Chapter 3: ISASP Aviation Forecasts

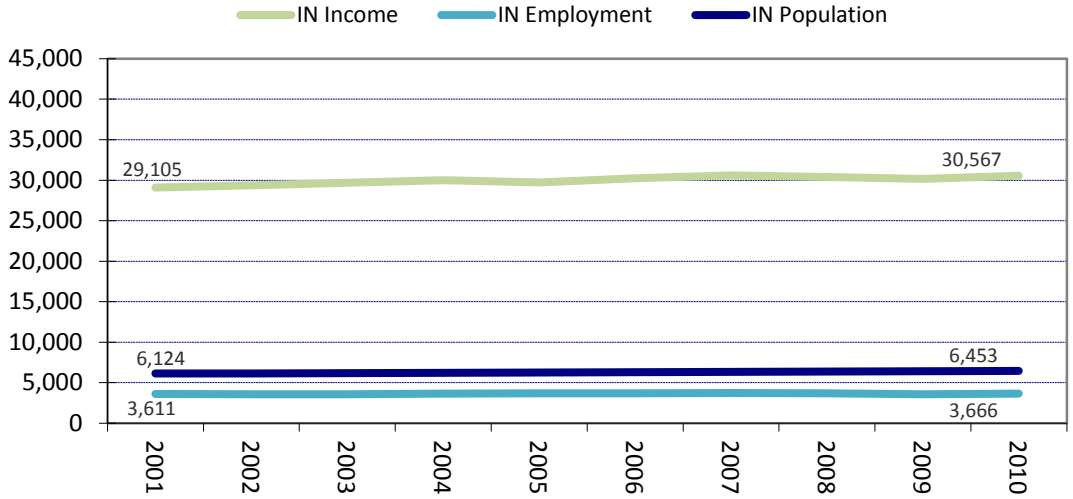
3.0 Introduction

Aviation is a fluid industry that is constantly changing to meet the demands of both commercial and general aviation (GA) users. Although the industry has endured some tough years recently as a result of the economic downturn, several factors indicate the industry is bouncing back, such as an increase in airline traffic, the entrance of new business jets to the market each year, and the continued growth of the sport aircraft industry. Aviation activity at Indiana's airports generally follows the changes in national activity trends, varying somewhat based on Indiana's local economic conditions. While aviation has many activity indicators, the two most common are based aircraft and annual operations (takeoffs and landings). In order to project based aircraft and annual operations at Indiana State Aviation System Plan (ISASP) airports, Indiana's current market share of the national activity was reviewed in addition to recently completed forecasts by individual airports and the Federal Aviation Administration (FAA) Aerospace Forecast. The base year for the forecasts presented in this chapter is 2010, as it was the most recent year for which an entire year of data was available for analysis at the time the ISASP update was initiated.

3.1 Indiana Socio-Economic Conditions

Aircraft levels have commonly been thought to follow certain socio-economic conditions, since socio-economic conditions can often be indicators of expendable income for individuals (and businesses) to use or purchase aircraft. As such, the historic state population, employment, and income levels for Indiana for the last 10 years were acquired and are shown in **Figure 3-1**. These figures have been obtained from Woods & Poole Economics, an independent firm that specializes in long-term economic and demographic projections. Woods & Poole data is commonly used for comparison and forecasting efforts since it is a consistent summary of historical and forecasted data for various socio-economic indicators.

