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Forced Co-Production in Service Supply Chain:

A Case Study of the 2026 Schiphol Airport Winter Disruption

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By

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Abstract

Co-production, as a mechanism with collaborative and voluntary nature within the service-oriented logic framework, presents different characteristics in the event of system collapse. When the service infrastructure fails, if the authorities withdraw from the frontline, leaving a gap that disrupts the normal contracts of services. This study focuses on the winter disruption at Schiphol Airport in Amsterdam in January 2026, which reflects the vulnerability of the service supply chain. Although a large amount of service management literature has explored the participation of consumers under stable conditions, there is a scarcity of empirical research on how the system can self-repair when multiple crises such as digital platform failures and staff shortages occur. Therefore, this study adopts an interpretivist approach and social constructivist theory, using a qualitative single-case study method to explore this phenomenon and integrating empirical data from semi-structured interviews, network observations on digital platforms, and official documents. Our research results break the active-passive classification model of consumer behavior. Instead, we describe a dynamic continuum of co-production, including passive stable type, active coordinated type, and active generative type participation, while revealing the dark side of the service logic, which we call "forced co-production". When the authorities lose control and the digital infrastructure collapses, stranded passengers do not experience the satisfactory results generated by idealized value co-creation. They are subjected to the pressure of being transferred and have to undertake operations, acting as temporary travel agents and translators in multiple roles, merely to complete the journey and pay some unpaid labor. Moreover, we find that there is a significant individual difference in self-management ability under such crises. We call this phenomenon "stratified resilience", which shows how legal restrictions such as non-Schengen visa traps, financial limitations, and customer prioritization weaponize the paralyzed terminals to counter marginalized groups. Finally, this study combines service supply chain theory with power dynamics to explore, providing detailed theoretical insights for forced co-production and important practical significance for more equitable emergency management in the aviation network.

Keywords: Forced Co-production; Service Disruption; Service Supply Chain; Schiphol Airport

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Table of Contents

1 Introduction

1.1 Background and Motivation

On the morning of Friday, 2 January 2026, heavy snow began to blanket Amsterdam. By the end of that day, Schiphol Airport had cancelled more than 300 flights and delayed a further 600. Over the following ten days, more than 3,200 flights had be cancelled, making Schiphol the most disrupted airport in the world during the period. Thousands of passengers were stranded in terminals. KLM publicly acknowledged that it was unable to fulfil its obligations under EU Regulation 261/2004, and the Dutch rail operator NS suspended services to the airport time and again.

This observation forms the starting point of this study. As flights were cancelled on a massive scale and airport staff were powerless to help, a temporary, spontaneous order began to emerge gradually from the chaos among thousands of stranded passengers.

This new order spread rapidly within the digital sphere. On social media, travellers exchanged information about queues, shared details of available rooms in nearby hotels, and discussed alternative ways of leaving the airport. Some even chose to abandon their checked luggage, travelling with hand luggage only to catch trains or buses, others formed temporary partnerships with strangers to share accommodation and translate information. When the formal service infrastructure was no longer able to provide stable support, passengers did not simply sit passively awaiting rescue, instead, through the integration of resources and the coordination of efforts, they took it upon themselves to re-establish a minimal level of operational order.

This study refuses to view this phenomenon as a coincidence. The core argument of this study is that the actions of these passengers essentially constitute a specific form of co-production. The outcome of this co-production, whether at the micro-level of the individual or the macro-level of the system, points to a valuable quality that resilience, which is a core capability that enables systems to maintain operations, adapt flexibly and ultimately self-repair in the face of severe disruption.

1.2 Problem Statement

However, existing research still lacks a thorough explanation of how consumers actually behave once service has withdrawn from the front lines. In particular, to what extent do the collaborative behaviours formed by consumers sustain the ongoing operation of the service system when the entire system collapses and how are these temporary networks of action formed, coordinated and maintained. Current theory still fails to provide adequate answers to these questions.

This academic gap is particularly pressing in light of current realities. The disruption experienced at Schiphol Airport in January 2026 was by no means an isolated or random incident. On the one hand, the increasing frequency of extreme weather events in Europe under climate change is exposing the aviation system to a higher risk of disruption. On the other hand, the hub-and-spoke structure on which modern aviation networks rely is vulnerable because any disruption at a core hub tends to rapidly affect the entire network.

Within this context, this study has selected the large-scale service disruption at Schiphol Airport as the subject of a qualitative single-case study, seeking to bridge the gap between empirical data and theoretical analysis in order to address the theoretical gap. Through semi-structured interviews with affected passengers, netnographic analysis of online community behaviour during the disruption, and analysis of official documents from the airport, airlines, regulatory authorities and so on, this study will provide an in-depth analysis of how consumer co-production emerges in the extreme context of service disruption, what forms it takes, and through what mechanisms it operates.

1.3 Research Question

The overarching research question guiding this study is:

How is service supply chain resilience co-produced through consumer participation during disruptions?

This question has been broken down into two sub-questions that together address both the descriptive and the mechanism dimensions of the phenomenon:

RQ1: What forms of consumer behaviour contribute to resilience co-production, and how do these differ across phases of the disruption?

RQ2: What mechanisms enable, constrain or necessitate consumer co-production of resilience during service disruptions?

1.4 Research Objectives

In order to translate the core questions above into specific analytical objectives, this study propose four research tasks:

Firstly, this study will identify and distinguish among forms of co-production through an in-depth analysis of micro-level interactive processes during large-scale disruptions to aviation services. It will further examine how these behaviours evolve dynamically as service disruptions persist.

Secondly, this study aims to identify and define the key mechanisms linking consumer participation to the construction of service resilience. These mechanisms are embedded within digital networks, institutional frameworks and physical spaces.

Thirdly, this study attempts to extend traditional co-production theory to crisis situations. Specifically, this paper regards service disruption as a particular situational trigger. It causes consumers to gradually shift from a previously supplementary state of participation to a deeper level of involvement. In this process, it is no longer merely a supplementary activity aimed at improving the service experience, but rather an essential component in maintaining the basic functioning of the service system.

Finally, this study also aims to provide practical insights for service supply chain context and emergency management in the real-world.

1.5 Scope and Delimitations

This study is conducted under an interpretivist approach and employs a qualitative single-case study methodology. We focus our most attention on Amsterdam Schiphol Airport during the period from 2 to 12 January 2026, conducting in-depth researches within this specific time-space context and commercial aviation setting. In order to maintain the focus of the research question and the purity of the theoretical analysis, this study draws clear boundaries with other non-core issues. For example, internal crisis management decision-making processes within organisations, as well as passenger satisfaction, have not been included in the scope of this study. Likewise, this study does not attempt to make cross-comparisons between different airports, different countries or different types of service disruption incidents.

The use of a single-case study has chosen to compromise the scope of cross-sectional comparisons in exchange for a more detailed understanding of the specific context. We have also deliberately shifted our research perspective from the traditional enterprise-centred perspective to a consumer-centred one.

Consequently, this study does not aim for statistical generalisation. Instead, it focuses on analytical generalisation. This study aims to develop a conceptual lens that offers explanatory power across different contexts, thereby enabling its future application to similar crisis scenarios, such as medical emergency responses, public transport or retail services.

1.6 Structure of the Thesis

The structure of this study is organised into seven chapters.

Chapter 2 aims to set out the background of the research. Here, we will conduct an in-depth analysis of the service supply chain structure at Schiphol Airport, reconstructing the sequence of events leading to the major disruption in January 2026 in chronological order.

Chapter 3 turns to an overview of academic theory. This study takes the service-dominant logic and the theory of co-production as its solid theoretical foundations, viewing the service supply chain as the contextual framework within which the overall argument unfolds.

Chapter 4 sets out the research methodology, including the philosophical perspective, research design, data collection procedures and analytical methods.

Chapter 5 presents the empirical findings, organised thematically.

Chapter 6 discusses the relationship between the research findings and the theoretical framework, developing the theoretical contributions of the study.

Chapter 7 concludes with a summary of the research findings, an acknowledgement of limitations, and directions for future research.

2 The Case Context: The 2026 Schiphol Winter Disruption

2.1 Schiphol Airport as a Complex Service Supply Chain

Amsterdam Schiphol Airport (AMS) is a complex network rather than a physical location. This section will provide the background of Schiphol Airport to establish a quicker understanding of the disruption caused by the large-scale flight cancellations and delays during the snowstorm in January 2026. As one of the top five largest passengers volumes airports in Europe (Schiphol Group, 2026a, 2026b; ACI EUROPE, 2026). Behind the smooth operation of such large-scale traffic is an interdependent network of participants, which includes the Schiphol Airport Authority providing basic facility operation and overall coordination, KLM Royal Dutch Airlines (the dominant airline and the main de-icing operator in the region), affiliated airlines as supporting carriers (e.g. Transavia), and various ground service providers that assist in daily operations (Schiphol Group, 2026; KLM, 2026; Transavia, 2026). In addition, the Dutch Railways provides intermodal connections that links the airport with the European ground transportation network.

Crucially, in this service supply chain, consumers are defined as one of the indispensable participants in the entire system instead of passive recipients of services (Sampson, 2012). To some degree, this disruption at AMS during the January 2026 blizzard can be attributed to the airport's hub-and-spoke network. In addition, unlike winter-resilient airports in neighbouring countries that incorporate redundancy, AMS reflects the characteristics of a tightly coupled hub-and-spoke system in which efficiency is prioritised over redundancy and buffering capacity (Burghouwt & de Wit, 2005; Woxenius, 2007; Scheibe & Blackhurst, 2017). Although this model can maximise efficiency under normal circumstances by consolidating flows (Woxenius, 2007) because it aims for resource efficiency rather than redundancy (Burghouwt & de Wit, 2005). As recent supply chain resilience literature under normal situations highlights, such tight coupling structurally eliminates operational buffers (Scheibe & Blackhurst, 2017). Therefore, the system has limited absorptive capacity, making it inevitable that localised disruptions will rapidly widespread because any delay of a "spoke" will lead to failure at the hub node, for example, the cancellation of local short-haul flights can quickly spread to the delay of long-haul flights (Pettit et al., 2010; Bode & Wagner, 2015; Scheibe & Blackhurst, 2017).

Furthermore, this network vulnerability has been exacerbated by the lack of official information. Although consumers initially attribute this chaotic phenomenon to extreme weather, potential operational failures remain undetected. Due to limited official information, the validity of the original service contracts becomes weakened, and recovery shifts from a coordinated system to decentralized self-management. In this situation, risks and responsibilities actually shift downward from the enterprises to the consumers. This transfer is not the result of consumers' active choice but is a forced alternative due to the lack of subsequent institutional response. The information gap mentioned above forces the system to rely heavily on the self-managed actions of consumers to recover. To address the crisis of service supply chain disruptions, airports and airlines have utilised digital self-service systems (e.g. online ticket modification systems) as one of the convenient functions, and operational tools on site (Meuter et al., 2000), allowing digitally capable passengers to absorb part of the recovery burden and release the space resources in the terminal buildings. Therefore, when the system fails to recover through internal adjustments, the pressure is directly exerted on the very end of the supply chain, which is the consumers, transforming consumer co-production from a supplementary aid into an essential supporting service recovery. For this reason, AMS provides a revealing empirical context for examining forced consumer co-production during large-scale service disruptions.

2.2 Chronological Case Narrative

Since the beginning of 2026, AMS has experienced severe weather disruptions that have significantly disrupted both passengers and cargo operations. The following chronological narrative sourcing from official documents organises the crisis into three phases with representative milestones.

2.2.1 Phase 1: Initial (January 2nd to 3rd)

Phase 1 was characterized by an initial reduction in the runway capacity and route-priority adjustments. Due to the strong winds and heavy snow brought by the Anna Storm, this crisis initially large-scale impacted the airport’s daily operations on January 2nd. Approximately 450 flights at Amsterdam Schiphol Airport were cancelled or delayed (NL Times, 2026), and the runway capacity was significantly reduced. This reduction was primarily driven by KLM's

proactive strategy to manage consumer expectations and avoid broader systemic bottlenecks by selectively prioritizing intercontinental routes. At the same time, the airport issued official warnings through various channels, advising passengers to verify flight status before travelling and to avoid unnecessary visits to the terminal building. Additionally, the impact of disrupted multimodal transportation began to manifest, such as NS Rail experiencing varying degrees of train delays or cancellations due to weather reasons.

2.2.2 Phase 2: Worsening (January 4th to 7th)

The second phase recorded severe operational bottlenecks including the supply chain disruption of de-icing fluid, leading to a temporary shutdown. In the following days, the unstable weather conditions and the continuing landing of intercontinental flights led to an increasingly severe backlog at the airport. Specifically, AMS was forced to implement a temporary shutdown due to de-icing fluid shortage, limited runway cleaning equipment, and insufficient staff, resulting in approximately 700 flight cancellations on January 5th (Flightradar24, 2026). One day after that, airlines continuously cancelled approximately 600 flights with over 300 flights delayed, which caused approximately 60% of the flight plans at AMS to be unable to be executed and made it one of the airports most severely affected by this extreme snowstorm worldwide. (NL Times, 2026). By January 7th, another 700 to 800 flights were cancelled, and over 1,000 passengers were stranded overnight at the terminal building. To address the crisis, the airport implemented emergency management measures, including providing temporary tent beds in the terminal building and other basic guarantees. At the same time, digital service mechanisms prioritising such as airlines and airport applications significantly pushing "self-service ticket change" notifications, on-site volunteers displaying QR codes to provide real-time online information, clearly indicating that passengers should arrange accommodation themselves and manage their trips through online channels, rather than queuing at crowded physical service counters.

2.2.3 Phase 3: Stabilisation and Recovery (January 8th to 12th)

The third phase of the disruption was characterized by the gradual stabilization of service supply chain and the replenishment of critical supply chain resources. Although it continued to affect the cargo transportation, the airport gradually achieved stable operation, as the cancellation of passenger flights meant a significant reduction in belly cargo capacity, thereby limiting the

volume of cargo transportation. To manage this limited capacity, primary operators implemented strict strategies, for instance institutional records indicate that KLM Cargo imposed temporary embargoes, suspending the handling of live animals, and goods that required constant temperature (Air Cargo News, 2026). In terms of passenger transportation, the key deicing fluid supply was replenished, allowing flights to gradually resume regular operations. By January 10th, almost all affected passengers' flights were successfully rescheduled, and normal operations were fully restored on January 12th. At the same time, to maintain the operation of the supply chain, freight operators had to make adjustments, such as providing early warnings to cargo owners and transporting goods to other hubs like Frankfurt through road services. Based on our empirical materials, we have comprehensively compiled the following table in chronological order, which more clearly shows the responses taken by airlines and airports at each time point.

Date	**Event Trigger**	**Operational Impact**	**Airport/airline strategies**
2026-01-02	Storm Anna with snow showers and strong winds	a) ≈ 450 flights cancelled or delayed	a) Weather warning issued
2026-01-05	Full train ground stop due to heavy snowfall Code orange weather warning	a) ≈ 711 flights cancelled b) Operational bottleneck in aircraft de-icing and runway clearing	a) Flight demand reduction that airlines requested to cancel flights b) Inbound traffic restrictions
2026-01-06	Pre-emptive reduction due to continued snowfall	a) airlines cancelled ≈ 600 flights b) ≈ 60% flight	a) Proactive schedule reduction b) Travellers asked not to come to the airport

		capacity cut	
2026-01-07	Severe snow disruption	a) 700–800 flights cancelled b) 1000 passengers stranded	a) Snow removal operations b) Emergency passenger management, including temporary beds and overnight accommodation
2026-01-09	Schiphol cargo operations severely affected by snow	a) Reduced cargo capacity	a) No acceptance of special cargo, including live animals, and temperature-controlled cargo untill January 11

Table 1: Summary of the major flight delays related to the weather and the corresponding mitigation strategies adopted during this crisis.

