

IMPLICATIONS OF EVOLVING CIVIL AVIATION SAFETY REGULATIONS ON THE SAFETY OUTCOMES OF AIR TRANSPORT INDUSTRY AND AIRPORTS

Devinder K. Yadav, Hamid Nikraz

Curtin University, Bentley Campus, Kent Street, Bentley, WA 6102, Australia
Email: dkharyanvi@yahoo.com.au (corresponding author)

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Devinder K. YADAV

Education and affiliation: holds a doctorate degree in engineering and is associated with Curtin University, Australia. In addition to his academic qualifications, he also holds an aircraft engineer license with several ratings, starting from Cessna 152 to wide-body Airbus and Boeing aircraft and a pilot license.

Research interests: aeronautical engineering, airport engineering, aviation regulations, multidisciplinary engineering, and aviation management.



Hamid NIKRAZ

Education and affiliation: holds a doctorate degree in engineering and he is associated with Curtin University, Australia.

Research interests: civil engineering, pavement engineering, transportation and airport engineering, and multidisciplinary engineering topics.

Abstract. Historically, the aviation industry has been highly regulated under national and international regulations and various agreements due to instinctive safety risks associated with operations of an aircraft. Therefore, safety sensitive aviation activities used to be regulated under prescriptive standards and regulatory regimes by respective national civil aviation authorities. Airports and commercial aircraft operators are experiencing tremendous commercial pressure due to the globalization and liberalization of the industry in recent years. Consequently, the civil aviation industry is moving progressively from prescriptive safety rules to performance based legislation. This paper analyses the significance of this regulatory shift in aviation safety. Furthermore, the potential safety risks associated with the outcome based legislative framework and deregulation of safety sensitive aviation activities are also indicated in this study together with an example of the maritime industry.

Keywords: aircraft, airline, airport, aviation, engineering, flight, globalization, regulation, runway, safety.

1. Introduction

Air transportation plays a multi-faceted role in the pursuit of development of a nation and maintains international, social, and economic connections. An airport facilitates the air transport industry and serves a key function in aircraft operation. Therefore, airports have been

contemplated as a fundamental infrastructure rather than commercial entities by themselves. Consequently, civil airports have always been publicly managed. However, the traditional airport management model seems to be unsustainable as states become concerned about financial liabilities. As a result, the airport industry has

evolved significantly in terms of aviation safety regulations, business model, and economic regulatory regime. Subsequently, civil airports are regarded as a profit centre instead of a public managed community infrastructure. The structure of civil aviation legal framework has had an international outlook from the beginning. Therefore, the aeronautical components of civil airports, such as the structure and operating systems of runways, taxiways, apron, and aircraft operational areas are strictly regulated by national regulations under the standards developed by the International Civil Aviation Organisation (ICAO)¹.

Traditionally, aviation has been a highly regulated industry due to the inherent risk associated with aircraft operations. Consequently, the actions of airports and aircraft operators have been bound by a multitude of bilateral, national, and international regulations and standards. Generally, most legal frameworks in the world have a history of establishing a national base before entering the international scene, but the peculiarity of aviation regulations and practices is that they have been both international and national from the very beginning. Since the establishment of ICAO in 1944 as a specialized agency of the United Nations to develop aviation standards and recommended practices (SARPS), the civil aviation industry has been regulated significantly by national aviation authorities (Aviation... 2008). The primary purpose of civil aviation regulations is to ensure the safe operation of aircraft and control the risks to an acceptable level. The safety objectives are being achieved by various regulatory tools, such as licensing of airports, requirements of airworthiness certificates for aircraft, air operator certificates for airlines and so on. As a result, most national aviation authorities (NAA) used to have a team of specialist inspectors to inspect airports, aircraft maintenance, flight operations, and performance of aircraft personnel (Hunt, Macfarlane 2003). Likewise, most safety sensitive aviation activities used to be regulated under prescriptive regulatory regimes.

Due to their global nature, air transport activities related to aircraft operation must be regulated in accordance with international standards (Convention... 2006). Therefore, all domestic and international flights operating in the ICAO defined airspace are required to follow international air traffic procedures. For example, in Australian airspace all flights above 11000 feet are required to follow the altimetry procedure that requires the pilot to read the aircraft altitude in terms of flight

levels instead of feet (ENR 1.7...2010). Similarly, aircraft flying through this airspace must meet the internationally accepted airworthiness standard (Annex 8...2005; Annex 6... 2001). Likewise, all aeronautical parts and activities of a civil airport must meet ICAO standards. However, the aviation industry has evolved significantly since the invention of the first aircraft, and a shift from the prescriptive rules to performance based legislation (partly due to liberalization) has been noticed in the civil aviation industry since last decade, especially with the establishment of European Aviation Safety Agency (EASA)². This paper discusses the salient features of the traditional and outcome-based regulations and analyses the effects of these two different sets of legislative regimes on aviation safety in the civil aviation industry. The liberalization and privatization of the civil aviation industry have increased the commercial pressure by adding more competition to airports and aircraft operators. Though safety and economy are two different issues, but there are clear indications that commercial concerns can put pressure on safety outcomes. Therefore, the influence of globalization of certain sections of the aviation industry on aviation safety is also explored in this research. Examples of maritime industry, airlines, airports, and aircraft maintenance repair overhaul (MRO) businesses are used to examine potential aviation safety issues related to airport and aircraft operations arising as a consequence of the regulatory shift.

