Economic Impacts of Improving General Aviation Airports

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EVERY state and many communities face the issue of priorities for investments in airport facilities. This issue has received the most public attention regarding the regional economic importance of investment in major new commercial airport facilities. Relatively little attention has been given to the role of general aviation (GA) facilities. As a result, the issue of investment priorities is particularly problematic for GA airport facilities, as their contribution to local and state economies is not well understood.

This article focuses on the problem of defining and measuring state and local economic impacts of GA airports, and the problem of assessing the benefits of improvements to those airports. After a brief summary of GA today, this article examines the measurement of airport benefits, with particular attention to different approaches for economic impact analysis. Results are presented from a new survey of businesses that use GA, which focuses on the relative importance of GA for those businesses. Finally, the basic model system for evaluating GA benefits, developed for the Massachusetts Aeronautics Commission, is presented.

GENERAL AVIATION TODAY

General aviation refers to private aircraft that are used neither for scheduled air services (passenger or cargo) nor for military uses.

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They are typically smaller aircraft, although they may be prop or jet airplanes or helicopters. They may be owned by individuals or by corporations. Aircraft available for charter services (air taxi) or flight training are included.

Contrary to the popular view, "flying private planes" is far from just a recreational activity. Nationally, it is estimated that at least 26 percent of the GA fleet is operated exclusively for business and that 60 percent is used at least partly for business purposes.[1] Other key findings from prior studies are:

- Nationally, an estimated 34,000 firms operate 68,000 private aircraft.[2]
- Of the Fortune 500 list of the largest publicly-held corporations in the United States, 363 operate their own business aircraft.[3]
- Business turboprops and business jets in North America now number over 10,000, and are growing at a pace of over 3 percent annually.[4]
- More than two-thirds of all business aircraft trips make use of GA airports rather than commercial air terminals.[5]

Nationally, the importance of corporate access to GA is being increasingly recognized as manufacturing corporations decentralize. As noted by an executive of John Deere: "In this day and age, if you don't have a good all-weather airport, you're substantially jeopardizing your ability to grow and attract business. The more we grow, the more of a problem it becomes to us. The more reason we have to travel around."[6]

MEASUREMENT OF AVIATION BENEFITS

General aviation facilities (and improvements to those facilities) can provide a range of potential benefits in terms of user and economic benefits.

User benefits include travel time and operating cost savings, as well as safety improvements, for travelers. Economic benefits include business expansion (as generators of jobs and business income) and business attraction (as necessary facilities to attract new businesses).

1. Survey by Aircraft Owners and Pilots Association.
2. *Fortune Magazine* (1985).
3. *Fortune Magazine* (1985) and *Business Flying* (1985).
4. *Business Aviation-Interavia Aerospace Review* (1986).
5. Management Mobility (1986).
6. *Milwaukee Journal* (March 6, 1988).

It is the user benefits of an airport (or airport improvement project) that cause the subsequent economic benefits of business expansion and attraction.

User Benefit

User benefit is the measure traditionally used to evaluate the transportation system efficiency impacts associated with transportation projects. For any given transportation improvement, the aggregate economic value of time savings, out-of-pocket cost savings, and safety improvements for all travelers can be compared to current (or "base case") conditions. User benefits associated with a project can then be compared to the costs involved. This type of benefit/cost analysis can be used to compare the net benefits of alternative projects for project prioritizing in statewide airport system plans. This process is actively used by the state of Wisconsin, through its statewide airport benefit cost computer system. This process is also embodied in the Federal Aviation Administration's airport data analysis microcomputer program.

Application of benefit cost analysis based on transportation efficiency (user) impacts is a respected approach used in project evaluation for highways and seaports, as well as aviation facilities. However, it is increasingly being recognized that user benefits can understate the full economic benefits of a project. This is particularly true when the proposal for a new facility or expansion of an existing facility is explicitly motivated by its potential role as a catalyst for local economic development.

Economic Benefit

There is much confusion about how to measure economic impacts of GA airport facilities. In fact, different measures are appropriate depending on the policy questions, which may include:

- What is the value of an airport to the economy of its surrounding community or county area?
- What are the economic benefits of improving an airport, compared to the costs involved?