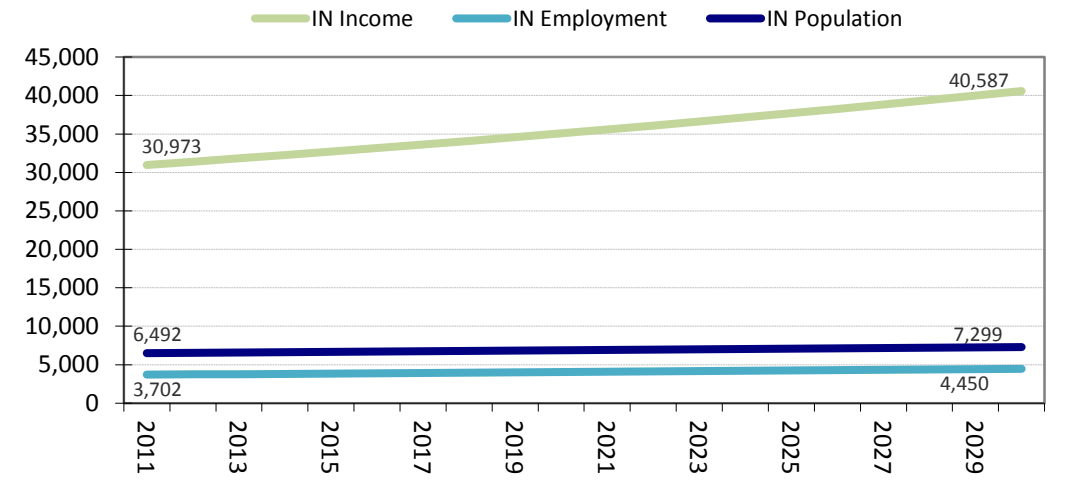
Figure 3-1 - Indiana Historic Population, Employment, Income (Thousands)



Source: Woods & Poole Economics, 2010.

According to the Woods & Poole data, Indiana has grown in all three socio-economic indicators: population, employment, and income. Historically these indicators have shown slow but steady growth, as indicated in **Figure 3-1**. However, over the planning period, income is projected to rise at a much faster rate than employment and population, as indicated in **Figure 3-2.**

Figure 3-2 - Indiana Forecast Population, Employment, Income (Thousands)



Source: Woods & Poole Economics, 2010.

3.2 Forecasts of Based Aircraft

As mentioned previously, the number of based aircraft in an aviation system is one of the most common activity indicators in the industry. In order to project based aircraft at ISASP airports, Indiana's current market share of the national activity was reviewed in addition to recently completed airport forecasts and the FAA's Aerospace Forecast. Aircraft totals in the state were compared to aircraft totals across the country for both historic and forecasting purposes. Historic comparisons allow market share forecasts to be calculated for Indiana's share of the United States' total fleet and for each individual ISASP airport's share of this same fleet. Since the FAA annually forecasts aircraft totals for the nation for a 20-year period, historic market shares can be used to project future market shares from the FAA's forecasts.

In addition to projected aircraft totals, the FAA's forecasts also include historic totals for "active" aircraft in the U.S. An active aircraft is defined as one that flies at least one hour during the year. There may be several reasons an aircraft is not considered active. For example, if it does not have an annual inspection it is not considered airworthy, and therefore cannot be flown until it passes such an inspection. Indiana's historic records for aircraft include "all aircraft," whether they are active or not, because their records are based on aircraft registration payments made to the Indiana Department of Revenue. Since an aircraft that is not active can become active, it still has the potential to affect the market. The assumption is made that the percentage of people who choose to pay annual aircraft registration fees for aircraft that are not active is low. As such, comparisons with the FAA's historic aircraft fleet is considered viable for forecasting purposes.

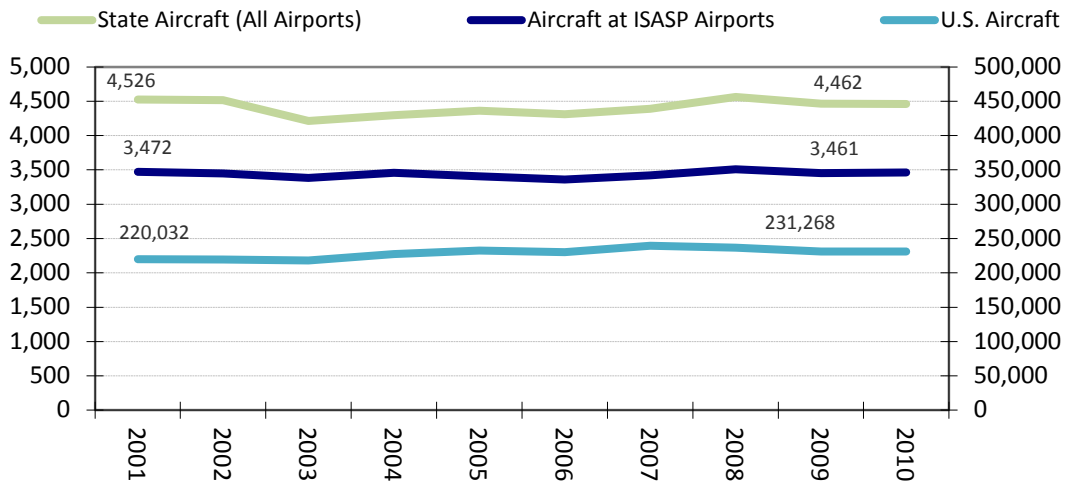
According to FAA data, historic totals of active aircraft in the U.S. have varied over the last 10 years, but have grown overall by 11,236 aircraft, or about five percent (5%). The total was lowest in 2003 with 217,964 aircraft and highest in 2007 with 239,650 aircraft. (See **Figure 3-3** and **Table 3-1**.)

