Aviation Safety: Comparing National and Regional Governmental Regulatory Commercial Oversight Affiliations

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Abstract

The ever-increasing scope of aviation safety initiatives across the globe justifies a higher level of coordination. The creation of regional aviation organizations, comprised of experts from multiple nations, would ensure that benefits are shared and that an unnecessary duplication of effort is avoided. Because international airline safety is currently a function of national regulatory oversight, the amalgamation of national programs into regional organizations would decrease accidents through the sharing of resources and the advantages of an economy of scale. It was determined in the study that current aviation regulations are not capable of global oversight. A quasi-experimental 2 x 2 factorial design was used in this study and results through ANOVA. The differing accident rates among different nations indicate a stark contrast and reveal the effects of differing regulations.

Introduction

It is incumbent on governmental civil servants to ensure safety within a nation's airspace, including the safety of foreign aircraft operators (International Civil Aviation Organization [ICAO], 2006b). Creating an oversight agency is the standard method of aircraft operator regulation, and the ever-increasing scope of aviation safety initiatives worldwide justifies a higher level of coordination among these oversight agencies (Dillingham, 2007). The grouping of nations by region would ensure that the benefits of safety initiatives are shared and that duplications in effort are avoided. In this study, the pros and cons of such a grouping were examined. Does grouping of nations have an impact on safety or not? Grouping of nations to coordinate aviation safety regulations has the sanctioning of the major organization of global aviation, the International Civil Aviation Organization (ICAO). To answer the question, accident rates associated with individual national aviation regulatory oversight were compared against accident rates associated with the oversight of regional organizations. Analysis of variance (ANOVA) was used to develop a statistical comparison of the national and regional contexts.

Aviation regulatory oversight is defined as the airline safety rules adopted by national governments or regional organizations. A calculated accident rate for each country (for both injuries and fatalities) is the dependent variable as it relates to the number of scheduled flights. Currently, national governments regulate airlines' commercial flying and are organized into 98 different international agencies.

Given the forecast for sustained air transport growth (United States Department of Transportation [USDOT], 2003), a change in the focus of accident prevention efforts is necessary. Keller (2001) stated that in addition to a solid framework of regulatory requirements and an approved procedure, a more proactive approach is vital. This approach would involve the development of new safety outlooks that would incorporate human factors, a more scientific approach to risk assessment, and the development of means of collecting and analyzing vast amounts of operational data. An example of human factors is Crew Resource Management (CRM). Crew resource management training in aviation emphasizes the social and cognitive skills in connection with technical skills for safe and efficient flight operations. According to the Manual of FAA Crew Resource Management (2004), "The multidisciplinary field of human factors is devoted to optimizing human performance and reducing human error" (p. 2). Crew resource management is a method for improving personal interaction between personnel involved in flight operations so that safety and efficiency are increased. Core values are cultural and social interaction, error management, risk management, decision-making, and situational awareness. After analyzing 189 final accident reports from the National Transportation Safety Board (NTSB), Lu, Wetmore, and Przetak (2006) identified 10 groups as direct hazards in aviation:

Flight operations, ground crew, turbulence, aircraft maintenance, foreign object damage (FOD), flight attendant, air traffic control, manufacturer, passenger, and the Federal Aviation Administration.

After a fatal aircraft accident in 1978, the National Transportation Safety Board (NTSB) reported poor communication within the flight crew as a causal factor (Meyer, J. R., & Oster, C.V. Jr., 1982). According to the Manual of FAA Crew Resource Management (2004), the field of human factors is researching variables that influence individual performance and variables that influence team or crew performance. "Many problems encountered by flightcrews have very little to do with the technical aspects of operating in a multi-person cockpit. . . . .Problems are associated with poor group decision making, ineffective communication, inadequate leadership, and poor task or resource management" (FAA Crew Resource Management, 2004, p. 4). The traditional approach to safety is prescriptive and reactive; it responds to accidents by stipulating measures to prevent their recurrence. Often those measures are set forth as increasingly complex regulatory requirements. "For many years the international community has known that certain nations are having difficulties through lack of human or financial resources or lack of experience, to fulfill their international obligation in respect to safety oversight" (ICAO, 2006d, p. 2).

An empirical review of commercial arrangements and practices is one approach that can identify factors that have implications for aviation safety (Learmount, 2006). Most of the problems are not a result of economic liberalization, but are accurately characterized as the result of poor regulatory oversight. In a broader sense, Poole (2004) stated that, "Governmental bureaucracies, such as the Federal Aviation Administration are given substantial powers to enforce their mandates; often with little regard for the effect their actions may have on those under their sphere of control" (p. 9). Additionally, from an empirical standpoint, few other regulatory oversight agencies require a level of competency, maturity, and ability equal to that of commercial aircraft operations. An example of poor international regulatory oversight is the October 2005, transport aircraft crash in Lagos, Nigeria, which killed 126 people (Michaels, 2007). Africa is the most dangerous part of the developing world for aviation. "The risk of dying on a large jet flight is much higher in Africa, Asia, and Latin America than in North America or Europe according to Arnold Barnett at the Massachusetts Institute of Technology Sloan School of Management" (Michaels, p. 35).