Role in the Economy. Promotional literature about an airport often describes its economic importance in terms of its involvement in many aspects of the local economy. This is done by counting the value of sales, employment and payroll of the fixed-base operators, airport-related services and all businesses that depend on or use the airport in some way or another. This method essentially takes credit by association. It overstates the economic value of an airport by taking credit for all the business activity that ever uses the airport. Local airport proponents like it because it can generate big numbers.

Economic Contribution. A more sophisticated measure, the economic contribution of an airport, is measured by a process of accounting for revenue received by business in the community as a result of airport activity. It includes spending at the airport on landing and storage fees, plus fuel and maintenance. It also includes spending at hotels, restaurants and retail stores by travelers visiting the community because of the airport. Economic contribution further includes "indirectly and induced" spending flowing to other businesses in the community, as a result of the additional worker income and business orders. Economic contribution may be measured in terms of business sales and employment on payroll. It may also include the business activity generated by construction of airport improvements. One adjustment that should be (but is not always) done is to distinguish the actual share of this revenue, which stays as income to residents of the community, as opposed to the share of this revenue, which flows out to suppliers or manufacturers located elsewhere.

Unlike the earlier measure of role in the economy, economic contribution counts no benefit from local businesses that depend on or use the airport except insofar as they spend money at the airport. If an airport improvement project saves time and costs for business users, or facilitates the attraction of new industry or tourism, no further benefit is recognized unless already reflected in projections of local spending. However, this measure also counts local spending generated by an airport project regardless of whether it is newly-generated air travel or merely travel shifted from a neighboring airport. For this reason, economic contribution may be used for summarizing local economic impacts of an airport, but it is not appropriate for statewide project prioritizing.

Net Economic Benefit. This refers to the benefit measure that is appropriate for benefit/cost analysis. The benefit measure is the income to residents that is generated as a result of maintaining or improving an airport, compared to a base case of not maintaining or improving that airport. This measure has three components.

1. local income generated as a result of *business expansion,* from

increased direct user spending at the airport and in the community, as well as from indirect and induced business growth;

2. local income generated as a result of additional jobs due to new *business attraction,* made possible by airport improvements; and

3. additional value of those *user benefits* (time and cost savings) associated with non-business travel by local residents and existing visitors, who do not generate any increase in their spending because of those additional user benefits.

For statewide evaluation, any local income benefits associated with trips shifted from other airports in the state are rightfully excluded as merely intrastate distributional shift. An input-output model is used to identify and exclude that portion of spending which flows to out-of-state suppliers.

ANALYSIS MODELS

The measurement of economic benefits of GA airport projects is a non-trivial accounting process. A variety of microcomputer analysis tools are now emerging. The state of California Economic Impact Model (1988) provides a framework for assessing local impacts by measuring economic contribution and potential business attraction. It includes a suggested survey of local airport users to provide data. The Wisconsin Airport Benefit Cost Model (1985) provides a parallel accounting of both user benefits and net economic benefits (compared to costs) from the local point of view and the statewide point of view. It also includes default statewide averages for valuation of user benefits and local spending benefits. The Massachusetts Airport Impact Model (1988) provides a method for estimating changes in airport business usage, economic contribution and business attraction based on characteristics of airport improvements, its service area population and the area economic profile.

SURVEY OF BUSINESS USERS OF GENERAL AVIATION FACILITIES

The hardest part of evaluating economic impacts of airport projects is not estimating the local spending that is generated, but rather, assessing the additional impact of airport facilities on attracting new business activity, or keeping existing business from leaving. While many local and regional economic factors come into play, a basic understanding is needed of how different kinds of businesses currently depend on GA airport facilities for their existence, their location and their expansion decision-making. This can be addressed by considering the following questions.

- What kinds of businesses use GA? In what ways? Just how important is access to GA for those various types of businesses?
- What alternative options would be feasible for those businesses, if GA access were not maintained? To what extent would businesses shrink, relocate or close?
- What role does current GA access play in business location and expansion plans? What role would future changes in GA access facilities play in affecting future business location and expansion plans?
- What types of improvements can be made to airport facilities to enhance business use of GA? How can that support the economies of communities and the state?

These questions help to address the fundamental question, "What are the regional economic consequences of changes in the availability and quality of GA airport facilities and services?"