2. Prescriptive regulatory framework and challenges

Regulations increasingly shape the structure and conduct of civil aviation industries and can influence flight safety. Some researchers argue that in industries, such as aviation, electricity, railways, telecommunications, banking, and pharmaceuticals, regulation is the single biggest uncertainty affecting capital expenditure, corporate image, and risk management (Beardsley *et al.* 2005). Similarly, regulation reflects an explicitly formal contract between business and society in many aspects. Even in the absence of regulations, informal agreements may ask organizations to meet certain social responsibilities. Therefore, when deciding on a regulatory stance, aviation organizations must consider complicated trade-offs between maximizing profits while at the same time taking into account the safety of aircraft operations.

The aviation regulatory system has come a long way. Passing from civilian to military hands and back to civilian control; it has gone through enormous technological advances in air navigation, aircraft, and airport systems. A Canadian study found that the regulatory focus has

¹ The International Civil Aviation Organisation was formed in 1944 by the Chicago Convention as a specialized agency of the United Nations to promote the safe and orderly development of civil aviation. ICAO develops international civil aviation standards, practices, and procedures for its 189 member countries known as the Contracting States.

² European Aviation Safety Agency was formed in 2003 by the European Union (EU) countries as their representative body. However, neither EU is a member state of the ICAO nor is the EASA a regulatory authority of any such member state.

moved from strict economic regulations to looser ones, but it still holds control where public interest and flight safety are warranted (Fiorita 1995). The civil aviation regulations may be divided into two broad categories. Firstly, one that includes safety regulations, which cover flight operations, airworthiness of aircraft, air navigation, airport, airspace, and licensing of³ aircraft personnel. Secondly, an economic category is distinguished that addresses commercial activities of the civil aviation industry, such as bilateral air transport service agreements and other commercial uses of aircraft and airports.

Since the beginning of civil aviation, the regulatory framework has been prescriptive by nature: defining what the safety requirements are and how they are to be met. The Australian civil aviation safety regulator states that the old prescriptive civil aviation safety regulations mostly prescribed the precise steps to be taken, leaving little or no discretion for deviation (Byron 2006). Similarly, a prescriptive set of requirements does not provide flexibility required for continuous improvement of the system. For example, most civil aviation authorities in the world use prescriptive regulations to limit flight time and duty periods of flight crew (Benjamin 2010). This approach has the advantage of providing clear-cut limits, but it is necessarily a one-size-fits-all solution. Therefore, it is rarely the most efficient or cost-effective method of managing the fatigue-related risks of any single specific airplane fleet or route structure. Additionally, these prescriptive limitations have often been based more on industrial agreements than on evolving science related to fatigue and its effects on performance. It also gives an impression that the delivery of safety outcomes is primarily the concern of the regulator and the regulations. According to ICAO, this regulatory system was based on a quality control concept rather than the quality assurance philosophy (Working... 2006). It did not define the quality assurance system requirements and accountabilities of the management of the organizations for compliance with the regulatory requirements. As a result, it did not guarantee a measurable safety outcome. However, due to the prescriptive nature of the regulations under this regime the harmonization of aviation practices is not very complex.

In recent years, a regulatory theory has been developed along the process regulations. Under process regulations, the regulatory process is developed and measured against a criterion of efficacy and reliability rather than inspection of the end result (Michael 2006). Consequently, the risks are to be identified and measures are placed to control them. This system is especially

suitable to areas, such as safety regulations, because performance based detection and enforcement is not as much of a challenge as design or process based prevention. Therefore, process based regulations are primarily designed to prevent failure. Additionally, the process regulations necessarily enlist the help of the regulated entities. In fact, it may extend further and vest them with primary responsibility for the development of preventive programs. According to a major civil aviation safety regulator, an operator will always be better placed than the regulator to know and understand the safety risks they face in their particular circumstances (Byron 2006). It is obvious that the civil aviation authorities do not fly or maintain aircraft, manage aerodromes or train pilots and aircraft engineers. Therefore, it is convincing that those involved in the industry may be best suited to identify the greatest safety risks.

As a result, the civil aviation authorities are seeking partnership with the organizations in addressing the regulatory issues related to aviation safety because the implementation regulations alone do not ensure safety. In fact, the regulations only seek to cover the minimum necessary requirements and they can never hope to cover all situations and circumstances. Therefore, in future the civil aviation authorities may encourage the aircraft and airport operators to go beyond the regulations and look for more innovative ways to manage their risks, particularly those not covered by the regulations. For example, they may grant flexibility to airlines in managing⁴ working hours of the flight crew provided the risks are identified and addressed; or allow airport operators to carry out runway pavement evaluation based on predicted runway deflection suggested by some recent researchers (Yadav, Shukla 2012). This may encourage the industry to adopt more research based approaches, instead of empirical procedures.