Statement of the Problem

Air transport is by its very nature one of the most international of economic activities. Safety in air transportation requires shared responsibility. The increased sophistication of civil aviation systems at all regulatory levels—national, regional, and international—pose significant regulatory challenges, and safety measurements are likewise becoming more sophisticated (Norman, 2007). Air travel safety is usually expressed in accidents per 100,000 departures; the rate is now at .022 in the United States (Foyle, 2007). The Boeing aircraft manufacturer publishes a sample of typical accident summaries; according to these records, from 1959 to 2007 there were 498 accidents in the U.S. and Canada, while the rest of the world totaled 1,066 for 1,564 accidents for the same time frame. This last figure included 565 fatal accidents and 999 nonfatal accidents. During this time, U.S. and Canada accounted for approximated 45% of the world traffic (Boeing, 2008). These safety levels reflect the challenges of the new century in parallel with the increased sophistication of civil aviation systems.

The international component of the air transport industry has grown tremendously and the tenets underlying this regulatory system are increasingly coming into question. Economic liberalization, and liberalized agreements between nations, does not diminish aviation safety oversight responsibilities (Boteva, 2001). In adopting a regional approach to safety oversight, the employees involved must address several important issues, including whether the regional oversight organization is adequately empowered to enact each nation's laws (Richards, 1997). However, the harmonization of the participating nations, the regional organization, and the operators participating in national safety oversight procedures enhance the distribution of safety/security responsibilities among the parties concerned. A harmonized process for the recognition of certificates and licenses, as well as a uniform approach to the surveillance of foreign aircraft operations is desirable (ICAO, 2006d). According to the International Civil Aviation Organization, national safety statistics indicated lapses in the areas of national safety oversight; however, since that time many regional and multinational organizations have been created to alleviate this problem (ICAO, 2006d). No definitive research currently exists regarding the efficacy of this approach. The analysis conducted in this study makes use of a quantified accident rate for each airline within civil aviation agencies (CAAs) that are responsible for airline safety.

This accident rate for the airlines within the responsibility of a related civil agency is averaged to determine an overall accident rate for that CAA. A total of 88 CAAs had measurable data, comprised of the records of 169 airlines. The data allowed for an empirical investigation into the question of whether a collaboration of nations into regional or multinational groups has had an impact on aviation safety. The amalgamation of nations into regional organizations could potentially decrease accident rates through the advantages of shared resources and economies of scale. On the other hand, there may be difficulties, particularly for third parties, in determining exactly what functions are delegated to the regional body and what functions will remain with the national agencies. There is also the difficulty of ensuring that members of such groups maintain a consistent approach, compliance, and seamless interface where safety is concerned (Smithies, 2007). The purpose of this study is to determine if any differences exist in accident rates based on type of regulatory oversight.

Background and Significance of the Problem

Given the forecast for sustained growth in aviation traffic, a change in the focus of accident prevention is necessary. These accident prevention changes include a more solid framework of regulatory requirements, as well as the designation of a governing authority (U.S. DOT, 2003). The current situation is troublesome in that a lack of adequate surveillance, and thus substandard safety, may spread to all levels within the industry and jeopardize the safety of air transport. As documented by ESG Aviation Services ([ESG], 2005), there is a close correlation between shortcomings in safety oversight and accident rates in many parts of the world. Without innovative solutions, it is highly probable that the safety situation will deteriorate during the upcoming century and that an increasingly wide divergence will emerge between nations ("Significant," 2007).

ESG provided documentation that shows in the last 60 years, there were marked improvements in the safety of the international aviation system. The significance of this reflect a rate of 4.48 passenger fatalities per 100 million passenger miles in 1945, with the rate dropping to 0.04 in 1995. Thus, over 50 years, the risk of fatalities to the flying public reduced by 4.44 per 100 million ([ESG], 2005). Although there is a continuing trend towards safety, worldwide fatalities continue to decline as shown in Figure 1.