To better understand these matters, a survey of businesses owning or operating GA aircraft was conducted. The survey was conducted for the Massachusetts Aeronautics Commission. A mailback survey (Figure 1) was sent to all aircraft owners that were businesses or voluntarily reported use of their aircraft for business purposes on their Massachusetts registration. Approximately 1,000 aircraft owners out of 3,000 registered owners in the state fit this criteria and received the survey. Completed surveys were returned from 250 owners. Key findings from the survey are summaried below.

WIDE VARIETY OF BUSINESSES USE GENERAL AVIATION

A wide variety of types of business own or use GA in Massachusetts, as shown in Figure 2. The largest group is the service sector, which represents over 35 percent of survey respondents. This includes consultants, lawyers, doctors and advertising firms. Manufacturing makes up 19 percent of all business users. This group is dominated by computer/electronics and machinery manufacturers. It is, however, notable that 32 percent of the survey respondents were engaged in diverse industries such as wholesaling, retailing, construction, utilities, agriculture or fishing services. Finally, 14 percent were engaged in educational services or transportation services (primarily flight training or aircraft charter services).

Firms using GA in Massachusetts include all sizes. While 60

1. **What is your firm's primary product or service?**

______

2. **What size is your firm?**

______ Number of people

$______ Annual sales

3. **Do you ever use general aviation aircraft for your business?**

☐ yes ☐ no

If YES, skip to Question 4 and complete remainder of the survey.

*If NO, **answer question 3a** and do not complete the survey.*

Please be sure to return the survey form. Thank you.

3a. **Have you ever considered using general aviation for your business?**

☐ yes ☐ no If YES, why haven't you used it?

______

4. **Is your firm's aircraft** (Check as many as apply.)

○ business owned
○ owned personally
○ leased
○ chartered

If business owned, is the aircraft

○ used exclusively by the business
○ leased back to a FBO from a charter or rental
○ used jointly with an other business

5. **What type(s) of aircraft do you use?**

Make/Model	# of Aircraft
______	______
______	______
______	______
______	______
______	______
Total in fleet	______

6. **How much does your firm spend for**

aircraft **operating** expenses per year . . . . $ ______
(fuel, maintenance & servicing)

aircraft **capital** costs per year . $ ______
(lease payments, equipment purchases, depreciation, etc.)

7. **What percent of your firm's total transportation costs are spent on general aviation?**

______ %

8. **In the future, does your firm plan to** (Check as many as apply)

○ increase the number of aircraft owned
○ decrease the number of aircraft owned
○ make no changes to the fleet
○ upgrade the fleet

9. **Estimate the TOTAL number of HOURS PER YEAR that your aircraft is used for BUSINESS purposes?**

______ hours

10. **What percent do these business trips represent of your aircraft's TOTAL tripmaking?**

______ %

11. **Estimate the PERCENT of total aircraft use attributable to transporting**

______ % staff/executive transport
______ % visitors/clients
______ % suppliers/contractors
______ % receiving supplies (incoming)
______ % delivery of products (outgoing)
______ % aerial surveying
______ % non-business use
______ % other (specify) ______

100% Total

12. **Where is your firm's aircraft based?**

☐ Massachusetts: → → Please specify airport name or code:

______

☐ Connecticut
☐ New Hampshire
☐ Vermont
☐ Maine
☐ other state (please specify)

______

13. **What are the five primary airports that you fly to in MASSACHUSETTS, and approximately how often do you go to each?**

Airport Name or Code	# of Times Per Year
1. ______	______
2. ______	______
3. ______	______
4. ______	______
5. ______	______

14. **When you were selecting a site for your business, how important was proximity to a general aviation airport?**

☐ not a consideration
☐ moderately important
☐ very important
☐ essential

15a. **What would be your response IF your BASE AIRPORT were no longer available for your use?** (Check as many as apply.)

○ substitute other modes, e.g., bus, truck, rail
○ use next closest airport (specify)

______

○ make fewer trips
○ relocate business
○ go out of business
○ other (specify) ______

15b. **How much do you think your business/ sales would change? (Estimate PERCENT CHANGE.)**

☐ remain the same
______ % higher
______ % lower

15c. **What would you expect your firm's transportation costs to be?**

☐ remain the same
______ % higher
______ % lower

16a. **What would be your response IF your most frequently used DESTINATION AIRPORT were no longer available for your use?** (Check as many as apply.)