2.3 The De-Icing Fluid Buffer Shortage

In order to more accurately analyze the disruption caused by extreme weather, this study distinguished the external weather (such as the Anna Storm) from the internally airport service supply chain. Although extreme weather is usually regarded as an exception in legal regulations such as (EC) 261/2004, attributing the complete system collapse to natural causes would conceal the fragility of the service supply chain. Therefore, this study argues that the key factor causing the disruption of airport operations is not the extreme weather itself, but a resource buffer shortage within the airport's service supply chain infrastructure. In supply chain management, buffers act as essential absorbers designed to protect the system from unexpected disruptions (Sheffi, 2005). For an airport's service supply chain, these buffers primarily consist of three categories including inventory buffers (e.g., de-icing fluid), capacity buffers (e.g., backup snow-clearing vehicles and standby ground staff), and time buffers (e.g., schedule slack to absorb minor delays).

The reason why the buffer inventory level at Schiphol Airport has always remained at a relatively low level is the institutional evolution of the European aviation industry. Following the

implementation of the Ground Handling Directive (EU Directive 96/67/EC), European airports transformed from government-funded public utilities to self-funded, highly commercial entities (Graham, 2001). Therefore, Schiphol Airport and many other airports in Europe, considering operational efficiency and in response to the typical maritime climate of their locations, have significantly optimized their resources, including the reduction of inventory for deicing. In this context, having deicing fluids and professionals and vehicles available throughout the year was regarded as an expensive and valueless cost expenditure. However, the extreme weather in January 2026 caused an immediate imbalance between supply and demand, leading to the rapid depletion of the limited deicing buffer resources under the aforementioned strategy (KLM, 2026). As a result, the initial weather impact rapidly evolved into the collapse of collaboration between airport infrastructure buffers and airline services, disrupting the operational support system, preventing airlines from conducting normal flight take-offs and landings, and forcing passengers to rely on their own recovery capabilities to co-produce the service supply chain.

Briefly, pinpointing this de-icing fluid resource buffer shortage is crucial for this study. It proves that when stranded passengers engaged in self-managed recovery, they were not merely reacting to unavoidable bad weather, but were structurally forced to absorb the operational failures of a limited service supply chain.

3 Literature Review

The overarching research question is at the intersection of four interconnected areas of academic thought including service-dominant logic (SDL), co-production theory, service supply chain theory and supply chain resilience (SCR) research. Each school of thought has contributed indispensable conceptual frameworks, but no previous approach has addressed the issues raised in this study from a combined perspective. This chapter first explains each school of thought in turn, and then synthesizes them into a comprehensive theoretical framework.

3.1 Service-Dominant Logic and Co-Production

In this study, we will use the Service Dominant Logic (SDL) framework to understand customer participation. The fundamental theory of SDL is that value is not created solely by the enterprise, but rather through the integration of resources by multiple actors within a service ecosystem. Within the SDL framework, consumers are not passive recipients, but active integrators of resources. Their knowledge, skills and relationships constitute every service interaction. These interactions facilitate value co-creation, with the outcomes arising from collaboration between participants.

So, based on SDL's theoretical framework of value co-creation and the customer as a resource integrator, how might the process of value co-creation change when, as in this case study, the enterprise-side service suddenly fails? However, SDL has not explicitly theorised disruption as a context in which the nature and necessity of co-creation change, a gap that this study addresses directly. This is not simply a practical dilemma but also an urgent issue that the academic community needs to address.

To analyze this dynamic, we draw upon the "actor-to-actor" (A2A) network perspective outlined by Vargo and Lusch (2016). This perspective redefines the way value is created, positing that every actor possesses unique skills and knowledge for integrating resources. All Entities (businesses, customers, employees, governments) are regarded as generalised actors and resource integrators.

During periods of large-scale aviation disruption, passengers are no longer isolated victims; the A2A network perspective offers a powerful analytical framework for understanding how they collaborate with companies, staff and other passengers, both online and on the ground, to exchange information and support one another.

Besides, the SDL establishes a core premise: value is always co-created by multiple actors through the integration of resources, however, this raises new questions: how exactly do consumers participate in the production of services? What factors drive or hinder their participation? SDL leaves these questions unanswered. To address these issues and translate theory into observable mechanisms, we must focus more on the literature of co-production.

Co-production refers to the active participation of consumers in the operational process of producing services. Unlike the broader concept of value co-creation, which describes the general principle that value emerges through interaction between multiple actors, co-production is concerned with a more specific and observable question: what do consumers actually do as part of service delivery, and how does that doing contribute to the production of outcomes?

The most fundamental difference between the two lies in their distinct understandings of how value is created. The logic of traditional manufacturing supply chains holds that value is primarily created by upstream enterprises and their partners, and is then transferred to consumers through the sales process. From this perspective, consumers are largely mere recipients at the end of the supply chain, playing a relatively passive role. Research on co-production, conversely, redefines the consumer's role. This theory asserts that within a service context, consumers are not merely passive recipients of value, but rather key participants in the service production process. They provide information, invest time and effort, and engage in decision-making, working alongside the enterprise to shape the final service outcome. Just as Sampson and Froehle (2006) noted, without consumer participation, the service simply cannot be fully realized.

Based on this theoretical logic, this study adopts Etgar's (2008) classic definition of co-production, which is understood as "consumer participation in the operational production process". In other words, consumers do not merely gain experiences or perceive value during the consumption process; rather, they actively participate in service provision as resource

contributors, for example by providing information, investing time and effort, or even directly influencing the progression of service processes. This definition is significant for this study, as it shifts the research focus from "how consumers feel about the service" to "what consumers do within the service process". For research aimed at exploring passenger behaviour in the context of airport service disruptions, this perspective, centred on observable actions, is better equipped to help us understand how passengers participate in, coordinate and influence the service recovery process.

So, to explore what triggers consumer participation, Etgar's (2008) model provided a further analysis of the "antecedents" of co-production. These include not only individual factors such as expertise and motivation, but also situational factors that can alter the cost-benefit analysis of participation. This study argues that a major service disruption constitutes precisely such an extreme and specific "situational antecedent", which the crisis systematically escalates the cost of "non-participation". Under this pressure to survive or escape hardship, even consumers who are accustomed to waiting passively are instantly mobilised and engaged in co-production.

Consider the chaos at Schiphol Airport. In the context of a service system breakdown, several of the situational antecedents described by Etgar were activated. When corporate-side services failed completely, passengers happened to possess certain operational resources, including knowledge of alternative transport options, proficiency in digital tools, and intricate social networks. At this point, the spark of co-production was ignited.

It is important to recognise that co-production is not a singular, uniform process. Auh et al. (2007) proposed a multidimensional co-production framework, arguing that consumer participation is not simply a matter of "participation" or "non-participation", but rather varies across multiple dimensions, including the breadth of activities, the intensity of engagement, and the degree of integration with corporate processes. This theoretical framework provides a clearer analytical perspective for understanding the complex and diverse passenger behaviour at Schiphol Airport. For example, from information-seeking to legal advocacy, this reflects the breadth of behaviour; passengers' sustained investment of time, effort and resources in addressing crises reflects the intensity of engagement. Meanwhile whether travellers follow official procedures to resolve issues or bypass the system to find their own solutions demonstrates the degree of connection.

Lengnick-Hall's (1996) research further extends the discussion of co-production to the context of service supply chains. She argues that customers influence their own service experiences but can also directly enhance a firm's competitiveness. The knowledge, feedback and labour provided by consumers are, in essence, important strategic resources that firms can utilise. Unlike Lengnick-Hall, who focuses more on how firms proactively design and manage customer engagement, this study focuses on the improvised, organically emerging forms of co-production that arise when official systems fail.

Moreover, Prahalad and Ramaswamy (2004) emphasise that platform support and the ability to access information are fundamental prerequisites for the realisation of co-creation of value. This aligns closely with this study's focus on digital tools and the flow of information. During service disruptions at airports, passengers often rely on social media, airline apps and online communities to obtain real-time information, coordinate their actions and seek alternative solutions; as a result, digital platforms effectively serve as critical infrastructure for co-production.

And also, the concept of "customer citizenship" defined by Groth (2005) provides further insight into the phenomenon of consumers voluntarily helping others beyond the scope of their formal responsibilities. During the long waits at Schiphol Airport, those travellers who selflessly shared information about queues and patiently guided strangers to the right terminal were precisely the practitioners of this "good soldier" spirit. They spontaneously offered mutual assistance, contributing their efforts and warmth to the recovery from the crisis.

Although research on co-production is already quite extensive, there remains a significant gap in existing theory. Most studies assume that service systems are operating normally that businesses maintain operational control, while consumers are invited to participate within a fundamentally stable and effectively functioning institutional framework. Yet, there are some gaps among the questions such as when institutional structures collapse, when enterprises withdraw entirely from the service front line, digital systems fail, and the full weight of systemic shocks falls upon consumers, what form will co-production actually take. Existing theory offers little adequate explanation for these questions. It is precisely this core issue that the present study aims to explore further.

3.2 The Service Supply Chain As a Context

In this study, the service supply chain is not treated as an explanatory tool for establishing causal relationships or deriving theoretical propositions. Its role here is not to provide rigorous logical deduction, but rather to define the system boundaries of this study.

The service supply chain, as a distinct field of study, was first established by Ellram, Tate and Billington (2004). At a time when the research landscape was almost entirely dominated by the logic of manufacturing, they recognised the unique characteristics of the service sector: intangibility, the inseparability of production and consumption, heterogeneity, and perishability.

For the purposes of this study, the most theoretically significant contribution to service supply chain theory is Sampson and Froehle's (2006) Unified Service Theory (UST). The UST posits that the service production process depends on customer inputs. The customer is the supplier of all service processes. The customer first supplies their physical effort, information or objects as production inputs, and only then receives the output. By contrast, traditional manufacturing is able to achieve standardised inventory production precisely because it excludes this real-time dependence on customer inputs.

In product supply chains, inventory acts as a buffer, sufficiently isolating production from the impact of demand fluctuations. Service supply chains, however, lack such a buffer. As Sampson and Froehle (2006) explain, manufacturing supply chains can achieve standardised inventory production precisely because production is decoupled from customer inputs. Service processes, by definition, depend on real-time customer inputs and therefore cannot be decoupled in this way; inventory as a shock-absorbing buffer is structurally unavailable (Sampson & Froehle, 2006; Ellram et al., 2004). The simultaneity of production and consumption means that any disruption instantly affects customer experience, with no buffer to absorb or delay its effects.

Furthermore, since customers themselves are providers of production factors, their behaviour during disruptions is no longer merely a passive response to corporate failure. Take passengers at Schiphol Airport as an example: when thousands of people began using social media to share queue information, plan alternative routes themselves, or contact hotels directly, they were

effectively reconfiguring the input conditions of the service system. In UST terminology, these spontaneous actions both reflected the trajectory of the airport's recovery and shaped that trajectory.

3.3 Consumer Participation Mechanisms

Having clarified the definition of co-production and its theoretical significance, this study now needs to introduce another closely related concept: consumer participation mechanisms.

As discussed in Section 3.1.2, co-production focuses mainly on "what" consumers do during the service process and "why" they do so. It emphasises specific behavioural practices and the motivational logic behind them. For its part, the mechanism of participation focuses not on the behaviour itself, but on the institutional conditions under which such behaviour occurs. It points to the various structural arrangements established by enterprises, which are sometimes consciously designed and at other times emerge naturally through long-term operations. It is precisely these conditions that determine whether co-production can take place, and that shape its ultimate form and intensity. In short, co-production is the behavioural phenomenon on stage; the mechanism of participation is the institutional infrastructure that guides or constrains these behaviours.

This distinction follows Dong and Sivakumar's (2017) framework, in which consumer participation is defined as the umbrella term for any customer activity related to the development, creation, or delivery of service offerings. Nevertheless, co-production is merely one specific form of this phenomenon. It emphasises not merely that consumers participate, but whether they genuinely contribute their own resources to the core operational and service production processes. These resources include time and effort, but also knowledge, judgement and emotional labour. This implies that not all forms of participation can be narrowly labelled as co-production. For example, when a passenger is merely refreshing an airline's FAQ page, they are indeed participating; but it is only when they independently rebook a flight, plan an alternative route, or even act as an interpreter for a fellow passenger they have never met before that they are truly engaged in co-production.

In this study, maintaining this distinction is of considerable analytical significance. It enables us to observe what passengers did (co-production behaviors) during service disruptions, and to ask further such as under what structural conditions were these behaviours triggered, supported or constrained. This is precisely the central question that RQ2 seeks to address.

3.3.1 Defining Consumer Participation

The definition of Consumer participation comes from the "partial employee" tradition (Bowen, D. E. 1986). Customers are not viewed merely as passive recipients of services, but rather as temporary contributors to the service production process. They invest resources such as information, time, physical effort and emotional energy, thereby helping to ensure the successful delivery of the service.

Building on this, Dong and Sivakumar (2017) further systematised the concept of consumer participation and proposed a more inclusive definition. They argue that consumer participation should be viewed as an overarching concept, encompassing the various activities undertaken by consumers during the development, creation and delivery of services, as well as the tangible and intangible resources they contribute. The significance of this definition lies in the fact that it no longer focuses merely on whether consumers participate, but rather emphasises the specific ways and the extent to which they are involved in the service production process. Furthermore, their framework classifies customer participation activities into three categories: mandatory, replaceable, and voluntary. During normal service delivery, much consumer participation is voluntary or replaceable. During disruptions, however, activities that were previously facilitated by firm infrastructure (rebooking, accessing service alternatives, obtaining status information) may become effectively mandatory as consumers must perform them independently in the absence of functional firm-side provision.

3.3.2 The Structural Dimensions of Participation Mechanisms

The partial employee tradition established that firms must design participation mechanisms, and then the subsequent literature has proceeded to address the question of exactly how such engagement is organised through specific mechanisms. Consumer participation mechanisms can

broadly be categorised into four key dimensions: informational mechanisms, self-service infrastructure, role clarity and socialisation tools, and incentive and feedback systems.

First of all, accurate, timely and easily accessible information is the fundamental condition for consumers participation in the service process. Kelley et al. (1990) regarded information provision as a core component in the design of participation mechanisms and pointed out that when consumers clearly understand their roles in participation and the tasks they should undertake, they are more likely to effectively cooperate with the service process. Moreover, informational mechanisms do not solely facilitate active co-production; they are equally vital for managing passive consumer participation. During service disruptions, if a company is able to provide consumers with transparent information, it is effectively helping consumers to re-establish their understanding of the situation and a sense of control over it. When consumers are unable to understand what is happening within the system or predict what will happen next, anxiety, anger and collective chaos often spread rapidly. Information mechanisms do not merely help consumers to act; they also shape how they do not act. Instead, clear and consistent communication can guide emotions that might otherwise escalate into conflict towards more orderly forms of behaviour, such as waiting patiently, or accepting temporary service downgrades. At the crisis peak, this passive yet controlled form of engagement is often just as vital for maintaining system stability.

A second major dimension of participation mechanism design concerns the provision of technological interfaces that enable consumers to produce service outcomes independently of direct firm employee involvement. Meuter, Ostrom, Roundtree, and Bitner (2000) defined self-service technologies (SSTs) as technological interfaces that enable customers to produce a service independent of direct service employee involvement. And their findings demonstrated that consumer satisfaction with SSTs is significantly higher when the technology performs as expected and meets a genuine consumer need. In disruption contexts, self-service portals that enable rebooking, service substitution, or status tracking provide consumers with a genuine means of active participation in their own recovery, reducing both consumer frustration and firm-side recovery burden simultaneously.

It should be noted that, in the existing literature, self-service technology (SST) is often employed across different theoretical perspectives that it may be incorporated into discussions of

co-production, interpreted as a vehicle for value co-creation, or regarded as part of the broader design of participatory mechanisms. This study adopts a more rigorous definition of the concept, explicitly defining SST as a specific form of participatory mechanism. They are infrastructural interfaces designed by enterprises, which establish the conditions under which consumer co-production can take place. When a passenger successfully changes their booking or re-routes their journey via an online system, this action in itself qualifies as co-production; but the re-booking system that enables this action should be understood as part of the participation mechanism. This distinction is significant in the extreme context of service disruption: when the SST infrastructure fails, the mechanism channels originally established by the enterprise to guide co-production disappear; yet the pressure on consumers to engage in co-production still exists.