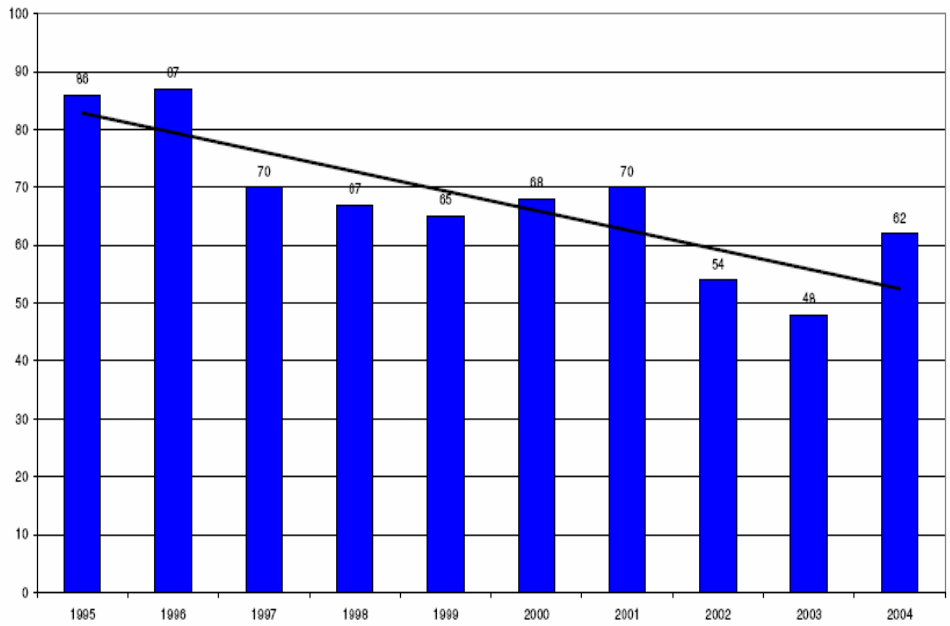

Figure 1. Fatal accidents, all air transport operations, fixed wing aircraft over 2,250 kilograms (ESG, 2005)

"Outlook for air transportation until 2015," by International Civil Aviation Organization records the rate of accidents involving passenger fatalities in scheduled air transport operations, excluding accidents caused by acts of unlawful interference, dropped from 0.12 per 100,000 flights in 1995 to 0.04 in 2004, a reduction of 66%. In the same period, the number of fatal accidents in all air transport operations involving fixed wing aircraft dropped from 86 to 62, and the number of fatal accidents in scheduled airline operations decreased from 31 to 12. Global fatalities are shown in Table 1.

Table 1: Accidents of Aircraft With a Certificated Maximum Take-Off Mass of More Than 2,250 Kilograms Involving Passenger Fatalities on Scheduled Air Services, 1985–2004

Year	Aircraft Accidents	Passengers Killed	Passenger Miles	Kilos Flown	Miles Flown	Aircraft Hours	Aircraft Landings
1985	25	1,037	0.14	0.24	0.39	0.15	0.21
1986	19	427	0.05	0.17	0.27	0.10	0.15
1987	23	889	0.10	0.19	0.31	0.12	0.18
1988	26	712	0.08	0.21	0.33	0.13	0.19
1989	29	879	0.09	0.22	0.36	0.13	0.21
1990	23	473	0.05	0.17	0.27	0.10	0.16
1991	24	518	0.05	0.17	0.28	0.11	0.17
1992	24	972	0.09	0.16	0.26	0.10	0.17
1993	31	806	0.07	0.20	0.32	0.13	0.21
1994	23	961	0.08	0.14	0.22	0.09	0.14
1995	20	541	0.04	0.11	0.18	0.07	0.12
1996	21	1,125	0.08	0.11	0.18	0.07	0.12
1997	24	859	0.05	0.12	0.19	0.07	0.13
1998	20	904	0.06	0.10	0.15	0.06	0.11
1999	20	498	0.03	0.09	0.15	0.06	0.10
2000	18	755	0.04	0.08	0.12	0.05	0.09
2001	11	439	0.02	0.05	0.07	0.03	0.05
2002	13	777	0.04	0.06	0.09	0.03	0.06
2003	7	466	0.03	0.03	0.05	0.02	0.03
2004	8	171	0.01	0.03	0.05	0.02	0.04

Adapted from "Outlook for air transportation until 2015," by International Civil Aviation Organization, 2005. Copyright 2005 by the International Civil Aviation Organization. Reprinted with permission of the International Civil Aviation Organization.

To obtain a more complete picture, regional rates have been established using 5-year averages. This helps to nullify the volatility inherent in the annual accident rates for regions with small amounts of traffic, such as Africa and the Middle East. The 5-year average rates reveal that there are substantial differences in safety among different regions. For example, Africa had a rate of 5.0 fatal accidents per million departures for the period of 2000 to 2004. This rate is more than 6 times higher than that of the world average of 0.8. This rate was also higher than the preceding 5-year period in Africa, when the rate was 3.6. The 5-year average rate for the Middle East was 1.8, and for South America and the Caribbean it was 1.7. The average rate for the Asia and Pacific Regions was 1.0, just above the world average, while rates in Europe (0.6) and North America (0.4) were lower than the world average (ICAO, 2006d). The data indicates that in spite of the disparities, overall world aviation safety has improved. The global average dropped from 1.3 for the years 1995–1999 to 0.8 for the years 2000–2004.

Current Regulations

When the International Civil Aviation Organization states adopt new commercial practices, contracting states become the provider of safety oversight for the entities or individuals for which they issue certificates and licenses. National governmental staffs are required to review and adjust safety oversight systems to ensure that an appropriate level of oversight is applied to airline operators (Von Den Steinen, 2006). National governmental staffs will need to increase their level of cooperation with one another and with ICAO, particularly in the sharing of safety information and the updating of safety standards, to ensure that the safety net remains intact. By signing an international treaty called the Chicago Convention in 1944, all 185 contracting states agreed to certain principles and arrangements in order for international civil aviation to operate in a safe and orderly manner. A commitment was made to secure the highest practicable degree of uniformity in all matters when such uniformity could simplify and improve air navigation (Boteva, 2001).

