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William D. Geibel
Editor

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An Assessment of Economic Benefits From Airports: The Building of a Model

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Abstract

Past research indicates that significant economic impacts are generated from airports. Over time several airports and statewide systems of airports have been studied and economic impacts determined. However, many airports remain unstudied and the knowledge of community economic impact is vital for airport public relations programs to demonstrate worthiness.

Using a recent airport economic impact study conducted by the Illinois Department of Transportation data were subject to multiple regression and correlation procedures in order to build an estimation equation. The results of the study indicate that a very strong relationship exists between several typical airport operational variables such as employment, total based aircraft, and annual enplanements and total economic impact. Two regression equations were developed for commercial airports and non-commercial airports. These equations were found to be statistically useful as estimating tools for determining total economic impact at a given airport.

An Assessment of Economic Benefits From Airports: The Building of a Model

Do airports contribute to the economic well-being of a community? There was once a time, not too many years ago, that this question could not be readily answered other than, it appears that airports do stimulate economic benefit. As one researcher concluded, "airports do not merely involve travel; there are implications for urban development, pollution, noise, and industrial activity," (Walters, 1978). Since 1970, there has been an alarming need for airport officials to "justify" airports on the basis of economic contribution to a community so as to prove worhtiness for continued receipt of community resources and services. The Air Transport Association of America (ATA) was instrumental in the initiation of several benchmark impact studies for major hub airports (Foster, 1972), including Los Angeles, New Orleans, Kansas City, Pittsburgh, Denver, Chicago, and San Francisco. Some of the larger airports embarked on such benefit assessments as a foundation of public relations programs to facilitate communications between airports and communities.

The need for such visibility transcends the single airport and many states have undertaken state-wide economic benefit studies that not only include the assessment of airport economic impacts but analyze the total aviation industry, i.e., government, manufacturing, business, tourism, etc. (Aviation Association of Indiana, Inc., 1984, Pennsylvania Department of Transportation, 1983, and Florida Department of Transportation, 1983).

The early efforts of the ATA to bring airport economic impacts to the forefront of community attention laid down a study framework, a pattern from which most subsequent studies based their research procedures. To the greater extent the ATA methodology was adopted as the quasi "industry standard" by other trade associations and even some Federal Aviation Administration regional offices (U. S. Department of Transportation, n.d., AAAE, 1981, and AOCI, 1979). Over time new adaptations in research methodologies have evolved but regardless of the many and varied methodologies used to assess economic impacts it can generally be stated at this time that yes, airports do have a major impact on a community in which it is located. What was eluded to over a decade ago (Jerome and Nathanson, 1971) has been tested and that direct causal links can be identified between airport development and community economic growth. In addition, (Sincoff and Dajani, 1975) concluded in their past research that airports do impact community and industrial development but not exclusively. It has also been concluded that commercial viability of an airport is not the sole criterion in airport planning; that benefit extends way beyond airport "profitability" (Rudzinski, 1971). However, airports in and to themselves are not the sole reason for growth and if not fully integrated into community planning can stimulate detrimental economic effects (Hoare, 1973).

To undertake an economic impact study of any given airport requires time, skills, and money. Most of our nation's airports cannot muster the necessary resources to accomplish such studies but could greatly benefit by having the specific information for their particular airfield. Therefore, the ability to generalize from much of the previous airport economic impact research could provide order of magnitude estimates of impact to non-studied airports. The purpose of this paper is to determine if the results of previous research can be adapted to provide airports with estimates of economic impact using generally available site specific operational data. The intent of the study is not to devise a complete solution but to test the feasibility of the hypothesis and present preliminary results. The final goal in the line of research is the development of a national formula(s) in which a local airport can enter its own operational data and arrive at order of magnitude estimates of economic impact that it has in it's community.

Method

Subjects

The subjects for this study were the 119 airports comprising the Illinois public and private airport system. Data were derived from two secondary sources as developed by the Illinois Department of Transportation, Division of Aeronautics. Economic data were obtained from The Economic Impact of Aviation in Illinois (Egeberg, 1984) summarizing a state-wide survey research project conducted for the 1982 base year. Airport operational data was derived from the Illinois Airport Inventory Report for 1982 through 1984.