○ substitute other modes, e.g., bus, truck, rail
○ use next closest airport (specify)

______

○ make fewer trips
○ relocate business
○ go out of business
○ other (specify) ______

16b. **How much do you think your business/ sales would change? Estimate PERCENT CHANGE.**

☐ remain the same
______ % higher
______ % lower

16c. **What would you expect your firm's transportation costs to be?**

☐ remain the same
______ % higher
______ % lower

17a. **What is the most important improvement that needs to be made to general aviation airports? (e.g., runway, navaids, services provided, etc.)**

Kind of Improvement: ______

______

______

Airport: ______

17b. **How would this affect your business?**

______ % increase in sales
______ % decrease in business costs

Please use the space below to elaborate on any of your answers or to describe an occasion on which your aircraft played a major role in your business.

______

______

______

______

______

______

______

If we have any further questions, may we give you a call? All responses will be strictly confidential.

Contact Person: ______
Firm: ______
Telephone: ______

Thank you very much for your time and effort.

Figure 1. Survey instrument

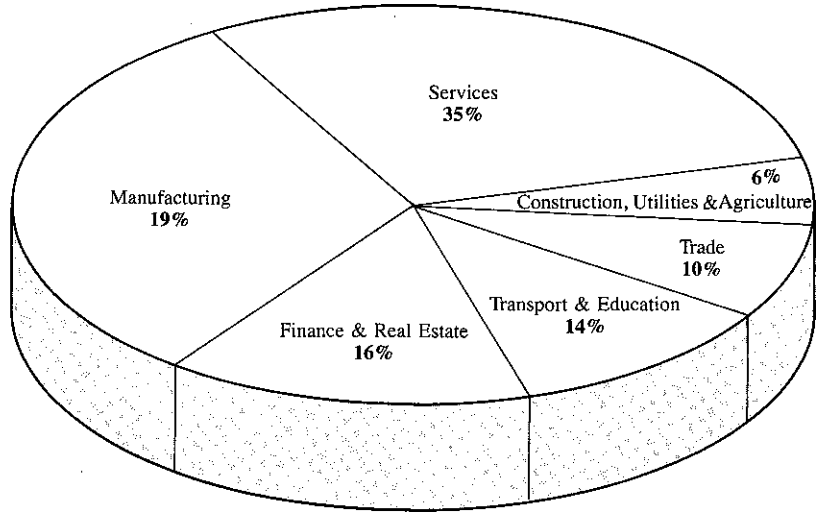

Figure 2. Business type of GA users

percent of the businesses have under 25 employees, many of the manufacturing firms that use GA employ over 2,000 workers.

General aviation is used by businesses in many different ways. Transporting people—staff, visitors or clients—accounts for 67 percent of its use. Delivery of supplies and shipping products accounts for 6 percent of the use, while aerial surveying accounts for 4 percent. Other uses were flight training (3 percent), miscellaneous business (4 percent) and non-business use (16 percent).

Not surprisingly, the way that businesses use GA differ significantly by type of business (See Table I). For utilities, aerial surveying and delivering of products are the major uses of GA. Delivering products and receiving supplies are also particularly important uses for high-tech electronic equipment manufacturers, and for businesses engaged in wholesale trade. Aerial surveying is also an important use for businesses engaged in agriculture, real estate sales and fish spotting.

IMPORTANCE OF GENERAL AVIATION FOR BUSINESS

There are many ways to assess the benefits that businesses receive from GA. A minimum estimate of the productivity and cost-saving benefits to business from GA is what they are willing to spend on it, in terms of capital and operating costs incurred in GA. If one accepts the premise that businesses typically decide to spend money on aircraft only when the value to the firm exceeds the cost of acquisition and