The current approach to aviation safety is based solely on the concept of national regulatory oversight, but air transport is evolving within an increasing complex global environment. The reason for disparity in negotiations is the famous nationality clause that appears in every bilateral agreement, even in so-called "open skies" agreements. "Some 60 open-skies air service agreements have created the opportunity for our airlines to improve service, lower prices, and to introduce new travel options in thousands of international aviation markets" (U.S. DOT, 2003, p. 1). In the last few years, many aviation safety initiatives were introduced through national regulatory authorities, groups of nations, international organizations, and other organizations (Airports Council International [ACI], 1999). Operators in all aspects of civil aviation—flight operations, air traffic management, airport management, communication and navigation systems, aeronautical information systems, and training—have also introduced initiatives (ICAO, 2006d).

Highlights and Limitations of Methodology

The lack of full and open accident reporting continues to create a considerable barrier to further aviation safety progress in many areas (ICAO, 2006d). Major impediments are a fear of prosecution and a lack of appropriate confidentiality. The effectiveness of reporting is dependent on a conducive reporting environment, defined as a culture in which front line operators are not punished for actions or decisions that are equal with their experience and training, but also a culture in which violations and willful destructive acts by front line operators or others are not tolerated (ICAO, 2006b). Because of the difficulties, the aviation regulatory staff meets at the national level to introduce provisions for a just reporting system in new safety processes. One such process is System Safety Management (SSM), a precursor for global process safety management.

The term "safety management" conveys the notion that managing safety is a managerial process that must be considered at the same level and along the same lines as any other managerial processes. In order to reinforce the notion of safety management being a managerial process, the proposal includes a provision for an organization to establish lines of safety accountability throughout the organization, as well as at the senior management level. The term "safety management," as used by ICAO, includes two key concepts. First, the concept of a State Safety Programme (SSP), which is an integrated set of regulations and activities aimed at improving safety. Second, the concept of Safety Management Systems (SMS) which is a systematic approach to managing safety, including the necessary organizational structures, accountabilities, policies and procedures (ICAO, 2006c). The traditional approach to safety is to react to accidents by prescribing measures to prevent recurrence (ICAO, 2006a). "For many years the international community has known that certain nations are having difficulties through lack of human or financial resources. Or lack of experience, to fulfill their international obligation in respect to safety oversight" (ICAO, 2006d, p. 2).

The aviation accident rates have decreased in safety of international aviation. Nevertheless, recent events have shown that there are limitations to traditional approaches to safety and new approaches are required to prevent the number of fatalities and accidents from rising as traffic increases due to aviation liberalization (Barclay, 1997). The analysis conducted as part of this study determined if collaboration of nations into regional or multinational groups have an impact on safety. Individual national aviation regulatory oversight accident rates were compared to nations grouped in a regional organization. The null hypothesis is that no significant difference between regional and national collaboration for safety in terms of accident rate, using ANOVA with alpha set at .05. Rejection is appropriate when the resulting value is below .05. The alternate hypothesis is that there is a difference between regional and national collaboration for safety, using ANOVA with $p < .05$.

A quasi-experimental parametric methodology was used to assess individual national aviation regulatory oversight accident rates in proportion to nations grouped in a regional organization. The levels of safety were determined by calculating the mean accident rate resulting in injuries and fatalities. The mean of individual nations was compared to that of regional organizations. The source of statistical information for accident and safety rates was ICAO. *ICAOData.com* was the website used to record the availability and visibility of the statistical data on the air transport industry. International scheduled departures, the independent variables, were divided by accidents, resulting in defining the dependent variable for the purposes of this study. Data regarding safety, accidents, and departures per airline are only as accurate as the source quoted. The data with the highest level of internal as well as external validity for the purposes of this study was that on the International Civil Aviation Organizations Web site. Available information included actual airline departures, with the criteria of a scheduled international airline within the associated countries (Travis, 2001).

However, even in this data set there are some missing years, therefore the departures in every case may not be included, and the years of actual departures per airline may occasionally be absent due to no reporting by a specific airline. The departures used as criteria match accidents for the airline in the specific year. During data collection, there was incomplete departure information for approximately 25% of the countries involved. Many countries with civil aviation authorities (98) did not have an airline with internationally scheduled service, and therefore lacked data to contrast with safety percentages. As a result, the database of the World Wide Aircraft Summary (WAAS) was used due to substantiate data to assemble safety percentages. The records of accidents for each airline, divided by international departures, resulted in the accident rate. The WAAS accident details are from many sources both official and unofficial, including press reports. The data supplied could therefore have been incomplete or incorrect**.** Similarly, the need to condense accident descriptions could have resulted in unintentional shifts in emphasis. The limitations of the available data restricted the complete accuracy of the measurement methodology. Thus, missing information was averaged in the dataset, with the averaging of the numbers making the omissions equal among the data/groups included in this study. Because means and averaging were used in comparing groups to each other, any issues of missing data were resolved using statistical methods, including the Bonferroni correction for repeat analysis on the same data set.

