

FUTURE DEVELOPMENTS REGARDING THE AIR CARGO MARKET – A SCENARIO BASED ANALYSIS

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ABSTRACT

The air cargo market is highly sensitive to fluctuations in the global economy, changes in consumer behaviour as well as environmental regulations. Especially during the crisis in 2008 and 2009, the decline in freight tonne kilometres (FTK) exceeded that in world passenger traffic by far, i.e. a decrease by -24 per cent and -8 per cent to previous years, respectively. Stakeholders in the air cargo market are hence faced with high uncertainties and their business is prone to cost increases. However, industry forecasts predict a strong growth of FTK between 5.2 to 6.6 per cent per year over the next 20 years, possibly characterized by high volatility. Consequently, air cargo will have to become more robust against external influences in order to cope with these and other future challenges. These different aspects are major drivers for optimized intermodal transport solutions and improvements regarding the carbon footprint in order to attain cost reductions and hedge against uncertainties.

This paper provides a scenario-based analysis of the air cargo sector which allows to identify robust trends and to anticipate risks arising from the market environment, potential competition or other influencing areas and factors. The applied scenario methodology is briefly described followed by an overview of relevant drivers and developments in the air cargo sector. Three alternative future scenarios outline different possible developments in the air cargo sector in terms of its modal share or the demand for air cargo goods until the year 2030. The analysis takes social, technological, environmental, political and economic changes into account. Finally, scenario-specific implications for air transport stakeholders such as (cargo) airlines, freight integrators, airports and manufacturers are derived.

1. INTRODUCTION

The air cargo market, as a part of the air transport system, features very specific characteristics. It is, on the one hand, described by high average growth rates, but, on the other hand, very sensitive to fluctuations in the global economy, to changes in customer behaviour as well as to new environmental regulations.

A major reason for its strong growth history and prospects is, of course, the continuing globalization. The strong increase in worldwide trade volume will evolve further due to e.g. dynamic product innovations of an ever increasing number of countries which are participating in the worldwide trade community. The air transport market is a major enabler of this development, which makes it also vulnerable to fluctuations in the global economy. However, its capability to easily connect fast-growing regions (like the BRICS¹ countries) to industrialized markets entails an increasing number of routes and the development of new and better transport infrastructure.

But there are several challenges for the air cargo market, notably those in context of climate change and changes in customer behaviour. Carbon emissions are a major driver for global warming and they are therefore an issue which is likely to affect environmental regulation and customer behaviour. The relatively high specific emissions per tonne-km of air cargo compared to other transport modes (McKinnon, 2004) can compromise its competitiveness. Further improvements of the air cargo carbon footprint are therefore required. Despite this necessity to improve and renew the air cargo fleet, the average age of freighter aircraft continues to increase (ASCEND, 2011). Economic instruments to reduce noise and emissions (e.g. EU-ETS) are already in place and can be complemented by other ecologically motivated regulations and possibly also further night flight curfews, which poses a major threat to the air cargo market. Despite its outlined vulnerability, industry forecasts predict an average growth of freight tonne kilometres (FTK) between 5.2 to 6.6 per cent per year over the next 20 years (Airbus, 2011).

¹ Brazil, Russia, India, China and South Africa

Air cargo has the advantage of featuring time benefits, flexibility, a high amount of safety and security, geographical flexibility as well as a high international range and reliability. Typical air cargo goods are therefore capital intensive, temperature sensitive, time constraint or they feature a short product life cycle (see Table 1). Due to the increasing variation in customer expectations and product characteristics the advantages of air cargo goods can either become more important or lose their attractiveness.

Table 1. Types of air cargo goods

Type of good	Characteristic	Examples
Capital intensive	High value relative to mass and dimensions	Microelectronics, medical technology, computer
Temperature sensitive	Perishable goods	Fresh food, living animals, pharmaceutical products
Time constraint	Express delivery	Spare parts, air mail, production bottlenecks, relief shipments
Short product life cycles	Trend products	Fashion, technical equipment

This paper describes plausible alternative future paths of development and corresponding challenges the air cargo market might face in the next 20 years. Three alternative scenarios were developed to improve the understanding of possible future evolution and impact regarding major players in the air cargo market. Corresponding strategies will enable these players to cope with globalisation, changing customer behaviour and tightening environmental regulations.