The third dimension concerns the communication of clear consumer roles. Empirical research by Bitner et al. (1997) indicates that when consumers have a clear understanding of their role and behavioural expectations during participation in service delivery, the quality of their contributions is significantly higher, and their overall satisfaction is more positive. Conversely, in situations where roles are ambiguous or expectations are unclear, consumers are more likely to experience confusion and uncertainty, thereby reducing the efficiency of their participation and the quality of their service experience. Consequently, when a service disruption occurs, if a business can clearly define what consumers can do, how each action should be carried out, and what the outcome will be, it is effectively creating the conditions for co-production to take place. Conversely, when an organisation fails to provide a clear framework of roles, consumers often find themselves in a state of uncertainty, and their responses may be characterised by passivity, disorder, or even dysfunction. For example, they may repeatedly attempt to use ineffective channels, overburden customer service resources, or take actions that conflict with system recovery efforts. Furthermore, role clarity also involves explicitly communicating when consumers should not act. In other words, an effective engagement mechanism must not only tell consumers what to do, but also clearly explain in which situations non-intervention is the most beneficial choice for system recovery. Clearly defining the boundaries of passive behaviour helps to minimise unnecessary system interference and prevents consumers from carrying out disruptive or repetitive actions driven by anxiety.

A fourth dimension concerns the motivational architecture that firms can build to sustain consumer participation. Kelley et al. (1990) point out that the design of participation mechanisms depends on the configuration of incentive systems, which include compensation, recognition, and reciprocal value provision. Closely linked to incentive mechanisms are feedback mechanisms. This refers to how a company communicates to consumers the outcomes of their participation and the extent of their impact. From the perspective of mechanism design, feedback is not merely the transfer of information, but also a process of meaning-making; it influences how consumers understand their position and value within the service system. Dong, Evans, and Zou (2008) found that consumer participation generates higher role clarity, greater perceived value of future co-creation, and stronger satisfaction outcomes when the participation is explicitly acknowledged and its contribution to resolution is made visible.

However, existing research on participation mechanisms is, on the whole, still primarily based on conventional settings where default service systems operate normally under organisational control. Research on the more extreme and uncertain scenario of service disruption remains relatively limited. There is still a lack of systematic theoretical responses to the question of how service users are re-embedded into service processes when systems fail and participation mechanisms break down. This study will therefore address this theoretical gap.

4 Methodology

In this methodology chapter, the research paradigm is a qualitative, interpretivist research design grounded in social constructionism to investigate the subjective logic and dynamic behaviors of passengers during extreme service supply chain disruptions. Then, a single-case study approach centered on the 2026 Schiphol Airport crisis, using data crystallization through semi-structured interviews, netnography, and official documents.

4.1 Research Design

4.1.1 Epistemological perspective: Interpretivism

This study takes interpretivism as the epistemological foundation, aiming to explore the subjective logic behind passengers' behaviors during supply chain service disruptions. The interpretivist perspective argues that social reality is not an independent objective existence outside of individual consciousness, but is constructed through individual subjective interpretation and meaning attribution (Bryman, 2016). Therefore, in the context of this study, supply chain service disruptions are reflected in objective data such as flight delays or cancellations, and include a series of complex interactions. In contrast, the positivism, although capable of objectively the number of cancellations, fails to reveal the phenomenon and the reasons behind the markedly different reactions from passengers. For example, the gap between active alternative seeking behaviours and passive terminal waiting stems from some passengers choose to actively seek alternative transportation options, while others get stuck in prolonged passive waiting in the terminal. These behavioral differences stem from different interpretations of crisis situations by individuals, evaluations of enterprise capabilities, and understanding of their own resource integration capabilities. Therefore, interpretivism enables us to truly understand the specific behaviors of participants and comprehend the internal logic behind their actions.

4.1.2 Ontological perspective: Social Constructionism

The ontological perspective of this study adopts the theory of social constructivism, emphasizing that supply chain services are not an objective and static entity, but are jointly created by

multiple participants in a specific context (Creswell, 2014; Lincoln & Guba, 1985). In the extreme weather cases covered by this study, when the official service systems (such as airline customer service hotlines, airport ticket change counters) fail in function, the value is no longer determined and provided unilaterally by enterprises. Instead, it is co-produced by consumers through mutual assistance, information sharing, and real-time information exchanges on social media (such as RedNote). In brief, when facing service supply chain crises, consumers follow the solutions provided by enterprises but also create an informal self-management network through collective social interaction. Therefore, adopting the position of social constructivism can provide an accurate explanation for how consumers dynamically construct this "forced co-prodction" in reality.

4.1.3 The Single Case Study and Extreme Case Selection

Before determining the research method, this study evaluated various different methodological options and ultimately chose the single case study method. The logic of the evaluation, for example, if a quantitative questionnaire survey is adopted, it is more effective in answering questions such as "what" or "how many", such as the proportion of consumers involved in co-production. However, such a large-scale survey strips away rich background information and simplifies the complex emotions of consumers into static variables (Bryman, 2016). A questionnaire would miss the panic. Standard surveys flatten chaos into clean percentages. Therefore, we needed the friction and those quantitative methods cannot capture processes such as how risks are transferred and the dynamic decision-making of different individuals in the event of the collapse of official institutions. On the positive side, according to Yin (2018), when researchers want to answer "how" or "why" questions regarding a contemporary phenomenon in its real-life environment, especially when the boundary between the phenomenon and the background is not obvious, the single case study method is the most appropriate methodological strategy. In this research, the phenomenon cannot be artificially separated from its specific context (the extreme weather, the shortage of de-icing fluid, and institutional visa constraints). Therefore, the selection of a single case study design is justified by its capacity to provide in-depth information value for theory building (Flyvbjerg, 2006).

Next, to maximize the informational value of this single case, this study specifically employed an extreme case sampling strategy because it activates more actors and more basic mechanism as

mentioned from Flyvbjerg (2006). Thereby it exposes the hidden crises in the service mechanism under normal circumstances. This disruption at Schiphol Airport was not just a natural disaster but also a complex extreme disruption involving technical failures (such as 404 errors in apps), resource shortage (de-icing fluid), institutional restrictions (non-Schengen visa transit restrictions) and so on.

4.2 Data Collection

Consistent with interpretivist epistemology, this study adopted multi-source data not for the traditional data triangulation to cross-verify and find the unique objective truth. Instead, this study adopted the crystallization strategy proposed by Richardson (2000). Different data sources are like different facets of a crystal, official documents reveal the framework of power, interviews reveal the stories from individuals, and network ethnography presents the immediate collective tension which are mentioned in details at the Chapter 5. The truth is found in the gaps between what the airport said happened and what the stranded passengers felt in their bones. This combination of multi-source data aims to capture the richness and multiple realities constructed by different participants of the "forced co-production" phenomenon.

4.2.1 Semi-Structured Interviews

The main primary data for this study was obtained through semi-structured narrative interviews conducted with 13 consumers affected by flight disruptions in January 2026. Firstly, in terms of the selection of respondents, a purposive sampling strategy was employed to cover as diverse a range of backgrounds and narrative perspectives as possible. The 13 actual respondents included ordinary passengers and business travelers who were extremely sensitive to time, transfer passengers, and airline service staff. They also represented passengers of different routes and flight classes, as well as different visa holdings. This diversity of respondent backgrounds is crucial for understanding structural inequalities, as for example, visa holdings directly determine whether passengers have the basic autonomy to leave the airport on their own. The duration of these 13 formal interviews ranged from 26 to 72 minutes, with an average duration of 42 minutes. To further enhance the rigor of the research design, an online pilot interview was conducted before the formal data collection. This pilot interview provided us with an opportunity

to test and improve, ensuring that the questions raised were logically coherent, expressed clearly and accurately, and could obtain the necessary depth information through appropriate prompt questions (Bryman, 2016).

During the recruitment of potential respondents in the early stage, the study made the selection of interview platforms, including Zoom, Microsoft Teams, WeChat group chats, and Tencent Meeting. In addition, the language and time arrangement of the meetings, which were determined by the preferences and familiarity of the interviewees, because in addition to the conventional anonymous agreement required by the department, this study design particularly focuses on avoiding secondary harm to participants and properly handling their emotional distress. Given that the disruption at Schiphol Airport is traumatic, we placed psychological safety at the forefront. For example, during the recruitment stage, some potential respondents indicated that they were still emotionally affected by the crisis and needed more time to recover. To respect their emotional considerations, we promptly adjusted the data collection methods, such as through written emails, or postponing the interview date until they were ready to express information and emotions, and then conducting the interview. For those who ultimately preferred not to be interviewed, their publicly shared narratives were respectfully incorporated into the netnographic dataset instead.

In the design of the interview guide, this study strictly followed Etgar's (2008) "Antecedent-Process-Outcome" model. The interviews began with an exploration of the disruption experience (antecedent), asking about the channels through which passengers received the information, their mental state at that time, and the impacts on their own agenda. Then it transitioned to the behavioral narrative (process), detailing the first reactions of the passengers and their internal considerations for deciding to wait or take over after the failure of the official mechanism. Next, it explored the use of personal resources, social media, individual connections and so on utilized by the interviewees. Finally, the interviewees were asked to evaluate the trust to companies and its long-term impact on future travelling behavior. Additionally, to avoid the recall bias, where participants may inadvertently reshape their memories to fit a more coherent narrative in qualitative interviews, the study used timeline prompts in the interviews (Golden, 1992). The interviewees were guided to narrate based on the emails or photo evidence at that time (Harper, 2002), and paying special attention to distinguishing what the participants

remembered doing at that time from the reasons they attributed to that behavior afterwards, in order to support richer meanings.

4.2.2 Netnography

In order to further refine some real-time behavioral or information details that might be overlooked during post-interviews, this study chose netnography to continue collecting data and conducting analysis. Regarding the selection of online platforms, this study chose international information-sharing platforms such as TikTok, YouTube, and RedNote. We found that during this crisis, these platforms demonstrated high activity and effective data complementarity. For instance, the TikTok platform provided visual data on operational disruptions, while the RedNote platform saw a large amount of information search and interaction based on institutional regulations. Although the time period of the case study was strictly based on the occurrence of the event, considering the posting habits of some users on these online platforms, such as making two revisions to articles, we selected online comments limited to the time period of the event and observed and recorded the information mentioned in the case in the comments. These comments are also indicated in a table in the additional documents with the specific posting or last modification time. However, overall, the collected data covered the entire process of the crisis outbreak, and 65 representative records were extracted and analyzed in depth, including the original posts, visual media, and subsequent interactive comments. In terms of the participation strategy, we first spent a long time observing the relevant online communities as spectators to understand the special language style of this digital subculture. To ensure that the most natural and unaffected consumer reactions could be captured, this study adopted a non-participatory observation throughout the process. Briefly, this approach is valuable in service research because it enables us to capture consumers' interactions, emotional expressions, and meaning-making processes in digital environments (Heinonen & Medberg, 2018).

4.2.3 Document Analysis

To establish an objective timeline reference and deeply understand the responses of the enterprise, this study collected official institution documents including official announcements from Schiphol Airport, onsite announcements, KLM's press room, Eurocontrol's traffic flow announcements, and concurrent reports from professional media such as NL Times and

Flightradar24 blog. In terms of the analysis, the study applied Bowen's (2009) document analysis method, not considering these documents as absolute objective truths, but rather as specific manifestations of the enterprise's crisis communication strategies. For example, by comparing the "systematic de-icing process video" released by the official authorities with the information of "ice remover depletion" in the network ethnography, the study was able to reveal how the enterprise utilized information to construct differences between official communication strategies and service realities.

4.3 Thematic Analysis

Consistent with the interpretivist perspective, we further adopted the reflexive thematic analysis method, utilizing subjectivity as one of the analytical resources. This study explicitly employed the reflexive thematic analysis method proposed by Braun and Clarke (2019), emphasizing that our subjectivity is a tool for advancing the analysis rather than an obstacle that must be eliminated. This enables our study to systematically reveal the power and class logics hidden within the data through continuous self-reflection.

Therefore, in order to comprehensively understand the complexity from empirical data, this study adopted a multi-stage thematic analysis method. (Ellingson, 2009; Richardson, 2000). 13 semi-structured interview records, 65 network qualitative summaries, and related official documents were regarded as a suppliment to reflect the meanings behind the actions. Our analysis process consists of the following six stages. Firstly, we carefully read and familiarized ourselves with all the collected data, and the researchers repeatedly read through to grasp the overall narrative logic and background information, and recorded their initial analysis drafts. we generated initial codes through an interpretive engagement with the dataset, identifying meaningful patterns across the interview, netnographic, and documentary materials, which highlighted meaningful experiential patterns within the dataset. Thirdly, the initial codes were examined and grouped into broader interpretive themes based on shared meanings across the dataset. Fourth, these 12 potential themes were reviewed and refined to define clear analytical boundaries to ensure that they meaningfully captured the complexity and diversity of participants’ experiences. Fifth, the analysis advanced to theorizing, where we explored the

connections and differences between themes. Finally, the analysis concluded with the production of the report, using representative quotations to support the interpretive arguments developed throughout the analysis. Crucially, the entire process was characterized by a continuous go through across the three data sources, allowing them to crystalize rather than rigidly converge. For example, the organizational fact of an ice-melting fluid shortage was not treated as a data, instead, it crystalized through the netnographic data as reactive emergency information sharing among passengers, and through the interviews as an expression of extreme criticizes toward the airline's official explanation. This cross-source crystallization illuminates the multidimensional reality of the crisis from various perspectives. The following figure illustrates the two steps of coding analysis and the relations between initial codes and interpretive themes, and those in blue background showing the unique findings from the semi-sturctured interviews.

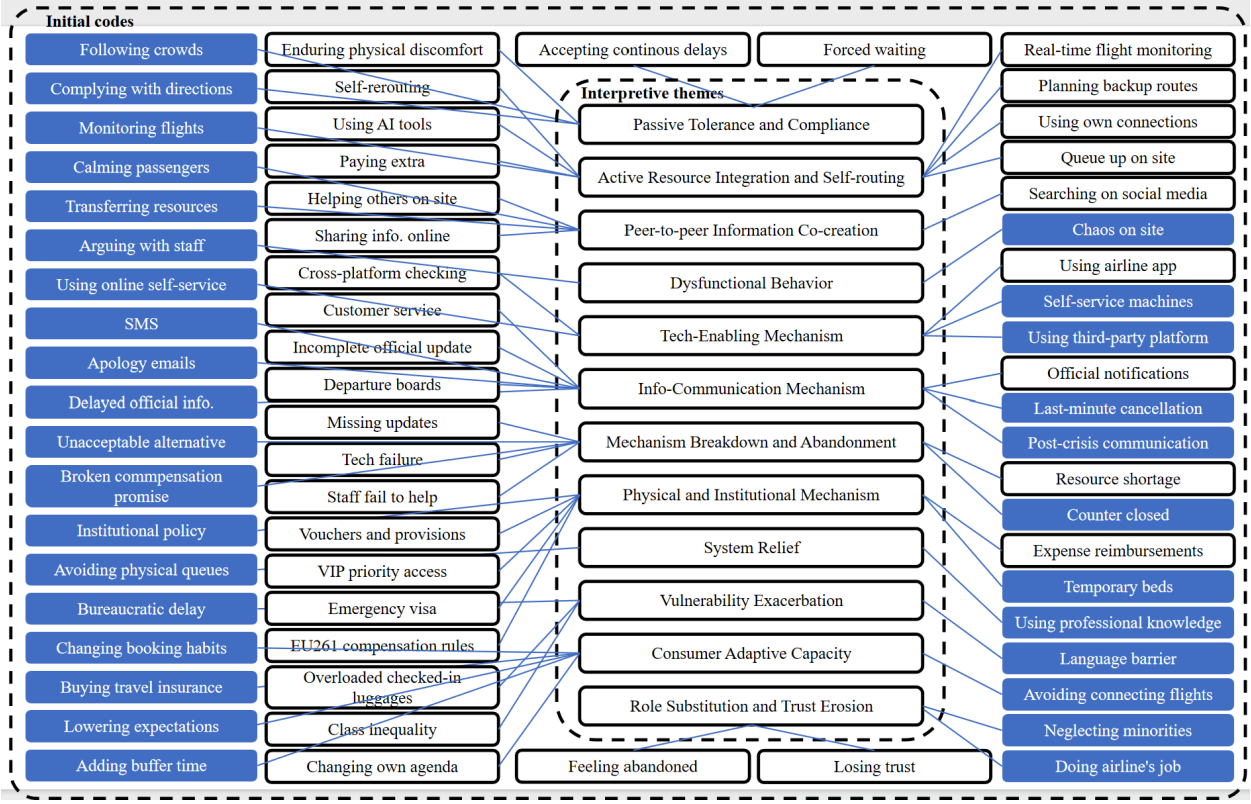

Figure 1: The relations between initial codes and interpretive themes

4.4 Research Quality

To ensure the rigor of this study, the research process strictly followed the trustworthiness framework established by Lincoln and Guba (1985) and optimized by Flick (2022) and Nowell et al. (2017) for modern qualitative research and processed as follows.