Research Expectations

A parametric quasi-experimental 2 x 2 factorial design was used in this study, examining post hoc data from the airline industry. This design allowed for group comparisons of data previously collected for other reasons (secondary data) from various sources when non random assignment is not possible. Collaboration and safety are two factors considered in this study; in addition each of these factors has two sublevels. The two sublevels of collaboration were the national oversight and regional oversight. The two sublevels of safety were the number of injuries and the number of fatalities. The design is illustrated in Table 2, where DV (dependent variable) is the accident rate as measured in incidents per departures.

Table 2 Quasi-Experimental 2 x 2 Factorial Design

DESIGN	Collaboration	IV2 level1	IV2 level 2
Safety		National	Regional
IV1 level1	Injuries	Accident Rate	Accident Rate
IV1 level 2	Fatalities	Accident Rate	Accident Rate

It is encouraging to see a vast body of worldwide knowledge and experience actively improving safety. However, the full potential of these initiatives are not always realized due to a lack of prioritization, duplications of effort and shortfalls in communication. There is a risk that lessons learnt and solutions found in different locations that involve knowledge, procedures and techniques may not be shared in a way that can provide benefits to all (ICAO, 2006d). Coordinated efforts and improved communications are the keys to achieve optimum aviation safety benefits through reductions of inconsistencies and duplications in effort. Further initiatives need to be widely publicized and coordinated so that maximum advantage of the work can be taken. To this end, there is a need to closely coordinate safety initiatives underway by national civil aviation authorities and industry stakeholders through an integrated approach. To this end, this dissertation will develop an initial benchmark in determining each nation's airline transport safety effectiveness.

Statement of Research Question and Hypotheses

The accident rate for the airlines within the responsibility of the related civil aviation agency is averaged to determine an overall accident rate for the specific civil aviation agency. A total of 88 civil aviation agencies had measurable data, which included 169 airlines. This data was used to determine whether the collaboration of nations in regional or multinational groups has had an impact on aviation safety. This accident rate is tabulated for each nation that regulates aviation safety.

The central research questions of this study and the associated hypotheses were as follows: determine the accident rate was the number of accidents within a period (X_1) divided by international scheduled airline departures within the period (X_2), resulting in the accident rate (Y). The analysis conducted as part of this study determined the collaboration of nations into international regional or multi-national groups had an impact on safety.

RQ1: Is there a significant difference, if any, exists between the accident rates associated with cooperative regional oversight and the accident rates associated with more limited national oversight?

$H1_0$: There is no significant difference between accident rates associated with regional contexts and those associated with national contexts.

$H1_a$: A significant difference exists between accident rates associated with regional contexts and those associated with national contexts.

RQ2: Is there a significant difference between the accident rates associated with cooperative regional oversight and the accident rates associated with other national collaborations?

$H2_0$: There is no significant difference between accident rates associated with regional contexts and those associated with the contexts of other national collaborations.

$H2_a$: A significant difference exists between accident rates associated with regional contexts and those associated with the contexts of other national collaborations.

Selection of Subjects

Currently, 98 international agencies of national governments are regulation aviation safety. Nations that have established autonomous CAAs which are empowered and are adequately funded tend to be in a position to provide effective safety oversight. Nations with limited resources to join efforts in addressing safety oversight deficiencies through such programs in harmonization of regulations, joint training of safety inspectors, development of guidance materials and joint use of human resources. In practice, national safety oversight organizations would be better positioned to participate in such joint efforts if appropriately empowered. Airworthiness is an aircraft's relevant condition of safety. Under a legal regulatory oversight agency, an aircraft must be airworthy to operate in the commercial airways (Gourdin, 1998). The ICAO audit mechanism continues to leave essential responsibility for airworthiness regulation with state

Methodological Assumptions and Limitations

Lack of full and open accident reporting continues to pose a considerable barrier to further safety progress in many areas. Major impediments are a fear of prosecution and a lack of appropriate confidentiality (ICAO, 2006d). The effectiveness of reporting is dependent an open reporting environment. Because of the difficulties, the aviation community delegates meet at the national level to introduce provisions for a just culture reporting system in new safety processes. Safety data, accidents, and departures per airline are only as accurate as the source quoted. Data from the ICAO web site charts airline departures, with the criteria of a scheduled international airline within their associated nation. The data for some years was missing; therefore, the departures in every case were not included. The period of actual departures per airline may occasionally miss years due to lack of reports by the airline. Many countries with civil aviation authorities (98) may not have an airline with internationally scheduled service, and therefore may lack data to measure accident safety percentages.

The WAAS database records accidents for each airline and the accidents, divided by international departures, formulate an accident rate. The WAAS accident details are from many sources both official and unofficial, including press reports. The data could be incomplete or incorrect**.** The limitations of available data restricted the complete accuracy of the measurement methodology. The WAAS publication generally excluded events involving damage contained entirely within an engine and deaths and injuries caused by slips and falls, food poisoning, turbulence, onboard machinery, and so forth. Excluded from the published data were non operational accidents, such as hangar fires. WAAS also limited coverage to the more major accidents where, generally, repair costs exceeded 10% of the aircraft's value.

Results

The data on accident rates summarized all of the information into the observation average. The first step in the hypothesis testing was determining a mean or μ_o. This accident rate was tabulated for each nation that regulates aviation safety. The accident rate was composed of accidents within a period divided by international scheduled airline departures per each national regulatory authority. Table 3 shows the top twenty five alphabetical results from the accident rate formula, and the official name of the associated civil aviation agency. Table 4 shows top twenty five safest nations and regional affiliation, if any of the specific state.