Within this paper, section 2 will explain the methodical approach. The subsequent section 3 will then introduce the developed scenarios. The scenario specific implications and a concluding synthesis of the scenario results complete the paper in sections 4 and 5.

2. METHODOLOGICAL APPROACH

In the following section, the methodical approach within the scenario process is described which includes an outline of the benefits of this particular technique. Furthermore, the focus of the scenario project under consideration is illustrated as well as the different steps involved in the analysis.

2.1. SCENARIO TECHNIQUE AS STRATEGIC INSTRUMENT

Scenario techniques are increasingly relevant and approved when dealing with uncertainties of complex long-term market developments. In this context a scenario can be defined as a plausible

combination of alternative future developments. Thus, in contrast to prognoses evolving from past principles and evolutions, scenarios are mostly used as a qualitative method to derive different, non-linear but consistent future environments (Gausemeier et al., 1998, Kuhlmann et al., 2009). This enables a more robust analysis of potential opportunities and threats or risks within the air cargo market segment. Furthermore, it is possible to identify operational performance implications, technical requirements for future cargo aircraft and other specific recommendations. Next to the qualitative analysis, focusing on quantifiable measures as well, scenario techniques can serve as foundation for numerical simulations and technology evaluations by deriving quantitative input data from the qualitative scenarios based on expert discussions and statements (Phleps, 2010, Eelman, 2006).

2.2. SCENARIO PROJECT

The scenario study presented in this paper focused on the future of the air cargo market which is faced with several challenges resulting from globalisation, customer behaviour and environmental regulations. The results were developed in 2011 as part of a joint scenario process between Technische Universität München (TUM), Airbus Operations GmbH (Cabin Innovation & Design Department), and Bauhaus Luftfahrt. The project team consisted of experts from different fields of science (aeronautical engineering, corporate foresight, economics, social sciences) including experts from DHL and 14 TUM aeronautical students. The following framework conditions and key questions were defined at the beginning of the project (see Table 2):

Table 2. Scenario framework conditions and project related key questions

Region: global
Timeframe: 2010-2030⁺
Key Questions
<ul style="list-style-type: none"> • What are the relevant environment factors in the context of air cargo development until 2030? • What types of goods and product segments will primarily be transported by (cargo) aircraft in the future? • How can the air cargo industry become more robust against external influences? • How could air cargo be integrated more effectively into other transport sectors in the future? What security measures should be taken into account? • What are the consequences for (cargo) airlines, manufacturers and airports?

2.3. SCENARIO GENERATION METHODOLOGY

After defining the boundaries for the scenarios the study followed a standard scenario approach (see Figure 1) (Phleps, 2011; Gausemeier et al., 1998; Becker et al, 1997). Step 1 contains the analysis and definition of the problem, including the selection of a

time horizon. Step 2 investigates and builds the relevant environment, searching for key influencing factors and selecting them according to pre-defined qualities. Step 3 details the selected factors and defines plausible, alternative projections, which describe the possible developments of each factor. In step 4 these factors and their projections are put into correlation with each other, which can be realized either with an intuitive logic or a more tool-based approach. The latter uses consistency or cross-impact matrices supported by computer tools, linking all possible combinations by numeric formalisms and possibly using cluster algorithms as well. According to the logic chosen, scenario frames are generated consisting of one defined future projection per factor. On the basis of the frames, scenarios are formulated to describe the future environments of the defined problem in step 5. In a last step relevant conclusions and implications of the scenarios are derived and transferred to subsequent processes like strategy planning.

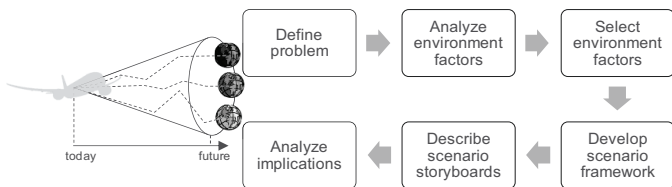


Figure 1. Methodical approach for the scenario development

Within the regarded scenario study 21 environmental factors were selected covering seven different categories (see Table 3). A subsequent system dynamics analysis supported the selection of ten factors used for the development and cluster-based selection of three scenario frameworks. This model-based approach was accomplished with the help of a consistency based scenario tool, which ensures that the complexity of the regarded environment is covered and described in order to handle the respective topic.

