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Crises and the Resilience of the Aviation Industry: A Literature Review of Crises and Airline Responses

Daniel Cook[a], Robert Mayer[a,*], Gary Doy[a]

[a]*Centre for Air Transport Management, Cranfield University, College Road, Cranfield MK43 0AL, United Kingdom*

Abstract

This paper aims to identify major crises that airlines have faced across multiple regions of the world simultaneously, and the responses to them. To comprehend the present status of the literature on this topic, relevant publications are reviewed. Following the COVID-19 pandemic, the coverage of literature analysing airline responses to crises in academia has increased, with new literature emerging at a fast pace. To date, most of the literature that encompasses aviation has formed part of a wider study, usually on tourism, transportation, or hospitality. It normally analyses these fundamental issues generically from the perspectives of many organisations within these vast sectors, with little emphasis on airlines. However, there are only a few exceptions producing academic publications with airline crisis responses and resilience as their focus. This paper breaks down literature into different categories to appraise various types of crises, sourcing literature with a wide variety of methods, geographies, purposes and results. It finds little agreement in academia regarding the best way for an airline to respond to a crisis in a resilient manner. Nonetheless, the study finds that crises events act as a springboard for research into crisis response within the industry.

Keywords: Airlines; Crises responses

1. Introduction

According to Martin-Breen and Anderies (2011), the study of resilience is extremely multifaceted and applicable on a variety of levels. As a result, there is no agreement in academia or practice on a precise definition. Within aviation research, the study of resilience is still within its infancy.

Literature was sourced using Google Scholar and Scopus over a period from 1999 to 2023. Figure 1 highlights this by showing the number of publications in the Journal of Air Transport Management (JATM), Transport Policy (TP)

* Corresponding author. Tel.: +44 (0)1234 754971.
E-mail address: r.mayer@cranfield.ac.uk

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and Tourism Management (TM) journals between 2004 and 2023 that contain the key words “airline” and “resilience” (or terminology that is similar but not identical, such as “air transportation” and “robustness”) in their titles. Literature from these journals were chosen as they contain the highest number of relevant publications that focus on the economic and operational resilience to shocks in the airline industry. The overall pace of accelerated growth has varied throughout the past ten years. Between 2014 and 2019, it moved more slowly than between 2020 and 2023, when COVID-19's severe effects were seen worldwide (Sun, Wandelt, and Zhang, 2023). It is noteworthy to observe the exponential increase in publications that took place throughout and right after the pandemic. Also from a practical perspective, it is critical for airlines to be “resilient” in times of difficulty, resulting in soaring interest in resilience research during this period (Guo et al., 2023; Sun, Wandelt, and Zhang, 2023).

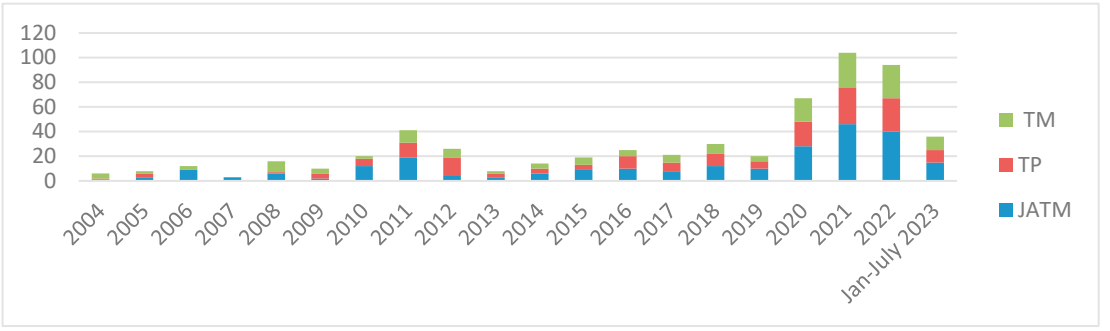

Fig. 1. Number of publications in JATM, TP and TM from 2014-July 2023 (Source: Scopus, 2023).

In general, studies use a variety of methods, such as analysing historical data to evaluate the resilience of airlines during crises, simulating hypothetical situations to provide recommendations for airlines should they encounter such a future event, and building working theories using various techniques (e.g., resilience engineering). Some research only uses quantitative or qualitative methodologies, while others conjoin them.