In positivist research, triangulation is typically employed to eliminate bias and approximate a singular, objective truth. However, the reflexive and interpretivist paradigm of this study, hinges on the ability to authentically capture and present the multiple realities constructed by the participants. Thus, this study achieved methodological crystallization through multi-source data collection (Richardson, 2000). We did not consider interview records (retrospective perspective), network ethnography (immediate perspective), and official institutional documents (institutional perspective) as conflicting evidence that needed to be verified for truth against each other. Instead, when there were differences among the data, for example, the description of orderly response in KLM's official logs being completely contrary to the complaint of "total abandonment" by passengers on Reddit, we did not regard it as "low data validity", but rather as an excellent entry point to reveal the power structure and the breakdown of the service contract. By integrating these different perspectives, the study effectively captured the multi-faceted nature of the service interruption phenomenon (Flick, 2022). Additionally, the study adopted the member checking mechanism, but this was not to seek a single "fact truth", but to verify whether the our academic interpretation resonated deeply with the participants' phenomenological experience (Nowell et al., 2017).

Through the thick description of the extreme disruption cases at Schiphol Airport, this study provides a sufficient background basis for the transfer of conclusions to other service scenarios. Considering that qualitative research does not pursue statistical universality, this study elaborately depicts the specific context of the disruption event in mid-January 2026 in Chapter 2, including its highly synchronous hub structure, the physical limitations of the deicing fluid supply chain, and the legal boundaries of European Regulation 261 (Lincoln & Guba, 1985). This deep contextual depiction provides readers with the necessary "thinking tools" to evaluate the findings of this study regarding consumers taking over the service supply chain, whether they can be transferred to other highly digitalized, high-density aviation hubs or other forms of infrastructure crises. Therefore, the transferability in this study is manifested as an analytical

insight, making the research conclusions relevant in similar service ecosystems (Nowell et al., 2017).

This study ensures the logical rigor and traceability of the research process by maintaining a transparent and detailed audit trail. The requirement for reliability is that the analytical decisions of the research must not only be systematic but also be subject to external verification. To this end, the study follows the thematic analysis strategy recommended by Nowell et al. (2017). We fully documented every decision-making step from the transcription of original recordings, the generation of initial coding (such as encoding "extra money for tickets" as "active resource integration") to the establishment of final themes (such as "forced co-production"), and organized them into a coding matrix and attached it to the additional documents. This transparent analysis process demonstrates that the analytical interpretations were developed through engagement with the empirical materials and reflections across multiple data sources back and forth. Transparency in this study was not pursued to achieve positivist objectivity or coding neutrality. Instead, consistent with reflexive thematic analysis and crystallization, the audit trail functioned as a reflective account of how interpretations were continuously constructed and refined throughout the analytical process. Therefore, transparency was employed to make the interpretive development of themes visible and traceable, rather than to claim the discovery of a singular objective truth.

Through continuous self-reflection, cross-checking among researchers, and repeated analysis of empirical data, this study minimized the influence of individual subjective biases in the analysis process, ensuring that the findings were interpretively constructed through engagement with the data, rather than our preconceived ideas about the research question. As Flick (2022) emphasized, researchers must constantly question whether conclusions are based on our preconceptions or can guide our values (Lincoln and Guba, 1985). Therefore, throughout the data analysis period, we repeatedly employed critical thinking, especially when analyzing the reasons for the failure of the service supply chain. We evaluated the issue of ice melt shortage within the entire system but also incorporated an in-depth understanding of the subjective reasons analysis logic for consumers. Additionally, to avoid simply romanticizing consumers' co-production behavior for the sake of ideal value co-production, we insisted on repeatedly returning to the original data and using direct quotes from the interviews (such as the anger or despair expressed

by the respondents) to balance the idealized value co-production that the service-dominant logic (SDL) might bring. This repeated analysis of the data and continuous self-reflection ensured that our findings were scientific discoveries based on the actual forced co-production behaviors of consumers.

4.5 Ethical Considerations

This study cautioniously adheres to the ethical guidelines of the university, regarding ethical consideration as a core investigative principle rather than an administrative procedure. The ethical framework of this research is constructed upon the foundational principles of respect for persons, non-maleficence, and beneficence. Also the consent form attached as Appendix and the full empirical materials as well as the usage of AI tools statement attached as the additional documents.

4.5.1 Informed Consent and Autonomy

In this study, a compliant and academic standard informed consent process was implemented for all 13 respondents. We ensured that each participant who agreed to be interviewed received a data collection informed consent form, which clearly stated the academic nature of the study, the research objectives, and the basic rights of the respondents as participants, such as the right to interrupt or withdraw from the interview at any time without any reason (as detailed in the Appendix's consent form and interview guidelines). Additionally, to further protect the privacy of the respondents, we distinguished between anonymity and confidentiality. Each respondent was assigned a unique English letter code to ensure that their identity and background could not be traced in the final report. We also took strict confidentiality measures for data that could not be fully anonymized during the collection stage (such as original audio recordings obtained with the prior consent of the respondents, etc.). All audio and meeting files were encrypted and stored on offline devices accessible only to the researchers. Furthermore, we established a data destruction mechanism to ensure that all original records would be permanently deleted after the research was submitted and defended, thereby preventing future incidents of data leakage or secondary use.

4.5.2 Ethical Integrity in Netnography

We carefully weighed the use of public social media data against the protection of personal privacy. This study adopted the strategy of theoretical paraphrasing instead of verbatim excerpts that might lead to reverse identification through search algorithms. We extracted the essence of the behavior and rephrased it in academic language. All real user IDs were hidden, retaining only platform identifiers and timestamps.

4.5.3 Non-maleficence and Beneficence

Beyond standard anonymity, the research design placed a critical emphasis on mitigating emotional distress, strictly adhering to the principle of non-maleficence. Considering that the respondents had experienced extreme exhaustion, the interviewers maintained an empathetic and reflective attitude during the transcription process. Furthermore, during the interview period and the subsequent data collection process, we also adhered to the academic principle of reciprocity. When interviewees exhibited anxiety or confusion, we would use the verified information collected through official document analysis and online ethnography, etc., to answer their questions. For instance, one of the respondents clearly stated during the interview that they had confirmed with the on-site staff that they could self-manage the purchase of an alternative ticket, and that after completing the voyage, they could submit an application to the airline for compensation for the self-paid ticket. However, as of the interview date, she had not received any response from any airline regarding her submitted application. Then, a few days after the interview, she updated the message stating that she had received an email from the airline rejecting the application, with the reason for the rejection being that it was an exception due to extreme weather. In response to this situation, we referred to the official updated information of KLM Royal Dutch Airlines, the latest legal interpretation of EU Regulation 261/2004, and consulted with relevant legal experts. We then provided the accurate information to the respondent to help them better understand the airline's claim mechanism and terms, alleviating some of the confusion caused by the information gap for consumers. This approach ensured that participants left the interview with a clearer understanding of the systemic failures they had endured.

4.6 Methodological Critical Reflections

This section identifies and addresses the inherent temporal differences between the immediate nature of netnographic data and the retrospective character of semi-structured interviews. In general qualitative research, the methodological approach guiding practice is not a perfect tool but rather a lens artificially constructed to be as comprehensive as possible. Therefore, this section conducts a preliminary critical reflection on the possible flaws in the research design, the differences among data sources, and the ethical considerations of the "forced co-production" theory.

4.6.1 Reflexivity in Case-Based Analysis

This study adopts a single-case design to examine service supply chain disruption at Amsterdam Schiphol Airport. The research method based on a single case can conduct a detailed study of the process dynamics and underlying reasons within a limited context, especially for the complex service supply chain failures involving multiple participants and a clear chronological line. However, we must admit that the design of this method limits the generalizability of the research results to other airports or service systems, because the analysis focuses only on an extreme independent event, which means that the specific background factors and event nature of Schiphol Airport may have an impact on the observed patterns and the underlying reasons for the analysis. Therefore, although the single case study provides an in-depth understanding of the context in detail, it also limits the possibility of more extensive comparisons between different institutional environments. Another limiting factor is related to the time gaps between the event and data collection. The interview data mainly relies on retrospective descriptions, which may be influenced by the respondents' selective recollection of particularly impressive experiences. To minimize this problem, we adopted multiple information sources for cross-validation and critical memos, including official announcements, online individual comments, media press, etc., to reduce excessive reliance on any single form of evidence.

Overall, the methodological design prioritises analytical depth over generalisability, which should be considered when interpreting the findings.

4.6.2 Digital Exclusion in Ethnographic Data Collection

The use of netnographic data from platforms such as RedNote and TikTok, together with digitally mediated recruitment, introduces a selection bias related to digital participation. This study draws on the concept of digital exclusion to reflect on this limitation, referring to differences in access to digital tools, skills, and literacy that shape individuals' ability to participate in online environments (Helsper, 2012; Robinson et al., 2015).

However, we realized that the main data could be accessed and obtained through the internet, which led to the data mainly reflecting the consumers who were able to flexibly use digital platforms during or after service disruptions, because these individuals had sufficient digital skills to cope with the service recovery process and utilize online communication channels. Their experiences were more prominent in the empirical materials than those of consumers with limited digital capabilities. Therefore, dealing with the data that accounts for a relatively small proportion such as elderly passengers with low digital skills and groups facing language barriers, we obtained them indirectly through third-party relay or media reports rather than directly describing. To reduce this limitation, this study incorporated official documents and multi-perspective data collection, such as interviews with airport volunteers and public video interviews on media platforms. These sources provided some insights into the experiences of those consumers who were not active on digital channels.

Despite these additional sources, the dataset remains shaped by digital participation patterns. This should be considered when interpreting the findings, particularly in relation to whose experiences are represented in the empirical analysis.

5 Findings

5.1 The Co-Production Continuum

Our analysis of cross-source data suggests that, in the context of the Schiphol Airport crisis, consumer participation cannot be simply understood as a binary distinction between active and passive. This study tends to view consumer participation as a dynamic participatory structure: different passengers are situated at varying levels of participation based on their own resources, situational pressures and the information available to them. This study further categorises these forms of participation into three types: passive-stabilising, active-coordinative, and active-generative.

5.1.1 Passive-Stabilising Participation

Passive stabilising behaviour tends to occurs quietly. In this behaviour, individuals do not explore new paths or seek new resources, but instead choose to conform, wait, and silently endure feelings of frustration. This phenomenon is widespread in both interview and netnographic data. Its analytical significance lies precisely in the fact that it has been overlooked in the existing literature on co-production. Passive stabilising behaviour does not represent a lack of proactivity. Rather, it makes a crucial structural contribution to the balance of the system.

The powerful influence of this stable situation often stems from public compliance. The authorities explicitly urged those stranded to stay away from the airport: *"If your flight has been cancelled, please do not come to the airport"* (Schiphol Airport, January 2026). And KLM repeatedly emphasised this message across its various platforms. The public heeded these instructions. Interviewees showed that:

> *"Yeah, I didn't go to the airport at all that day." (Transcript K)*

> *"When he suggested taking the train back, I was like, no, let's just wait until Tuesday. Maybe it'll fly then." (Transcript J)*

Viewed in isolation, staying put might seem like a compromise. However, when this state of inactivity is amplified many times over within a paralysed infrastructure network, it constitutes a co-production contribution of significant operational importance. It is precisely this collective 'absence' that has greatly relieved the pressure on ground operations. Passengers who remained at the airport secured valuable operational breathing space for airline staff who were running themselves ragged, allowing the latter to concentrate their efforts on assisting those stranded within the airport. Viewed through the lens of SDL (Vargo & Lusch, 2004), these passengers contributed to the restoration of services by integrating various resources, including situational knowledge, self-restraint and trust in the organisation.

Netnographic data further confirms the scale of this behaviour. A previous post on RedNote, published on 5 January, noted that the blogger chose to remain at a hotel to monitor the situation rather than travel to the airport following two consecutive flight cancellations (SCH-XHS-006-M; 4 likes, 2 saves, 17 comments). Comments beneath the post documented three other passengers who had made the same choice, and they also stated that the post was their source of information.

The second form of passive compliance involves accepting long waits and enduring physical discomfort without escalating the conflict. Interview findings indicate that passengers slept on airport chairs (transcript F), hard benches (transcript M), cardboard (transcript M), and on the terminal floor alongside thousands of others (transcript I). Although this behaviour appears purely passive, it argues a certain systemic value: whether voluntarily or not, passengers who remain calm enable airport management to maintain a degree of crowd control and to deploy limited resources more efficiently. Netnographic data from TikTok documents airport environments filmed by passengers during periods of chaos; many videos show that, despite long waiting times, queues remained orderly.

Emotional containment is the third form of passive-stabilising participation evidenced in the data.

> *"I couldn't even bring myself to stay angry; I was mad for like a second... and then I just went numb." (Transcript M)*

This is not merely a matter of individual coping strategies. When such emotions spread amongst tens of thousands of stranded passengers, they become a survival mechanism that prevents the system from collapsing entirely. Transforming rage into resigned compliance inevitably comes at a heavy psychological cost. Yet it also cleverly creates an environment of minimal friction, allowing staff to escape the crushing weight of endless conflict and keep the service supply chain running. The few documented incidents of dysfunction, such as arguments between passengers and staff, and one near-conflict (Transcript M), actually serve to highlight the stabilising effect that emotional containment has on the majority.

5.1.2 Active-Coordinative Participation

Active-coordinative participation refers to consumers' behaviour in actively organising existing resources, coordinating with other passengers, and utilising official systems, without the need to create entirely new resources or routes. This is the most comprehensively documented category in the data sources, covering the widest range of specific behaviours.

Self-service rebooking is the most common form of proactive coordination. In all thirteen interview transcripts, passengers mentioned that they used airline apps, third-party booking platforms, self-service kiosks and online portals to rebook their flights themselves. Transcript C (an airport employee who observed the disruption from a service perspective) explicitly highlighted the operational significance of this behaviour:

> *"Passengers at home can rebook online; those at the airport before checking luggage can rebook outside... My translation helped speed up their rebooking process significantly... I helped about 25 people rebook in the six hours I was there." (Transcript C)*

This statement reveals two levels of co-production practices: self-help at the individual level, and the systematic protection of the group by individuals with an information advantage. Furthermore, Interviewee C mentioned their colleagues' gratitude for this unofficial assistance: *"My colleagues handling rebookings really appreciated our help because it made their jobs much easier"*. This confirms a key fact that this unplanned coordination effectively resolved the operational crisis faced by official bodies.

Netnographic data adds scale and detail to these individual accounts. In RedNote posts and comments, self-service kiosks gradually emerged as a key coordinating infrastructure. One post (SCH-XHS-009-M) noted that passengers had discovered that the self-service machines in the terminal corridors could be used to rebook flights for passengers without checked baggage. This information was shared by the original poster and corroborated in comments by multiple users, forming a peer-to-peer guide that effectively directed passengers to utilise self-service resources and avoid the overcrowded manned service desks. The post received a high volume of engagement, indicating that the information was both widely accessed and of practical value.