Ten key indicators (Table 3, marked with an asterisk) were chosen for the tool calculation. The three scenario frameworks developed with the scenario tool were systematically expanded by the workshop participants using intuitive methods to finally cover all 21 selected environment factors. This approach leveraged the advantages of both approaches (tool-based and intuitive extension within groups), thus managing complexity and keeping the process time within reasonable limits. Building on these results, qualitative storyboards were created to illustrate the key statements.

Table 3. Selection of environment factors

Categories	Factors
	(* Factors selected for tool-based scenario development)
Economy and companies	<ul style="list-style-type: none"> World economic development* Globalisation vs. regionalisation* Economic development of emerging markets (BRIC)
Manufacturer, Product and Development	<ul style="list-style-type: none"> Investment in aircraft R&D Freight aircraft technology development
Politics, Legislation and Regulation	<ul style="list-style-type: none"> Political stability* Introduction of aviation emissions trading systems (ETS) Local/regional noise & emission restrictions and charges*
Society and Customers	<ul style="list-style-type: none"> General environmental awareness in society* Environmental acceptance of air traffic Demand for air cargo consumer goods* Industrial customer's willingness to pay for air cargo time benefits* Population growth and demographics Middle class development
Air Traffic Market and Operators	<ul style="list-style-type: none"> Co-modal cargo transport solutions* Modal share of air cargo* Impact of fuel price, charges and taxes on air freight
Ecology and Energy	<ul style="list-style-type: none"> Fuel price development* Air pollutant and greenhouse gas emissions of other transport sectors
Infrastructure	<ul style="list-style-type: none"> Airport and terminal area ATC development Development of intermodal airport interfaces

3. DESCRIPTION OF THE SCENARIOS

As a result of the combination of the tool-based and the subsequent intuitive scenario approach, three alternative scenarios were developed (see Figure 2). For each scenario a storyboard was devised addressing qualitative key statements on the seven environmental areas shown in Table 3.

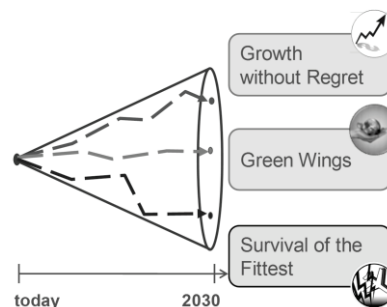


Figure 2. Output of the scenario process

3.1. SCENARIO A “GREEN WINGS”

Within the scenario “Green Wings”, the global economy recovers from the recession of 2008 to

2010 and gains momentum at an average global growth of about 2.5 per cent per annum. This growth is mainly driven by the BRICS countries and here India and China in particular. In addition to that, the globalisation trend has continued since 2011 as world-wide trade agreements have increased and barriers have been removed to facilitate trade between countries. However, this particular economic development slows down and levels out at an average growth rate per annum of about 6 per cent between 2011 and 2030. Factors contributing to this are an increasing political commitment on an international level to actively cope with climate change issues. Along with that, emission reduction policies become pervasive and have been enacted strongly. The N-11 countries² increasingly become economic competitors to the BRICS states. However, regional political instabilities, conflicts and frequently occurring natural disasters are restricting their development.

In terms of ecological aspects, a consistent reporting on related issues by the media encourages society's movement towards conservation-conscious actions. Environmental acting has become a human mindset within society. This induces a rising willingness of consumers to change their behaviour, especially in countries with a high middle class share. However, at the same time a high standard of living remains indispensable and therefore causes trade-offs in certain fields. On the one hand, the demand for luxury goods such as high-tech electronic devices or fashion clothes rises as the middle class fraction is growing, especially in the BRICS and N-11 countries. On the other hand, the compulsory labelling of consumer goods including information on their transport chain leads to a reduced demand for perishable products transported by air cargo. Hence, increasing environmental awareness causes pressure for the air cargo industry to improve its ecological footprint. Operators have to invest in technology and process improvement to increase transport eco-efficiency in order to ensure competitiveness with other transport sectors. Furthermore, rising fuel prices, charges and taxes on air freight create an economic incentive to adapt to the new ecologically driven market situation. Especially the significant tightening of noise and emission related restrictions and charges create a higher pressure for cargo aircraft operators to invest in fleet renewal.