3. Outcome-focused aviation safety regulations

In the last decade, the idea of having government regulatory agencies set goals for performance has attracted increasing attention. Subsequently, the interest in performance-based regulations has become visible in a number of regulatory developments. For example, the then presidents Clinton and Bush of the United States of America (USA) directed their federal government agencies to specify performance objectives rather than behavior in crafting new regulations (Coglianese *et al.* 2004). The focus on performance is based on an intention to achieve the same results as other standards while giving organizations a flexibility to achieve those results in a cost effective manner. For example, the Civil Aviation

³ Under the Chicago Convention, the term aircraft personnel includes: the pilot, flight engineer, navigator, aircraft maintenance engineer, air traffic controller, flight radio telephone operator, and flight dispatcher (Annex 1... 2006).

⁴ Flight duty time limits of flight crew are regulated under national civil aviation regulations of the contracting states as recommended by ICAO (Annex 6... 2001).

Safety Authority of Australia (CASA) is encouraging the aviation industry to actively manage its own safety risks (Byron 2007; Ward 2008). The CASA believes that the best balance is struck when the organizations have the responsibility to determine the desired aviation safety outcomes and then consider an optimal course of action to achieve them.

A recent study ascertains that the outcome or performance-based regulations set goals for the outcome of the behavior instead of establishing specific prescriptions for that behavior (Coglianese *et al.* 2004). The performance-based regulations set performance goals, and allow individuals and organizations to decide how to meet them. Under the outcome-based aviation safety regulations, safety is recognized as being the responsibility of everyone involved in an organization, and the top management of the organization must be committed to safety by anticipating that errors may happen. According to a regulatory expert, the outcome-based regulations specify the safety requirements that are to be met, but provide flexibility in terms of how safety requirements are met (Byron 2006). However, the expert does not indicate any effective and affirmative regulatory tool to assess the safety outcomes under a performance-based regulatory regime. The new CASA regulations emphasize the required outcomes and aim to make the regulations less prescriptive. This approach allows a level of freedom to the civil aviation authorization holder to identify the means by which to achieve the outcomes by designing and implementing compliance assurance systems. The new regulations are focused on safety risks and safety outcomes and they are supported by guidance materials, such as the 'acceptable means of compliance' and manuals. This is a very different approach to the past, and it is also claimed that the new regulations will be simpler, shorter, and easier to comply with. However, the regulations themselves will not detail how to achieve compliance. This approach is based on the EASA regulated European civil aviation regulation model. The EASA-based regulations define the regulatory obligations of the organization by holding it responsible for ensuring that all activities, such as management accountability, safety management system, and quality assurance system are performed according to the required standards. The requirements for key management of the organizations and the quality system are more evident than in the previous regulations. It is also suggested that the new regulations introduce a well-defined balanced approach in-line with ICAO recommendations (Byron 2006). In fact, ICAO encourages a balanced approach to the safety oversight system where a contracting state and the industry share responsibilities for safe, regular and efficient conduct of the civil aviation activities.

Financially, there is no single answer whether the outcome-based regulations are more cost effective than the prescriptive system. A contemporary study establishes that the performance standards give organizations flexibility and make it possible for them to seek the lowest cost means to achieve the stated level of performance (Coglianese *et al.* 2004). The performance standards can accommodate technological change and the emergence of new hazards than the prescriptive ones better. Nevertheless, the outcome-based standards can sometimes be ambiguous, if they are loosely specified. Additionally, measurement of the performance presents distinct challenges when the standards are based on predictions rather than actual measurable events. As a result, the outcome-based safety regulations may impose excessive costs on companies. Consequently, small airports and airlines may be affected significantly, because under this regime the organization must search for ways to meet the regulatory standards even though the compliance guidance material is to be supplied by the regulator. Small aviation operators may simply prefer to be told exactly what is to be done rather than incur costs in deciding methods to achieve a performance standard. Though non-binding guidance materials, such as manuals, advisory publications, and acceptable means of compliances are provided by the CAAs to assist the companies, such documents sometimes become the prescriptive standards that the performance standards are supposed to replace.

4. The effect of globalization and privatization on aviation regulatory framework

The civil aviation industry has experienced a significant change in the last fifteen years. International air transport has been reshaped and globalized through complex global airline and airport alliances. It has been observed that the flag carriers are being replaced by the airlines flying under global branding, and they have started sharing the important operational functions involving safety, such as crewing and aircraft maintenance, with their global partners (An Agenda... 2005). In addition, the deregulation seeks to reduce government role in the aviation industry, and airlines and airport operators are under pressure to reduce the cost of operations. Consequently, airlines are moving away from their traditional role of operators that own aircraft, employ pilots and aircraft engineers to fly and maintain the aircraft. The business model is changing to focus on the core businesses of organizing people to travel by air under a global airline brand whose services are often supplied by contractors, franchisees, and alliance partners. Similarly, airports are also becoming private business entities rather than state owned infrastructures. As a result, the modern aviation industry increasingly operates under a

liberal market context. Therefore, liberalization of the aviation industry has significantly contributed to globalization. It started with airlines, and now many airports are progressively becoming private entities and business centers. Therefore, regulatory models are also evolving to address the issues arising as a consequence of this privatization and globalization.