At the state level, the number of aircraft have been relatively stable over the last 10 years, declining slightly by 64 aircraft, or 1.4 percent (1.4%) overall. According to aircraft registrations, the total was lowest in 2003 with 4,211 aircraft, and highest in 2008 with 4,563 aircraft. (See **Table 3-1**.)

The total number of aircraft at ISASP airports as a group has followed the same trends as the state with a low of 3,381 in 2003 to a high of 3,507 in 2008. However, the aircraft at ISASP airports have declined by only 11 aircraft over the past 10 years (see **Table 3-1**), or about .3 percent (0.3%), which is a lower rate of decline than the state as a whole (at 1.4%). While the ISASP airports have been home to an average of 78 percent (78%) of the total aircraft in Indiana, their decline in based aircraft over the last

decade has been fairly minimal as compared to that seen at non-system plan airports. In comparing historic aircraft counts for Indiana to historic socio-economic conditions, aircraft totals have fallen even though total income, employment, and population have all risen. This may in part be due to the general rise in aircraft prices and fuel costs.

Figure 3-3 - Historic Aircraft



Source: INDOT, 2011; FAA, 2011.

Table 3-1 - Historic Aircraft

Year	U.S. Aircraft	State Aircraft (All Airports)	Aircraft at ISASP Airports	ISASP % of State
2001	220,032	4,526	3,472	77%
2002	219,539	4,515	3,450	76%
2003	217,964	4,211	3,381	80%
2004	227,612	4,297	3,458	80%
2005	232,575	4,363	3,405	78%
2006	230,028	4,313	3,359	78%
2007	239,650	4,391	3,422	78%
2008	236,524	4,563	3,507	77%
2009	231,151	4,463	3,453	77%
2010	231,268	4,462	3,461	78%

Source: INDOT, 2011; FAA, 2011.

3.2.1 Forecasted Statewide Aircraft

Three methods were used to forecast total aircraft based in the state as a whole: market share, historic trends, and historic socio-economic indicators. These three methods are typically used in the industry to determine forecasts of based aircraft.

For the market share forecasts, two periods were used: Indiana's current market share and their ten-year average market share of the nation's total aircraft fleet. These shares were applied to the FAA's forecasted aircraft totals and resulted in similar projections over the next two decades: an increase of 889 aircraft using the current market share and 893 aircraft using the 10-year average market share. (See **Table 3-2**.)

The next forecasting exercise was based on historic trends. Since a trend over the historical period may not be present or may even reverse, a process was used to assure that trend forecasts are prepared only if significant, consistent, and meaningful trends are present. For trend forecasts to be viable, they had to be in the same direction (both positive or both negative [R Square of at least 0.5]) and the trends had to be statistically significant at 0.05 or less (less than a one in 20 chance the observed trend is the result of random variation)[1]. For this trend exercise, four time frames were analyzed. First the five-year and 10-year trends were calculated, but they did not produce statistically significant, correlated, or viable results. Therefore, the seven-year and eight-year trends were also calculated to determine if these produced statistically significant, correlated, and viable results, which they did. The results were basically the same for these two time frames and are shown in **Table 3-2**.

[1] R Square is the proportion of variability in a data set that is accounted for by a statistical model.