Nevertheless, industrial customers benefit from the on-going globalisation trend by expanding to other markets and by decentralising their production. Additionally, product life cycles for e.g. electronic devices decrease. This development ensures that air cargo transport stays attractive because it helps

to foster the success of a fast and decentralised production. The air cargo industry additionally reacts with the introduction of a higher number of intermodal transport solutions such as intermodal containers. Public R&T (research and technology) funding for more efficient (cargo) aircraft and cargo related intermodal airport interfaces rises and fosters these developments even further.

3.2. SCENARIO B "SURVIVAL OF THE FITTEST"

Within this particular scenario, the GDP grows at a low average level of around 1.0 per cent per annum. This is the result of recurring crises and reduced capital streams between major world economies. While western industries suffer from economic stagnation, emerging markets fall back to an average growth of about 3.0 per cent per annum, induced by rising taxes on imports and exports. The poor performance of a high amount of national economies leads to fluctuations in the financial system, difficulties to raise capital as well as long-term liquidity issues. Especially the air cargo market with its high capital demand suffers from more restrictively granted credits. In addition, the stagnating economic situation leads to national and international tensions. This manifests itself in unstable governments, civil disturbances and rising protectionism as well as embargoes.

Considering these developments, there are manifold consequences. First of all, the given circumstances and the uneven wealth distribution induce governments to put less focus on environmental and social issues. Secondly, as a result of political tensions, individual regions become economically more independent and form regional economic unions to promote local trade, i.e. there is a trend towards regionalisation. Bilateral agreements lead to a reduction of transcontinental cargo traffic flows. Particularly the air cargo market with its high transportation costs is negatively impacted by these developments. Third, another development within this scenario is a higher rate of unemployment which leads to a decreasing average income. Hence, people focus on consumer goods required for everyday life. By this, they want to save money to preserve their basic living standard. Air-cargo goods are therefore considered luxury and high-value goods, thus the main consumers of these goods stem from the upper class.

As a side effect of the struggling economy and a resulting decrease in overall production activities, environmental quality does not deteriorate as severely as expected. This diverts public focus and concern away from ecological topics, leading to a decreasing environmental awareness. There are no global solutions and restrictions in the environmental policy sector applied. Instead, local and regional concepts such as regional emission trading prevail.

² The Next Eleven (N-11) countries comprise Bangladesh, Egypt, Indonesia, Iran, Mexico, Nigeria, Pakistan, Philippines, Turkey, South Korea, Vietnam

Resulting from these developments, the air cargo industry is under pressure. First, a tense global political situation leads to an increasing public security awareness driven by a growing number of requirements. The strongly rising cost of security screenings of cargo goods threatens to be a show-stopper for the air cargo market. Secondly, the increase of fuel prices is strongly fostered by strategic capacity shortages within trade unions and in the oil-rich regions of the Middle-East. Due to the resulting increasing cost pressure and limited access to capital markets, the air cargo industry is hardly able to invest in more efficient cargo aircraft. As a third point, the aviation industry has little motivation and reduced financial opportunities to invest in research and technologies. As a result, the air cargo market has to cope with a growing number of company consolidations and insolvencies. The few remaining air-cargo carriers increasingly focus on belly cargo. Integrated network carriers progressively concentrate on other more cost efficient transport modes (road, sea, and rail). Although the modal share of air cargo decreases, niche markets emerge especially for expensive ad-hoc-solutions for high value air cargo goods. Intermodal transport interfaces are not developed in an optimized way, especially due to remaining ineffective airport interfaces.

3.3. SCENARIO C “GROWTH WITHOUT REGRET”

In the scenario “Growth without Regret” economically driven political regulations support the stable development of global financial markets with an average GDP growth of 3.5 per cent per annum until 2030. Both politics and society prioritize long-term economic stability and security on a global level. Driven by on-going globalisation, the high GDP growth in the BRICS countries with up to 9.0 per cent per annum leads to advanced living conditions and growing prosperity in the global middle class. The increasingly even wealth distribution in Europe, North America and the BRICS countries influences political stability in a positive way. This economic growth strongly drives the demand for primary energy resources. As a result, the fuel price is at a high level but rather stable due to the development of a global fuel policy and the profitable exploitation of persistent oil resources. However, high fuel prices imply high transport costs and therefore the air cargo sector is faced with a strong incentive to actively invest in fuel alternatives.