Aviation safety rules place primary responsibility for the implementation of safety regulations on the operator, but airlines and airport operators are increasingly sub-contracting some of the safety related tasks, such as aircraft maintenance, aeronautical facility development at airports, management of air navigation equipment, etc. (An Agenda... 2005). This has created a challenge for the traditional regulatory framework established in civil aviation, and flight safety monitoring by respective national aviation authorities (NAA) has become complex as compared to the past. ICAO sets the safety and regulatory standards for civil aviation products and activities, such as airworthiness and operation of aircraft, air traffic control and management, runways and aerodrome specifications, etc. For example, ICAO is currently developing a multimedia service implementation program for air traffic management (ATM) and air traffic control (ATC) to improve air traffic processes and interaction between pilots and air traffic controllers (Zhukov 2010). It is also developing aircraft operation procedures and practices to address the social and environmental impact of civil aviation activities. Noise abatement is a typical issue in aircraft operations. Therefore, the international agency promotes a standard procedure for aircraft takeoff and departure from a runway to keep the noise at an acceptable level (Vanker *et al.* 2009). These programs and regulatory standards are designed to be implemented globally, but the responsibility for the implementation rests with individual contracting states. Nevertheless, ICAO has established an audit program known as the Universal Safety Oversight Audit Programme (USOAP) to ensure compliance with the recommended aviation standards and practices (Making... 2009). The objective of the programme is to identify whether the contracting states are adequately discharging their responsibility for the aviation safety oversight or not. Unfortunately, the economic climate dominated by liberalization and deregulation has tried to reduce the role of ICAO and to have civil aviation treated as just another commercial service dealt with by the World Trade Organisation (An Agenda... 2005).

Despite the claim that economy and safety are separate issues, the economic liberalization has an impact on technical aviation safety standards (Civil... 1994). Hence, robust standards are needed to prevent the liberalized aviation organizations from cutting aviation safety margins under commercial pressure created by globalization. An example from the maritime industry

may be considered to explore this issue further. According to a report, the current legal framework for international shipping is based on the concept of "Flag State" sovereignty (Steering... 2003). This means that a ship will have the nationality of the State whose flag they fly. Therefore, the flag states have a wide range of responsibilities placed upon them by international law, including the safety oversight of ships flying their flags. Traditionally, flag states would only register the ships of ship owners from their own country and they used to apply strict nationality rules, but shipping companies have increasingly begun to look for ways to escape the obligations placed on them by their flag states. Consequently, it was found that a number of states were ready to rent out their flags to ship owners seeking to evade their own country's rules. This is commonly known as the flags of convenience (FOC). A flag of convenience ship is one that flies the flag of a country other than the country where its beneficial ownership is based. The FOC has become a safe haven for ship owners wanting to shelter from the regulatory regimes of their own governments. This was not expected under the regulatory philosophy of the maritime industry, whereby the right to fly a national flag is subject to stringent conditions. Therefore, one of the major concerns is a risk that airlines or airports will seek to step outside proper regulatory oversight control, similarly to the maritime industry, because the FOC has led to a spectacular abandonment of safety standards in the shipping industry. Hence, the experience of maritime industry leads to a conclusion that a smart and strong regulatory framework is required to prevent the spread of such culture to the aviation industry.

It has been noticed that the contemporary aviation Maintenance Repair Overhaul (MRO) business is subtly heading towards a similar flag of convenience. For example, many aircraft maintenance organizations (AMO) located and owned by local entities in the contracting states other than EU member states are progressively seeking regulatory approvals from EASA instead of their local relevant regulatory authorities to carry out aircraft maintenance and repair work, despite the fact that EASA does not have any jurisdiction outside the EU. In fact, EASA is not a regulatory body of any contracting states. Under ICAO SARPS, an AMO must hold the required regulatory approval from the contracting state where they are primarily located (Convention... 2006). Observers in aviation industry are afraid that the EASA regime may unilaterally enforce standards that are at odds with those agreed globally through ICAO, as the European Commission (EC), a previous similar regional organisation of Europe, had done in the past (Chung 2004). This will affect ICAO's efforts to harmonize international civil aviation standards and practices including the aeronautical activities at aerodromes across the contracting states.

Modern airport infrastructure and operational concept are going through a major transformation and governments are reluctant to support airport expansion requirements due to financial constraints (Airport... 2006). Consequently, the traditional management model was becoming unsustainable and the industry started to evolve with changes being brought about in the airport regulatory regime, which was later known as deregulation and privatization. Currently, airports are considered as potential profit-making enterprises rather than a part of social infrastructure. With the global wave of airport privatizations, private investors entered the scene, which resulted in the emergence of privately owned airport companies. Generally, airports are privatized under two different models. The first one involves total ownership of assets, and the second model involves control of airport management by a private hand while the government retains the ownership of the infrastructure (Bel, Fageda 2010). Therefore, it is not clearly established yet whether the trend to privatize and deregulate the airport industry is used only for profit and growth opportunities or whether it may also enhance the safety standards of aeronautical activities, because airports are natural monopolies.