The Egeberg study developed estimates of airport economic impact for each of Illinois' airports using previously developed methodologies from many of the past studies. Similar studies have been undertaken for Arizona, New Jersey, Florida, South Carolina and

Iowa. The Illinois study reviewed four major components of the state's aviation industry, 1) airports, 2) federal government airports and facilities, 3) aviation related manufacturing, and 4) aviation education. This analysis will only focus upon the airport component of the industry.

Procedure

A data set was created which captured economic and operational information for each Illinois airport. The elements included:

- airport name
- airport type
- direct economic impact
- indirect economic impact
- induced economic impact
- total economic impact
- employment[1]
- annual operations
- based aircraft - helicopter
- based aircraft - glider
- based aircraft - single-engine
- based aircraft - multi-engine
- based aircraft - jet
- based aircraft - military
- based aircraft - total
- annual enplanements

The data set was segregated into to basic categories by airport type, airports with commercial enplanements ($\underline{n}$ = 17) and those without ($\underline{n}$ = 101). Thus the two categories of airports were defined as commercial and non-commercial airports. One airport was eliminated from study

[1] Employment considers both fulltime and part-time individuals. Employment includes direct airport employees as well as employees from fixed based operations and tenants (airlines, restaurants, business parks, National Guard, FAA towers, Flight Service Station, GADO, etc.).

due to inconsistent data. See Exhibit 1 for a profile of Illinois airports under study.

Insert Exhibit 1 about here.

The data were analyzed using multiple correlation and regression statistical techniques. The SAS (SAS Institute, Inc., 1982) computer system software was used to conduct the analysis. The STEPWISE procedure was used to determine from the many independent variables (X_i) which should be included in a regression model that accounts for the variability in the dependent variable (Y_i), an airport's total economic impact. The basic multiple regression model is described as:

$$Y_i = B_1 X_{i,1} + B_2 X_{i,2} + \ldots + B_k X_{i,k} + E_i, \quad i = 1, 2, \ldots, N$$

where:

Y_i = ith dependent random variable corresponding to $X_{i,1}, \ldots X_{i,k}$

$B_0, B_1, B_2, \ldots B_k$ are (k + 1) parameters in the model

$X_{i,j}$ = ith level of the jth independent variable, j = 1, 2, ... k

E_i = random error term.

Results

Several exploratory regression models were developed to acquire a "feel" for the interactions of the independent variables. The main emphasis was to determine the level of detail within the independent variables that could be used. For example, should the detailed description of based aircraft by type be used as six independent variables or is the single variable, total based aircraft, sufficient. It was found that the detailed scenario produced some misleading results caused from the development of several negative regression coefficients. A negative coefficient implied, for example, that for each additional helicopter based at an airport negative economic impact was generated. Reality suggests that this is not a true happenstance. Reality suggests that all coefficients should be positive. As a result, a less detailed approach was taken in describing airport operations.

The basic models that were tested consisted of the following components:

<u>Non-Commercial Airports</u>

Y = Total Economic Impact

X_1 = Employment

X_2 = Total Based Aircraft

X_3 = Annual Operations

<u>Commercial Airports</u>

Y = Total Economic Impact

X_1 = Employment

X_2 = Total Based Aircraft

X_3 = Annual Operations

X_4 = Annual Enplanements

The results indicate that the best single variable that explains the variability in total economic impact is employment for non-commercial airports and annual enplanements for commercial airports. There is a strong relationship between dependent and independent variables.

Correlation coefficients are 0.924 between total impact and employment for non-commercial airports and 0.999 between total impact and enplanements for commercial airports. For commercial airports there is also a strong relationship between total impact and employment (*r* = 0.998) and total impact and annual operations (*r* = 0.947). The magnitude of the coefficients describe nearly a direct relationship between variables. The results of the single variable models are shown in Exhibit 2.

Insert Exhibit 2 about here.