Table 3 : National Accident Safety Record.

State	Accident	State Civil Aviation Authority
1. Algeria	0.00835	Aéroportuaires d'Alger (EGSA)
2. Argentina	0.01923	Fuerza Aérea Argentina
3. Australia	0.00835	Civil Aviation Safety Authority
4. Austria	0.00631	Ministry of Transport, Innovation and Technology
5. Bahrain	N.I.S.A	Civil Aviation Affairs
6. Belgaum	0.00271	Service public fédéral Mobilité et Transports
7. Bolivia	0.05055	Dirección General de Aeronáutica Civil
8. Bosnia and Herzegovina	N.I.S.A	Department of Civil Aviation
9. Brazil	0.02011	Brazilian Civil Aviation Certification Division
10. Brunei Darussalam	0.00821	Department of Civil Aviation
11. Bulgaria	0.02663	Civil Aviation Administration
12. Cambodia	N.A.D	Ministry of Public Works and Transport
13. Canada	0.00179	Transport Canada
14. Chile	0.00601	Dirección General de Aeronáutica Civil
15. China	0.01783	Beijing–Civil Aviation Administration of China
16. Colombia	0.03468	República e Colombia Aeronáutica Civil
17. Costa Rica	0.00919	Dirección General de Aviación Civil
18. Croatia	N.A.D	Civil Aviation Authority
19. Cyprus	N.A.D	Directorate of Civil Aviation
20. Czech Republic	N.A.D	Civil Aviation Authority
21. Denmark	N.A.D	Civil Aviation Administration
22. Dominican Republic	0.06501	Dirección General de Aeronáutica Civil (DGAC)
23. Estonia	N.A.D	Estonian Civil Aviation Administration
24. Fiji	0.02539	Civil Aviation Authority
25. Finland	0.00283	Civil Aviation Authority

"N.I.S.A" indicated that there was no scheduled international airline as per ICAO data. "N.A.D" indicated that no accident data was found.

Based on the data presented, with N.A.D. and N.I.S.A. removed from the descriptive statistics, Table 4 reflects the top twenty five safest state that has international airline departures. The regional organization associated with the state was also listed, if applicable.

Table 4 : Nations Ranked According to Airline Safety

State	Accident Rates	Regional Affiliations
New Zealand	0.00108	PASO
Sweden	0.00127	EASA
Ireland	0.00149	EASA
Netherlands	0.00162	EASA
Switzerland	0.00164	EASA
Canada	0.00179	n/a
Germany	0.00202	EASA
United Arab Emirates	0.00205	COSCAP
Belgium	0.00271	EASA
Finland	0.00283	EASA
France	0.00321	EASA
Japan	0.00327	COSCAP
Israel	0.0033	n/a
Saudi Arabia	0.0034	n/a
Hungary	0.0037	EASA
Portugal	0.00375	EASA
Poland	0.00389	EASA
Singapore	0.00449	COSCAP
Kuwait	0.00466	COSCAP
Trinidad and Tobago	0.00515	RASOS
United Kingdom	0.00598	EASA
Chile	0.00601	SRVSO
Austria	0.00631	EASA
Italy	0.0074	EASA
Thailand	0.00784	COSCAP

Table 5 shows the *t*-testing for nations in a regional organization (55) and nations not affiliated with a regional organization (24), and revealed the variation in the data. The number of country records from the regional organization category totaled 55; therefore 55 of the 80 countries participated in a regional organization.

Table 5: T-Tests by Member States in a Regional Organization

Statistic	Regional	Non Regional
Size	55	24
Mean	0.04241	0.02772
Std. Deviation	0.09465	0.0359
Test Statistic	0.99782	n/a
df	76	At an □ of .05
Null Hypothesis	*p*-value	0.3215

Table 6 reports *t*-test results for all national mean (80) accident rates and those of nations (55) in a regional organization.

Table 6 : Comparison of t-Testing for Nations in a Regional Organization versus Overall National Totals

Statistic	Regional	All Nations
Size	55	80
Mean	0.04241	0.03031
Std. Deviation	0.09465	0.04987
Test Statistic	0.9654	
df	133	At an □ of .05
Null Hypothesis	*p*-value	0.3880

Hypothesis Testing

The first research question is stated as: Is there a significant difference between the accident rates associated with cooperative regional oversight and the accident rates associated with more limited national oversight? The test statistic, as shown in Table 5, compared nations that belong to a regional organization and nations that do not. If $p < .05$, then the null hypothesis can be rejected. P = 0.3215, which is greater than .05 so the alternate was accepted. The results indicated there was a significant difference that existed between the regional and non regional contexts of oversight. Thus, the alternate hypothesis ($H1_a$) was accepted, affirming that a significant difference existed between regional and national collaboration for safety for both injuries and fatalities in terms of accident rates.