According to observations, aircraft safety is a concern at some airports that are in the process of privatization (Craig 1999). Furthermore, violations of international safety standards are found at already privatized airports, and also at new airports proposed for private sector development. Implementation of ICAO standards is lacking at small regional airports in some contracting states. Similarly, deficiencies including: insufficient obstacle clearances, use of airport by aircraft beyond the code for which the airport was originally constructed, upgrading of instrumentation from non-precision approach aids to installation of instrument landing system (ILS) without complying with a wider-strip and obstacle clearances associated with precision approaches, are also noticed. Privatized airport owners responsible for these non-compliances end up with the risk of high costs, if relevant NAAs enforce the compliance. Likewise, it is hard for an NAA to enforce safety standards at a privatized airport, because these airports are commercial entities defied by a consolidating airline industry putting pressure on airports to lower their service charges, including aeronautical fees. Government agencies would hesitate to suspend an airport license and thereby affect the business of the airport, while encouraging privatization at the same time. Additionally, it has also been observed that the airport designers of the privatized airports driven by profit motives adopt a minimalist approach to reduce costs in areas such as obstacle clearances and pavement widths (Craig 1999). Instances of airport owners overruling the advice of airport engin-

eers, which results in substandard development and violation of safety standards, have been observed as well.

Therefore, the airport regulatory framework must be designed to provide incentives for the airports to invest in aeronautical infrastructure in order to ensure compliance with ICAO SARPS. It is understandable that regulatory authorities struggle with regulatory challenges, because the issues are often extremely complex and interdependent. However, when deciding on a regulatory stance, the regulator must also consider social factors, especially while deregulating a monopolistic industry, such as airports. Hence, regulators should treat airports as a public good similar to roads and railways. Moreover, regulations form a contract between business and society, and in the absence of an existing law to address certain issues, an informal agreement may force companies to meet certain social obligations. Failure to accomplish these obligations may drive the regulator towards imposing prescriptive rules with strict liabilities.

5. Aviation safety risks

With the advent of outcome-based regulations the government's presence will diminish significantly with time. The CASA admits that it is the operating company who takes the day-to-day responsibility for the safe operations of aircraft and this is the reality of aviation safety (Byron 2007). Therefore, it is important for the operators to be able to define the risks involved in their particular operation and integrate a safety system to manage those risks. Especially in the areas of potential private monopolies, such as airports and air navigation services, strong regulatory surveillance will be required to ensure that safety and risks remain at an acceptable level. Hence, this is a call for smart safety regulations that can be sustainable and compatible with the long term social, economic, and environmental needs of the industry. Regulatory systems must be measurable to the extent that any regulation does not overburden the industry and at the same time provides adequate protection for affected parties.

It is understandable that safety is impossible to assure, because the safety regulations are not easy to supervise as there is no traditional end-of-the-pipe inspection. For example, no one can say that an aircraft is a hundred percent safe, but a regulated industry can be relied upon. Nevertheless, the initial reassurances must be supported with reaction, and the credibility be signaled by government involvement. Similarly, confidence must be backed with results. In a recent study by Roy Morgan Research, 61 percent of the respondents felt that CASA should supervise the airlines more closely and only 6 percent of the population believe that CASA should give airlines more freedom (Public... 2008). This result clearly indicates that the public wants an extensive involvement of the

government in aviation affairs. Therefore, the public interest in a democratic society must not be ignored while the focuses of the aviation safety regulations are changing, because safety is not a static concept and it is not easy to monitor. For example, such simple measures as indicating the number of loss of life or incidents per year at an enormous infrastructure system, such as airports, are not enough to determine whether safety is assured (Bruijne *et al.* 2005). Furthermore, a lack of transparent and easily comparable data about safety performance of various runways and operational areas of airports may influence the identification process of potential risks. Additionally, maintaining adequate levels of safety is not sufficient; the aviation operators, whether airlines or airports, must be regulated to ensure that safety risks are kept as low as possible. It is also believed that the outcome based safety regulations may create adverse unintended behaviors, because the flexibility provided by the regulations to airline or airport operators may be used in ways that cause undesirable side effects, even if the operator still meets the performance goals (Coglianese *et al.* 2004). Thus, letting the industry choose its own path always presents the possibility of generating new or even larger risks. In contrast, the prescriptive standards provide clear direction to both the regulated entity and the regulator. Therefore, the choice of an outcome based regulatory framework in a high risk area, such as aviation safety, is a debatable issue.