The SAS STEPWISE procedure produced the best multiple regression models for estimating total economic impact. For commercial airports a trivariate model produced an R^2 of 0.9999 and a C(p) of 3.25. The equation is shown below:

Total Impact ($) = 10,524,580 + 65,177(Employment) + 121,722(Total Based Aircraft) + 182(Annual Enplanements)

This equation accounts for over 99.99% of the variability in total economic impact. There appears to be a very strong relative linear relationship between total economic impact and employment, total based aircraft, and annual enplanements in these sample data. A bivariate regression was developed for non-commercial airports. This equation produced an R^2 of 0.8577 and a C(p) of 4.00. The equation is shown below:

Total Impact ($) = 1,068,779 + 326,968(Employment) + 37(Annual Operations)

This model is not as "strong" of a predictor as the equation accounts for 85.77% of the variability in total economic impact. Yet the R^2 value is relatively high in statistical terms. F-tests indicate that both equations are significant at the 0.0001 level. As a result the regression equations developed are deemed useful for estimating total impact for the range of variables examined.

Discussion

The results that have been developed are two mathematical equations that can be used to predict order of magnitude total economic impact for an airport given the specific airport operational data. Airport officials can now mathematically see the relationship between economic impact and their day-to-day environment of employees, based aircraft, enplanements, and operations. The results can also be used to generate growth strategies for airports and communities. For example, in a non-commercial, general aviation setting, the equation indicates that the addition of one airport related job is the same as attracting an additional 8,837 annual operations, they both produce the same effect in the community as a change in total economic impact; all other things remaining equal. Similar trade-offs exist between the variables within the commercial airport regression equation.

One also could conclude that if a community did not have a small general aviation airport and desired such a facility that the expected annual total minimum impact would be approximately $1,000,000. This assumption is arrived at by observing the constant term within the non-commercial airport regression equation and assuming the hypothetical situation of an airport with no employment and no annual operations. Although the scenario is unreal, the constant describes a base situation. In addition, some 76% of the impact is felt within a 10-mile radius of the airport (Economic Research Associates, 1982).

The findings from this study are promising but have limited usefullness until the research is taken some steps farther. The models need to be verified using other studies' findings. The models are however valid for the state of Illinois and could be used today to estimate impact in 1982 dollars. The results would just have to be indexed to current dollars. In addition, the data set should be expanded to include as many data points as possible from which to generate new regression coefficients. The dependent variable might be changed to direct economic impact or the combination of direct and indirect instead of total. This would neutralize the regional economic multiplier differentials that occur in the different parts of our country.

The broad definition of employment used in the Egeberg study should possibly be adjusted to a narrower definition of direct employment (on-field employment) that only includes employees directly related to the operation and maintenance of aviation on the airfield.

The presence of Chicago - O'Hare International Airport as a data point within the commercial airport data set may have caused some unusual results. As O'Hare is the busiest airport in the world it is an outlier point in the data. O'Hare's impact and operational statistics are much greater than the other 16 commercial airports by many orders of magnitude. In Exhibit 2 the data point for enplanements is highlighted. To illustrate the difference all remaining data points are contained within the small black rectangle located near the origin of the equation line.

Finally, confidence intervals should be developed to show the range of the estimates derived from the equations. This would provide a range of impacts that would be more credible than one specific point estimate.

The research does indicate that there are some extremely strong relationships between economic impact and ordinary airport operational data. The models developed are statistically correct and prove useful although further development may be required. The goal of the phase of research has been achieved and there is no apparent reason to conclude that a national model could not ultimately be constructed.

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EXHIBIT 1

Profile of Illinois Airports 1/

Commercial Airports (n = 17)

Variable	Mean	Standard Deviation	Minimum	Maximum
Total Economic Impact ($)	$378,689,365	1,267,401,888	6,359,864	5,290,334,162
Employmemt (FTE)	1,699	5,056	12	21,222
Total Based Aircraft	99	69	2	269
Annual Operations	107,176	137,661	18,000	605,000
Enplanements	1,348,348	5,170,113	2,173	21,400,000

Non-Commercial Airports (n = 101)

Variable	Mean	Standard Deviation	Minimum	Maximum
Total Economic Impact ($)	$ 8,701,352	22,561,757	0	190,097,764
Employment (FTE)	20	61	1	446
Total Based Aircraft	53	83	0	534
Annual Operations	25,139	34,875	1,000	166,000

1/ Does not include military or government facilities.