TABLE I—PERCENT OF EACH TRIP PURPOSE BY INDUSTRY

Industry	*Trans-porting Staff*	*Trans-porting Clients*	*Transporting Suppliers Contractors*	*Receiving Supplies*	*Delivering Products*	*Aerial Surveying*	*Non-business*	*Flight Training*	*Other*	*Total*
A. All Industries										
Agriculture	20	2	0	2	3	23	17	0	33	100%
Construction	58	11	4	1	6	8	7	4	1	100%
Miscellaneous manufacturing	70	16	4	0	3	0	8	0	0	100%
Machinery manufacturing	60	8	2	1	6	1	21	1	0	100%
Electronic equipment manufacturing	55	7	2	5	13	0	12	2	6	100%
Transportation services	34	30	8	0	1	6	9	1	10	100%
Utilities	23	8	7	2	17	24	9	0	10	100%
Wholesale trade	54	10	1	12	11	0	13	0	0	100%
Retail trade	71	4	0	2	0	0	13	0	9	100%
Finance	71	15	2	0	2	2	7	0	0	100%
Real estate	53	12	5	1	1	9	20	0	0	100%
Services	53	10	1	2	2	4	22	2	5	100%
Education	24	1	1	3	0	2	27	41	0	100%
Average	53	12	2	2	4	4	17	3	4	100%

Source: Survey of Business Users of General Aviation, Cambridge Systematics and Massachusetts Aeronautics Commission, December 1987.

operation, then the annual level of spending on GA represents a minimum estimate of its true economic benefit to business.

Average annual expenditure on aircraft is $11,000 for operating expenses plus another $13,000 for annual capital costs for their GA aircraft. With an average business fleet in the Massachusetts survey of 1.7 aircraft, total spending on GA averages $40,000 per business.

To more directly examine the importance of GA, surveyed businesses were asked how they would respond if their base airport were no longer available for their use. (See Figure 3 and Table II.) Overall, 66 percent of the firms reported that they would adjust by using the next closest airport and/or make fewer trips. Another 8 percent reported they would substitute another mode of transportation. Of particular concern, however, is the finding that 19 percent reported they would relocate and 7 percent reported they would go out of business. While this latter response may be an overestimate of true impact, it nevertheless highlights the seriousness with which some businesses view their access to GA airport facilities. It is also notable that incidence of these reported impacts was highest (over 20 percent) for businesses engaged in agriculture/fishing, utilities, retail trade, finance and real estate. Businesses reporting that they would relocate or go out of business account for 8,050 employees and $2.2 billion of sales within Massachusetts. If these survey results are taken at face value, then the total statewide impact of GA access is even

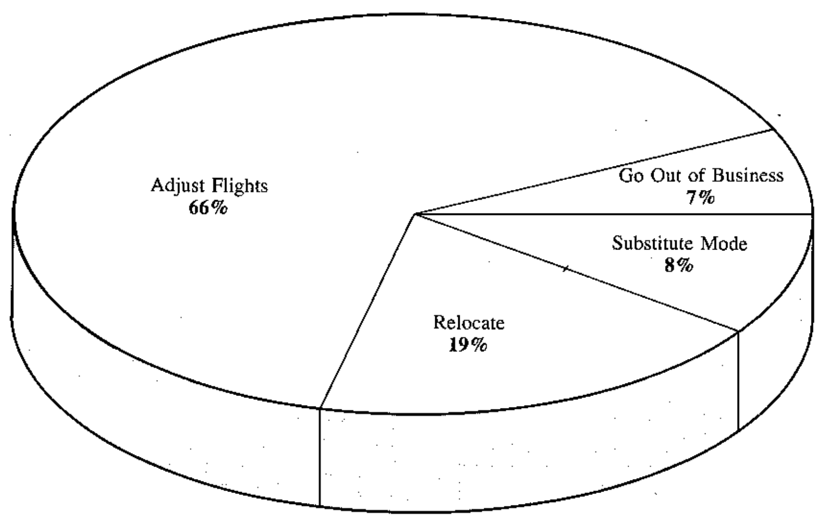

Figure 3. Response to closing base airport

TABLE II—EXPECTED RESPONSE OF BUSINESSES LOSING BASE AIRPORT, BY BUSINESS TYPE

	Responses to Losing Destination Airport				
Business Type	*Substitute Other Modes of Transportation*	*Use Next Closest Airport*	*Make Fewer Trips*	*Relocate Business*	*Go Out of Business*
Agriculture	0%	33%	0%	67%	0%
Construction	0	86	0	14	0
Miscellaneous manufacturing	7	79	7	0	7
Machinery manufacturing	10	80	0	10	0
Electronic equipment manufacturing	7	64	14	14	0
Transportation services	6	44	0	19	31
Utilities	20	60	0	20	0
Wholesale trade	8	67	8	8	8
Retail trade	22	44	0	22	11
Finance	0	73	0	27	0
Real estate	10	58	0	32	0
Services	9	63	2	20	6
Education	0	50	10	20	20

