specific incidents during the aforementioned forest fires in which a shortage of helicopters occurred. The shortage was further exacerbated partly because private owners needed to prioritise between already scheduled transports and sudden incoming requests for emergency aid and due to the armed forces lacking a clear mandate to support civil society. The forest fires occurred during the main holiday season, which also contributed to a lack of personnel and material, something that severely limited air transport capacity. Informal contacts and collaborations, as well as international assistance, eventually helped to alleviate the situation via increased monitoring and firefighting. However, between missions, airplanes and helicopters must be serviced, refuelled and parked, and the crew must be given an opportunity to recover. All of this highlights the importance of regional airports not only for crisis management but also civil defence. The main advantage of regional airports is the proximity to incidents, which improves the balance between flying time and time spent on the actual mission, such as firefighting. A regional airport that provides regular operations also contributes to shortening the initiation time of the emergency organisation and facilitates the execution of the intervention. In a more strained international situation with pressures on national interests, intermodal transport logistics are even more important. This is where aviation plays a crucial role in transporting both people and material.

Regional airports can also be useful for postal services by transporting mail and packages. At SDL, postal aviation was terminated in 2018 following the governmental decision to give the postal service more time to make deliveries [62]. Although the number of letters declined by 8.3% from 2017 to 2018 [63], this decline did not correspond to the decrease in postal aviation, indicating that post transports were conducted through other modes, likely road transport. This conclusion seems reasonable because the parcel volume at PostNord grew by about 10% in the same period [63]. However, no reliable statistics are available regarding the overall volume increase of parcel deliveries in Sweden [64].

In the region, medical transport by air is indispensable for providing healthcare to the local population within a reasonable period and distance from a person's home and to make use of specialist care at the only university hospital in northern Sweden, located in Umeå. For services such as organ donation, it is essential to facilitate organ transport in a swift and safe manner.

In addition, airborne monitoring is also used for nature conservation, such as conducting animal and forest inventories and surveying the state of the environment in remote and hard-to-reach areas.

### *4.5. Perspectives from the Business Community*

Access to fast air transport is essential to many businesses in the region surrounding the airport. Air travel provides opportunities for businesses to reach customers and partners and to maintain distribution channels, which gives entry to global markets. A

limited choice of transport modes is a risk businesses evaluate when relocating their operations. In addition, limited public transport that impacts accessibility and travel time to connecting flights may result in businesses taking steps that result in a loss of employment and thus tax revenue in the region. Such circumstances are crucial when making decisions concerning the location of meetings or internal training courses, which in turn have economic consequences for the destination.

Businesses and industries must also prioritise time efficiency, marketing effects, costs and turnover as well as protecti employee work-life balance to attract desired talents. Time efficiency is of particular importance to industrial production that cannot be interrupted without severe consequences to the economy, people's health or the environment. In the studied region, several companies, such as those involving aluminium smelters, pulp mills and chemical production, depend on fast access to expertise and spare parts. In addition to playing an important economic role for the region, these companies can be considered critical infrastructure because they also contribute electricity and heating to the local community.

The choice of quick and efficient means of transportation is thus important to ensure the company's position in the market and thereby safeguard job creation, skill supply and employment opportunities in the region. Access to fast passenger transport to and from the region is therefore a crucial factor for companies to establish and maintain operations while further developing the business in the region. In this context, the recruitment of specialist skills is of particular importance. Since specialist skills often constitute a limited resource in the market, the possibility of recruiting a specific talent is essential to operations. Efficient means of transport is important here as well to attract talent. For work and an active private life, short, efficient travel times are important competition factors. Train travel is frequently seen as a more time-consuming alternative to flying, partly because it takes longer but also because departure and arrival times rarely align with business hours—a problem that has worsened due to cancelled public transport during the COVID-19 pandemic.

### *4.6. Perspectives from Destination Development*

Tourism is a driving force in regional and local developments. This concept refers to visiting individuals and companies that are expected to spend money in the region as well as travel opportunities for locals, which contributes to raising the appeal of said region. Tourists are important for many regional businesses that offer services within the tourism sector, including hotels, restaurants and companies organising events or training courses. The offers target people who travel for work (e.g., meetings, conferences or training courses) or personal reasons.