Source: Illinois Department of Transportation, Division of Aeronautics, The Economic Impact of Aviation in Illinois, 1984 and Illinois Airport Inventory Report(s), 1981 - 1984.

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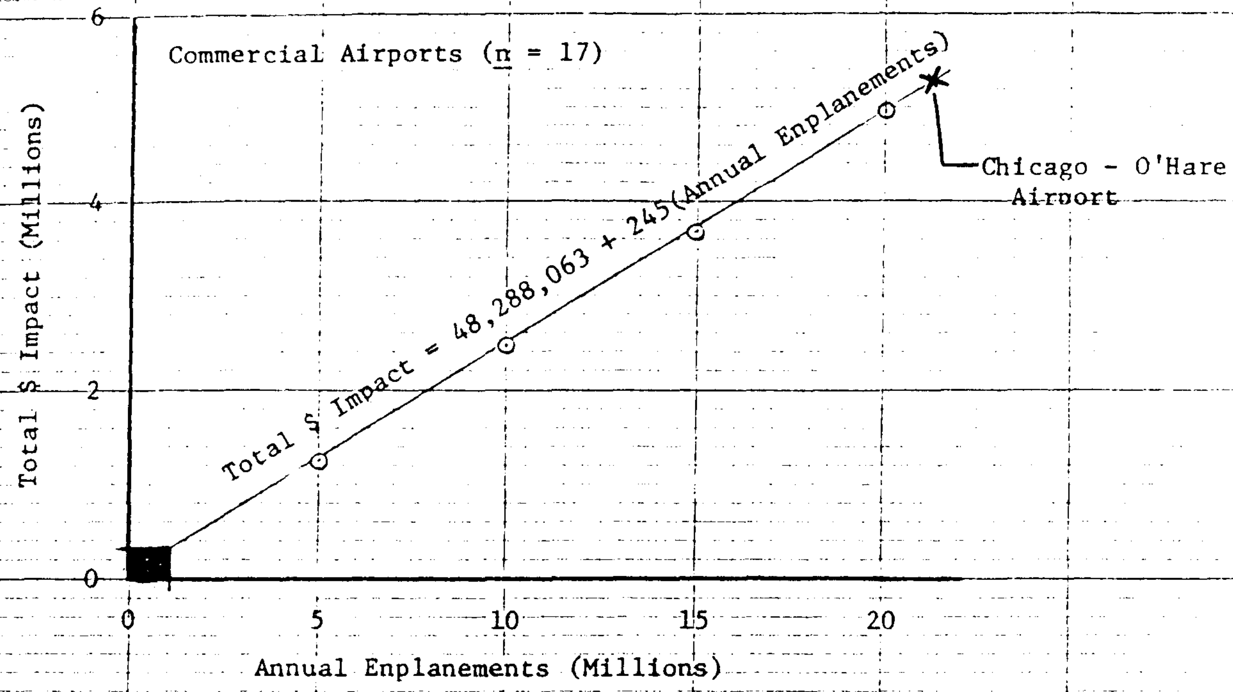
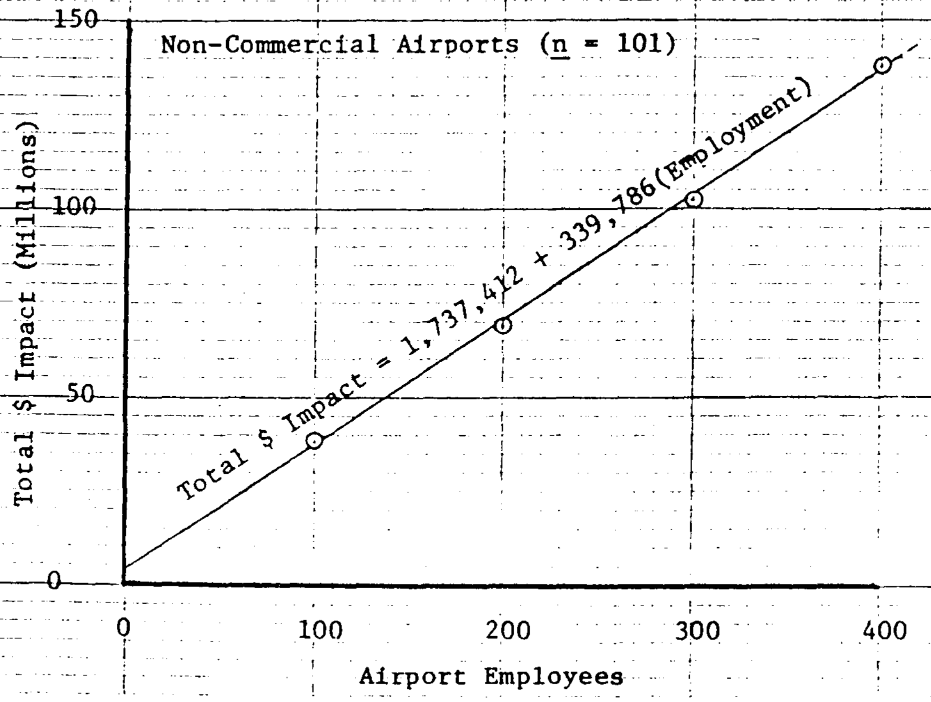
EXHIBIT 2