This paper aims to review all the literature that has focused on crises and airline responses to them to develop an understanding of airline resilience in 2023, and provide recommendations for the future research topics in this area. This paper will categorise airline responses to crises into themes, topics and methods, its purpose being to explore the evolution of knowledge in this field (Kuckertz and Block, 2021).

The remainder of the paper is laid out as follows: Section 2 examines crises and the aviation industry. In section 3, airline resilience and crisis responses are discussed, followed by a conclusion.

Crises and the Aviation Industry

1.1. Industry developments

During the past thirty years there have been several high-profile crises that have affected the airline sector. The sector itself has grown continuously over this time from one billion passengers in 1990 to four and a half billion in 2018 (IATA, 2019). An annual increase in passenger numbers was observed as a trend, with lesser depressions corresponding to the crises in 1998, 2001, 2003, and 2008, and a significant depression in 2020. Since COVID-19 affected all airlines in a comparable way, the downturn in the number of passengers transported reached a 30-year nadir. Many past events have had a detrimental effect on the sector, including the Asian Financial Crisis in 1998, the US 9/11 terrorist attacks in 2001, and the SARS virus pandemic in 2003, though some were more localised than others.

Crises that have affected the airline sector can be broadly categorised into three major themes; namely, infectious diseases, terrorism, and financial crises. However, it needs to be noted that while many crises that fall into these themes have affected the global air transport industry, some of them only had local impacts. Furthermore, natural disasters can also affect the air transport industry, such as the eruption of the Eyjafjallajökull volcano in Iceland in 2010, that shut down European airspace for ten days (Bolić and Sivčev, 2010). However, in this paper the focus is on events that have a global or interregional impact, rather than a purely local effect.

1.2. The airline business and infectious diseases

Existing literature has established that infectious diseases can damage the airline business in miscellaneous and multiple ways (Pongpirul et al., 2020). Health crises include SARS (2003), Influenza (2009), Ebola (2014) and COVID-19 (2019-2022) viruses (Mason, 2005; Khan et al., 2009; Lamptey and Awojobi, 2014; Budd, Ison and Adrienne, 2020). Clearly, diseases can spread internationally via air transport when infected passengers travel between nations. Yet, most scholarly works focus on the role of airlines and air transport in disease dissemination, not on the way in which it affects business operations, and its ramifications on airline resilience (Hertzberg et al., 2018). For instance, Bowen and Laroe (2006) ascertained that air travel is the key element that quickens the spread of a virus between nations in their study on SARS. Mason (2005) noted that infectious diseases had a harmful impact on the health and economy of a nation. For example, people can voluntarily cease visiting disease hotspots and the governments of some nations can bar their citizens from travelling abroad to specific countries and regions. According to Kuo et al. (2008), the demand for air travel in SARS-affected nations plummeted during the outbreak. In China domestic traffic decreased by 64% and international traffic by 84% in 2003 (Beutels et al., 2009).

In their 2004 research, Pine and McKercher looked at how SARS affected Hong Kong's tourism industry. For example, Cathay Pacific only carried 30% as many people as it had before the epidemic. However, many airlines from Europe, The Americas, Australasia, and Africa saw only a slight change in their passenger flow as SARS was mainly focused on Asia. A similar pattern to SARS was observed by Ebola as it expanded throughout West Africa. The Centre for Disease Control (CDC) in the US recommended screening for all passengers flying between the US and the Ebola infected areas (Regan et al., 2015). The Atlanta to Lagos, Atlanta to Monrovia and New York JFK to Accra flights of Delta Air Lines and the Washington Dulles to Lagos route of United Airlines were all discontinued in 2014 and 2015 (Vara, 2014; Amankwah-Amoah, 2016).

Despite the numerous infectious diseases that have affected the air transport industry over the last 30 years or so, the most impactful remains the COVID-19 pandemic. The main distinction between COVID-19 and other pandemics is the former's global reach. There is little research that has a sole focus on airline resilience with regards to the impact of COVID-19 (Suk and Kim, 2021). Some studies, such as those by Belhadi et al. (2021), Barbash and Khan (2021), and Haraguchi et al. (2023), include aviation as a minor component of a more extensive and comprehensive examination of resilience, either in the hospitality or transportation sectors. However, as these papers were published while the COVID-19 pandemic was ongoing, new data was emerging, and current data was changing while the studies were being completed. Thus, any findings might have altered as the pandemic spread, making it challenging to identify trends (Harahushi et al., 2023). As a result, there is a sizable literature gap following COVID-19.