The second research question was is there a significant difference between the accident rates associated with cooperative regional oversight and the accident rates associated with other national collaborations? In this case, the null hypothesis was also rejected. A significant difference existed between regional and national collaboration for safety for both injuries and fatalities in terms of accident rate, as shown in Table 6. If $p < .05$, then the null hypothesis can be rejected. P = 0.3880, which is greater than .05 so the alternate was accepted.

According to the significant difference between regional and national collaboration in terms of accident rate as indicated in Table 6, the lowest accident rates were for those nations not associated with regional organizations. The accident rate mean indicated a difference in nations within a regional organization and nations not affiliated with regional organizations. In the previous section on hypothesis testing, the amount of the difference showed the probability of the benefits achieved by belonging to a regional organization. Using t-testing, the difference in the means stated if the null hypotheses could be rejected or accepted. The mean central tendency of the samples was 0.03031 for all nations, 0.04240 for those with regional affiliations and 0.02107 for those without regional affiliations Analysis and Evaluation of Findings

The international aviation arena is experiencing a period of unprecedented turmoil. Deregulation, largely limited to the U.S. as recently as 2004, is now occurring in many nations around the world. State-owned or controlled airlines are rapidly being privatized, as countries that have historically maintained a national carrier redirect their scarce resources in addressing other more important social needs (Gourdin, 1998). In addition, strategic alliances between airlines are becoming more widespread and complex as companies seek to expand their services without increasing their costs. Global issues must be examined in detail, and their collective impact on the airline industry assessed.

The traditional approach to safety is to react to accidents and incidents by prescribing measures to prevent recurrence as additional regulatory requirements (ICAO, 2006a). The data collected in the previous section makes suppositions based on the calculated accident rate. Analyses noticeably show the safest regulatory authorities were New Zealand, Sweden, Ireland, Netherlands, Switzerland, and Canada. These states' accident rates were below .002, which translated to a .000002 chance of getting into an accident when one of these states regulates an airline. The second tier, below .004, was Germany, the United Arab Emirates, Belgium, and Finland. One outstanding feature of the data was that many member states of EASA were included on the list of the safest aviation regulatory authorities. All but three EASA members were below a .004 accident rate.

The research findings authenticated that being in a regional organization had no advantage over being a stand-alone civil aviation authority when it came to safety. Although the data collected were nominal, the non organized states had a safer mean average accident rate than did the organized states. The only outlier to this conclusion was the observation that EASA states had a better-than-average safety percentage. If other regional organization had such an outstanding accident rate, it would justify being a member. The worst-performing states, with accident rates above .08, were Indonesia, Uganda, Nigeria, Nepal, and Nicaragua. There was a .00008 chance of being in an accident when flying in an airline under these state regulatory authorities. This means that the airlines they regulate operate less effectively than the safest regulatory authority states. To put this in perspective, travel on an Air New Zealand flight resulted in a .000001 chance of being in an accident. A Nicaragua airline chance of being in an accident was .0006. The secondary analysis showed that there were significant differences among the various states' regulatory oversight. The higher accident percentage reflected dangerous aviation practices.

The accident rate findings indicated the disparity in states' ability to regulate their airlines. The great difference in accident rates is accepted that that one central global regulatory authority is required. A central governing body would take the best ideas of aviation authorities and translate these regulations and practices globally.

The accident rates differentiation from the safest to the least safe was an extraordinary indicator that advised towards the development of such an agency.

Conclusions

The airline globalization process is being driven by economic demand and airlines' desire to enhance their competitive positions through better access to as many markets and passengers as possible in the most efficient way possible. Airlines, like other global network industries such as telecommunications, are in many ways on the cutting edge of the truly global economy. They face the challenge of providing services to customers around the world who fly primarily from a home base where they live and work to a myriad of domestic and international destinations. To compete profitably by satisfying the increasingly global needs of customers, airlines must offer passengers as many destinations around the globe as possible. The traditional approach to safety is to react to accidents and incidents by prescribing measures to prevent recurrence often as additional regulatory requirements (ICAO, 2006b). Also, as stated in the ICAO working paper *A New Approach to Safety Oversight for the 21st Century*, "For many years the international community has known that certain states are having difficulties through lack of human or financial resources. Or lack of experience, to fulfill their international obligation in respect to safety oversight" (p. 2).

China is an example of intervention by a strong central aviation agency. For much of the 1990s, Chinese airlines were arguably the world's most dangerous, beset by persistent pilot errors, unreliable maintenance, and erratic government oversight. The statistics obtained in this study substantiate these conclusions, as China is listed in the bottom 50% of this studies accident safety statistics. The challenges "are quite similar . . . requiring a way to balance safety and growth says Ma Tao, Chinas representative to ICAO" (Pasztor, 2006, p. 13). One must have a very strong, central agency to establish rules, and well trained people able to adapt and impose them in the Chinese environment (Pasztor). With the help of the FAA, China continues to rewrite its aviation regulations. Chinese's officials knew that the FAA was concentrating on safety assessments of foreign carriers, and Beijing officials were eager to avoid friction that could restrict Chinese flights to the U.S.