Various activities and events contribute to regional development through job opportunities that generate income for companies and employees. These services are also provided to the local community, which leads to a wider range of offerings, such as restaurants and leisure activities. In addition, it is recognised that people who travel central Sweden for work also, to some extent, return on holidays and sometimes bring their families. Alternatively, they may be ambassadors for the region where they live, which may lead to more people travelling to the region. Destination development has noted the positive correlation between a region being easily accessed and the number of business travelers and tourists visiting, which means air transport is crucial to the development of a destination. Prosperous companies within the tourism sector have also been acknowledged as drivers of making local and regional communities more varied and appealing, which in turn attracts more tourists and future inhabitants.

Inhabitants regard the local range of leisure activities as contributing to the region's appeal. In addition, direct holiday trips may strengthen individual and family decisions to settle in a region, which is understood to affect skills supply for organisations and the region's revenue. A growing population also leads to growth in several businesses, such as those in the retail sector. People moving here, businesses opening, and employment jointly impact one another as well as a region's overall appeal and revenue. In the interplay

between different factors, accessibility to air transport is viewed as fundamental. From the perspective of destination development, a wide range of transport modes should be available, enabling fast and cost-effective travel to and from a region. At the same time, it is emphasised that the community's capacity to accommodate visitors should increase in relation to demand. Otherwise, other regions which offer better capacity and transport may be sought.

Aside from air transport, connecting traffic between an airport and final destinations is also an important factor underlying travel, as regional airports are often located in some distance from towns or meeting places. Depending on passenger frequency and geographic location, car rental opportunities, taxi operations and public transport can also impact the choice of destinations.

Finally, visitors also affect issues related to local and regional emergency preparedness, which necessitates both fast transport and expanded local and regional emergency preparedness.

### *4.7. Summarising Reflections*

Based on the stakeholder perspectives discussed above, Figure 4 visualises the interconnections among the transport sector including aviation and other sectors of critical infrastructure on a more general level. It emphasises that transportation not only depends on a number of critical infrastructures but also is a precondition for other systems of critical infrastructure in society. The presented evidence suggests that transportation by air contributes to the resilience of remote areas because it bridges the distance to societally important functions and public services. In turn, regional airports constitute the basis for aviation, which implies that their level of resilience affect the resilience of the surrounding community.