These developments foster political support for high research and development (R&D) investments in more efficient and sustainable energy technologies. More renewable energy plants (biomass, solar, hydro) are built, however the BRICS still focus on nuclear plants.

Although globally harmonised environmental

regulations are attempted to be implemented as part of a global environmental policy, the economically driven political support and especially the uncompromising economic growth of the BRICS countries result in a strong ineffectiveness concerning environmental protection. Hence, emission trading systems are introduced only on a regional level – a global harmonisation still is a distant prospect.

From the industry perspective, the on-going globalisation trend leads to increasing transportation demand of consumer goods following a just-in-time policy. The industrial customers' willingness to pay for air cargo time benefits remains high. As a result, especially time-constrained air cargo goods strongly increase. The sea and rail sectors, in comparison, take higher profit from new environmentally friendly technologies. Lower costs and less environmentally harmful means of transport strongly stimulate the demand for sea and rail freight. Consequently, the modal share of air cargo goods decreases slightly, although the absolute amount of air cargo (in RTK) triples till 2030.

These developments pose several challenges for the air cargo market. First, the strong growth of this particular sector induces the need to introduce intermodal cargo transport solutions including more effective airport interfaces with other transport modes. As a consequence not only the sea and ground transportation sectors are fostered, but also the air cargo sector benefits from new transportation routes. Additionally, new container solutions are developed which are compatible with other transport sectors. Second, the positive developments in the field of economics and air transportation - combined with an easy access to capital markets - allows aircraft manufacturers in the mid-2020s to bundle resources for the development of new aircraft specifically designed for freight transportation. Furthermore, new airports are built, especially in BRICS regions, to handle the increasing demand for air cargo goods. Current airports are upgraded to increase capacity. Airport environmental restrictions and charges are only moderately tightened. Last but not least, on-going process optimisations within the air traffic management system, e.g. SESAR, NextGen, extended hub-and-spoke structure, and ground handling add to a significant increase in fuel efficiency.

4. SYNTHESIS OF SCENARIO-SPECIFIC IMPLICATIONS

In this paper three alternative scenarios are presented to demonstrate the bandwidth of effects for a given number of variables. There is no statement about the probability or even the certainty that a given scenario will occur. Instead, these scenarios can be used to reveal the spectrum of alternative developments the air cargo sector has to

be prepared for. All these cases would have to be considered for strategic decisions (Gausemeier et al., 1998). Scenario processes are a first localization of possible developments and they help to anticipate possible future market conditions through thinking in alternatives. The results from these analyses are mostly used as a management tool to derive robust strategies for decision making (Wilson, 2000). Therefore, the specific implications have to be analysed thoroughly.

A short comparison of the distinct paths of development within the three scenarios highlights the differences in parameters (see Table 4). Considering economic development, scenario C ("Growth without Regret") performs best, followed by scenario A ("Green Wings") and scenario B ("Survival of the Fittest") showing the weakest signs of economic growth. Correlating to the economic prosperity is the increase in revenue tonne kilometres (RTK). The reasons for this and the consequences resulting from it are manifold and will be elaborated in further detail within the following section.

The economic performance of a country has a high influence on the employment rate and hence the level of households' disposable income. If the income level is low, household spending concentrates on the necessities. However, with rising income levels people spend a higher share of their disposable income on luxury goods. These products include electronics, for example, and often have a short product life cycle. They therefore tend to be transported by air. In scenario C, consumers are most willing to pay for the benefits that come along with air cargo. The air cargo business is hampered to a certain degree by ecological restrictions in scenario A whereas in scenario B the decreasing average income causes consumers to move their focus away from typical air cargo goods.

Economic as well as political developments have a strong influence on the growth and performance of the air cargo market. Continuous advancement of globalisation comprises an increase in worldwide trade flows and trade agreements. Hence, political conditions to foster international cooperation as well as economic stability are a major driver of growing trade volumes. As a result, the amount of goods and products that is transported by air increases. Scenario A and C both experience this described development whereas in scenario B the trend rather moves towards regionalisation.

