

# **Evaluation of Risk Perception Asymmetry in the Commercial Airline Industry**

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On my honor as a University Student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments

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## STS Research Paper

### Introduction

Every day, approximately 2.9 million American passengers take to the skies in commercial planes, placing faith in the vast interconnected web of airlines, air traffic controllers, and technicians to deliver them safely to their destination (Air Traffic Organization, 2023). It is almost universally the case that their faith is rewarded; Air travel is consistently rated as one of the safest modes of transportation per kilometer, with an incident rate three times lower than that of trains. While this is a comforting statistic to those in the air, it is not necessarily the whole truth. Consider instead if you measure per journey instead of per kilometer; suddenly the incident rate is reversed, with air travel measured as being 20 times more dangerous than rail travel (Weir, 1999). How is it that air travel can become orders of magnitude more dangerous depending on how you choose to measure it? By its nature, the communication of risk is a complex subject that has very real implications on how risk is perceived and impacts interactions with the world around us.

Commercial airlines constitute a half-trillion-dollar industry, responsible for the safety and security of their passengers as well as the economic interests of their shareholders. Given this vast degree of responsibility and control given to airlines, it becomes necessary to evaluate risk using analytical frameworks and abstractions. Passengers, in contrast, exhibit relatively little autonomy in their relationship with airlines, and as individuals, are neither disposed nor entirely capable of perceiving risk in the same statistical manner as airlines. This difference in the nature of risk perception between passengers and airlines results in an inherent disconnect between the two groups which can result in long term dysfunction and stagnation in the airline industry. It is therefore necessary to examine the perception, evaluation, and communication of risk in the

aerospace industry in order to promote the long-term stability and ethical operation of commercial airlines.

### **Background and Significance**

Every aspect of life invariably has some aspect of risk, from the daily danger of a commute or the chance of long-term disease, each with a series of associated potential statistics that could be used to quantify it. However, we as individuals do not perceive risk in this manner. Risk can ultimately be divided into two broad groups: risk as feelings and risk as analysis (Slovic & Peters, 2006). It would neither be intuitive nor practical to perform a statistical risk analysis at every sign of danger, and so we eschew the abstractly large numbers of statistics in favor of our personal judgement, refined by years of experience and millennia of evolution. By perceiving risk in an affective manner, we lose precision and objectivity in exchange for efficiency and practicality. This is not the case for organizations however, who not only are incapable of using an affective perception of risk, but also have the time and resources to analyze risk from a quantitative perspective. Risk is inherently perceived through different schema between individuals and organizations such as airlines.

This discrepancy in risk perception becomes immediately relevant when considering the asymmetrical nature of the relationship between airlines and their passengers. Airlines consistently exercise the greater part of control in nearly all aspects of commercial flight, in every step from the maintenance of their planes to the routing of flights. In comparison, the greatest degree of autonomy afforded to the passenger is limited to their choices of airline and boarding group. Unlike other similar corporate power structures, the alternatives available to potential customers are extremely limited. Air travel provides a niche of fast, long-distance private transport that is not adequately supplemented by other forms of transport in the US,

effectively limiting passengers to 15 mainline airlines operating the same handful of brands of aircraft and using comparable operating procedures. The vast majority of passengers in the United States will find themselves on either an Airbus or Boeing airframe flying one of four main carriers (Hayes, 2024; OAG, 2024). This artificial scarcity results essentially in an artificial monopoly, allowing commercial airlines to go largely unchecked by the free market as an implement of public opinion, furthering the asymmetry between airlines and passengers.