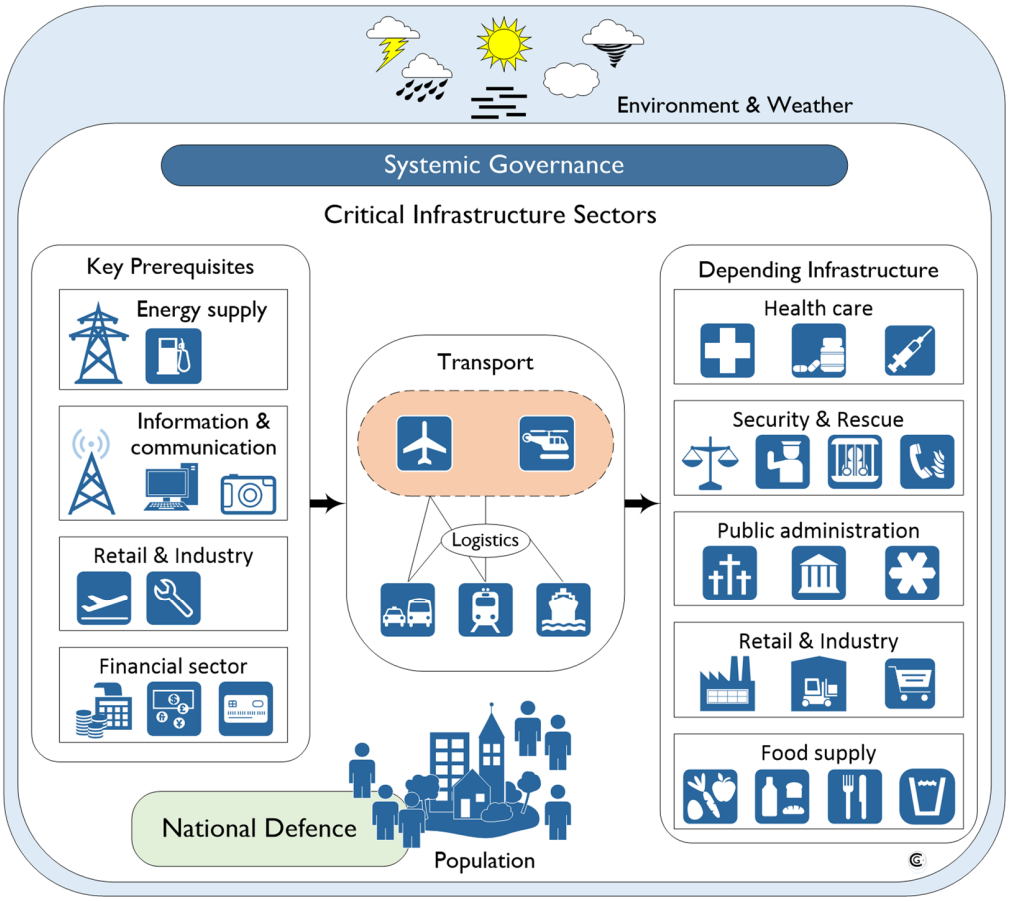


**Figure 4.** Relationships between sectors of critical infrastructure.

## 5. Discussion

### *5.1. Recent and Approaching Challenges for Airports in Remote Areas*

The categorisation of Swedish airports as national, regional or other depends on two criteria: the number of passengers and proximity to the major airport. However, this study demonstrates that airports can be considered critical infrastructure and are therefore important for several other societal activities in addition to passenger transport.

Many stakeholders who participated in this study emphasised the role of airports in providing efficient and varied means of transport that enable different types of public and private sector operations in relative peripheral societies. Access to efficient transport of individuals and groups is a central concern for both industry and destination development alongside public services related to crisis management, health care and civil protection. For example, representatives from the business community highlighted the impact of transport not only on their own operations but also for creating the conditions that enable a better skills supply. For destination development, efficient transport is crucial for enabling visitors to travel to and from the region. With respect to the investigation which led to the categorisation of Swedish airports, this perspective is partly represented, as the need for any airport should be reflected in the number of passengers using the airport. However, the sector-specific needs were not highlighted in the inquiry. This extends especially to the business community's need for efficient transport of critical spare parts to avoid major loss of production or, in a worst-case scenario, a total shut down of operations.

The role of airports in effective emergency preparedness is emphasised in terms of combating crises that have already occurred and preventive measures to mitigate the effects of potential emergencies. The preventive work on forest fires is identified as particularly important by both the Swedish Voluntary Air Corps and public stakeholders such as municipalities and the rescue service. Public documents reflect this perspective, but it was not highlighted in the investigation preceding the categorisation of airports in the country. The effect of the categorisation is that some regions receive state funding for creating proper conditions for airborne emergency preparedness, whereas other regional airports heavily rely on funding from the owning municipalities. The operations at SDL are particularly vulnerable, as government funding is more limited there compared to other regional airports.

Västernorrland Region, which is responsible for coordinating public health care, highlights the importance of airports for life and health. Transport of the seriously ill and injured by helicopter and airplane to the regional hospital in Umeå is particularly essential, together with the transport of organs in connection with transplants. This aspect is signified in public documents relating to healthcare but is not highlighted in the inquiry as to how the country's airports are structured. This study accented the role of airports relative to the prison service. In this context, aviation ensures secure transport to and from prisons, including Saltvik. This aspect is rarely discussed in the public documents detailing the role of airports.

Current challenges were also discussed among the participants in the case study, such as 'flygskam' and the COVID-19 pandemic. As statistics from the Swedish Transport Agency indicate, flight-shaming affected domestic travels, whereas COVID-19 had great impact on the entire industry [59,65]. The majority of the regional airports have either maintained their operation on a very basic level or completely stopped it during the pandemic. Although Sweden recently lifted all restrictions [66], it is likely that all modes of passenger transportation remain affected. Potential reasons for this include health concerns, the rapid digitalisation of business meetings, workplaces and education as well as organisational travel policies that promote eco-friendly travel alternatives. The mainly municipality-owned regional airports face consequently the risk to be closed down, which the recent example of Skövde airport indicates [67]. Nevertheless, current alternatives to air travel, such as driving and public transportation by train and bus, are not always available, practical or convenient, especially in remote and sparsely inhabited areas.