Source: Survey of Business Users of General Aviation, Cambridge Systematics and Massachusetts Aeronautics Commission, December 1987.

higher, since the survey accounted for just 20 percent of all businesses using GA in the state.

Interestingly, these results are consistent with other survey questions that asked businesses about the relative importance of proximity to a GA airport in their original site selection. Approximately 23 percent of the businesses considered it an essential factor.

These survey findings are of interest because they highlight the importance of GA airport facilities for the location decisions of some businesses. However, they leave many questions unanswered.

- Are stated intentions to relocate or close in response to such a hypothetical situation a good prediction of actual behavior?
- To what extent do businesses actually close down or relocate in cases where GA airports are downgraded or closed?
- If businesses relocate, is it usually to another community within the same state?

Those businesses reporting they would *not* go out of business or move out of state were asked to estimate how much their sales volume would change and how much their transportation costs would change. Of the businesses that would not relocate or close, 40 percent reported they expected their sales volume to decrease. Average estimated loss of sales (including businesses that expected no decrease) was $1 million (15 percent). When asked about how their transportation costs would be effected, over half reported that they expected their transportation costs to increase. The average increase was 18 percent ($30,000).

If these survey results are indicative of true impacts, then they can help to estimate both the resulting change in business costs and the change in local business employment and sales. Alternatively, an economic simulation model of business competition (such as the REMI model) could be used to estimate how increases in GA-related transportation costs (compared to areas elsewhere) are likely to lead to decreases in local business activity.

Quality and availability of GA airport facilities also affect non-local businesses that use those facilities. In the survey, businesses were also asked to report their expected response if their base airport was still available, but their most frequently used destination airport was no longer available for use. Their response to this question differed from their response to the previous question about loss of base airport access. Fewer businesses reported they would relocate, close or use the next closest airport. A significantly greater proportion of the businesses reported that they would substitute other modes of transportation or make fewer trips. Of those businesses that reported they would not go out of business, the expected impacts on sales and transportation costs were similar to the expected impact of the base airport closing.

If the portion of business sales at risk of loss due to business closing, relocation, or business sales contraction are combined, a measure of overall business sales vulnerability associated with loss of base or primary destination airports can be constructed. The results, summarized in Table III, show a wide variation in the portion of sales at risk. Overall, the average level of sales at risk of being lost is approximately 40 percent of total business activity for the surveyed businesses. This is equivalent to roughly $1 million of sales at risk for the typical (median) size business, although the average (mean) sales at risk is $30 million per business due to the existence of some very large businesses in the Massachusetts survey. Either way, these figures for potentially lost business sales dwarf the $40,000 average annual spending per business on GA costs.

In any case, care must be taken to avoid double counting of benefits. The benefit can be measured either in terms of the firm's estimate of its savings in cost of doing business (average $1 million/business), or in terms of the firm's estimate of local business sales at

TABLE III—PORTION OF BUSINESS SALES AT RISK[a]
(MASSACHUSETTS)

SIC	*Industry*	*Percent*
1–9	Agriculture	67%
10–14	Mining	0
15–19	Construction	21
20–34, 37–39	Manufacturing	13
35	Machinery manufacturing	12
36	Electrical manufacturing	19
40–47	Transportation services	57
48–49	Utilities	20
50–51	Wholesale	18
52–59	Retail	36
60–64, 67	Finance	31
65–66	Real estate	34
70–81, 83–89	Services	33
821–823	Other education	0
824–829	Flight training/education	98
90–99	Government	0
Average Weighted by Number of Aircraft		40.80%

a. These figures represent percentage of total business sales accounted by companies that claim they would relocate or go out of business if their base or primary/destination airport were to close, plus the reported loss to other companies that would not relocate or go out of business. Source: Survey of Business Users of General Aviation (Massachusetts Aeronautics Commission and Cambridge Systematics, December 1987).

stake (average $1 million to $30 million/business), or in terms of the business expenditures associated with the aircraft use (average $40,000/business). Business expenditures for fuel, repair, storage and fees, in turn, provide a major portion of the revenue of local fixed-base operators. To include this activity as an additional element of business benefit would, however, be double counting.