Simple Linear Regression Model





Organization and Management Techniques for Collegiate Flight Training Programs -- A Foundation for Improved Human Resources Management

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RUNNING HEAD: Organization and Management Technique

ABSTRACT

Whether an organization has one employee or 1,001, the effective and efficient use of time and effort is an on going challenge for management. The collegiate flight school is no different from any other business enterprise and is fertile ground for the implementation of many techniques of human resource management which have existed for sometime in the educational and business administration fields. Through an examination of several historically significant models and concepts that have been utilized to improve the productivity and health of the organization, it is the intent of this paper to equip the flight school manager with some effective "tools" with which to develop and sustain a happier and more viable unit.

Organization and Management Techniques for Collegiate Flight Training Programs -- A Foundation for Improved Human Resources Management

The effective and efficient utilization and management of human resources has become a challenge for managers in virtually any enterprise that involves the need for cost containment, operational efficiency, worker and client satisfaction, quality assurance, and production control. Collegiate aviation programs in general and flight training operations in particular all have need to meet the same goals and objectives.

The purpose of this document is to attempt to provide college/university flight training programs with ways to develop a better organizational climate and management team. The primary premise is that these tasks can be accomplished through the utilization of a number of techniques and practices that have, over a period of years, become common "tools" in the arena of business and educational administration. Through an investigation of many landmark management techniques, it is the intent of this study to provide the flight operations manager with a more effective and efficient method of organizing, operating, and evaluating operations within his/her span of control.

Particular emphasis will be placed on the Weberian Model of Bureaucracy, Theory X and Theory Y, the Managerial Grid, and Quality Circles. Even though many of these organizational models, techniques, and practices may be considered by some to be rather passe', they nonetheless may be utilized in whole or in part to advantage in many college and university flight training organizations.

Background

For the purpose of this discussion, a three tiered level of unit organization will be employed to exemplify a the collegiate flight training organization. The three levels include manager, worker, and product/client.

Manager

The management figure in such an organization may have the title of aviation department chair, coordinator of aviation, director of flight operations, chief flight instructor, or a combination of those descriptors. Whether the manager holds faculty rank or not will be dependent on the specific situation within each college or university and will not be considered as having an impact on this study.