Table 4. Summary of the three scenarios

	Green Wings (A)	Survival of the fittest (B)	Growth without regret (C)
GDP [% p.a.]	2.5	1.0	3.5
RTK [% p.a.]	4.0	1.0	5.6
Social	rising environmental awareness	decreasing average income	growing middle class just in time policy
Technological	improve eco image, efficient (cargo) a/c increasing co-modality	cost pressure, ineffective airport interfaces	sustainable energy technologies optimised co-modality
Economic	on-going globalisation willingness to pay for air cargo benefits	stagnation, volatility rising unemployment	uncompromising economic growth
Environmental	political commitment & pressure	perceived environmental benefits through stagnating economy	strong primary energy demand fosters implement. of alternative energies
Political	BRICS take more responsibility increasing stability	increasing regionalisation & instabilities	political regulations to ensure stable economy

Changing environmental conditions also play an important role in the future. These are addressed in different ways in each of the scenarios. In scenario A, there is a strong focus on environmental awareness and respective improvements which lead to political commitment and the enforcement of strict regulations in this area. Contrasting this is scenario B where environmental aspects retreat since declining worldwide production levels cause less emissions nevertheless. Within scenario C the technological advancements in the field of e.g. transportation technology allow for uncompromising economic growth. Advancement, both in scenario A and scenario C, is the progress in terms of optimized intermodal solutions, i.e. the effective integration of the different transport modes. Increasing trade volumes and the demand for just-in-time deliveries spurs the need for efficient cooperation between road, rail, sea and air.

Resulting from these diverse developments are distinct challenges for the air cargo market participants within each of the scenarios. For each

scenario there is an analysis of these opportunities and threats which describe the future operating environment (see Table 5). Accordingly, stakeholders are given strong incentives to develop strategies to either use the opportunities or to hedge against arising risks.

Table 5. Opportunities and risks within the different scenarios

	Green Wings (A)	Survival of the Fittest (B)	Growth without Regret (C)
Opportunities	High RTK demand due to global growth of middle class	Stagnation in environmental regulations allows longer fleet life	Globalised production demands complex logistic solutions
	Globalised production & shorter product development times	Other transport modes become insecure and less reliable	Globalised and faster production cycles: Just-In-Time
	Growing demand for high-value goods		Cost advantage with optimal cargo capacity utilisation
Risks	Environmental restrictions and charges inhibit RTK growth	Limited access to capital market	Inability to match rapid growth of the air cargo market
	Ecologically driven consumer behaviour	Strong regionalisation	Long cargo A/C delivery and conversion times: unable to meet cargo airline demand
	High investments in technology & processes required to increase emissions efficiency	Security issues as show stopper	

On the one hand, strong economic development fosters the surge of the global middle class and, relating to that, the demand for high-value goods which are transported via air. Hence, the required just-in time deliveries necessitate efficient process alignment and capacity provision. On the other hand, a stagnating economy asks for strategies that deal with excess capacity and high volatility of demand. Furthermore, restrictive environmental regulations may act as an impediment for growth. Considering the diverse chances and threats arising within the scenarios, there will be an outline of possible consequences for the different stakeholders. The groups in focus are freight integrators, freight airlines, aircraft manufacturer,

and airport operators.

In terms of air cargo operators different business models exist. Freight integrators, for example, concentrate on the complete supply chain, i.e. from door to door, whereas the freight airline only provides the services concerning air transport. Facing an increasing volatility in air cargo demand, both operators have to adjust their capacity more flexible. The freight integrator can transfer capacity to other transport modes. The freight airline can consider new ways of hedging against capacity uncertainties by e.g. including passenger transport as well. An aspect which is relevant for both operators, too, is fuel efficiency. Due to tightening environmental restrictions as well as scarcity of fossil fuels there are strong incentives for the introduction of new alternatives such as biofuels or new technological approaches. However, the actors in the market are required to invest in these new developments in order to increase e.g. fuel efficiency. This might pose a burden considering access to capital markets, liabilities, or accumulation of debt.

Another development which strongly influences future business strategy alignment of air cargo operators is the changing behaviour of industrial customers. Just-in-time reliability becomes more important since product life cycles become shorter and therefore it is essential that products arrive at their point of sale without delay. In regard to this, the advantages of air transport pay off and can create a competitive advantage towards other transport modes. Especially for the freight integrator it is relevant to address intermodal integration in order to guarantee fast and efficient processes. This includes the introduction of intermodal container solutions and systems. By doing this, the freight integrator also strengthens its advantage of employing all different transport modes depending on the cost and efficiency of each one.