PROCESS FRAMEWORK FOR ESTIMATING BUSINESS BENEFITS

The Massachusetts Airport Impact Model system measures the economic benefit of GA airport project as the local worker income associated with that portion of business sales activity that depends on continuation or improvement to the particular airport. For example, airport projects that may affect business use of an airport (and hence business sales activity) include:

- whether or not a runway is extended to accommodate corporate jets;
- whether or not operating hours are extended and lighting is installed to allow night flying;
- whether or not instrument landing systems or a crosswind runway is installed to allow operation in adverse weather conditions;

- whether or not jet fuel and full maintenance services are provided; and
- nature of user facilities and amenities.

Each of these decisions has the potential to encourage or else prevent future business use of an airport.

The process of estimating business use of an airport, with and without improvements, is based on a multistep process. The key steps are illustrated in Figure 4 and described below.

Step A: Characteristics of Business Aircraft Ownership

Prevalence of aircraft ownership by businesses, average fleet size, and mix of aircraft types all differ systematically by type of business. Table IV summarizes these in terms of number and types of aircraft owned by businesses in each industry, expressed as a ratio per total statewide employment in that industry. As the economy of the state changes over time, employment in some industries will grow faster

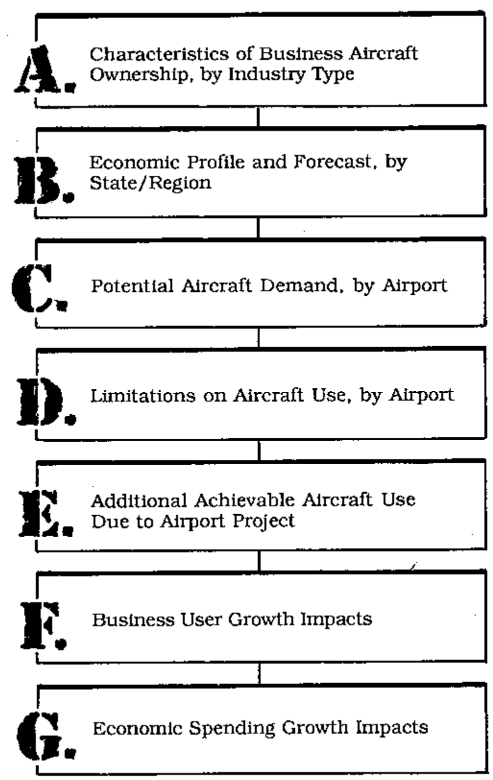

Figure 4. Steps in the process of estimating business benefits of airport projects

TABLE IV— AIRCRAFT OWNED PER 1,000 TOTAL EMPLOYEES (MASSACHUSETTS)

SIC	*Industry*	*Single*	*Multi*	*Jet*	*Heli*	*Total*
1–9	Agriculture	0.80	0.00	0.00	0.00	0.00
10–14	Mining	0.00	0.00	0.00	0.00	0.00
15–19	Construction	0.18	0.09	0.00	0.05	0.32
20–34, 37–39	Manufacturing	0.10	0.02	0.01	0.00	0.13
35	Machinery manufacturing	0.35	0.16	0.08	0.04	0.63
36	Electrical manufacturing	0.41	0.17	0.03	0.00	0.61
40–47	Transportation services	1.87	0.62	0.05	0.10	2.64
48–49	Utilities	0.16	0.16	0.00	0.08	0.41
50–51	Wholesale	0.35	0.06	0.00	0.00	0.41
52–59	Retail	0.08	0.01	0.00	0.00	0.09
60–64, 67	Finance	0.32	0.09	0.00	0.03	0.44
65–66	Real estate	2.31	1.08	0.15	0.00	3.55
70–81, 83–89	Services	0.47	0.10	0.01	0.03	0.61
821–823	Other education	0.00	0.00	0.00	0.00	0.00
824–829	Flight training/education	34.02	1.79	0.00	0.00	35.81
90–99	Government	0.00	0.00	0.00	0.00	0.00
	Total	0.36	0.09	0.01	0.02	0.48