The primary responsibilities of the manager are to supervise all flight operations, insure product (student) quality, certify training records, prepare budgetary reports, monitor the financial health of the operation, facilitate communication within the organization, and delegate any responsibility to subordinates that is appropriate. Such functions are consistent with the model proposed by Hersey and Blanchard (1982) that indicated that the process of managing includes planning, organizing, motivating and controlling.

Henri Fayol (1841-1925), a pioneer in scientific management, may have provided the basis for Hersey and Blanchard's four levels of duty. Fayol defined the management functions as planning, organizing, commanding, coordinating, and controlling (Hoy & Miskel, 1982). It is interesting to note that the notion that management had a role in motivation did not appear to be a consideration at that time.

As with any organization, the manager is usually accountable to someone above them in the structure; such a situation commonly exists in the collegial model. A customary title for the immediate supervisor may be chairperson, dean, coordinator, director, or quite possibly vice president. An important comment that is appropriate at this juncture is that although the university or college flight school exists in a scholarly environment, it is still with respect to organizational structure and quite often behavior a bureaucracy in the classical sense.

The challenge of such a situation is to take the best of the bureaucratic model and combine it with productive methods of team building while successfully operating in an academic setting. Accounting for so many variables such as these can be an extremely challenging situation.

It is important to note that in a very large academic organization, there may exist an intermediate level of management between the chief flight instructor and the flight instructor. An appropriate title at this level would be assistant chief flight instructor. Responsibilities of this position include many of those presently assumed by the chief flight instructor.

An additional factor that can have a significant effect on the management structure at all levels is whether the flight school is certified and operates under Federal Aviation Regulation (FAR) 141. While an indepth discussion of the implications of this FAR is beyond the scope of this study, additional information is available in AC-141-1 or FAR 141.1 (a) through (f).

Worker

The worker in the collegiate flight school is the flight instructor. The flight instructor has the direct responsibility for providing the necessary flight and ground instruction for students enrolled in training courses, maintaining training records, monitoring periodic equipment maintenance, preparing student charges, and any other duties specified by superiors.

Although it is customary for flight instructors to be employed full-time, many institutions have periodic need for additional part-time flight instructors or flight instructor assistants. If such a condition exits, the University Aviation Association (1976) in its College Aviation Accreditation Guidelines specifies the optimum qualifications for part-time positions as well as for full-time flight instructors.

Product/Client

The product of collegiate flight training programs is the flight student and that student's completion of the necessary training and acquiring the appropriate knowledge and skills to obtain flight and ground ratings. Included among these ratings are private pilot, instrument rating, commercial pilot, flight instructor, airline transport pilot, ground instructor, as well as additional aircraft category/class/type ratings.

While the completion of these goals is extremely quantifiable, the primary objective at all times is the quality of the product.

Organizational Analysis

Before any meaningful discussion of improving the management of human resources in flight training programs can proceed, a brief review of classical organization structure and how it relates to an academic setting may be meaningful. "Almost all modern organizations have many of the characteristics enumerated by Weber -- a division of labor and specialization, an impersonal orientation, a hierarchy of authority, rules and regulations, and a career orientation" (Hoy & Miskel, 1982, p. 81).

As collegial as most colleges and universities try to be, particularly with respect to shared governance, these basic Weberian principles are still extremely useful. All too often the existence of a bureaucracy has a less than desirable connotation. Contrary to many popular beliefs, however, such a structure should not be considered as counterproductive to that organization meeting its goals and objectives.

The problem in accepting that a bureaucracy exists seems to be that quite often Weberian concepts have not been defined in positive terms. It may be helpful then to examine how each of these concepts relate to the collegiate flight school.

Division of Labor and Specialization

No one person can be "all things to all people at all times." Accepting this as reality, the manager of the collegiate flight school must attempt to utilize each person in the organizational structure to their, and the organization's, best advantage.

The chief flight instructor, traditionally a "high-time" pilot and/or flight instructor is often too valuable to be relegated to giving only phase/stage checks for a major portion of the workday. This statement does not imply that expertise should not be utilized in the aforementioned areas but rather wishes to suggest that the best use of experience may be in the form of more supervisory duties and less mundane activities.