6. Analysis and discussion

Many contracting states are going through a revolutionary change in aviation safety regulations and gone is the prescriptive and restrictive legislation of the past (Bartsch 2007). The new regulations recognize the fact that modern complex organizations necessarily acquire a high level of organizational specialization and the elusive one-size-fits-all type of regulation simply cannot exist. The CASA has acknowledged that compliance with traditional prescriptive legislation does not guarantee safety and compliance with the prescriptive legislation may become an obstacle to aviation safety due to the complex technical specialization of modern aviation organizations. Some regulatory experts argue that the regulatory authorities should be interested in safety outcomes, not necessarily in how the outcomes were achieved (Byron 2007). They can be achieved by many ways. A similar approach has been adopted by EASA. However, it has been observed that while flexibility to meet the requirements by a method of one's own choice might have influenced some people, the concept has not been embraced by many in the aviation industry even though the outcome-based regulations are being supported by the manuals and other guidance materials.

The highly regulated aviation industry is around 100 years old now and quite a few large corporations do aviation business or are becoming involved in the operation of aircraft or airports. Therefore, it may be a call for the aviation regulatory authorities to deregulate a few activities and shed some of its aviation safety responsibilities to the industry. This may be considered as a normal process once an industry becomes mature enough to take-over the obligation of self-regulation. For example, initially aircraft used to be flown by the people who have high technical knowledge about them, but later people without any formal education were allowed to become pilots. Presently, under American Federal Aviation Administration (FAA) regulations, a person who can read and write English can become a pilot, provided he or she meets medical and other competency requirements for a pilot license (Become... 2010). Similarly, there is no minimum educational requirement to become an aircraft maintenance engineer under the Australian civil aviation regulations (Engineer... 2007).

Thus, the performance standards under the outcome-based regulations need to be set carefully and the outcome must be tested over a period of time, because a loosely specified standard to reduce costs may jeopardize aviation safety. For example, a performance standard could require that the construction of high rise buildings in the vicinity of an airport is controlled, so that they do not become a safety hazard for aircraft landings and takeoffs. Such a regulation provides less guidance to the airport owner and the regulator than a tightly specified regulation limiting the height of the buildings quantitatively. Loosely specified standards require the regulators to make quantitative judgments, while tightly established standards employ a quantitative measure of performance. Furthermore, it has been acknowledged that there is a lack of empirical studies aimed at measuring the effectiveness of the performance based standards especially in comparison with the effectiveness of other regulatory instruments (Coglianese *et al.* 2004). This makes the benchmarking of outcome-based regulations really difficult, if not impossible. No one can afford to wait till an aircraft accident happens and then collect the data. Therefore, it is a matter of debate as to who will own the uncertainty. Should it be the regulator, the standard-setting organizations, or the industry? Without reliable data, the role and reliability of the performance-based regulations will continue to be questionable. It can also be argued that even though the outcome-based regulations are advantageous in decentralized governance by giving greater flexibility to the airlines or airports, the civil aviation authority (CAA) must still monitor the performance of each company and may be required to get involved so deeply that it is essentially running everything again. In perspective, the informa-

tion requirements for either a performance standard or a prescriptive standard may be so demanding that both approaches could be very similar in terms of what the CAA needs to know.

Some CAAs and industry operators may resist the adoption of the outcome-based regulations, because they consider them ambiguous (Coglianese *et al.* 2004). The CAA inspectors find it especially difficult to make the transition from hardware oriented checklist inspections to inspections that call for them to judge the quality and effectiveness of an entity's performance. Similarly, the industry generally prefers the flexibility inherent in the outcome based regulation; many companies are anxious about the ambiguity and associated increase in regulators' discretion that sometimes accompanies performance-based regulation. Therefore, the regulator's comfort with the existing prescriptive approach, measurement problems, and the institutional path's dependence on the existing legislation may also become inhibiting factors for the transition to the outcome-based regulatory framework. Hence, it is suggested that this evolutionary process may take a generation to be developed to a fully performance-based civil aviation. Consequently, it is important for all stakeholders to foster comfort with these new approaches to the civil aviation safety regulation and to adopt a long term outlook instead of looking at them as a cost cutting tool.

Since neither performance-based nor prescriptive standards offer aviation operators an incentive to go beyond compliance, it is suggested that the regulators should introduce some incentives to encourage continuous improvements in safety outcomes (Coglianese *et al.* 2004). Similarly, in addition to a performance based goal, the CAA could charge a fee from the organizations for behavior that increases risk. This is one of the advantages of market-based or incentive-based regulations. When an airport or airline is expected to pay a safety tax and, if it is allowed, to trade credits, it may reduce its risk to a level lower than it otherwise would have. The safety performance of an airport or aircraft operator cannot be directly measured for rare and catastrophic accidents. It has to be predicted, which makes the implementation of the performance standards more difficult. Since the consequences of regulatory failure in the area of aviation safety are significantly high, the nature and extent of these consequences may affect the choice of performance versus prescriptive standards. According to a report, the prescriptive standards might be preferred when there is high risk and existing systems are known to work well (Coglianese *et al.* 2004). Hence, it is worthwhile to debate why the aviation industry is moving towards the outcome-based regulatory framework? Although it can be suggested that the outcome-based aviation safety regulations are probably preferable to the prescriptive rules

in most situations, there is little empirical evidence to support this claim.