Table 3-2 - State Aircraft Forecasts (All Airports)				Preferred Forecast
Year	Current Market Share of U.S. Aircraft	10-Year Average Market Share of U.S. Aircraft	7- and 8-Year Trends	Current Market Share of U.S. Aircraft
2010	4,462	4,462	4,462	4,462
2011	4,468	4,471	4,542	4,468
2012	4,486	4,489	4,576	4,486
2013	4,513	4,515	4,610	4,513
2014	4,540	4,543	4,644	4,540
2015	4,571	4,574	4,677	4,571
2016	4,603	4,606	4,711	4,603
2017	4,635	4,638	4,745	4,635
2018	4,670	4,673	4,779	4,670
2019	4,708	4,711	4,812	4,708
2020	4,750	4,753	4,846	4,750
2021	4,797	4,800	4,880	4,797
2022	4,846	4,849	4,914	4,846
2023	4,897	4,901	4,947	4,897
2024	4,953	4,956	4,981	4,953
2025	5,013	5,016	5,015	5,013
2026	5,073	5,076	5,049	5,073
2027	5,137	5,140	5,082	5,137
2028	5,205	5,208	5,116	5,205
2029	5,276	5,279	5,150	5,276
2030	5,351	5,355	5,184	5,351
Difference	**889**	**893**	**722**	**889**

Source: Woolpert, 2011.

The historic socio-economic indicators discussed earlier were also analyzed for regression forecasts of aircraft totals. Regression forecasts predict the number of based aircraft at an airport using characteristics of the area in which the airport is located. Regression analysis is used to establish the relationship between the quantity being forecast (i.e., based aircraft) and other measures potentially associated with and possibly affecting that quantity (i.e., socio-economic indicators of population, employment, and total income). Then the estimated regression equation is used to forecast future values of based aircraft from separately forecast values of socio-economic indicators. For the regression forecasts, the socio-economic indicators of the state as a whole were used.

Simple regression (one predictor variable per equation) is found to be appropriate for forecasting future based aircraft; multiple regression (more than one predictor variable per equation) was not found to be appropriate due to the very high intercorrelations between the data (employment is related to population, per capita income is related to population, etc.) and multicollinearity (lack of independence among the predictors). With the existence of intercorrelations and multicollinearity, the resulting multiple regression relationships are likely to be randomly weighted rather than based on relationships in the data.

In addition, for a regression analysis to be viable, it has to represent a positive relationship with the predictor variable (R Square of at least 0.5) and be statistically significant at the 0.05 or less threshold. A positive relationship results in an increased number of based aircraft as population, employment, or income increases or a decreased number of based aircraft with decreasing population, employment or income. When a negative relationship occurs (i.e., based aircraft growing with declining socio-economic indicators), the growth or decline of based aircraft is occurring for reasons other than socio-economic factors. Therefore, any regression equations with a negative relationship between based aircraft and the socio-economic indicators are considered illogical and are discarded from consideration.

For this regression exercise on socio-economic indicators, the same time frames were used as with the trend forecasts: 10-year, eight-year, seven-year, and five-year. Of these, none produced statistically significant, correlated, and viable results so none are included in **Table 3-2**.

Of all the statewide forecasts produced, the forecast prepared using the state's current market share of all U.S. aircraft was determined to best reflect future socio-eocnomic conditions of the state. Therefore, it was chosen as the preferred forecast.

3.2.2 Forecasted Aircraft at ISASP Airports

Individual aircraft forecasts were prepared for each ISASP airport using a market share approach. First, each airport's 10-year average and 2010 market shares of the nation's aircraft fleet (total U.S. general aviation aircraft for general aviation airports and total U.S. aircraft for primary airports) were computed. Then, each airport's respective market shares were applied to the aircraft projections found in the *FAA Aerospace Forecast Fiscal Years 2011-2031*. However, if an airport had recently completed forecasts via a local planning effort, those respective forecasts were used instead for this update of the ISASP because they better reflect local conditions.