Changing modes of transport constituted the second form of active-coordinative participation. Passengers abandoned air travel in favour of trains, buses, ferries or driving. Transcript J records the most detailed example: after two flights were cancelled, a passenger and her partner decided to take the train from Copenhagen to Amsterdam, a journey of 12 hours. They used Google Maps to plan their route in real time and purchased tickets in stages whilst on the move. Transcript K describes a passenger who downloaded the Schiphol Airport app and, upon seeing the scale of the flight cancellations, immediately booked a FlixBus coach to Switzerland without going to the airport. Netnography data indicates that this shift in travel mode was not merely an individual practice but spread among peers: a RedNote post published on 5 January shared various train route options, attracting 17 comments, several of which documented successful implementation of the suggested routes (SCH-XHS-006-M).

The third type of active-coordinative behaviour involves submitting a claim under EU Regulation No 261/2004. Several interviewees described how they independently submitted compensation claims, using online portals and AI tools to draft claim letters, as well as information shared by peers regarding eligible expenses:

> *"I found the portal on their website myself, asked AI to help draft the claim, and listed all the expenses." (Transcript I)*

> *"We researched online and submitted claims ourselves. We spent a lot of time Googling and asking AI tools about what the airline was supposed to cover in such situations."(Transcript A)*

Data from Netnography confirms that the EC 261/2004 claims guide has been widely circulated among passengers online. A post on RedNote shared a KLM reimbursement claim template, which included a list of eligible expense categories. This template was widely saved and prompted practical additions and corrections from other passengers (SCH-XHS-M). It enabled passengers to participate actively and collaboratively in the regulatory process, whereas without these guidelines, most passengers would have been unable to successfully complete the relevant procedures.

5.1.3 Active-Generative Participation

Active-generative participation represents the clearest theoretical extension of existing theories of co-production. Consumers create new resources, new pathways and even new information that do not exist within the official system. This is by no means a mere act of adaptation or mediation. It is a spontaneous, alternative process of resource generation.

One striking example emerges from the interview data: unofficial intelligence regarding the de-icing vehicle's operational window. Interviewee A came across a crucial piece of information: every morning between 6 a.m. and 7 a.m., just as the airport opens, the de-icing vehicle happens to be in operation; by targeting flights scheduled for this time slot, the probability of a successful take-off increases significantly. This information has never appeared in any official announcement. It is entirely the result of observations made by travellers who have quietly studied the airport's operational patterns, and has been passed on secretly within their peer networks. Interviewee A did not hesitate to put this intelligence into action, setting their alarm for 4 am to ensure they arrived at the airport in time, and ultimately succeeded in taking off.

> *"A key piece of information we got was about the de-icing issues. Flights after the early morning were all cancelled, and the only realistic chance to depart was during the 6-7 a.m. window, when de-icing vehicles would be operating right as the airport opened. Based on that, we immediately rebooked for that time slot, even though it meant waking up around 4 a.m. to reach the airport on time. "(Transcript A)*

This is a theoretically significant finding. On social media platforms beyond the reach of airlines, passengers have access to operational-level intelligence that is more accurate, actionable and timely than that provided through official channels. In SDL's terms (Vargo & Lusch, 2016), this is a classic example of peer-to-peer (P2P) resource integration. It has also generated a value outcome that the airlines' own P2P networks have failed to achieve the successful departures.

Netnographic data from the Flightradar24 comment threads provided a second example of active-generative participation. Users with air flight expertise were tracking inbound aircraft positions, calculating minimum turnaround times, and sharing departure assessments for specific flights several hours before official cancellation notices were issued. One Flightradar24 post noted that the inbound aircraft for a KLM departure had not yet left its origin airport and that departure was therefore practically impossible within the scheduled window. This is also confirmed by Transcript G, who predicted the likelihood of outbound flights taking off by monitoring the status of inbound flights:

> *"Most of the time, I checked the status of the inbound flight through online channels myself. Because I knew that if the inbound flight hadn't departed, our flight definitely couldn't take off." (Transcript G)*

A third form of active-generative participation involved material resource creation and transfer through peer networks. Interviewee H shared a deeply touching story. A Rednote user took the initiative to transfer their unused capsule hotel booking to a stranded traveller they had never met. This mechanism for generating resources, operating outside the official rescue system, was facilitated through the hidden channels of social media. As described by interviewee H, it was a relay race for accommodation resources. It changed hands multiple times within a vast network of travellers, providing a final refuge for those turned away by airline and hotel quotas.

5.2 Institutional Withdrawal and forced Co-production

The second theme explores the conditions that enable co-production by consumers. This is not a voluntary choice. Forced into action because support systems fail, people step in where institutions once stood. When digital platforms freeze, workers vanish, and rules dissolve, gaps

appear. The phenomenon of "institutional withdrawal", as defined by this study, is precisely the result of these fragmented elements coming together. The structures that once maintained normal service delivery have collapsed, forcing people to handle repairs on their own. The following are the three dimensions of institutional withdrawal observed in this study: the collapse of digital service infrastructure, the breakdown of official communication, and the withdrawal of staff.

Digital infrastructure collapse was the first and most extensively documented form of institutional withdrawal. The KLM website experienced 404 errors at peak demand (Transcript A). The airline app showed rebooking queue status without processing confirmations (Transcript B). Self-service rebooking was variously described as *"really difficult"* (Transcript E), non-functional for passengers with conditional tickets requiring phone confirmation (Transcript E), and returning no available flights for rebooking despite the instruction to use it (Transcript F). The KLM WhatsApp channel acknowledged being *"extremely busy"* and took twenty-four hours to respond with an automated message (Transcript J). Hotlines were unreachable across multiple transcripts (F, H, J):

> *"Couldn't get through at all. Like… I called from morning till night, the hotline just wouldn't connect. Totally impossible." (Transcript J)*

Netnographic data also confirms these failures. SCH-XHS-004-C documents a passenger who had been unable to access the KLM luggage tracking system for two days, with no status updates. Multiple X (Twitter) posts from the period document passengers tagging KLM's official account with reports of system failures and receiving either automated responses or no response at all. On the one hand, there are official channels that are overburdened and can only provide vague, outdated, or even incorrect updates. On the other, there are peer-to-peer support networks that are flourishing underground.

The breakdown in official communication further exacerbated the digital system failure. In its official update, KLM acknowledged the backlog of flight cancellations and rebookings, but did not provide specific operational information regarding a timeline for recovery, de-icing capacity or alternative route options. An update published on 6 January stated that KLM was *"unable to meet the expectations of our passengers"* (KLM, 2026), a statement widely cited in both netnography and interview data. Whilst it frankly acknowledged the severity of the

organisational failure, it failed to provide passengers with any actionable guidance. Interview data documented the consequences of this communication breakdown:

> *"The airport and airline only provided limited updates and only gave those that were cancelled but never gave clear timelines for recovery." (Transcript A)*

> *"What official info? All canceled, nothing else." (Transcript H)*

The third dimension of institutional withdrawal was staffing failures. Multiple interviews document staff refusing to assist passengers, directing them to online self-service that was itself non-functional (Transcript A), putting up "*closed"* signs at counters (Transcript A), abandoning posts mid-queue (Transcript M), and informing passengers that ground staff had no capacity to process rebookings (Transcript F). The social media evidence also proves this: SCH-XHS-007-C documents a passenger waiting in the KLM counter queue for hours with no assistance, with ground staff unable to provide hotel vouchers or visa assistance. TikTok videos documented by multiple netnographic entries showed scenes of counter abandonment and queue chaos.

The cumulative effect of issues such as digital system failures, communication breakdowns and staff shortages has given rise to what this study terms "forced co-production". This is a model of consumer participation that differs from existing theories of co-production.

Scholars in the past have invariably viewed participation as an active choice driven by positive motivations. Forced co-production reveals a different dimension. It is driven not by a vision of a better future, but by the desperation of having no other option. What consumers experience here is by no means the joy of co-creation, but a heavy burden. However efficient the actual outcome may be, what remains for the individual is always a profound sense of psychological alienation.

The interview data provides a very clear account of this point. Transcript A articulates the experience of compelled co-production most precisely: *"essentially taking on the airline's role ourselves. Because no one from the airline was available to answer questions, and their phone lines were unreachable."* Transcript J states: *"I couldn't trust them to provide a solution, so the best solution was to fix it myself."* Transcript L: *"They should have rebooked me, found me a place to stay, helped with hotels. But I had to do everything myself."* The phrase *"doing the airline's job"* appears across six interview transcripts. These descriptions clearly illustrate the

operational aspects of institutional withdrawal. What appear on the surface to be voluntary actions on the part of consumers are, in fact, the result of a lack of operational capacity on the part of businesses. It is precisely this distinction that lies at the core of the concept of forced co-production proposed in this study.

Furthermore, we found that this imposed operational responsibility not only undermined the co-creation experience but also triggered negative systemic consequences. Interview transcripts indicate that when pressure exceeds an individual's breaking point, some passengers transform from resource integrators into conflict instigators, exhibiting severe dysfunctional behaviour, such as engaging in heated arguments with the few remaining ground staff or disrupting airport order. This demonstrates that forced co-production is not merely a transfer of labour, but rather a downward transmission of systemic violence, ultimately leading to severe role substitution and the breakdown of trust.

5.3 Official Notifications and Peer-to-Peer Networks

During emergencies, the disruption of official notification channels forces consumers to establish fragmented information connections in order to fill the institutional vacuum caused by the interruption of official information. Methodological crystallisation reveals a gap between the planned communication strategy of the airport authorities and the lived reality of the systemic collapse, which is the institutional vacuum. The findings indicate that the construction of peer-to-peer (P2P) networks was not an expression of idealized value co-creation, but rather a functional compensation for the disruption of service supply chains.

5.3.1 Fake Order and the Trigger of Systemic Abandonment

In the initial phases of the crisis, the code "Info-Communication Mechanism" was mentioned by almost all interviewees as the information relied upon in the first reaction, but it operated largely as a fake order. The system hid. Instead of providing confirmed, real solutions, official channels, which include the airline's mobile application, automated emails, official websites, and terminal screens, attempted to project this fake order by pushing generic warnings and empty safety alerts. For example, according to some interviewees, they received a Schiphol app notification stated

that if your flight has been cancelled, we urgently request you not to come to the airport. However, by ordering passengers to clear out without offering real alternatives, the institutions dumped the entire physical burden of the backlog straight onto individual shoulders. This fake order made the confusion worse. Official announcements did not guide people but their delayed reality and kept travelers trapped at empty gates for hours. Transcript A captured this gap:

> *"My flight was scheduled for around 9 a.m., and we arrived near the gate at about 8 a.m. There was still no cancellation, only a notice that the gate might be changed. So…We just followed other passengers to the new gate…The airport and airline only provided limited updates and only gave those were cancelled but never gave clear timelines for recovery." (Transcript A)*

This difference between official messaging and operational reality was even more complicated for passengers who had seemingly bypassed the initial delays. As passenger demand for rebooking and assistance peaked, the institutional supports failed both online and offline. Transcript A described that:

> *"The airline website was down, showing a 404 error, so hh…queuing at the counter was the only possible way to get help... Staff at the counter were like a little bit irritable and told us not to line up and to handle everything online instead, as they couldn't assist us in person. When I joined the queue, staff tried to turn people away and even put up a 'closed' sign. But there were so many people waiting in front and behind me that no one left." (Transcript A)*

This physical withdrawal was mirrored by digital failure, severing the airline's connection with its customers. Netnographic data also captured this paralysis, for instance, SCH-FB-061-C documented a passenger's frustration with the digital bottleneck that to contact customer services via app was difficult. It was been an hour now, still no response on the phone. Transcript J detailed that:

> *"It redirects you to WhatsApp, and WhatsApp just says they're extremely busy and will reply when they can. I waited like 24 hours for one message, and it was totally useless." (Transcript J)*

It forced customer behavior to shift from passive waiting to active self-rescue. Additionally, the lack of transparency and the feeling of being deceived broke all remaining trust. Consumers regarded the communication methods of airlines to be inefficient, but some individual data also indicates that this approach has had a certain degree of negative impact on their emergency plans, thereby leading to the loss of trust. *"The KLM app push saying all European flights were canceled on the 7th, even though some actually operated... Without that push, I would have arrived in Krakow a day earlier. Instead, that message made things worse for me." (Transcript G)* and in SCH-FB-063-C, a user questioned the that due to extreme weather in Amsterdam, a large number of flights were cancelled or delayed and were unable to take off. Yet the airline maintained a facade of order by repeatedly postponing the flight times rather than communicating full cancellations. Those passengers, especially those on intercontinental flights, were still not clearly informed of the changes in subsequent flights by the authorities, resulting in their continued flight to Amsterdam and being stranded at the airport, and losing the best chance to re-plan their routes in advance.

5.3.2 The Emergence of Online Cooperation

In the face of institutional crises caused by extreme weather and the loss of trust in official institutions, they did not wait. They actively engaged in peer-to-peer information co-creation both online and offline. We have observed that on online social media platforms such as RedNote, TikTok, and Facebook, a flexible and real-time digital cooperation has emerged. This was not a planned collaboration. Most consumers use online social media during passive waiting periods to gather information, and in a compulsory cooperative production form, they share practical solutions to bypass the bottlenecks of official systems or information. Just as described in Transcript B regarding the performance of the network when official channels fail:

> *"We mainly used RedNote back then. Some bloggers posted really funny stuff, and we chatted with a few people on there asking how everyone was getting back to the UK. We also saw some pretty creative solutions, lots of people tried to book train tickets, and some even said they'd take a ferry." (Transcript B)*

This online collaboration has been confirmed by online observational evidence. In the data of network ethnography, platform users had more discussions about alternative routes or

multi-modal travel routes. A typical example comes from SCH-XHS-014-M, where the blogger posted real-time information about the operational disruption of Dutch Railways (NS), helping other passengers adjust their schedules before going to the airport. Similarly, another post, SCH-XHS-023-M, provided an operational guide to deal with the chaos in the waiting hall, giving specific suggestions such as if you already have a boarding pass, you can skip the main check-in queue and go directly to the ground staff at the self-service baggage check-in area. These more detailed and relevant real-time interactions can better reflect the actual situation during the crisis. In addition to sharing alternative routes or multi-modal travel routes and on-site response methods, this peer-to-peer information to some extent interprets the internal operation mechanism of the airport. Official channels only briefly released general delays, while consumers voluntarily and actively collected operational mode and other information to maximize the chances of future service supply chain recovery. Transcript A shows how they used RedNote to discuss the actual limiting factors of the de-icing supply chain:

> *"A key piece of information we got was about uh…that de-icing issues. Flights after the early morning were all cancelled, and the only realistic chance to depart was during the 6-7 a.m. window, when de-icing vehicles would be operating right as the airport opened. Based on that, we immediately rebooked for that time slot, even though it meant waking up around 4 a.m. to reach the airport on time." (Transcript A)*

Through these actions, consumers bypassed the paralyzed official queues. Crucially, this kind of cooperation upgraded digital information exchange, extending into the physical transfer of limited resources and emotional support. Transcript H documented a unique experience of a "hotel relay" among stranded strangers:

> *"another mom on that platform had a capsule hotel booking... offered to transfer the booking to someone in need. It was like a hotel relay among stranded passengers." (Transcript H)*

Furthermore, consumers also utilized these online platforms to track on their luggages when the airline's tracking systems failed, as Transcript H noted:

"Lots of people never got their luggage back, I kept in touch with two others who still hadn't found theirs." (Transcript H)

This peer-to-peer network proves that when official mechanism collapses, consumers do not merely communicate, they are forced to crowdsource operational intelligence and assume the logistics of their own evacuation. This forced co-production is not a romantic act of value co-creation. It is a survival mandate. Forced co-production operates here as a severe systemic subsidy, where consumers patch up a collapsed supply chain with their own uncompensated labor, purchasing the recovery with their collective physical and emotional efforts. Then we are going to focus on those peer-to-peer cooperational actions happened on-site.