Governments were important players in the aviation industry during COVID-19. Airlines had to regularly adapt their operational procedures to comply with these requirements due to the various rules in each jurisdiction (Devi, 2020). From a government standpoint, infection control is the priority. However, this reduces the profitability of the airline (Devi, 2020; Albers and Rundshagen, 2020). Another paramount consideration for governments is the heightened risk of cross border contamination by air travel. As a result, further hygiene precautions and physical separation measures are required (Hertzberg et al., 2018; Budd, Ison, and Adrienne, 2020). An infected person, for instance, may travel across continents in a single day and disseminate the virus to a new area. Passengers and staff are still at risk of getting sick even if there is just one infected person on board (Meslé et al., 2022).

During the pandemic, most nations decided to decrease the capacity of their airports, with airlines subsequently being forced to curtail passenger operations by reducing the number of flights (Vinod, 2020). As a result, only a small portion of airline fleets were utilised, and most aircraft were grounded (Suau-Sanchez, Voltes-Dorta, and Cugueró-Escofet, 2020). Furthermore, governments also implemented restrictions directly at their respective borders. For instance, during COVID-19, Japan implemented stringent border controls, including quarantine and testing requirements for arriving passengers, that made it impossible for most international visitors to enter (Hanaoka et al., 2022). The limitations were more in line with those in other Asian nations, and more severe than those imposed by most governments in Europe, Africa, and the Americas. Hanaoka et al. (2022) claim that the pandemic had a trifold detrimental effect - on airline yield, scheduled seats, and frequency. For every 1% fall in the quantity of scheduled seats and frequency, respectively, airline yield declined by 3.35% in 2020 and 2.94% in 2021.

1.3. Terrorism

Terrorism is a high-profile issue, especially as there have been several terrorist attacks on the aviation industry in the last thirty years (Szymankiewicz, 2022); albeit many of these have focused on specific airlines (e.g., Metrojet 9268 in Sharm El Sheikh, Egypt in 2015 (Dunning, 2015)), the 9/11 attacks in New York, Washington DC and Pennsylvania in September 2001 have affected airlines across the globe. Guzhva and Pagiavlas (2004) used a vector autoregression (VAR) model to assess the effects of 9/11 specifically on the performance of US airlines. They used revenue passenger miles (RPMs) as a stand-in for performance in their VAR model. They detected a 7.4% decline in RPMs and a 10% drop in yield in the year that followed 9/11. Ito and Lee (2005) used a comparable approach. Using simple linear models, that took into consideration the adoption of new, tighter security measures, they sought to assess the impact of 9/11 on air travel demand in the US. They determined estimates of the initial demand shock of more than 30%, after adjusting for cyclical, seasonal, and other specific events influencing the industry, such as the unemployment rate. Ito and Lee (2005) found a 7.3% RPM decline and Guzhva and Pagiavlas (2004) a 7.4% reduction.

Gittell et al. (2006) investigated the effect of pre-crisis financial buffers and corporate practices on post-9/11 layoffs and stock price recovery. All major airlines operating during the period were covered. They examined quarterly data from 1987 to 2000. By comparing various airline stock prices in September 2005 to their levels on September 10, 2001, airline performance recovery was quantified. Gittell et al. (2006)'s findings to illustrate the stock price recovery are shown. The figure shows the stock price on 10 September 2005 as a percentage of the price on 10 September 2001. They concluded that Southwest Airlines performed best and US Airways and United the worst. In this period, the latter two made the largest staff reductions and asset sales and it took longer for their stock price to recover. American Airlines and United were both intimately implicated in the attacks, which severely harmed each company's ability to recuperate from the disaster. Given that United was a direct target of the hijackings, it is not surprising that it ranked as the poorest or one of the poorest across all resilience proxies evaluated by Gittell et al. (2006), including the number of employee layoffs and days of cash on hand following the crisis. American Airlines recovered better than United, despite also being a direct victim of the attacks, as they laid off fewer employees in the subsequent months. The authors conducted a statistical analysis showing a statistically significant negative relationship between stock price recovery and the number of redundancies.