The forecasts prepared using the 10-year average market share (for those airports without their own locally prepared forecasts) resulted in a system total of 4,459 aircraft at the end of the forecast period (see **Table 3-3**). However, it also resulted in drops in aircraft levels for almost half of the airports, many being significant and not recovering for several years. The forecasts prepared using the 2010 market share resulted in a system total of 4,501 aircraft and did not show a reduction in aircraft levels at any airport. It is important to note that even with the individual differences among airports, the 10-year average and the 2010 market share forecast produced system totals within 41 aircraft of each other.

The 2010 market share approach was chosen as the preferred forecast for projecting individual airport aircraft totals for those airports that did not have locally prepared forecasts. This was due to the significant drops in based aircraft that would result in using the 10-year average market share and the little difference between the system total derived from each method. As mentioned previously, if an airport had performed their own forecasting exercise, these forecasts were used instead. (See **Appendix E** for individual airport forecasts.)

Table 3-3 - ISASP Airport Aircraft Forecasts

Year	2010 Market Share (Preferred Forecast)	10-Year Average Market Share
2011	3,617	3,582
2012	3,646	3,611
2013	3,680	3,644
2014	3,713	3,677
2015	3,749	3,714
2016	3,790	3,754
2017	3,825	3,789
2018	3,864	3,828
2019	3,907	3,871
2020	3,949	3,912
2021	3,998	3,960
2022	4,044	4,006
2023	4,097	4,059
2024	4,150	4,111
2025	4,206	4,167
2026	4,260	4,221
2027	4,318	4,278
2028	4,376	4,335
2029	4,436	4,395
2030	4,501	4,459

Source: Woolpert, 2011.

3.3 Forecasts of Aircraft Operations

Operation forecasts (an operation is either a takeoff or a landing) were prepared using the Operations Per Based Aircraft (OPBA) method, which compares the number of annual operations to the number of based aircraft. This method assumes that, other things being equal, the number of operations at an airport will grow as the number of aircraft based at the airport grows.

To use this method, an OPBA ratio must be determined. For airports with air traffic control towers, operations recorded by aircraft controllers were divided by the number of aircraft. At airports without control towers, operations determined by INDOT's aircraft traffic counting program were used. Since the early 1980s, INDOT has conducted aircraft traffic counts by sampling aircraft operations for

approximately 30 consecutive days at each of the 69 facilities in the ISASP every three to five years on a rotating basis. The 30-day sample is then extrapolated into an annual operations estimate via monthly factors that are established from operations records at towered airports in Indiana. The annual operations estimate is used to establish an OPBA level by dividing the annual operations by the total based aircraft.

When using the OPBA method, the operations forecasts for the ISASP airports are a product of the based aircraft forecasts. They have been developed by applying the 2010 OPBA to the forecasted based aircraft (See **Table 3-4**). Again, if an airport had performed their own operations forecasting exercise, these forecasts were used instead. See **Appendix F** for individual airport forecasts.

Table 3-4 – ISASP Airport Operations Forecast

Year	Forecasted Based Aircraft	Forecasted Operations
2011	3,617	1,554,139
2012	3,646	1,571,030
2013	3,680	1,591,474
2014	3,713	1,608,622
2015	3,749	1,629,712
2016	3,790	1,648,434
2017	3,825	1,666,694
2018	3,864	1,686,798
2019	3,907	1,706,572
2020	3,949	1,726,970
2021	3,998	1,751,527
2022	4,044	1,775,450
2023	4,097	1,800,998
2024	4,150	1,827,649
2025	4,206	1,854,592
2026	4,260	1,881,622
2027	4,318	1,908,999
2028	4,376	1,936,610
2029	4,436	1,965,734
2030	4,501	1,996,371

Source: Woolpert, 2011.

3.4 Forecasts of Licensed Pilots

Over the past decade, the number of active pilots in the United States has varied significantly, but overall the number of total pilots is down from its peak in 2002. Indiana has essentially mirrored the national pilot trends (see **Table 3-5** and **Figure 3-4**). The biggest decrease for Indiana has come in the