In a recent conversation with a chief flight instructor at a major Mid-West university, however, the need for the chief flight instructor to always maintain contact with the challenges of primary flight instruction was suggested as an important reason for such utilization. An additional component of such utilization would be that it would help to create a friendlier atmosphere between manager (chief flight instructor) and the client (student); the important issue is still to strive to maintain a proper balance.

Impersonal Orientation

Impersonal orientation is very much an accepted part of flight instruction. The bureaucratic employee, and the flight instructor, are expected to make decisions based entirely on facts and not on feelings.

Quite often, particularly in the case of a somewhat inexperienced flight instructor, the student and the instructor can become too personally involved for the instructor to make unemotional decisions. Such occurences must be handled carefully but expediently.

The flight instructor who "helps" the student too much or too often is in reality not helping the student at all. Flying requires, in addition to aeronautical skill and knowledge, a great deal of self-assurance and almost continuous decision making; the flight instructor must strive to develop these qualities -- being overly personal and too helpful can many times be very counterproductive. The relationship that must be strived for between the instructor and student is one of interaction ". . .without hatred or passion, and hence without affection or enthusiasm" (Hoy & Miskel, 1982, p. 81).

Hierarchy of Authority

The military refers to hierarchy of authority as "the chain of command" or more informally as the "pecking order." In more simplistic terms, such descriptors identify an organization in which each lower office is under the control and supervision of a higher one. Weber (1958) provided an interesting idea about hierarchy and levels of graded authority in that ". . .such a system offers the governed the possibility of appealing the decision of a lower office to its higher authority, in a definitely regulated manner" (p. 197).

Situations sometimes exist when working with flight students which require evaluation by a higher authority. An example of such a situation could be the need to evaluate unsatisfactory student progress. While this may be in reality not a common practice in many organizations, the need for phase checks, flight evaluations, or graduation certification is often an everyday occurrence in a flight school particularly one that is operated under FAR 141. The fact that the structure for such action is a function of the bureaucratic model, and is in place allows the operation of the organization to be maintained with a minimum of disruption.

Rules and Regulations

Functioning under many very specific rules and regulations seems to be a common situation in most flight schools. In their purist sense, rules and regulations provide continuity, coordination, stability, and uniformity -- this should not be thought of as dysfunctional.

Flight instruction, as well as the operation of the flight school itself, requires performance within many clearly defined parameters. Imagine a flight instructor or a primary flight student that did not know the required completion standards for a specific flight operation or maneuver! What should be cautioned against is the application of rules or regulations in such an extreme manner that what is really occurring is nothing more than disciplined compliance. "Such formalism may be exaggerated until conformity interferes with goal accomplishment" (Hoy & Miskel, 1982, p. 84).

Career Orientation

The opportunity to "move up" within an organization is usually an extremely positive incentive to any member of that organization. The collegiate flight school can exemplify that bureaucratic characteristic if one considers the opportunity to climb "career ladders" from flight instructor to assistant chief flight instructor to possibly chief flight instructor as a means to encourage employees and a way to enhance retention.

An additional incentive for a career orientation in an academic flight program can be in the form of increased pay for additional ratings or flight instruction hours given. The dysfunction in this bureaucratic trait is that conflict can often occur between achievement and seniority. The fact is that a flight instructor should not be rewarded solely on experience, the quality of the product (student) must always be factored into any decisions on promotion, retention, or recognition.

Toward Better Resource Management

Since the beginning of the scientific management movement over 80 years ago, the science of administration has evolved through three phases. Although these phases overlap somewhat, they can primarily be identified as the classical period which dates from Taylor's work in the early 1900s, through the human relations approach of approximately 1930, to the behavioral science school which became well established following World War II. Although each of these stages has had an effect on contemporary business practices, of foremost importance in human resources is the management behavioral school of thought.

Based on the work of Bernard, Simon, and others the behaviorists have provided the modern manager with many powerful tools and techniques with which to improve organizational health. Before a discussion of these practices can occur, some thoughts by Lehrer may be helpful.