As such, future aviation in these areas relies not only on the development of new types of fuels and technologies to reduce the impact of aviation on climate but also on new models of ownership and financing of the infrastructure that is critical for several vital societal services as well as businesses, industries, tourism and national security. Since transportation by air constitutes a valuable element in risk and crisis management, particularly with respect to the resilience of society and critical infrastructure, the maintained functioning of regional airports deserves a nuanced consideration. The findings of this study motivate the application of a broader perspective to determine the public value of an airport in remote areas. In particular, transport-time savings are crucial in the context of crisis management and societal resilience. Moreover, aviation provides access to a site from above, which can be another valuable success factor in handling crises. Finally, airborne transportation ensures accessibility to places that cannot be reached by other modes of transport. Such aspects can guide the future development of economic models that balance societal, environmental and economic aspects in a way that strengthens resilience in remote areas.

### *5.2. Limitations and Prospects of Future Research*

The interplay between the perspectives discussed above constitutes, to some extent, the combined benefit of an airport based on stakeholder views. It should be emphasised that other perspectives may also need to be considered regarding the role of airports.

Furthermore, the complex system of all the interconnected factors and interactions between them makes it difficult to calculate the total value of an airport to society. Models for calculating public benefits have yet to be developed. For example, the Swedish Transport Administration's calculations of the value of a human life in the context of a traffic accident can serve as a starting point in terms of healthcare. Although one study already sought to extend existing models for calculating the social and economic impact of airports by including the value of critical infrastructure for societal resilience [14], more research is needed in this area.

The environmental impact of airports was not addressed as a separate perspective in this study. The impact of transport on society in the form of various types of emissions, such as greenhouse gas emissions, pollution and noise, is unequivocal. How this aspect affects the importance and role of regional airports is an essential issue that remains to be studied and analysed. In this context, developments towards electrified aviation and unmanned drones [68] are highly relevant to consider. Examples of ongoing initiatives include experiments with electric aircrafts at the Örnsköldsvik airport in 2019 [69] and in Norway, which aim to enable all air traffic in Norway to operate by electricity from 2040 at the latest [70]. Because electric aircrafts and unmanned drones are predicted to serve shorter distances compared with traditional aircrafts, the conditions for regional airports may change considerably when electrified aviation and services by unmanned drones become the new modes of transportation by air, particularly in remote areas.

In sum, further research on the role of regional airports for societal and travel activities is required to determine their larger impact. This investigation was based on a case study of one regional airport close to a major city in northern Sweden. To substantiate more generalised conclusions, a comparative study of a greater number of regional and national airports is advised. Meanwhile, this study demonstrates that there are additional factors besides the number of passengers to consider when determining the role of regional airports for enhancing societal resilience. Additional studies could focus on other countries and their priorities regarding transport infrastructure in general and aviation in particular. Such analyses could compare implemented classification mechanisms and applied metrics as well as their usefulness for resource allocation in practice. This study sought to highlight the perspectives of different stakeholders and to emphasise the role of regional airports for transportation in remote areas. Figure 4 visualises the interconnections among the transport sector including aviation and other sectors of critical infrastructure. Such conceptual

representation could be a reference model for future discussions about how smaller airports are valued and supported in society.

## 6. Conclusions

The aim of the study was to chart the importance of regional airports for the functioning and development of society. The results showed that regional airports are important not only for business, charter or regular travel but for a variety of activities and stakeholders in society. In addition to crisis management and operation, resilient aviation infrastructure is essential for public service, private business and industries as well as for national security and civil protection, which necessitates cooperation among many societal actors.

The results demonstrated that stakeholders who participated in this case study highlighted the importance of aviation in terms of speed, monitoring and accessibility, especially in the context of saving human lives and safeguarding health, natural resources, recreational facilities and other economic and material values. The interviews and workshops with regional stakeholders supported several perspectives of the importance of aviation relative to their own operations and the region surrounding the SDL airport.

Despite the variety of concerns highlighted during this study, the government investigation almost exclusively relies on the number of passengers when determining how to categorise the airports in Sweden and subsequently finance them. The current decrease in the number of passengers due to flight shame and the COVID-19 pandemic might lead to a decrease in the total number of airports. This may affect the developments associated with new electric aircraft and unmanned drones, as this presupposes a resilient infrastructure of aerodromes that facilitates stopovers for secure and rapid charge of the batteries of electric-powered aerial vehicles.

This paper highlights the risk associated with ownership and consequent financing of airports and the impact on societal resilience. In the short term, the resilient operation of interdependent critical infrastructure is at stake, which this study illustrates through the various needs expressed by concerned stakeholders. In the long term, a lack of maintained airport infrastructure can hamper the development of future transport facilities, for example, electric aviation, since this in turn will rely on an enabling and close network of charging points for electricity-powered vehicles.

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