5.3.3 Unpaid Labor and System Relief

Ultimately, this forced co-production provided a buffer for the airport operation system at multiple nodes. Although this action was carried out purely out of necessity and instinct for self-protection, the mutual support provided by this peer-to-peer information exchange to some extent relieved the operational pressure on the airport and reduced the burden on the on-site equipment and staff. In fact, during the crisis, consumers voluntarily took on the roles that airlines had actually abandoned, such as organization, logistics, and communication. Interviewee C voluntarily took on the role of a site volunteer. She pointed out that her unpaid translation work directly helped some passengers with language barriers to successfully leave the airport:

"My translation helped speed up their rebooking process significantly…There were long lines for transfer buses, so I focused on transfer passengers and helped about 25 people rebook in the six hours I was there... My colleagues handling rebookings really appreciated our help because it made their jobs much easier…My translation and communication usually got passengers rebooked in about 10 minutes." (Transcript C)

This assumption of unpaid labor was not limited to professionals, ordinary passengers without any airline background similarly assumed organizing roles to aid those less capable of dealing with the crisis. Transcript G said that:

> *"Passengers from other countries asked me how to take a taxi, and I helped them. We just helped each other out when things were like this…I talked to them and gave them advice like…Don't wait at the airport, book a hotel first. The airline will reimburse the hotel cost... I offered all this information voluntarily." (Transcript G)*

Furthermore, while some consumers provided on-site operational support, others generated system relief through spatial self-removal. Their solution was independent of the airport's operational system and coordinated through the peer-to-peer model for other transportation methods. In Transcript J, the respondents recalled alternative transportation methods for returning to the Netherlands after a 12-hour train journey. Some consumers also mentioned booking bus tickets to return to Switzerland, and they did not even go to the airport that day. Additionally, according to Transcript K, the airport implemented a certain degree of evacuation strategy when the respondents arrived, but unfortunately, the airport management failed to effectively carry out this strategy.

However, there is a distinct risk of absolving the enterprise of its failures. The psychological cost of this forced co-production is perhaps most summarized by Transcript A:

> *"I think I could only describe myself as having lost even uh…my identity as a passenger or customer that day, because there was no proper way to seek help... I felt like a victim." (Transcript A)*

Crucially, it is worth noting that this P2P cooperation can resolve the immediate crisis and it also helps to build long-term consumer adaptive capacity. Through the exchange of strategies on these digital platforms, consumers altered their future travel behaviors. The empirical data reveals that this disruption functioned as a learning chance, teaching consumers to proactively mitigate future risks, such as choosing a direct flight or purchasing specialized travel insurance in advance:

> *"I never used to buy travel insurance, but after this incident, I will pay extra to get it." (Transcript A*)

or mastering complex multimodal transport alternatives:

“Next time... I won’t wait for a second rebooking to take the train. I’ll switch to the train after the first rebooking.” (Transcript J)

Therefore, forced co-production represents a coercive process of consumer re-education, where failures compel individuals to permanently upgrade their operational capabilities to protect themselves against future institutional abandonments from the officials.

5.4 Regulatory Vacuum and Resource Constraints: The Inequality of Co-production

Although the previous theme demonstrated how consumers actively established support networks to cope with such disruptions, a further analysis of the data reveals a more severe reality. The ability for forced co-production is highly unequal among individuals. Based on the theory that the market system often imposes unfair disadvantages on individuals with scarce economic, social or institutional resources (Baker et al., 2005), this study further explores how service disruptions in extreme cases further exacerbate these vulnerabilities through factors such as financial considerations, legal limitations, and digital isolation. The same institutional mechanisms have a facilitating effect on privileged groups but become an insurmountable obstacle for marginalized groups. We believe this gap is caused by the dual pressures of regulatory vacuum and strict resource restrictions. Through "physical and institutional mechanisms", these resources form a rigid class filter, as they separate consumers based on financial capital, legal identity (e.g. A transit consumer without the legal visa permission), and business status (e.g. A premium membership of KLM), etc.

5.4.1 The Regulatory Vacuum

During crises, institutional regulations aimed at protecting the vulnerable often unintentionally generate secondary harm and deepen existing inequalities. This phenomenon extends the “double deviation” in service research, where an initial service failure is followed by a failed recovery attempt (Suresh & Chawla, 2022). In this study, however, institutional protection mechanisms themselves became sources of secondary harm during the crisis. For instance, flight cancellations (the first failure) and complete loss of contact with customer service or failure of subsequent compensation (the second failure). In extreme cases, there will be a regulatory vacuum. The

instructions issued by the authorities seem simple that passengers could purchase alternative transportation or book hotels on their own, and then applied for compensation upon arrival at their destination. For those with extensive travel experience and sufficient financial backups, this policy becomes a powerful tool for their rapid self-recovery. For example, Record A:

> *"As I recall, the policy allowed us to book alternative tickets ourselves and then claim the cost from the airline... according to their policy, since my departure was disrupted, I was eligible to claim expenses such as transport to the airport the next morning and meal allowances." (Transcript A)*

But for the vast majority, this pay-upfront mandate encountered a severe market failure. The rule became a wall. The financial burden required for active resource integration was extraordinary and often prohibitive during the height of the crisis. Transcript B noted that:

> *"Hotel prices near the airport had skyrocketed several times over, and there were no available rooms left anywhere close by…" (Transcript B)*

> *"The man sitting next to him on that flight had also been failing to rebook his flight nonstop. He had his whole family refreshing their phones to grab a ticket, and finally bought a one-way ticket from Amsterdam to Edinburgh for over 1,000 euros just to get home" (Transcript B)*

Similarly, netnographic record SCH-FB-062-C further highlights this extreme financial cost, detailing how a passenger had to pay around 1500 euros for an alternative and landed in Germany. And still need to pick up the car there. For students, budget travelers, or economically vulnerable passengers, such out-of-pocket expenses were simply impossible, effectively barring them from co-producing their own recovery. Etgar (2008) pointed out that consumers' financial considerations can affect participation. And the empirical data collected in the Schiphol Airport case study in this research indicates that in extremely chaotic situations, financial considerations can become an obstacle to co-production. When students, budget travelers, or low-income families ran out of cash or credit card limits, they were instantly locked out of self-rescue. The cost of this exclusion was physical suffering. The inability to cross this financial threshold resulted in severe physical discomfort and indignity. As Transcript F recalled:

> *"I slept on chairs, looked everywhere for benches to sleep on. There were thousands of stranded people at the airport then…everyone was either sleeping on the floor." (Transcript F)*

Even worse, when passengers managed to scrape together the funds to participate in this forced self-managed recovery, the airlines often utilized regulations to deny reimbursement, exacerbating the financial harm. This is where bureaucratic betrayal exacerbates financial harm as what Transcript F mentioned:

> *"I didn't have accommodation…the cost of a shower at the hotel, and my self-paid ticket. I claimed all three. They only reimbursed meals and the shower. They also denied the self-paid ticket, saying it was due to extreme weather, so not covered by their compensation… The ground staff promised this would work, but when I actually bought the ticket and tried to claim reimbursement later, they said…This isn't covered by our compensation terms." (Transcript F)*

Therefore, P2P in extreme disruptions should not be viewed as a successful service ecosystem adaptation, but rather as a severe symptom of institutional neglect. Being financially exploited was echoed by Transcript M:

> *"I sent the email, but they never refunded me... I just got scammed out of 190+ euros that night." (Transcript M)*

Thus, the institutional policy failed twice: first by pricing out the vulnerable, and second by breaking its promises to those who paid. Under the banner of forced co-production, the airline did not just accept passenger inputs; it extracted them under financial coercion.

5.4.2 Legal Constraints: The Visa Trap

While financial limitations act as an economic filter, legal constraints function as a physical cage. During the winter disruption, the requirement for a Schengen visa emerged as an absolute, non-negotiable structural constraint that physically chained transit passengers to the center of the crisis. While European passport holders could freely walk out of the terminal to catch a train or sleep in a city hotel, non-Schengen travelers were trapped. On paper, international aviation frameworks assume that infrastructure failure will be mitigated by emergency administrative

provisions, such as a temporary emergency entry permission. Additionally, while European passport holders could freely exit the airport to seek alternative accommodation or multimodal transport, non-Schengen passengers were trapped in a legal grey zone. While Transcript C noted that theoretically that passengers stranded overnight get a nearby hotel and a temporary visa even without a Schengen visa the reality of the systemic collapse meant that immigration authorities quickly shut down this provision due to overwhelming volume. Transcript F shared this specific mechanism breakdown:

> *"I queued for two to three hours, and when I got to the customs window, they said they'd issued too many emergency visas these past few days, so they weren't issuing any more." (Transcript F)*

Non-Schengen travelers were left completely exposed, stranded in a space that refused to let them out or limited resources to get warm or sleep because they were told no temporary visa available at that time. These passengers became legally invisible, left in the corners of a paralyzed terminal:

> *"Most European travelers have visas and can go out to hotels and get reimbursed. But people like us who need visas can't leave. Some early arrivals got blankets from the meeting, but late arrivals like us got nothing…no support, stuck sleeping at the airport in miserable conditions. It was obvious most stranded passengers were South Asian, East Asian, or African. I could clearly feel that even though they said they couldn't accommodate everyone, they didn't empathize with ethnic minorities at all." (Transcript I)*

SCH-XHS-028-M also documented a passenger whose flight was cancelled. After immigration refused her a temporary visa, she slept on the terminal floor with other visa-restricted passengers, writing a bitter note about being a "*second-class citizen*". Similarly, SCH-XHS-011-C pointed out this barrier that the core issue for these passengers is that they are in transit without a Schengen visa, so they cannot enter the country and must stay inside the airport. For visa-restricted travelers, their financial capital or digital literacy did not matter. Legal resource limits took absolute priority over all other mechanisms. Then, forced co-production reveals that the corporate system demands that you save yourself, while the state locks you in a physical

room where self-rescue is treated as a border violation because neither the temporary visa was no longer available nor hotels in the airport were fully booked. The transit lounge ceases to be a commercial space and it functions as a site of legal limitations.

5.4.3 Customer Prioritization and Digital Barriers

We were further continued by customer prioritization, where premium flyer status acted as a bypass to the institutional breakdown. This phenomenon aligns with Zeithaml, Rust, and Lemon's (2001) customer pyramid framework, which refers that firms allocate critical resources toward top-tier segments ("Platinum" and "Gold") while marginalizing lower-value tiers during crises (Zeithaml et al, 2001). In this case, Transcript G openly admits the advantage of this:

> *"I have to admit my membership let me use resources that could have gone to regular passengers. I could get through to customer service in under 5 minutes." (Transcript G)*

However, for those non-elite passengers trapped at the bottom of this pyramid, it forces them to rely on peer-to-peer (P2P) networks to close the institutional gap as what Transcript L mentioned:

> *"I posted about my situation on RedNote. Then someone who said they were an Air France-KLM Gold Member contacted me and offered to help rebook... I didn't even try to contact customer service myself because of how useless they were earlier. I just went straight to that 'Gold Member' passenger for help." (Transcript L)*

Then, consumers without high-level membership were left to fend for themselves, facing a reality of resource limitations and lost connections with customer service at some time. Transcript M and L described the frustration of this class inequailty:

> *"The Dutch airport has a library or something... all the sofas were full of people sleeping, lying all over the place... there were rats all over the floor." (Transcript M)*

> *"I think they prioritize members first, then regular passengers. For regular passengers like me, there was basically no service at all." (Transcript L)*

Parallel to this customer prioritization, the digital tools used by the airport created an additional layer of resource constraints because they can determine consumers' ability to participate in forced co-production and access institutional support. The assumption that all consumers have the ability of transition to App-based rebooking and QR-code vouchers, however, digital divide research shows that access to digital technologies does not guarantee equal capacity to use them effectively during high-pressure situations (Van Dijk, 2020). Transcript M witnessed this:

> *"...his passport info wouldn't load or something, the machine just wouldn't print his ticket or boarding pass. He didn't get help until the next morning." (Transcript M)*

Netnographic evidence (SCH-YT-053-M) further noted in the comments that grandparents are sleeping there because of the canceled flight. For these individuals, the digital ability was not an enabler, but an absolute barrier. In short, this commercial pyramid structure utilizes digital capabilities to enlarge the impact of customer prioritization. Digital tools no longer have a uniformly positive effect, instead, they have exacerbated the significant individual background differences. Because it transforms the process of forced co-production into a highly selective one, only those with high digital capabilities, familiarity with the operating rules, and advanced identity background can participate in active value co-production activities.

6 Discussion

The present chapter will draw upon the theoretical framework established in Chapter 3 in order to examine the empirical findings presented in Chapter 5. For each research question, the discussion will first distill the key findings and then engage explicitly with the relevant literature. The study will demonstrate how the findings either confirm, extend or challenge existing theoretical positions. On that basis, the present chapter aims to make theoretical contributions including the conceptualisation of forced co-production, the conditions under which SDL's foundational premises require modification in crisis contexts, and the concept of stratified resilience as a structural rather than individual phenomenon.

6.1 The Co-Production Continuum: Addressing RQ1

The RQ1 asked what forms of active and passive consumer behaviour contribute to resilience co-production, and how these forms differ across phases of the disruption. The core finding is that consumer participation at Schiphol did not conform to the binary active/passive distinction that has structured the co-production literature since Bowen (1986). The disruptions at Schiphol Airport have completely overturned this rigid classification. Passengers caught in the eye of the storm did not strictly adhere to an either/or pattern of behavior. Instead, their participation manifested as a dynamic, continuous spectrum. We have distilled this into the co-production continuum, which comprises three dimensions: passive-stabilizing, active-coordinative, and active-generative.

6.1.1 Passive-Stabilising Participation: Challenging the Literature's Dominant Assumption

In the first phase, thousands of travelers made a collective decision to follow official advice and avoid heading to Schiphol Airport. This passive-stabilizing behavior directly challenges a fundamental assumption of the theory of co-production.

Looking back at the academic history, from Bowen’s (1986) framework of partial employees, to Etgar’s (2008) antecedent-process-outcome model, and on to Dong and Sivakumar’s (2017) classification of mandatory, replaceable, and voluntary participation, mainstream research has

focused on how consumers actively contribute resources. Passive behaviour is typically interpreted as a failure of participation, or regarded as an insignificant marginal behaviour.

The Schiphol evidence challenges this position directly. The collective restraint shown by travelers constitutes a substantial and highly valuable operational contribution: by reducing the demand on a system on the edge of collapse, this inaction acts as a systemic shock absorber.

This finding is consistent with Sampson and Froehle's (2006) Unified Service Theory, which defines service processes as those that depend on customer inputs. If labour, information and physical presence are regarded as conventional inputs, the data from Schiphol significantly broadens these boundaries, demonstrating that under extreme stress (when the system is pushed to its limits), the deliberate withdrawal of these inputs, that is, adopting a stance of "negative input," can also evolve into a critical form of participation. Consequently, the concept of passive-stability participation has been demonstrated to extend service theory into crisis situations, thereby illustrating that the absence of consumer input can itself be considered a form of resource integration.

This finding has a direct implication for how co-production is measured and studied. Since passive behaviors can contribute positive operational value to system resilience, empirical studies that rely solely on observable active behaviors to measure co-production inevitably underestimate the significant implicit contributions made by consumers during times of crisis. Future academic research needs to develop more sophisticated measurement tools to capture and evaluate the unique value of consumers' restrained behaviors in specific contexts.

6.1.2 Active-Coordinative Participation: Confirming and Extending Existing Frameworks

The second position on the continuum, active-coordinative participation, aligns more closely with existing frameworks, while also extending them in a significant direction.

The dimensions of breadth, intensity and degree of integration proposed by Auh et al. (2007) precisely reflect the various forms of coordination we have observed in Phase 2 of the disruption. These include self-service rebooking, multimodal route switching, peer information sharing, and the submission of claims under EU Regulation 261/2004. These actions, reflecting variations in

the intensity of participation as well as differences in the integration of actors with official systems, are aligned with the expectations of the model framework proposed by Auh et al.

The innovation of this paper lies in its exploration of the platform dimension of co-production. Prahalad and Ramaswamy (2004) argue that platforms are a necessary condition for large-scale value co-creation, implying that co-creation depends on infrastructure designed by corporations. The Schiphol Airport case complicates this view. When official information channels completely broke down, passengers creatively transformed social media originally intended for entertainment and socializing into a temporary citizen infrastructure for real-time crisis coordination. Information regarding queue lengths, de-icing times, alternative transportation routes, and claims procedures spread rapidly through these repurposed networks, often with greater accuracy and speed than official channels. This demonstrates that platforms for value co-creation do not necessarily require official corporate design; during the vacuum created by the sudden failure of corporate infrastructure, grassroots networks are fully capable of spontaneously fostering alternative platform ecosystems. A revisited examination of the arguments put by Prahalad and Ramaswamy (2004) reveals that the overemphasis on co-creation's dependence on corporate-owned platforms is somewhat flawed. In the event of institutional failure, consumers are capable of constructing platform infrastructure on their own.