The current aviation regulations are not sufficient for the development of global oversight, and the move toward more integrated systems will be contingent on the path economic liberalization. The accident rates between states are a stark contrast, indicating the differing effects of differing regulations. When economics liberalize, regulatory oversight must also advance. One existing agency that could be used as a central authority would be the World Bank. The World Bank has bylaws called the Articles of Agreement, to promote the long-range balanced growth of international trade and the maintenance of equilibrium in balances of payments by encouraging international investment for the development of the productive resources of members, thereby helping in raising productivity, the standard of living and conditions of labor in their territories (World Bank, 1965). The International Monetary Fund, the World Bank, and the World Trade Organization (WTO) have developed a coordination structure aimed at achieving coherence in global economic policymaking. This mechanism, promoting global state regulatory convergence under the master value of economic liberalization, excludes non economic institutions (Zapatero 2006).

By 2005, the WTO had 148 members, including China, which joined at the end of 2001 (WTO, 2008b). Another 25 countries, including the Russian Federation and Saudi Arabia, are negotiating for membership into the organization. Since its formation, the WTO has remained at the forefront of efforts to promote global free trade. The purpose and goal of the WTO is that it might emerge as an effective advocate and facilitator for future trade deals, particularly in areas such as services, and therefore in aviation service negotiation. The current problem is that economic globalization has outpaced political globalization. Governments once ensured that capitalism was tempered and that development helped people across society. "Now, we are interdependent and need collective action on a variety of things, yet we have yet to create the political structures that allow that to be done in a democratic way" (Kingsbury, 2006, p. 20).

Recommendations

It is encouraging to see a vast body of worldwide knowledge and experience actively improving aviation safety. However, the full potential of these initiatives are not always realized due to a lack of prioritization, a duplication of effort, and shortfalls in communication. Organizations such as ICAO have been tasked with the coordination of aviation safety, yet they do not have regulatory power (ICAO, 2006c).

The United Nations organization has also shown that it does not have the power to affect regulation change. There is a risk that lessons learned and solutions found in different locations, which involve knowledge, procedures, and techniques, may not be shared in a way that can provide benefits to all. Coordinated efforts and improved communications are the keys to achieve aviation safety benefits through the reduction of inconsistencies and of duplications in effort. Further initiatives need to be widely publicized and coordinated so that maximum advantage can be taken from existing programs. To this end, there is a need to coordinate closely the safety initiatives underway by states and industry stakeholders through an integrated approach. Acting in concert, even through a bulky, multilateral process, ultimately will produce an environment far superior to that achieved when fighting through a storm of uncoordinated, ill-considered renegade actions that are the antithesis of the free-trade/open-skies environment crucial to the long-term health of the industry.

The modern institutional architecture of global governance is composed of a group of coexisting and interrelated international regimes, such as international institutions and treaties with a degree of institutionalization (Zapatero, 2006). These regimes consolidate horizontal networks of inter-institutional relations on diverse stages of development. The mechanism of coordination between the International Monetary Fund ("IMF" or "Fund"), the World Bank, and the World Trade Organization ("WTO") stands out among them. This three-sided model of coordination promotes the convergence of agendas and activities in the areas of trade integration, development, and macroeconomic stability. Therefore, it is a major node in the global regulatory network of the world economy (Kingsbury, 2006). The degree of development of the institutional framework contrasts with the relative fragility of its coordination vis-à-vis other global institutions. The mechanism has been institutionalized through several legal instruments as well as inter-institutional agreements. It is, in fact, one of the most advanced mechanisms of coordination in the practice of international institutional law.

As a result, the three economic institutions are involved in a process to produce synergies between their rules and policies (Kingsbury, 2006). Trade liberalization is, in this sense, a global public policy where the purposes of the three institutions intersect. In fact, it is a purpose of the IMF to facilitate the expansion and balanced growth of international trade and to contribute to the promotion and maintenance of high levels of employment and real income and to the development of the productive reserves of all members as primary objectives of economic policy (World Bank, 1965). By incorporating economic regulation within this organization a WTO type of organization should be analyzed as the prototype organization to govern global aviation.

As markets globalize and an increasing proportion of business activity transcends national borders, institutions are needed to help manage, regulate, and police the global marketplace and promote establishment of multinational treaties to govern the global business system. The World Trade Organization is primarily responsible for policing the worlds trading system and making nation-states adhere to the rules laid down in trade treaties signed by WTO member states. As of May 2005, 148 nations collectively accounted for 97% of trade within WTO members, giving the organization enormous scope and influence (WTO, 2008a). The WTO unilateral negotiation committee is also responsible for simplifying the establishment of additional multinational agreements between WTO member states. Global economic expertise should be coordinated with the states' aviation safety regulation, and conducted within the WTO framework.

Areas for future research include a consideration of state accident rates in relation to deregulation, state owned airlines, and strategic alliances. Deregulation, largely limited to the U.S. as recently as 5 years ago, is now occurring in many nations around the world. State owned or controlled airlines are rapidly being privatized as countries that have historically maintained a national carrier redirect their scarce resources toward other, more pressing social needs. Strategic alliances between airlines are becoming more widespread and complex as state owned or controlled airlines attempt to expand their services without increasing their costs. These issues should be examined in detail, and their collective effect on airline industry should be assessed.

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