Converse to the US, research on the effects of 9/11 on European airlines is limited. Although, using revenue passenger kilometres (RPKs) as a proxy for airline demand, Aimable and Rossello (2009) examined the effects of 9/11 on Europe's national carriers between October 2001 and October 2002. They estimated that, depending on the country and carrier, the overall short-term impact of 9/11 on European airline demand ranged from 5% to 15%. They also found that, primarily due to seasonality, the impact on routes varied in size depending on the month, and that the Atlantic and transnational European markets were collectively most impacted. This is principally due to the greater operating difficulty induced by additional security measures on North Atlantic routes following 9/11 and the availability of transport options in Europe. Unsurprisingly, whilst US aviation certainly felt the fullest weight of the terrorist attacks, they undoubtedly impacted European airlines too.

1.4. Financial crises

Over the past 30 years, the industry has been severely affected by financial crises (Prideaux, 1999; De Sausmarez, 2007). Factors affecting the growth of air transport are linked to changes in the cost and revenue structure of airlines (Schosser and Wittmer, 2015), which are often linked to changes in financial markets (e.g., access to capital). Since the aviation sector requires substantial capital, airline financing focuses primarily on keeping a healthy balance sheet to lessen the impact of economic downturns (Belhadi et al., 2021). Additionally, capital has taken on an increasingly crucial role in the development of the supply side structure in this sector (Snider and Williams, 2015).

One of the major financial crises in the last 30 years was the Asian Financial Crisis of 1997. Prideaux (1999) and De Sausmarez (2007) investigated how quickly economic crises affected aviation businesses. To absorb the effects of a crisis, airlines must be agile. Many Asian carriers lacked this feature at the time. In the past, the Asian market was far less established than it is today. Therefore, it is likely that if the 1997 crash had occurred in the current era, the pattern of recovery would have been entirely different (Maung, Douglas, and Tan, 2022).

The global recession of 2008 likewise placed a strain on airlines' finances. The main concern was whether surviving businesses still had the financial means to complete aircraft deliveries in 2009. Michaels (2009), Zolotusky (2009), and Scheinberg (2009) conducted horizontal and ratio analyses of the balance sheets from a selection of airlines from various nations. They discovered that the only airlines that could accept new aircraft were those that were either wholly owned by the government or had excellent credit ratings. The more financially secure airlines were able to ask for delays or price breaks on their orders. Franke and John (2011) examined the immediate and long-term effects of the 2008 financial crisis on airline resilience. They evaluated three scenarios and potential rates of recovery. Except for air freight, they noticed that the passenger airline cycle typically lags the total industry cycle. The drop in profitability was less severe for airlines operating in industrialised countries than it was for smaller-scale, less developed nations. As a result, it took airlines in developed countries less time to get back to their pre-2008 levels (Didier, Hevia, and Schmukler, 2012).

Robust and agile finances are thus key to an airline's success as proven by effects of financial crises, such as in Asia over the past three decades (De Sausmarez, 2007; Franke and John, 2011). Those airlines at the forefront of growth were either government owned, or had strong credit ratings like Ryanair (Rodríguez-García et al., 2020).

2. Airline Resilience and Crisis Responses

2.1. Operational

According to the literature, airline responses towards crises and to build airline resilience can be categorised into operational, financial and commercial areas. Table 1 gives an overview of the three categories, examples from the literature and a brief description. Operational responses play an important role when crises occur. Operational elements assessed by Kiraci, Tanriverdi and Akan (2022), such as schedule and route flexibility, are connected to the airlines' control over flight and operating activities during the pandemic. Furthermore, Thepchalerm and Ho (2021) and Agrawal (2021) discovered that the operational sub-factors of reducing capacity and flight frequency have recently increased in saliency for airlines. These findings imply that airlines with greater operational capability and flexibility demonstrate increased resilience. Nonetheless, while debates continue regarding the impact of distinct types of emergencies on airlines and how the sector recovers from them, there is no study in the literature that conclusively establishes success elements for airline survival, operation during and recovery from, various crises.