6.1.3 Active-Generative Participation: A Theoretical Contribution

The third position, active-generative participation, constitutes the most theoretically novel contribution to the co-production literature.

Active-generative participation is defined as consumer activity that does not merely coordinate or draw on existing resources, but rather creates entirely new operational resources, including information, physical materials, or logistical pathways that did not exist before the consumer's engagement. It means creating something out of nothing.

Consider again the efforts of the woman who was able to track down the de-icing vehicle and share the information about its operation on social media. The woman was not simply performing the activity of coordinating resources that already existed. Instead, she created a new operational resource for the airline by sharing information that the airline had neither produced nor published about its operations. In SDL terms (Vargo & Lusch, 2016), this scenario

exemplifies actor-to-actor (A2A) integration of a distinctly different character from conventional co-production. Rather than acting as a partial employee of the company that is providing the service (Bowen, 1986), the consumer has, in this instance, become an operational entity that has stepped into the void that the company has created through its withdrawal from providing the service altogether.

While the concepts of active-generative participation had been discussed in the context of SDL theory by Vargo and Lusch (2016), no previous studies in the literature had empirically demonstrated the existence of that type of participation.

6.1.4 The Evolution of the Continuum Across Disruption Phases

The evolution of these three types of participation over the course of the three phases of the crisis also merits discussion. During Phase 1 of the crisis (between 2 and 3 January), when the airline was still managing the disruption within its own systems, there were mostly instances of the type of passive-stabilizing participation and early active-coordinative behaviors. However, during Phase 2 of the crisis (between 4 and 7 January), as the airline began to fail completely and without coordination, there were numerous instances of all three types of consumer participation, with active-generative participation emerging most visibly. Finally, during Phase 3 of the crisis (between 8 and 12 January), once the airline had begun to stabilize its operations, these three types of participation began to decline in number, with only active-generative participation remaining present in relation to the crisis, in the form of consumers learning of the crisis, purchasing travel insurance, and filing trip claims with the airline.

This evolution confirms Etgar's (2008) insight that situational antecedents shape both the form and intensity of co-production, while extending that insight into the crisis context by demonstrating that the nature of those antecedents changes dynamically as the disruption itself progresses.

6.2 Mechanisms Enabling and Constraining Co-Production: Addressing RQ2

The second sub-question asked what mechanisms enable or constrain consumer co-production of resilience during service disruptions. The enabling mechanisms frequently explored in academic

studies often fail to function during crises. Yet the constraints that truly restrict action are deeply embedded in the underlying structure of service systems. This is precisely the gap in existing theories.

6.2.1 Enabling Mechanisms: Extending Existing Theory

Peer-to-peer information networks emerged as the most consequential enabling mechanism identified in the data. Where Kelley et al. (1990) identified informational provision as a core component of participation mechanism design and stressed the importance of firm-side communication, the Schiphol case demonstrates that information provision can be generated autonomously by consumers when firms fail to supply it. Social media platforms, originally designed for entertainment, were transformed into vital crisis coordination infrastructure when the crisis occurred. Queue lengths, alternative transport routes, de-icing time windows, and claims procedures, these vital and accurate information circulated rapidly within the network of travelers, whilst official channels were simply unable to provide such support. This finding extends Prahalad and Ramaswamy's (2004) platform-centric view of co-creation by demonstrating that platforms originally designed for entertainment or social connection can be rapidly repurposed as crisis coordination infrastructure. This study demonstrates that, in crisis situations, consumer-generated information networks are capable of replacing institutionalised communication mechanisms designed by organisations. Furthermore, it highlights the limitations of existing theories, which rely too heavily on corporate-centric information models when dealing with crises.

Social capital and the norm of customer citizenship, as theorised by Groth (2005), constituted a second enabling mechanism. Multilingual travellers spontaneously offered translation services, while informal emotional support spread among the stranded group, alongside the relay of hotel documented earlier. These actions all reflected a spirit of “good soldier” that went beyond contractual obligations. In the extreme circumstances of systemic failure, mutual support among strangers became a vital substitute for the vacuum left by corporate care. The breakthrough of this study lies in its redefinition of the boundaries of this theory’s applicability. Groth focuses on functionally complete service environments, in which customers’ citizenship behaviour serves merely as a marginal supplement to corporate services. The case of Schiphol Airport, however, reveals a different ecosystem: when systematic provision at the corporate level collapses entirely,

consumers' social capital transforms from a secondary supplementary mechanism into a primary support network.

Knowledge of the rules also empowers travellers. More specifically, it is familiarity with EU Regulation 261/2004. For passengers who possess this knowledge, the legal framework provides a clear path to resource recovery that they simply need to pay upfront for alternative transport or accommodation and await reimbursement afterwards. Social media platforms once again play a key role here. Simplified claims guides circulate in the digital realm, and this equalization of knowledge fostered a collective institutional literacy. Although this finding aligns with Etgar's (2008) argument that consumer expertise serves as a prerequisite for engagement, it challenges the established assumption that knowledge must be pre-existing, demonstrating that, under the pressure of a crisis, specialist knowledge can be rapidly acquired and widely dispersed through peer networks within a very short period of time.

6.2.2 Constraining Mechanisms: Dimensions That Existing Theory Has Not Theorised

Against these enabling mechanisms, the data identify several powerful constraints that limited or entirely prevented consumer co-production for stranded passengers. Each of these constraints highlights a gap in the existing literature on participation mechanisms.

The most common constraint was the failure of self-service technology infrastructure. Meuter et al. (2000) demonstrated that self-service technologies must meet genuine needs and function as intended to deliver satisfaction. The Schiphol crisis serves as a case study that proves this logic from the opposite perspective. Web pages display errors repeatedly, the booking system freezes indefinitely, status updates are contradictory, and alternative flights are nowhere to be found. When technology fails, it does more than simply fail to assist; it actively deceives. Passengers who trust the rebooking portal only to receive confirmation errors, or those who wait in vain before silent digital help channels, waste precious time that could otherwise have been spent seeking alternative solutions. This finding extends the framework proposed by Meuter et al. (2000) that the true cost of self-service technology failures lies not merely in the service the technology was intended to provide, but in the opportunity cost of the time and attention passengers expend before finally concluding that it is unreliable.

Role ambiguity constituted a second major constraint. Bitner et al. (1997) demonstrated that consumers who participate in service delivery with clear role expectations produce higher quality contributions, whilst role ambiguity generates frustrated passivity or dysfunctional behavior. The case of Schiphol Airport confirms this theoretical perspective and illustrates how it manifests in situations of service disruption. The official communication strategy has been vague, contradictory and lacking in genuinely actionable guidance. Faced with a paralyzed self-service system, people are at a complete loss. This failure of communication has not only left consumers feeling uncertain; it has caused some passengers to shift from being constructive participants to becoming actors of conflict, resulting in staff being overwhelmed and undermining the minimum level of order that had been maintained. This study addresses a gap in the theory proposed by Bitner et al. (1997) by demonstrating that the role ambiguity arising from institutional collapse is distinctly different in nature from that found in ordinary service settings, and that its consequences extend beyond individual participants to affect the entire service environment.

The constraints of legal identity present an insurmountable barrier. Non-Schengen visa holders are physically confined to the transit area. No matter how substantial your financial reserves, how fluent your language skills, or how thoroughly you understand the rules and regulations, none of it matters at this moment. The right to leave the airport to seek accommodation or transfer to land transport was legally stripped away the very moment the systemic collapse occurred. This finding reveals a dimension of consumer participation that existing theory has not theorized: the role of legal status as a structural determinant of participation capacity in service disruption contexts. Kelley et al.'s (1990) participation mechanism framework, Bitner et al.'s (1997) role clarity model, and Dong and Sivakumar's (2017) participation typology all implicitly assume that consumers possess complete physical and legal freedom to engage in the participatory activities assigned to them. The Schiphol case shatters this taken-for-granted assumption. Not all passengers enjoy the same degree of freedom; legal identity, as a pre-existing structural force of domination, takes priority over all other mechanisms. This represents a significant shortcoming in existing theory, one that future research should address.

6.3 Theoretical Contribution One: Forced Co-Production

A key theoretical contribution of this study lies in the introduction of the analytical concept of forced co-production. This is not a concept intended for broader application, but rather one that argues that this specific analytical perspective offers greater explanatory power within particular empirical contexts. This analytical concept is an analytical tool constructed on the basis of empirical data from Schiphol Airport, designed to describe and explain empirical processes that existing frameworks of co-production and the service-dominant logic (SDL) struggle to fully capture. Precisely because the findings of this study stem from an extreme case using an interpretivist design, it is more appropriate to adopt this more cautious theoretical approach.

The form of forced co-production differs from all three types identified in Dong and Sivakumar's (2017) classification, and current thinking rooted in Service-Dominated Logic still lacks tools to fully explore such cases. To clarify what sets it apart, attention turns toward links with two research areas between the participation typology by Dong and Sivakumar (2017) and SDL's co-creation premises.

6.3.1 Extending and Challenging Dong and Sivakumar (2017)

Dong & Sivakumar (2017) organize participation into three types, which are mandatory, replaceable and voluntary. Mandatory participation is a requirement for the supply of services. For instance it is necessary that a person gives private health facts to a medical professional before a consultation occurs and this logic is based on an assumption that the business is in charge of the service procedure. Consumers are restricted to specific, required tasks within a system that is designed to work in a particular way.

In the case of Schiphol Airport, however, the activities of travelers at the location happened outside of an intended plan. As an example individuals used external systems to book new flights by themselves, located housing without help from the firm and translated for other people who could not understand available information, those actions became significant during work because the organizational systems stopped functioning. When workers are not present at critical times, travelers are forced to perform those tasks.

And this distinction is about the way that consumers are part of the process of production. According to Dong & Sivakumar (2017), firms plan what the consumer does while they keep the power to manage operations, but in forced co production, businesses are not involved at all. To keep the process moving, consumers perform duties that are usually the responsibility of the company. If they do not act, the negative results affect only the consumers.

Consequently, a fourth category should be added to crisis-activated forced participation. In this new category, the compulsion of consumer behaviour does not stem from service design, but from the complete collapse of the service system. The theoretical significance of this new category lies in its highlighting of the power dimension of participation: when the enterprise withdraws, who exactly bears the resulting costs, and in what sense can this cost-shifting be characterised as co-production rather than abandonment of the consumer.

6.3.2 Challenging SDL's Normative Framing

The forced co-production concept brings attention to a gap often overlooked in SDL research. Vargo and Lusch's (2016) actor-to-actor framework reconceptualizes all service exchanges as collaborative resource integrations among multiple actors, and the tenth foundational premise asserts that value is always co-created by multiple actors including the beneficiary.

While such collaboration sounds fair during normal business conditions, applying it strictly during crises reveals something else entirely: power imbalances become invisible under this lens. Withdrawal by firms from every part of service creation pushes effort, skill, and tools onto users - making so-called co-production one-sided. This outcome emerges when businesses transfer duties downward without consent. With no real option available, people simply absorb the work.

The labour, knowledge, time and financial resources that travellers invest in their own recovery are not a value co-created by all. They are merely the social costs, entirely shifted onto the weaker party in the exchange, when the system collapses. The existing academic vocabulary of SDL lacks tools to handle such imbalance. Voluntary engagement looks nothing like forced participation; yet current theory blurs both. Forced co-production requires a new conceptual framework: one that reveals how power operates, where costs are shifted, and under what conditions co-creation becomes a rhetorical cover for institutional withdrawal and avoidance of responsibility.

6.4 Theoretical Contribution Two: Stratified Resilience and the Commodification of Recovery

The second theoretical contribution of this study is the concept of stratified resilience. Not all travellers possess the same capacity for self-recovery in times of crisis. Three factors interact to determine the extent to which individuals can endure the crisis: financial capital, legal identity and commercial capital. This finding is significant for both co-production theory and research on service supply chain resilience.

In the chaos at Schiphol Airport, money is the primary factor limiting passengers' ability to help themselves. Although EU regulations require airlines to refund rebooking and accommodation costs, this mechanism faces practical obstacles. Passengers must first pay for all expenses out of their own pockets and then apply for reimbursement afterwards. This creates a barrier to self-help. Only those with sufficient cash or credit card limits can truly make use of this self-help rule. This finding confirms and extends Etgar's (2008) view that economic resources serve as a prerequisite for co-production. Etgar acknowledges that consumer resources influence the capacity to participate, but he regards them merely as variables that moderate the form and intensity of co-production, rather than as structural barriers capable of completely preventing it. The data from Schiphol Airport, however, suggests that if a certain economic baseline is not met, the process of co-production becomes structurally impossible, regardless of the efforts made. This phenomenon, transforming service rights into a competition based on purchasing power, has rarely been systematically addressed in the past.

Compared to the constraints imposed by financial resources, the restrictions arising from legal identity feel like an impossible barrier to overcome. Travellers holding non-Schengen visas are strictly confined to the international transit area of the airport under immigration laws. No matter how chaotic the situation at the airport may be, national border laws are still enforced as usual. Unable to leave the terminal, these travellers are powerless, regardless of how wealthy they are or how proficient they are with their mobile phones. Visa status thus becomes an overwhelming, absolute barrier. Data indicates that these restrictions on movement primarily affect travellers from South Asia, East Asia and Africa. The underlying reason lies in the uneven distribution of

global visa policies. This phenomenon adds a layer of structural inequality to the research. Any practical theory seeking to fully explain consumers' resilience to risk must not overlook the inequality stemming from such status. Previously, the participatory mechanisms proposed by Kelley et al. (1990), Bitner et al. (1997) and Dong and Sivakumar (2017) all implicitly assumed that consumers were legally free to participate in the various participatory activities described within their frameworks. The Schiphol Airport case demonstrates that this assumption does not apply to all consumer groups, and that legal identity must take priority over all other mechanisms.

The third factor is commercial capital. Specifically, the possession of elite frequent flyer status. High-tier membership is like a pass to safety, allowing one to bypass the system's total collapse. Whilst ordinary passengers wait endlessly in despair, Transcript G is able to speak to a customer service representative within five minutes. The hierarchical division of commercial power has forcefully reconstructed a parallel service delivery system for a privileged minority. This commercial stratification is by no means a coincidence. It is a deliberate design within the airline's service architecture. When allocating limited recovery resources, high-net-worth clients are always prioritized. The ultimate irony is that the well-resourced, experienced and privileged, who possess the greatest capacity to absorb the costs of the crisis, are precisely the ones most thoroughly protected, shielded from enduring any real storm. This observation raises a normative question to which existing theories have yet to provide an answer. The case of Schiphol Airport illustrates that recovery is a commodity allocated according to a client's commercial value. This raises an ethical question regarding fairness. When disaster relief resources are extremely limited and the allocation process places such heavy emphasis on commercial value, the most vulnerable passengers end up receiving the least protection. Is such a system design truly reasonable? The term stratified resilience is intended to highlight this reality of inequality and to provide a starting point for reflection in future research.

7 Concluding Remarks

This study has drawn two core conclusions regarding the research question as follows.

During service disruptions, consumers' participation behaviors cannot simply be classified as either positive or negative, even though such a description is quite common in the existing service management field. Instead, we found that these participation behaviors present a continuous dynamic process. Sometimes, the progress is slow and almost imperceptible, while at other times, it suddenly becomes very intense. Sometimes, passengers merely wait, browse the latest news, and absorb all the available information. In other cases, they actively integrate resources to rebook their trips, seek alternative transportation, and convey real-time information. The key we discovered is the diversity of individual behaviors in the cases, as well as the further elaboration of this behavioral evolution process.