Strong and weak economic developments both pose challenges for the different freight operators in the market. Due to high demand for air cargo transport solutions an operator might not be able to meet its customer demand. Some customers may therefore place orders with newly emerging or already existing competitors. Stagnating economic development, however, leads to a reduction in demand for air cargo related services. Operators are faced with excess capacity and have to find ways of risk aversion.

In addition to the outlined air cargo transport providers, stakeholders such as the aircraft manufacturer or the airport operator are also affected by the distinct developments within the three scenarios. The aircraft manufacturer has to evaluate the feasibility of different aircraft types in terms of freight operations. Operators aim at the

optimization of fleet efficiency which can be achieved by better fleet utilization and the operation of new aircraft. Furthermore a flexible combination of passenger and freight on-board the aircraft allows operators to react to changing circumstances. Another aspect to be considered carefully is the importance of environmental competitiveness. On the one hand, environmental restrictions and charges as well as rising consumer awareness foster the need for emission reduction and fuel efficiency. On the other hand, rising fuel prices require cost efficiency. In addition to that, the support of solutions for intermodal containers and systems ensuring an efficient and safe transport chain has to be considered thoroughly.

The airport operator faces challenges which are associated with increasing environmental awareness, the volatility of air cargo demand as well as safety and security regulations. First of all, environmental regulations as well as resource scarcity affect operations and processes at this level, too. An approach here might be to focus on alternative energies for ground handling operations and possible energy autarchy of the airport. Furthermore, the need for optimized and efficient transport solutions drives the introduction of intermodal cargo solutions. In this respect, the airport operator can focus on the optimisation of efficient airport interfaces and the integration of these concepts in the business model. For freight integrators and freight airlines one main goal is to minimize costs. An airport can foster its attractiveness and hence competitiveness by offering efficient services and processes at minimum cost.

One major challenge for all stakeholders will be future security regulations. Scenario B, for example, is characterised by political conflicts and instabilities which may result in an increase in terrorist attacks. To minimize the risk of the effectiveness of attacks, security measures are developed further. However, their implementation and operation is costly and time consuming. Especially the air cargo sector might lose one of its main benefits: time. Hence, fostering simplified but at the same time secure security processes at e.g. airports poses a major challenge in the future. These processes could include sealed transit containers which have to pass specially designed security systems.

Addressing all the outlined opportunities and risks in an appropriate way poses manifold challenges to the different interest groups involved in the air cargo market. However, aligning strategies and business models accordingly might help to create a competitive advantage and therefore succeed in this highly volatile market.

5. CONCLUSION

This paper gives an insight into a scenario based approach to possible future developments regarding the air cargo market. As the scenario process demonstrates, the paths of possible scenarios are manifold. For the different stakeholders in the market this requires the development and exploration of flexible strategies and business models outside the core business.

The specific method applied within this paper shows that uncertain future developments can be systematically approached. Scenario processes help to improve the understanding of developments and impacts. They enable a differentiation and assessment of alternative developments in context of the air transport market and industry. This helps aviation stakeholders to generate alternative strategies to prepare robust decisions.

With the air cargo market being highly sensitive to fluctuations in the global economy, strategies have to hedge against these rising uncertainties. Furthermore, globalisation drives shorter product life cycles and the need for just-in-time solutions. Climate change and rising environmental awareness also influence the requirements imposed on the various operators in the market.

Considering these evolutions, cargo operators, manufacturers, and airports have to be able to adjust their capacity more flexibly according to market demand. Furthermore, environmental pressure and a strong emphasis on cost competitiveness push the development towards e.g. efficient intermodal cargo transport solutions. In addition to that, political crises and instabilities cause and increase the threat of e.g. politically motivated attacks and conflicts. Closed security chains might be a way to ensure the security of goods and products in the global supply chain without cost or delivery time increases.

As can be seen from this particular example, scenario processes allow to address a wide range of topics. By this, possible future developments which cover a large bandwidth can be outlined. These projections can be used by various stakeholders to develop suitable future strategies. Hence, risks and opportunities within each of the scenarios can be identified and integrated in decision-making processes of airports, manufacturers, airlines or other relevant stakeholders. Regularly conducted scenario analyses also provide the opportunity to attain a thorough understanding of the diverse factors influencing future changes and evolution.

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