This asymmetry extends into how risk is perceived and addressed between airlines and passengers. As an organization, commercial airlines are concerned with risk as a statistic that can be numerically mitigated—ever present but brought within acceptable bounds. Information and recourse are ubiquitous, with mountains of reports, procedures, and memos being the staple crop of flight maintenance. The passenger, in contrast, is typically limited to looking out their window or the monotonous drone of the pilot over the intercom informing them of turbulence. What risk information that makes its way to the public eye takes the form of consumer statistics and audit results—useful for regulatory purposes but as unintuitive to daily life as lottery odds. This disconnect in risk autonomy and communication has the potential to spiral into larger, more systemic issues, becoming evident in the wake of accidents amidst media and economic backlash. For the stability of the commercial airline industry and the future of American aviation, it is necessary to address the disconnect in risk communication in airlines.

## **Methodology**

To examine and evaluate the nature of risk and its ethical and effective communication in the commercial airline industry, I use Actor Network Theory (ANT) to review the current interactions between commercial airlines and passengers so as to develop and further expand the study of industry-individual interactions in the context of aerospace. Actor Network Theory as

described by Latour (2008) states that all social phenomena can be attributed to interactions within larger networks, effectively reducing social phenomena to a closed system in which social situations are purely the result of the complex web of interactions within a network and not the result of ephemeral external social forces. This framework allows for the analysis of scenarios from the perspective of network interactions between different actors, with the benefit of allowing for greater focus to be placed on the connection between groups. In the case observed here, ANT allows us to analyze the various interactions between commercial airlines and passengers as actors while affording the flexibility to delve deeper into the nature of the asymmetrical interface between them.

Actor Network Theory can then be applied in concert with previous investigations into similar network interactions to develop a more robust understanding of industry-individual interactions and to provide a basis for the distinction of the commercial airline industry from other such examples. It should be noted that both ANT and industry-individual studies have been pursued extensively in sociotechnical research, and there exists a wide basis of study in this field. The goal of the work illustrated in this paper therefore is to apply the critical aspects of these previous works to the relatively underrepresented field of aerospace, thereby highlighting the unique aspects of air travel and their relation to sociotechnical academics. This methodology lets us examine both human-group and human-technology interfaces from both practical and ethical viewpoints. For the purposes of this paper, we will focus primarily on the individual-industry interaction in the form of passengers and commercial airlines, as it is one of the primary driving interactions in the social aspect of the commercial air travel network. The individual-group interface of passengers and airlines in this instance represents the most commonly experienced

and socially impactful interface for the general public within the larger airline social network and serves as an adequate case study of the system at large in regard to public perception.

The application of Actor Network Theory will occur in three stages. Firstly, the existing social schema is explored, examining current airline practices regarding risk and its communication to passengers. This is achieved through both primary and secondary sources that illustrate the nature of risk communication and its shortcomings in air travel. Following verification of current practices, the current understanding of risk communication and perception within industry is examined through the lens of literature review. This review seeks to synthesize a deeper understanding of the impact of risk perception and communication and expand this area of study into the field of commercial air travel. Finally, upon review of current risk practices and their context, their future viability and long-term sustainability is examined from both consumer and industry perspectives, with the goal of exploring potential areas of growth in the commercial airline industry to promote more ethical and effective business practices.

### **Current Practice Evaluation**

Current practices in aviation risk communication are characterized by a lack of passenger awareness that is compounded by a lack of accountability on the part of the airlines. The bottom line of air travel is that passengers are not engineers; they don't know the technical details of how a plane flies and is maintained, nor should they be expected to. The privilege of modern society is that we are not required to know how to construct or maintenance all the systems we use in everyday life—it would neither be practical nor efficient for everyone to hold a degree in computer science to be able to use their phone. It is for this reason that we have specialists; in the case of commercial air travel, they take the form of pilots, maintenance technicians, and engineers, all of which work together to keep planes safely in the air. It is essential, however, for

specialists to be held accountable to the people they provide service for—not just their direct customers or supervisors but also all that are directly impacted by the systems they maintain. In commercial air travel, this accountability to the passenger is drastically lacking. The primary mechanisms for passengers to receive information from their flight crew are limited to glossy preflight safety videos and monotonous PA announcements from the pilot. Smith (2011), a veteran commercial pilot, describes such announcements in the following manner:

Yet every time that microphone crackles, mostly what we hear is choreographed baby talk. Eyes begin to roll every time a customer service agent, or crewmember, opens his or her mouth. Even the most basic broadcasts are heavily fortified: the campy legal-speak theater of the cabin safety demo, the squealy condescension of the thanks-for-flying-with-us pitch. The most innocuous anomalies have been reworded, intentionally or otherwise, into a lexicon of infantile explanations. Turbulence becomes "a couple of bumps up ahead," the complexities of air traffic control delays are reduced to 'waitin' for some rain showers to pass.' The desire is to avoid confusion, keep things topical, and never, ever, insinuate danger. The result is the shaking of heads and a propensity, often enough, not to believe a word of it.

Smith goes on to further characterize airline-passenger interactions as being characterized primarily by secrecy, stating that "paranoia is perhaps natural in a corporate environment where safety and security lie at the heart of operational success" (Smith, 2011). This insight highlights a key facet of commercial airline carriers, namely that first and foremost, airlines are a business. Panic is generally bad for business, and for commercial airlines who deal in the lives of hundreds of millions each year, informing them of every risk is generally not conducive to market share. A good example of this phenomenon is the use of speed tape in aviation.

Speed tape is a specialized aluminum-based adhesive tape highly resistant to environmental changes used in the temporary repair of nonstructural surface on airplane skins to protect weathered surfaces (Bikales, 2022). No matter how advanced the tape however, it is never good optics for a passenger to look out their window and see a man applying what looks like duct tape to their wing. McEntyre (2023) describes one such scenario in which a video of a worker applying speed tape to a Spirit Airlines engine nacelle went viral to generally negative and incredulous public opinion. This sentiment is entirely understandable; passengers entrust their life and livelihood to airlines, and to see that their safety is being held together by a few pieces of adhesive is far from reassuring. The fact that the tape in question is highly regulated, thermally and UV resistant, and costs several hundred per roll, while extremely relevant to airlines and regulators, is entirely irrelevant to the perspective of passengers. This is because of the disconnect between passengers and airlines in the nature of how risk is perceived.

A good example of this disconnect in the context of speed tape is described by Phillips (2002) regarding a civil penalty by the FAA against United Airlines in which speed tape was improperly applied to a plane wing. What is critical about this case however is the specificity of the regulations that were broken by the airline which led to the fine.

While it's routine to use speed tape to make temporary repairs, in two cases the holes being repaired were slightly larger than allowed by the United maintenance manual, and all three were closer to the edge than allowed. The manual allows use of the tape with holes no larger in diameter than 2 inches and no closer to the edge of the panel than 3 inches. The three holes measured 2.6 inches, 2.5 inches and 1.75 inches in diameter and were located 2 inches, 2.25 inches and 2.125 inches from the edge of the spoiler.

In essence, United was fined \$805,000 for applying tape to holes that were half an inch too big and an inch too close. This level of specificity, and more critically, the binary nature of this regulation speaks to the purely analytical nature of how risk is assessed by both the airlines and FAA, a form of risk assessment that presents itself as alien and uncaring to the individual. The existence of this regulation in this wording implied the existence of some FAA code that defines the acceptable number of screws missing from a wing—a terrifying prospect for a passenger, but from an engineering and maintenance perspective, an acceptable risk. Dharni (2022) relays information from commercial flight crews describing the existence of Minimum Equipment Lists (MELs), detailing which systems are essential and nonessential for a flight to operate. Oftentimes the nature of what is essential and what is not is counterintuitive to common sense. Allegedly, a plane is permitted to take off if it is missing a generator, but it cannot leave the departure gate without a functioning ashtray in the lavatory. While frequently opaque and unintuitive, all air travel regulations exist for the purpose of mitigating risk at a statistical level; a fire in a lavatory has the potential to be more catastrophic than an electrical failure in a system that has two backup generators. These risks are meticulously tabulated and evaluated, irrespective of human affect, ultimately culminating in a safer and cost-effective flight experience. The challenge then is the ethical and effective communication of this risk evaluation to passengers who utilize an entirely foreign and antithetical system of risk perception.