In addition, the study also indicates that the consumer participation mechanism, digital self-service systems, official communication channels, and the airlines/airport, which play the role of guidance and organization, can also reduce uncertainty, are usually in the core position in general. However, in the disruption event at Schiphol Airport, these mechanisms became partially ineffective, unbalanced, sometimes present, and sometimes absent. During some blank periods, we found phenomena such as consumers taking on roles that were usually assumed by the official, etc. Therefore, we believe that consumer participation is no longer driven by pre-determined mechanisms, but gradually transforms into a forced alternative resulting from this. In summary, the continuity of services during crises is not solely maintained by the official party alone, but has a dispersed, redistributed, and sometimes transferred characteristic to consumers. In this case, co-production is no longer merely provided or chosen. When the official no longer has complete control and roles become blurred, it becomes necessary and almost inevitable. This is what we have repeatedly referred to as "forced co-production". Although we recognize that coordination has not disappeared, it cannot be organized centrally anymore. It becomes fragmented. In this fragmentation, consumers start to rely on each other, using any still available channels and methods to make information exchange more rapid, but the reliability is reduced. This is inevitable. From this perspective, forced co-production is not an exception of participation, but a strengthened form, that is, co-production becomes a necessary condition for maintaining the minimum operation of the system.

Furthermore, this study also points out that the self-management situation among individual consumers is not balanced. It does not unfold among the affected passengers. Some people recover quickly and can relatively easily cope with the chaotic situation, while others are trapped for a longer time, which is influenced by factors such as financial resources, identity differences, experience with the airline operation system, and the ability to skillfully use digital tools under pressure. These differences determine how individuals can react in actual operations.

Then, this study provides two theoretical contributions to the field of service research and co-production. Firstly, we derived a definition for co-production and pointed out the concept of "forced cooperative production" in the context of this case. We found that in the existing service field, consumer participation is usually described as voluntary, beneficial, or organized through enterprise design. However, the Schiphol Airport case revealed that in the case of official collapse, consumer participation did not disappear; instead, the risk responsibility and operational roles for maintaining service continuity were directly transferred to consumers. In this situation, consumers were forced to perform tasks that were usually carried out by airlines and airport management, including rebooking transportation, finding accommodation, coordinating information flow, and assisting other passengers. Therefore, participation is no longer merely a matter of value co-creation, but more of a survival-oriented forced labor form. However, this case study currently only indicates that this concept holds true under conditions of institutional failure. Additionally, we also challenged the normative assumptions inherent in the Service Dominant Logic (SDL). We believe that during a crisis, co-production does not represent balanced collaboration among participants, but may become a mechanism that shifts operational burdens, risks, and recovery costs to the least resourceful and least powerful consumers. Secondly, this study introduces the concept of stratified resilience. As our research results show, the individual self-management ability during service disruptions is not evenly distributed among consumers. It is affected by inequalities related to financial resources, legal identity, and business status. For example, passengers with more economic resources can obtain alternative flights, hotels, and transportation more quickly, while elite frequent flyers have privileged access to customer support systems that ordinary passengers cannot use. At the same time, some non-Schengen visa holders face travel restrictions, and the failure of the temporary visa system makes it impossible for them to leave the airport regardless of their personal status or preparation. These research results indicate that resilience should not be understood merely as an

individual's behavioral ability. It is also influenced by institutional arrangements, which determine who can obtain effective solutions in crisis situations.

In summary, in terms of theoretical contributions, consumer co-production is highly dependent on the environment. Under normal service conditions, participation may seem cooperative and voluntary, but in the case of collapse, participation may become forced, unequal, and deeply influenced by existing power dynamics.

For limitations, this study reveals the contradiction between the passenger protection regulations and the ambiguity of their enforcement in extreme chaotic situations. Although Regulation (EU) No. 261/2004 aims to safeguard passengers' rights through compensation and rerouting, empirical evidence from Schiphol Airport indicates that in large-scale disruptions, the actual implementation does not guarantee that all consumers can equally access resources. In fact, consumers often need to pay a high upfront fee before they can obtain partial compensation through an active application. This financial sequence creates an obstacle. However, it must be noted that this finding has an important methodological limitation, including documents F, I, and SCH-YT-053-M, which reflect a certain survivor bias. The data source is essentially provided by respondents and online contributors who are willing to actively participate in online platforms during and after the chaos, and are individuals with functional electronic devices, stable network connections, and sufficient cognitive and emotional processing capabilities to record and recount their experiences. However, we must admit that passengers who are more severely affected often remain invisible in the network, such as some passengers who cannot charge their electronic devices, have no access to information channels, or are unable to communicate due to language barriers or exhaustion of physical strength. Their experiences can only be presented indirectly, or not at all. Therefore, what is missing is not noise, but silence.

Another limitation lies in the platform dependence of the data. Most of the empirical evidence comes from social media traces and digital media communication. This means that the disruptions captured by this study are formed through narration, sharing, and re-expression on online platforms, rather than the actual disruptions experienced on the spot. We must admit that what emerges is often the content that can be disseminated, rather than the most severe part. This study's design also has a temporal limitation. Although the analysis is centered around three clearly defined disruption stages, the actual experience is often more flexible and variable. For

many consumers, these stages overlap, repeat, or are expressed in the opposite order according to their travel itinerary. Therefore, our simplification of the important stages of the case simplifies the highly fragmented story. Moreover, we cannot ignore the fact that reliance on retrospective narration introduces the possibility of reconstruction bias, as respondents often interpret their experiences after the problem-solving process has begun, which means that emotions, explanations, and perceptions may change over time.

Future research directions can continue to explore whether the phenomenon of forced co-production will occur in different case scenarios, how it occurs, and why it occurs. Firstly, future research can utilize methods such as on-site investigations at airports, or collaborate with airlines and airport management authorities to directly or indirectly reach out to those stranded passengers who do not appear in the online data collection process. This way, it can more comprehensively incorporate those non-digital users or the overlooked minority groups into the empirical materials for analysis. At the same time, conducting a horizontal comparative study of airports and other transportation systems can also help clarify the conditions for the emergence of forced co-production (only as an analytical concept). Additionally, further research can be conducted on how institutional design and digital infrastructure affect the unequal access during the recovery process, including detailed records of certain passenger groups gaining advantages during the crisis recovery, while others are neglected. By further extending this concept to areas such as healthcare and public transportation, it will deepen the understanding of vulnerability and responsibility allocation under systemic pressure conditions.

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Appendix A: Participants Consent Form

Informed Consent

The current study is a student project carried out by Xiaojing Gu, Yuxin Chang, Master students in the Service Studies Department, specializing in Supply Chain Management, at Lund University, Sweden.

Information on the processing of personal data

The following personal data will be processed:

Name, age, sex, nationality, country of residence, e-mail address, profession, voice recording.

Personal data will be processed in the following ways:

Sound recordings will be made using mobile phones and also using Zoom, and stored locally on the researchers' laptops and the mobile phone used to make the recordings. The file containing the other personal data will be stored on Google drive, and locally on the researchers' laptops. Access to personal data will be strictly limited to the two researchers and their supervisor. Personal data will be stored for the duration of the research project and will be deleted once the report has been assessed and has received a passing grade. We do not share your personal data with third parties.

Lund University, Box 117, 221 00 Lund, Sweden, with organisation number 202100-3211 is the controller. You can find Lund University's privacy policy at www.lu.se/integritet

You have the right to receive information about the personal data we process about you. You also have the right to have inaccurate personal data about you corrected. If you have a complaint about our processing of your personal data, you can contact our Data Protection Officer at dataskyddsombud@lu.se. You also have the right to lodge a complaint with the supervisory authority (the Data Protection Authority, IMY) if you believe that we are processing your personal data incorrectly.

Appendix B: Guidelines for the Semi-structured Interviews

B-1: Individual Interview Guide for Passengers

Part 1. Introduction

1. Interviewer's Introduction
2. Research Ethics

    2.1 Confidentiality

    2.2 Voluntary Participation

    2.3 Recording Consent

Part 2. Interview Questions

Q1: Where were you originally planning to fly to and when you went to the airport that day?

Prompt:

Did you have any absolute deadlines you couldn't miss (like the start of a semester, an exam, or a visa expiration)?

How high was your personal anxiety level at the time?

Q2: What was the first channel through which you found out there was a major problem with your flight that day?

Did the airline send an advance warning, or did you only realize both the information flow and physical operations had stalled after you arrived at the airport?

Prompt:

During the flight disruption, what notifications did you receive from KLM or Schiphol Airport? Through which channels like app, email, SMS, social media, airport screens?

How timely were these communications?

Did they clearly explain your options and what you should do?

Did they change your behavior?

After receiving information, did you feel the airline's warning gave you enough time to react?

(For those who hasn't been to the airport) Did the airport or the airline explicitly tell you 'you can choose the train/bus', or did you have to rely entirely on your own judgment to assess the situation?

Q3: What was the very first thing you did right after confirming you couldn't fly?

Did the airline issue any 'directives' via SMS or their app? For example, explicitly telling you, 'Please do not go to the manual counters, please operate online'?

(For those who hasn't been to the airport) After realizing (or having a premonition) that the flight couldn't take off, you made a very decisive decision at that moment that was to take the train/bus instead. What exactly prompted you to make this decision rather than staying at the airport and waiting for the airline to resolve the issue?

Prompt:

Did you buy your ticket through official channels or through a third-party agency? Do you think their sending of this information was a conscious effort to manage demand-side traffic and prevent the airport, as a physical node, from being overwhelmed?

(For those who hasn't been to the airport) Was it because the airline sent you a text message saying 'Do not go to the counter'? Or because you saw that there were too many people in line / the official app completely crashed and froze, making you feel 'There's no hope for the airline, I have to rely on myself alone'?"

Q4: Did you use them at the time? Was the interface design genuinely convenient for 'self-rescue', or did it constantly crash and give errors, making you even more frustrated?

Prompt:

Were you satisfied with the services provided?

Did you feel you were treated fairly?

Q5: At the same time, were you checking routes, refreshing for rebooking options, or researching refund policies on your phone?

What were your true inner feelings at that moment?

(For those who hasn't been to the airport) When you were searching for train tickets or bus tickets on your phone, and even delving into the refund policies of the original air tickets, what was your true feeling at that moment?

Prompt:

Do you think the airline provides these self-service tools primarily to 'empower' passengers and give you freedom, or for other purposes?

Whose responsibility do you think all this effort you put in should have originally been?

(For those who hasn't been to the airport) How much extra money and effort did you have to spend to buy this alternative ticket? Do you think these costs should have been borne by someone else?"

Q6: Apart from operating on your phone, there must have been a period where you could do absolutely nothing but wait. During those hours, which specific area of the airport were you in?

Prompt:

Did the airline proactively contact you to arrange accommodation, return transportation, lounge access, etc.?

With the scene so chaotic, did you choose to line up at the manual counter to demand compensation or an explanation?"

Q7: Did you interact with other stranded passengers at the scene, or go on social media platforms to see real-time updates or guides posted by fellow travelers? Or did you help each other out at the scene to find solutions?

(For those who hasn't been to the airport) How did you plan out this alternative train/bus route at that time? Did you search it blindly on your own, or did you look at the live updates or guides posted on some social media platforms?

Prompt :

Was the information shared among yourselves, to some extent, more useful and timely than the official announcements from the airport or airline?

Q8: Having experienced everything you just described, what role do you feel you played in this 'service system' throughout the crisis response process? Were you purely a consumer, or something else, or did you become a 'free outsourced emergency responder' who helped the airline solve the problem that would have otherwise been a hindrance for them?

(For those who hasn't been to the airport) Have you realized that your "self-funded search for alternative solutions" helped to relieve some of the physical pressure on the nearly collapsing airport?

Prompt:

How would you describe your emotional state during this turmoil?

Did your emotional state change as the situation developed? Why did you feel that way?

What costs or efforts that you put in do you think should have originally been the airline's job?

Do you feel that some of the airline's actions actually complicated the situation on the ground?

Q9: Afterwards, did the airline send you an email to thank you, or smoothly provide compensation?

(For those who hasn't been to the airport) Have you gone to the airline to request reimbursement for this train/bus ticket? Did they successfully compensate you or send you an email to express gratitude?

How has your trust in them changed since this incident?

Q10: Has this experience changed your future travel habits? For example, have you now become a veteran who is highly proficient in the rebooking rules of major airline apps?

Part 3. Conclusion & Closing

1. Wrap-up
2. Follow-up & Consent for Further Contact
3. Final Thank You

B-2: Individual Interview Guide for Employees / Volunteers at the Airport

Part 1. Introduction Part

1. Interviewer's Introduction
2. Research Ethics

    2.1 Confidentiality

    2.2 Voluntary Participation

    2.3 Recording Consent

Part 2. Interview Questions

Q1: As a volunteer at the airline's on - site, what role did you play on that day, and what were your main responsibilities? Were there any particularly memorable events or passengers?

Since I know that you usually work in an office. When Schiphol Airport was in chaos due to the heavy snowstorm that day, how did you first notice the situation at the airport?

What was the opportunity that made you decide to put aside your current work and go to the terminal as a volunteer?

What was the first sight you saw at the airport when you first walked into the departure hall?"

Prompt:

Regarding how to communicate with the affected passengers, what initial decisions were made? Which communication channels were utilized and what were the reasons for their selection?

Did the company have a pre-established crisis response plan, or was it formulated on an ad - hoc basis?

Q2: When you first approached them, what state were they in?

When the system crashed, were they completely at a loss, or had someone already started to try to find alternative solutions on their own?

Before you intervened to help them, how did they express their anxiety or demands?

Q3: Then we would like to know if the airline had any online platform or APP to send any information to the affected passengers at that time?

Did you observe that these passengers attempted to use those digital self-service tools?

Prompt:

At which step did they get stuck?

Was it due to a complete language barrier, or was the process too complicated?

Were there any multilingual signs at the scene at that time, or did the airline send any operation guides in different languages to them?

Q4: Could you provide me with a specific scenario? For example, when facing an aunt or uncle who is extremely anxious and completely unable to understand English, how did you help them clarify their demands step by step, and then communicate with your ground staff colleagues?

Q5: Have you noticed that when you gave them clear guidance, their 'behavior' changed on the spot? For instance, from being completely disoriented to waiting quietly or leaving the airport?

Prompt:

Have you observed that there was mutual assistance among the passengers on the scene?

After you helped one passenger, did these passengers go on to help other passengers in the same predicament?

Do you think this 'quiet cooperation' is also the best self-rescue they could do in that high-pressure environment?

Q6: From the airline's perspective, were there any proactive measures to arrange accommodation, return transportation, lounges, etc.?

Regarding what you just mentioned, of helping them organize their demands and then handing them over to the ground staff colleagues. Let's make an extreme assumption...

Q7: Besides on-site support, have you posted any relevant real-time information about the airport on online platforms or social media?

Q8: From the dual perspectives of airline staff and on-site volunteers, do you think the current emergency process design of the airline is friendly to passengers with language barriers?

Do the existing processes treat them as participants who can solve problems together (Participants) or merely as people to be managed?

Is the cost of responding to crises disproportionately placed on the vulnerable group?

Q9: Regarding your experience in this large-scale flight disruption, what aspects do you think the relevant companies (airlines/airports) should understand or consider in the future?

Prompt:

If the management now asks you to redesign the airline's emergency plan based on that day's experience, what 'mechanisms' would you add?

Or, reflecting on that day, do you think the efforts you made really changed the situation, or do you feel that the personal power was too weak in the face of the massive systemic collapse?

Q10: After the volunteer service ended on that day, was there any immediate review or subsequent system review of the service disruption caused by the blizzard?

Q11: How much did the passengers' proactive reporting of information, self-tracking (such as using an airtag), going to designated counters to claim, etc., contribute to the efficiency and resilience of airport services?

Q12: In the case of large-scale flight delays or cancellations caused by extreme weather such as blizzards and low temperatures, what are the main key nodes where the freight supply chain is most likely to be disrupted? For example, baggage handling, sorting system, on-site transfer, cross-flight transfer, passenger delivery, etc..

How can airport and airline entities, as well as different terminal buildings / cargo stations, achieve cross-regional coordinated transfer of stranded baggage to improve the recovery speed of the baggage supply chain?

After large-scale flight delays, what methods do you usually use to reduce passengers' waiting time for luggage?

How do these measures enhance the recovery ability of the overall service supply chain?

Part 3. Conclusion & Closing

4. Wrap-up
5. Follow-up & Consent for Further Contact
6. Final Thank You