A current study about the privatization of airports indicates that privatization spurs regulatory reform, and it may lead to more detailed regulations (Bel, Fageda 2010). Though the study was primarily focused on economic regulations, the same might be true for safety regulations too. Regardless of potential economic benefits, deregulation involves risks, and it requires vigilant monitoring from a competent aviation regulatory authority.

An effective assessment and balance mechanism needs to be established to examine the predicted safety outcomes of aeronautical activities at a deregulated airport. A series of safety or compliance audits by the regulatory authority might not be enough to ensure the same level of compliance standards that could be attained by prescriptive regulations. This study has found that certain categories of airports are deregulated to such an extent that they are not subject to any safety audit by an aviation safety regulator. For example, under Australian civil aviation regulations, an airport used by non-public transport aircraft of less than 30 seats capacity does not need to be certified (Civil... 2012). Therefore, such an airport is not required to be certified under Australian Civil Aviation Safety Regulation (CASR) 1998 Part 139 B that deals with certification and safety standards of civil aerodromes in Australia. Consequently, the civil aviation safety regulator of Australia does not have any legal authority to audit such airports directly. However, the regulator through airlines or aircraft operators can audit this category of airports, because the regulation outsources the responsibility of ensuring the safety standards of such airports to aircraft operators who use them for their operations (Advisory... 2003). This does not make good sense by itself in terms of purpose and concept of a regulatory philosophy, because airlines and aircraft operators are private entities and an audit carried out by one private entity on another private establishment neither has any legal binding nor does it apply to other operators. This is an unlikely case if the audit is carried out by the regulator. Consequently, this ambitious deregulation exposes aircraft operations to flight safety risks in this category of airports. Therefore, there is a potential risk that deregulation and an outcome based regulatory framework for the aviation industry may create a flag of convenience situation similar to the maritime industry in some sections of the aviation industry, such as airlines, airports, and MRO businesses. This will jeopardize the safety of aircraft operations as a result.

7. Conclusions

The role of air transport in the current globalized world is significant in connecting the society, economically and socially. The aviation industry has been highly regulated

since its inception and, due to its safety sensitive nature of operations, ICAO develops safety standards. Traditionally, aviation safety regulations administered by the NAAs have been prescriptive. However, the new safety legislative regimes based on an outcome-based regulatory philosophy have become popular in recent years. The performance-based aviation safety regulations are focused on achieving results while giving organizations the flexibility to achieve them in a cost-effective manner. These regulations set the goals for an outcome of the behavior instead of establishing a specific instruction to attain that behavior. Nevertheless, ICAO promotes a balanced approach where the state and the company share regulatory responsibilities for safety sensitive aviation activities.

Globalization and liberalization of aviation businesses have put an enormous commercial pressure on airlines and airports due to increased international competition. Thus, airlines are drifting away from their traditional role of aircraft operators to the business model of arranging air travel under a global partner airline. Consequently, the outsourcing of safety sensitive activities has created a challenge for the existing civil aviation regulatory framework and NAAs. The economic issues have an influence on the safety outcomes. This has been analyzed in this study by providing an example of the maritime industry practice. The outcome-based regulations seem fascinating due to the inbuilt flexibility, but it is hard to assess the performance outcomes, because there is no “end-of-the-pipe” inspection possible in the aviation industry. Therefore, any loosely specified performance standard under the outcome-based regulations may jeopardize aviation safety. Though the outcome-based aviation safety regulations are probably preferable to the prescriptive rules in most situations, there is not enough empirical evidence to support this assertion. In addition, this study has indicated that the liberalization and outcome-based regulations will reduce government involvement, which may increase the risks in certain sections of the aviation industry. This situation requires a smart regulatory system, which can manage the flight safety risks at an acceptable level. Hence, it is argued that choosing an outcome or performance-based regulatory framework for safety sensitive aviation activities may not be a suitable option.