## **Literature Review**

The nature of risk and its perception constitutes a highly explored field of study, including everything from the construction of analytical predictive models to social treatises on the ethical structures of risk dissemination. In its application to aerospace, risk studies tend more towards the former, being concerned with what is framed as more practical considerations such

as operational safety and mission effectiveness. It is important to consider however the central factor that distinguishes commercial airlines from other aerospace industries: its extensive and pervasive interface with the public, integral and inseparable from its explicit purpose. Keeping planes in the air is only half the battle for airlines, they also need to ensure those planes are filled with happy passengers; what separates commercial airlines from air freight carriers is that their cargo happens to have free will. It is therefore necessary to thoroughly explore this individual-industrial interface in the context of aerospace.

To this end, inspiration is taken from the work of Gladwell (2015) regarding the history and engineering background of the Ford Pinto recall of the late '70s. Gladwell's interview of Denny Gioia, an engineer who worked on the Ford recall team at this time, dives into an examination of how engineers perceive problems differently, and how that perception can clash with public sentiment. To the Ford engineers, the Pinto was a highly complex system of both physical and business aspects, all of which had to be balanced to create a functional and economically feasible car. Decisions need to be made based off of actionable and clear evidence in a manner that is feasible within the economic structure of their company. In regard to the decisions he made as a member of the recall department, Gioia makes the point that "If he didn't rely on the numbers, how would he know what to care about?" He further states regarding the Pinto case "I'd done what I trained myself not to do, make decisions on the basis of emotion. And, second, I realized, I had to prove it, and I couldn't prove it." This mentality is central to engineering, and it begins to explain why so many regulations exist within aviation that appear arbitrary and hyper-specific as seen in the speed tape example above. In reality a tenth of an inch difference in the location of a hole in a wing does not significantly affect the risk of failure, but by having such a specific metric, it becomes possible to delineate the actionable and

unactionable. Individuals have the privilege of gradients in risk analysis, but engineers are constrained to the discretization of risk.

One key obstacle in measuring and communicating risk in aviation is counterintuitively caused by the abundance of safety mechanisms in commercial aviation; accidents occur too infrequently to be able to generate meaningful and relevant data. Schlappig (2023) puts it best, asking “How do you really rank safety among airlines that haven’t had a fatal accident in well over a decade?” This is often the case in safety and risk analysis, as the goal of reducing accidents runs contrary to the primary method of data collection. Similarly, Gioia states “The whole time I managed the Pinto file, I never got above five [cases reported]” (Gladwell, 2015). When a key aspect of the engineering perspective of risk analysis is actionability, it becomes challenging to promote meaningful change and accountability based on such limited datasets. In this manner, what analytical risk performance that is performed becomes further removed from the reality of what is important to passengers.

### **Conclusion and Prospective Recourse**

Airlines and passengers inherently operate from two distinct forms of risk analysis and perception, but this does not necessarily preclude mutual understanding and development. While passengers are dependent on commercial airlines for their safety and wellbeing, airlines are likewise dependent on passengers for their continued economic survival. The artificial monopoly created by the current market niche of air travel in the US has thus far effectively sheltered airlines from direct accountability to customers, allowing for the signification deregulation of the ‘70s and the decline of in-air services; however, this era is coming to an end. Rising jet fuel prices, lowered demand during the pandemic, and passenger skepticism following multiple Boeing 737 MAX incidents have all challenged airline supremacy, and these do not represent

isolated incidents. Air travel is primarily a luxury expense for most Americans, associated with vacations and leisure travel, and thus is an expense that can be feasibly cut. It is therefore in the best interest of commercial airlines to serve not only their own needs and considerations of risk, but those of their passengers whom they rely on. In an industry where its sink or swim, by promoting accountability and mutual understanding, airlines have the potential to fly.

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