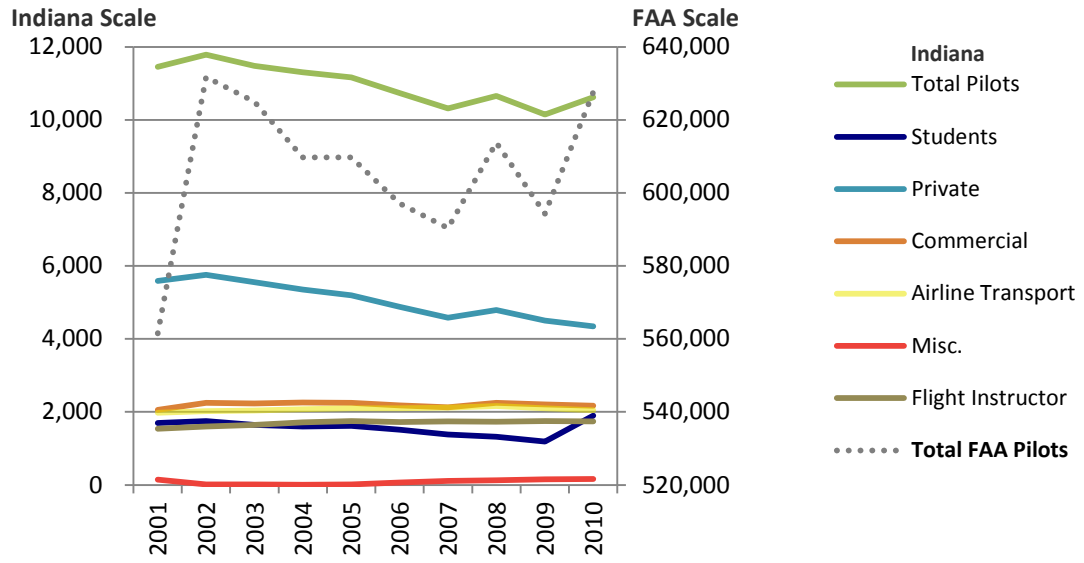
form of private pilots, which have declined by approximately 22 percent (22%). Every other category has increased.

Table 3-5 - Historic Pilot Levels

	INDIANA							FAA
Year	Total Pilots	Students	Private	Commercial	Airline Transport	Misc.	Flight Instructor	Total FAA Pilots
2001	11,453	1,694	5,588	2,052	1,974	145	1,537	561,472
2002	11,789	1,751	5,757	2,247	2,021	13	1,598	631,762
2003	11,477	1,641	5,553	2,235	2,037	11	1,648	625,011
2004	11,301	1,600	5,355	2,261	2,076	9	1,717	609,737
2005	11,162	1,615	5,190	2,247	2,100	10	1,747	609,737
2006	10,731	1,508	4,880	2,177	2,103	63	1,727	597,109
2007	10,317	1,385	4,582	2,123	2,117	110	1,742	590,349
2008	10,653	1,321	4,788	2,253	2,164	127	1,728	613,746
2009	10,150	1,191	4,501	2,205	2,097	156	1,751	594,285
2010	10,621	1,897	4,340	2,172	2,049	163	1,738	627,588

Source: FAA US Civil Airmen Statistics 2011.
http://www.faa.gov/data_research/aviation_data_statistics/civil_airmen_statistics/

Figure 3-4 - Historic Pilot Levels



Source: FAA US Civil Airmen Statistics 2011.

The *FAA Aerospace Forecast Fiscal Years 2011-2031* also forecasts pilot levels over the next 20 years. According to this forecast, pilot levels will increase across the country by approximately 8.7 percent (8.7%) over the next two decades. For this system plan update, the same methodology for forecasting aircraft is applied to forecasting pilots—projecting Indiana's current market share (approximately 1.69

percent [1.69%]) of the nation's total to the FAA forecasts. Since only the number of pilots in the state as a whole is known, only the state as a whole can be forecast. Individual airport pilot populations are not known, so a forecast of pilots at only ISASP airports cannot be performed. When multiplying Indiana's current market share to the FAA forecast for pilots, Indiana's number of pilots is expected to grow from 10,621 in 2010 to 11,544 by 2030. (See **Table 3-6** and **Figure 3-5.**)