References

- Advisory circular 139-01(0): Regulation of Aerodromes Used in Air Transport: An Overview*. 2003. CASA. Canberra.
- Airport Privatization* [online]. 2006. San Antonio: Frost & Sullivan [cited 28 April 2012]. Available from Internet: http://www.researchandmarkets.com/reports/358103/airport_privatisation
- An Agenda for Aviation Safety in an Era of Globalisation*. 2005. International Transport Federation, London.
- Annex 1 to the Convention on International Civil Aviation: Personnel Licensing*. 2006. Montreal: ICAO.
- Annex 6 to the convention on international civil aviation: Part I, operation of aircraft*. 2001. 8th ed. Montreal: ICAO.
- Annex 8 to the convention on international civil aviation: Airworthiness of aircraft*. 2005. 10th ed. Montreal: ICAO.
- Aviation* [online]. 2008. Department of Infrastructure Transport Regional Development and Local Government, Canberra [cited 11 June 2009]. Available from Internet: <http://www.infrastructure.gov.au/aviation/international/icao/index.aspx>
- Bartsch, R. 2007. Airline safety compliance: a changing environment, in *Proceedings of 11th Annual Conference*. Gold Coast: Australasian Compliance Institute.
- Beardsley, S. C.; Bugrov, D.; Enriquez, L. 2005. *The Role of Regulation in Strategy* [online]. The McKinsey Quarterly, Brussels [cited 09 April 2010]. Available from Internet: https://www.mckinseyquarterly.com/The_role_of_regulation_in_strategy_1691
- Become a Pilot: Student Pilot's Certificate Requirements* [online] 2010. FAA, Washington DC [cited 24 May 2010]. Available from Internet: http://www.faa.gov/pilots/become/student_cert/
- Bel, G.; Fageda, X. 2010. *Does Privatization Spur Regulation? Evidence from the Regulatory reform of European Airports*. Barcelona, Spain: University of Barcelona.
- Benjamin, R. 2010. *Wings of Change*. Montreal: ICAO.
- Working paper: Management of Aviation Safety*. 2006. Montreal: ICAO.
- Bruijine, M.; Kuit, M.; Heuvelhof, E. 2005. Airport privatisation and safety: does ownership type affect safety?, *Safety Science* 44(5): 451–478. <http://dx.doi.org/10.1016/j.ssci.2005.11.005>
- Byron, B. 2006. *Evolving Systems Safety* [online], CASA, Canberra [cited 06 April 2010]. Available from Internet: http://www.casa.gov.au/scripts/nc.dll?WCMS:STANDARDpc=PC_91698
- Byron, B. 2007. *Building the New CASA: A Check of the Scorecard* [online]. CASA, Canberra [cited 29 March 2010]. Available from Internet: http://www.casa.gov.au/scripts/nc.dll?WCMS:STANDARDpc=PC_91700
- Chung, C. K. 2004. *The new European Aviation Safety Agency: Is it Europe's Answer to the FAA?* [online]. 2004. Helicopter Association International, Alexandria [cited 03 May 2012]. Available from Internet: <http://www.rotor.com/membership/rotor/rotorpdf/p24.pdf>
- Civil Aviation Safety Regulations 1998, part 139 B: Certified aerodromes*. 2012. CASA. Canberra.
- Civil Aviation Section: The Globalisation of the Civil Aviation Industry*. 1994. London: International Transport Federation.
- Coglianese, C.; Nash, J.; Olmstead, T. 2004. Performance based regulation: prospects and limitations in health, safety, and environmental protection, *Administrative Law Review* 55(4): 705–729. <http://dx.doi.org/10.2139/ssrn.392400>
- Convention on International Civil Aviation*. 2006. 9th ed. Montreal: ICAO.
- ENR 1.7: Altimeter Setting Procedure* [online] 2010. Airservices Australia, Canberra [cited 09 April 2010]. Available from Internet: http://www.airservicesaustralia.com/publications/current/aip/enr/1_7_1-4.pdf
- Craig, V. 1999. *Risk & Due Diligence in Airport Privatisation* [online]. Montreal: ICAO [cited 23 April 2012]. Available from Internet: http://legacy.icao.int/icao/en/ro/nacc/aps/09_pp_craig_e.pdf

- Engineer Careers: Aircraft Maintenance Licences and Ratings* [online] 2007. Canberra: CASA [cited 03 April 2010]. Available from Internet: http://www.casa.gov.au/wcmswr/_assets/main/ame/guide/careerguide.pdf
- Fiorita, D. M. 1995. *Safety and Economic Regulation of Air Transportation in Canada*. Montreal: McGill.
- Hunt, G. J. F.; Macfarlane, R. 2003. *Innovation and Consolidation in Aviation* [online]. London: Ashgate Publishing [cited 06 April 2010]. Available from Internet: <http://books.google.com.au/books?id=q6lTKfmYFxC&>
- Making an ICAO Standard* [online] 2009. Montreal: ICAO [cited 09 August 2010]. Available from Internet: <http://www.icao.int/icao/en/anb/mais/index.html>
- Michael, D. C. 2006. Self regulation for safety and security: final minutes or finest hour?, *Seton Hall Law Review* 36(4): 1075–1134.
- Public Attitudes to Aviation Safety*. 2008. Roy Morgan Research. Canberra: CASA.
- Steering the Right Course: Towards an Era of Responsible Flag States and Effective International Governance of Oceans and Seas*. 2003. London: International Transport Federation.
- Vanker, S.; Enneveer, M.; Rammul, I. 2009. Noise assessment and mitigation schemes for Estonian airports, *Aviation* 13(1): 17–25. <http://dx.doi.org/10.3846/1648-7788.2009.13.17-25>
- Ward, N. 2008. *Adopting the EASA Implementing rules for Australia*. Canberra: CASA.
- Yadav, D. K.; Shukla, S. K. 2012. An analytical model for deflection of the runway pavement at touchdown point caused by an aircraft during landing, *International Journal of Geomechanics* 12(2): 113–118. [http://dx.doi.org/10.1061/\(ASCE\)GM.1943-5622.0000118](http://dx.doi.org/10.1061/(ASCE)GM.1943-5622.0000118)
- Zhukov, I. 2010. Implementation of integral telecommunication environment for harmonized air traffic control with scalable flight display systems, *Aviation* 14(4): 177–122. <http://dx.doi.org/10.3846/aviation.2010.18>