Suk and Kim (2021) and Migdadi (2022) investigated fleet utilisation during times of low passenger demand and tried to explain airline reaction tactics. They concluded that alternative uses, such as temporarily converting passenger aircraft to cargo specification, were the most effective ways to maintain a high fleet utilisation. De Andreis (2020) dubbed this type of conversion as 'preighters' and attributed this type of fleet adaptation to the solvency of many airlines during the pandemic's peak. Migdadi (2022) continued this by recommending different strategy options dependent on the type of airlines, with regional airlines ideally operating at a minimum frequency, while having a flexible route structure being optimal for international carriers. Although they are great substitutes for resilience, wet leasing and aircraft downsizing were not considered as possibilities for increasing fleet dynamics and flexibility (Hanaoka et al., 2022). For example, Cathay Pacific was given more latitude by both its employees and suppliers in the 1990s, allowing them to immediately reduce aircraft numbers after the crisis, lessening its financial impact (Pine and McKercher, 2004).

Table 1. Success factors for crisis management.

Responses	Example from literature	Description	References
Operational	Capacity reduction	During a crisis, airlines reduce the number of staff and aircraft	(Amankwah-Amoah, 2020)
	Multi-stop flights	Combine multiple cities on one aircraft	(Duong et al., 2019; Amankwah-Amoah, 2020)
	Delay the launch of new routes	The postponing of the start of new air services to be supplied by airlines.	(Budd, Ison and Adrienne, 2020)
	Frequency reduction	Decrease the number of supplied seats during crisis periods	(Duong et al., 2019; Amankwah-Amoah, 2020)
	Flexible and adaptable schedule	The flexibility to continue operations while enabling modifications to flight itineraries, based on customer demands and desires	(Colizza et al., 2006; Sokadjo and Atchade, 2020)
	Temporary suspension of routes	Temporary suspension of air flights because of airline decisions or government involvement due to decreasing demand or travel restrictions	(Duong et al., 2019; Amankwah-Amoah, 2020)
	Change in service quality	Reducing extras, such as free onboard catering to save money	(Rajaguru, 2016)
Financial	Liquidity of assets	Examples include cash and cash equivalents, inventory, debtors (accounts receivable), stocks (liquidity), and prepaid cost	(Ozkan and Ozkan, 2004; Budd, Ison and Adrienne, 2020)
	Share price/revenue generated per share	The airline's profitability and stock value.	(Capobianco and Fernandes, 2004; Cheema-Fox et al., 2021)
	Return on equity	Net income to equity ratio. Another measure of an airline's profitability.	(De Carvalho et al., 2016)
	Financial negotiating power	The strength of the airline in financial contracts and its ability to wield economic rights	(Kaplan, Martel and Stromberg, 2007; De Carvalho et al., 2016)
	Share of market	The ratio of airline revenues in the airline market to total market revenues.	(Kaplan, Martel and Stromberg, 2007; Choo, Corbo and Wang, 2018)
	Volatility of share price	The stock price's deviation or variation from the mean	(Yun and Yoon, 2019)
Commercial	Corporate social responsibility (CSR)	This means that airlines should be responsive to the larger society and embrace goals, policies, values, and activities that promote societal growth	(Lins, Servaes and Tamayo, 2017; Boulash, Kryzanowski, M'Zali, 2018)
	Customer retention	Through maintaining their service quality and providing promotions or rewards to their clients.	(Climis, 2016; Hotle and Mumbower, 2021)
	Customer centric services	Airline product and service design in response to client feedback	(Steven et al., 2012; Chow, 2014; Duong et al., 2019)
	Customer complaint rate	The number of complaints received by an airline in a period	(Steven et al., 2012)