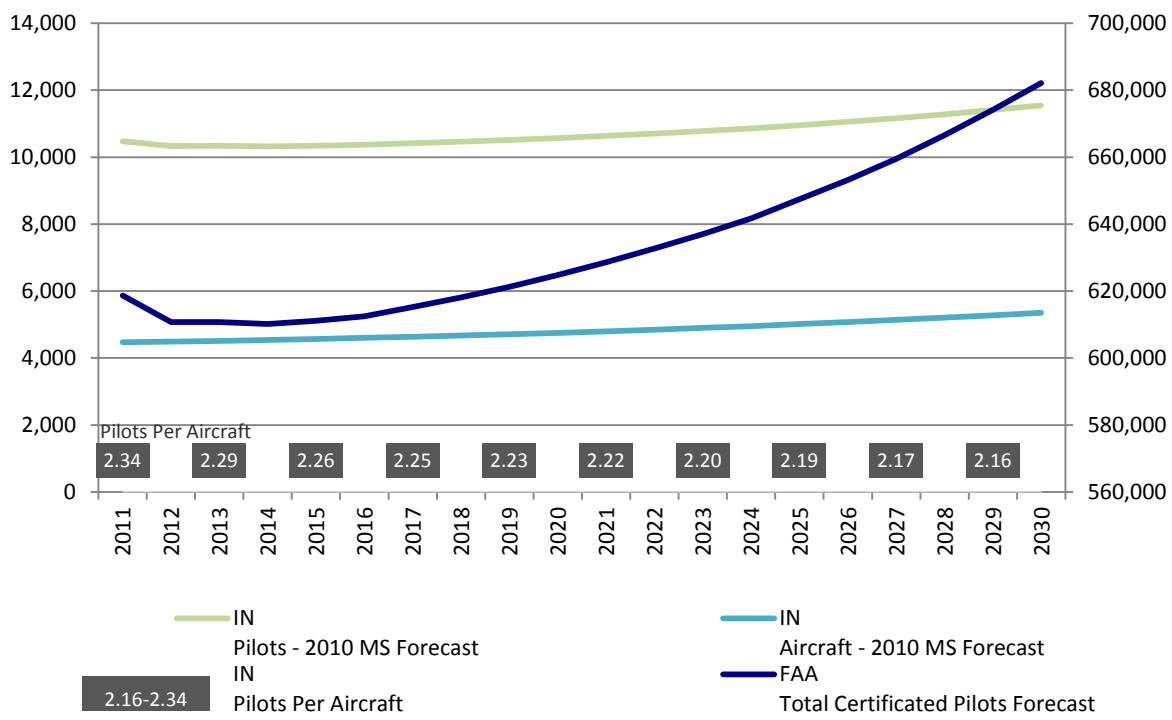
While the general trends for the number of pilots and aircraft in Indiana is expected to grow, the amount of pilots is anticipated to grow at a slower rate. This translates into a declining number of pilots per aircraft or vice versa, an increasing number of aircraft per pilot. There has never been a 1:1 ratio in this area as most pilots do not actually own aircraft due to the expense; rather they fly professionally or they rent. However, if Indiana maintains its current market share of the nation's aircraft and pilots, the state could experience a demand for pilots in the future.

Table 3-6 - Forecast Pilot and Aircraft Levels

Year	FAA Total Certificated Pilots Forecast	IN Pilots - 2010 Market Share Forecast	IN Aircraft - 2010 Market Share Forecast	IN Pilots Per Aircraft
2010	627,588	10,621	4,462	2.38
2011	618,660	10,470	4,468	2.34
2012	610,710	10,335	4,486	2.30
2013	610,760	10,336	4,513	2.29
2014	610,140	10,326	4,540	2.27
2015	611,140	10,343	4,571	2.26
2016	612,450	10,365	4,603	2.25
2017	615,270	10,413	4,635	2.25
2018	618,130	10,461	4,670	2.24
2019	621,210	10,513	4,708	2.23
2020	624,840	10,574	4,750	2.23
2021	628,650	10,639	4,797	2.22
2022	632,680	10,707	4,846	2.21
2023	637,000	10,780	4,897	2.20
2024	641,720	10,860	4,953	2.19
2025	647,410	10,956	5,013	2.19
2026	653,160	11,054	5,073	2.18
2027	659,510	11,161	5,137	2.17
2028	666,560	11,281	5,205	2.17
2029	674,160	11,409	5,276	2.16
2030	682,130	11,544	5,351	2.16

Notes: 2010 Historic; 2011-2030 Forecast.
Source: Woolpert, 2012; FAA Aerospace Forecast 2011-2031.