Source: Total aircraft by industry based on Survey of Business Users of General Aviation, (Massachusetts Aeronautics Commission and Cambridge Systematics, December 1987); estimated 1987 employment by industry from Massachusetts Division of Employment Security: Massachusetts Industrial Employment Projected Changes 1984–1995; and aircraft owned per 1,000 total employees is the ratio of the two above sets of figures.

than in other industries. As a result, number of business aircraft and mix of aircraft types will also change over time.

Step B: Employment Profile and Forecast

State and federal sources provide forecasts of statewide employment growth (and decline) by industry (SIC groups) over the next decade and beyond. These forecasts reflect expectations of growth and decline in various industries as a result of shifts in the national economy, shifts to foreign manufacturing in some industries, and changing technology.

Step C: Potential Based Aircraft

Steps A and B together allow estimates of the projected future number and mix of based aircraft in the state. Estimated potential for each individual airport depends on the specific employer profile forecast for its service area.

Step D: Limitations on Aircraft Use and Step E: Additional Achievable Use

Business growth benefits of investment in GA airport facilities depend on the adequacy of facilities provided. This can be defined in terms of criteria such as:

- critical aircraft type: limitations on the type of aircraft that can use the airport (related to runway length and pavement)
- lighting: limitations on use of the airport at night
- instrument navigational aids: limitations on use of the airport during low visibility/inclement weather conditions
- other factors: hangars and tie-downs available, weather services, fuel available, plowing in winter, restaurant available, etc.

Any project that broadens the types of aircraft that can use the airport, or the percentage of time that the airport can be used, or that otherwise increases reliability for its usage, will encourage greater use of the airport and hence attract additional business activity and economic growth. Existing characteristics of an airport (with respect to the above criteria) can be used to identify the existence of factors now limiting its use by business. Actual or hypothetical airport improvement projects can then be defined in terms of whether they address some or all of the factors now limiting that business use.

Step F: Business User Growth Impacts

It is a clear oversimplification to credit a new business startup, business relocation to an area or business expansion solely to the improvement of a nearby airport. It is also a clear oversimplification to blame a business failure, business relocation out of an area, or business contraction solely to reduction in facilities or services of a nearby airport. While access to GA is certainly an important factor in business location decisions and business sales, it is not the only factor. Usually, the combination of airport facilities together with other business costs and competition factors (such as availability and cost of labor and raw materials, and the nature of market competition) work together to encourage or discourage business growth. Therefore, the most appropriate ways to assess the effect of airports or changes in airports on business activity are in terms of associated business activity and "at risk" business.

Associated Business Activity. This includes additional business employment, payroll and business sales generated by direct and indirect spending associated with the forecast of additional numbers of aircraft using the airport.

At Risk Business. This is the portion of current employment, payroll and sales volume of businesses using the airport, which is at risk of being lost when their GA needs are not met, or gained when their GA needs are met.

CONCLUSION: USE OF FRAMEWORK FOR ESTIMATING BUSINESS BENEFITS

In setting priorities for airport projects, a great many benefit and cost factors must be considered. The transportation efficiency benefit to users is one measurable factor. The additional impact on the economy due to potential business expansion and business attraction is another factor addressed in this article. There are, of course, other financial, environmental and community impacts to be considered.

In addition to the specific economic benefits of airports to businesses, there are the less quantifiable benefits of provision of access to more remote regions of the state, enhancement of mobility, and ability to locate businesses where factors such as labor supply and resources are located. These quality-of-life aspects of GA airports make a more subtle, but nevertheless real, contribution to the quality of the business climate.

Not all benefits of airport improvements can yet be quantified. Much further work is necessary to establish the transferability of results from the Massachusetts survey for other states. Further work is also needed to better understand the process of business relocations and business transportation changes resulting from changes in GA airport facilities and services. Nevertheless, the framework outlined in this article is designed to demonstrate how impacts on the economy can be addressed.

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