2.2. Financial

In the literature, profitability is frequently used as a stand-in for resilience. Because airlines have significant fixed expenses, the more profitable they are, the more cash they can set aside to support themselves in a crisis (Jansson, 2018). The World Financial Symposium (2020) states that the ability of an airline to recover from a crisis is directly connected with the airline's resilience. Bülbül (2022) and Kiraci, Tanriverdi and Akan (2022) identify that the economic aspects of airline operations are crucial in ensuring their commercial stability and sustainability. Whilst airlines continue to bear certain fixed costs (such as employee wages, leasing payments, and loan repayments) in times of crisis, their level of liquidity and “daily cash burn” will determine how long they can withstand a crisis (Budd, Ison,

and Adrienne, 2020). The amount of cash held by airlines also shows how long they can continue to operate under their current level of liquidity before going bankrupt (S&P Global, 2020). According to Kiraci, Tanriverdi and Akan (2022), the most heavily weighted financial sub-factor is liquid assets. An airline's ability to weather a crisis depends on how many of these it has (Vinod, 2020). Vinod (2020), Shared and Orelowitz (2020), and Vinod (2022) take this idea a step further by stating that the most crucial factor in determining whether an airline will survive is income stability. They also highlight additional essential elements, including liabilities and market share. Albeit scholars, such as Amankwah-Amoah (2020) and Budd, Ison and Adrienne (2020) disagree on the relative importance of these components. Therefore, there is no clear consensus on ranking.

2.3. Commercial

The COVID-19 pandemic has shown airlines responded by altering their service provision to reduce the spread of the virus but also to reduce costs. Many airlines stopped offering food and drink services to reduce direct interaction between cabin crew and passengers (Pjurova et al., 2022). Airlines also altered the way ground services were delivered. For instance, to minimise human contact, they promoted self-check-in via mobile devices, a practice that has persisted since the pandemic (Thepchalerm and Ho, 2021; Haraguchi et al., 2023).

In addition, some airlines have fully automated their bag drop systems, whereby passengers check-in online and drop their bags themselves. Driven by cost-cutting, during the COVID-19 pandemic this system had the additional benefit of reducing human contact (Kungwola, Trerattanaset and Guzikova, 2022). Secondly, pioneered on a large scale in China and Japan, automatic boarding gates using face recognition technology were implemented quickly and throughout many airports. They are used primarily on domestic flights within these two countries (Zhu and Wang, 2020). Passengers upload their ID to the airline's app, obtain a boarding pass and scan this at the gate. Technology such as this reduced virus spread and saved airline's personnel costs. Zhu and Wang (2020) found that in Japan and China it minimised the rate of human error, vastly lessened the strain of the security personnel, cut down on the time passengers wait to have their identity checked and saved airlines money. Thus, the technology has largely stuck in these two countries following the pandemic and has begun to see implementation in other markets too, such as the US.

3. Conclusion

While in the general engineering discipline, Hollnagel et al. (2006) provide a comprehensive account of the concept of "resilience", this literature review shows that there is limited consistency of what resilience in aviation research means and of what makes an airline resilient. Furthermore, until recently, there has been limited official use of the word "resilience" in aviation, which has also been recognised by Pariès (2011). Studies use a variety of methods, such as simulating fictitious situations to provide recommendations for airlines should they encounter such a future scenario. Some studies just use quantitative or qualitative data, while others favour a combination of both.

The review of the extant literature shows how internationally focussed crises, such as the global financial crisis of 2008, act as a springboard for research with a surge in the number of published works into resilience around these times when survival for airlines becomes more aggressive. Thus, resilience is now at the forefront of airlines' long term business plans (Nemelkar et al., 2022). Understanding the obstacles and challenges to companies, while also acknowledging the opportunities and benefits of a resilient structure, is required if aspirations are to morph into realities. This greater understanding is only possible when resilience is fully understood, defined apropos to airlines and when allocated its commensurate place alongside the strategic operations of airline businesses.

Despite the continually growing importance and scale of international air transport in a globalised world, its resilient operations and longevity, specifically during times of crisis, remain neglected as a subject. Mostly, research on resilience and air travel has formed a component of a more generic study, usually one involving tourism, transportation, or hospitality (Suk and Kim, 2021). Thus, there are considerable knowledge gaps to be filled. As a result of this literature review, several potential areas of future research can be recommended. In a crisis like the COVID-19 pandemic, for instance, comparing two or more regional air markets, or using a variety of proxies for resilience, can help to better understand how resilience affects and shapes airlines in their different operational venues. Furthermore, individual case studies examining specific airlines, geographies, practices, and policies, would also

benefit the industry serving as microcosms of the wider society. They could act as yardsticks or benchmarks by which to gauge the industry whilst also highlighting those airlines and places that are frequently under-represented in scholarly research.

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Cook, Daniel

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