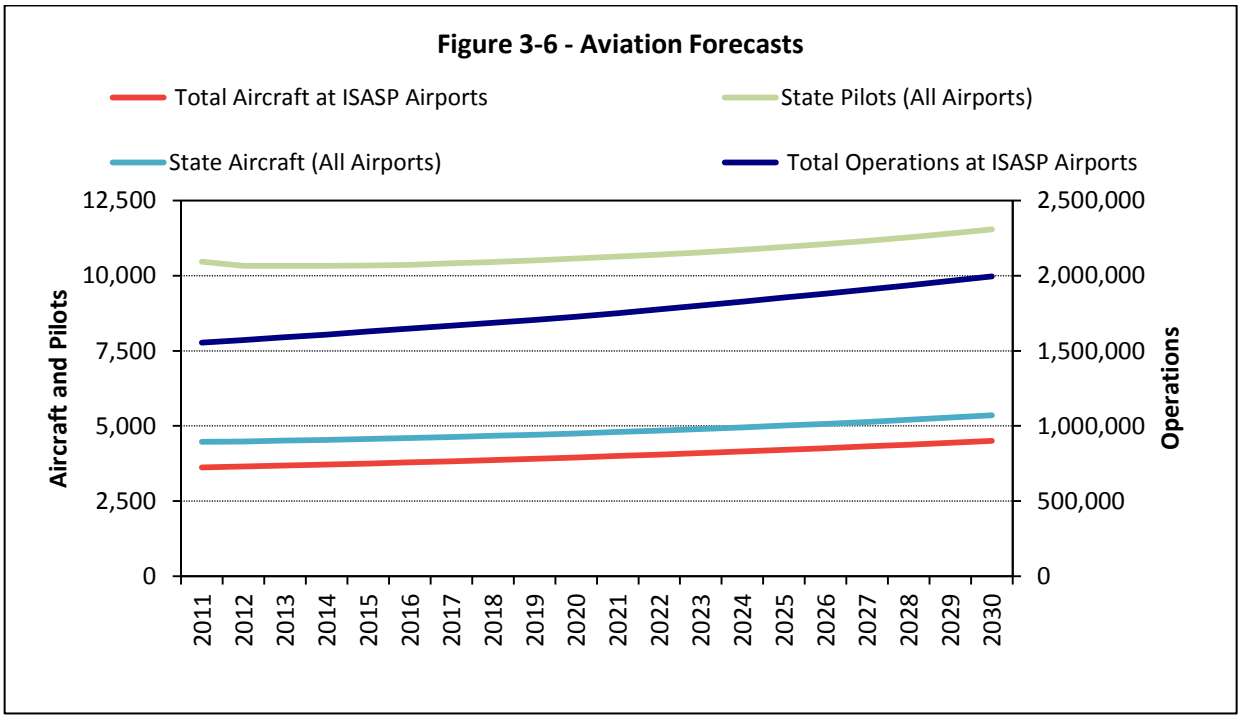
Figure 3-5 - Forecast Pilot and Aircraft Levels



Notes: 2010 Historic; 2011-2030 Forecast. MS=Market Share
Source: Woolpert, 2012; FAA Aerospace Forecast 2011-2031.

3.5 Conclusion

Overall, the aviation industry in Indiana appears to be on the rise based upon the three activity indicators: based aircraft, annual operations, and the number of pilots within the state. Having used national forecasts and applied market share projections to those figures, state and ISASP airport trends have been calculated. Using these forecasts and market share projections, based aircraft at ISASP airports are expected to grow by approximately 1,100 aircraft over the next 20 years to a total of 4,501 aircraft. With more aircraft anticipated in the state, operations are expected to increase by about half a million to a total of 1,996,371 by 2030. (See **Figure 3-6.**) The increases in based aircraft and operations at Indiana's airports should coincide with increases in population, employment, and income projected by major economists.



Source: Woolpert, 2011.