> Every organization has a mission. It is its reason for being. Strategies and objectives are developed to guide the organization toward fulfillment of its mission. Conceptually, strategies and objectives are the basis for determining a set of functional specifications for accomplishing a mission. These specifications define the functional organization, which is translated into the formal organization by adding the physical dimensions -- mainly the human resources needed to perform the functions to achieve organizational objectives. (Lehrer, 1983, pp. 7-8).

The need to define the importance of the individual in terms of whether an organization achieves specific goals and objectives is one of the most important uses of management theory in general and resource management in particular. As previously stated, the need or even the desire to provide a motivational component in the management function did not exist until well into the 20th century.

The Hawthorne Study at the Western Electric Company's plant near Chicago in 1927 is considered as the landmark study in improving human relations in a work setting. Even though the intent of the original project was to determine the effect on productivity resulting from changes in work scheduling, rest periods, lunch breaks, and various industrial lighting arrangements, the resulting determination that production can be linked to other than tangible rewards was an important finding. Suddenly, the question of motivation or simply what makes people perform and either do or not do their job received considerable attention. Although the Hawthorne findings and the study itself may have been biased and flawed as suggested by Lee (1980), the fact that something increased employee productivity other than traditional rewards was an important result.

Since this document is attempting to make a case for better human resource management in a specific collegial organization, the assumption that a university flight school is no different than any other organization in terms of what makes people do what they do and when they do it must be strongly suggested. What makes a manager effective and an employee satisfied and productive in one organization is just as applicable to another setting. The question of why this occurs seems to hinge on the word "motivation", a more detailed examination of that phenomena is appropriate. McGregor (1967) found the following:

> Strictly speaking, man is by nature motivated. He is an organic system, not a mechanical one. Inputs of energy are transformed into outputs of behavior. We do not motivate him because he is motivated. The work of Maslow suggested that human needs are organized in a hierarchy with the physical need for survival at the base. Generally speaking, when lower-level needs are reasonable well satisfied, higher levels of need become relatively more important as motivators of behavior. (pp. 10-11)

McGregor's Theory X and Theory Y are well known postulations in management theory. What may not be well known is the fact that ". . .Theory X and Theory Y are not managerial strategies: They are underlying beliefs about the nature of man that influences managers to adopt one strategy rather than another" (McGregor, 1967, p. 79). What must be gained from an investigation of McGregor's work is that people are different with respect to the view that they have concerning organizational productivity and how they fit into the scheme of that unit meeting its goals and objectives.

What motives each individual, whether manager (chief flight instructor), employee (flight instructor), or client (flight student) can and usually is very different. Some of the more commonly accepted motivators are survival, security acceptance, approval, belonging, control, caring, and money.

Blake and Mouton (1978), in The New Managerial Grid, offer many valuable insights concerning how a manager can, by using a grid system based on task behavior, relationship behavior, and the maturity of the followers, motivate organization members to increase productivity and effectiveness. While the managerial grid identified many of the important components in the scheme of motivating followers, the grid shoûld not be thought of as a rigid constraint but should be used in concert with a flexible managerial style commonly referred to as situational leadership.

Situational leadership stresses that ". . .there is no one best way to influence people. . .; which management style a person should use with individuals or groups depends on the maturity level of the people the leader is attempting to influence" (Hersey & Blanchard, 1982, p. 151). In reality, the management style of the leader can include telling, selling, participating, and delegating. It does not take a great deal of imagination to see that each of these styles is applicable almost every day in flight training operations -- the trick is to know when and with whom to use each of them!

A great deal of excitement as well as concern has been apparent in this nation's industrial community with respect to the quality of products that have been coming from foreign, and particularly Japanese, manufacturing concerns over the past 10-20 years. It seemed that American buyers have been quick to purchase automobiles, cameras, electronic gear, and countless other hard goods that were perceived to be better as well as cheaper than those manufactured in this country. The question that needed to be answered was how could an industrial power like the United States be beaten so handily at its own game.

As a result of extensive investigation by American educational and business scholars, it was determined that an unusual relationship existed between Japanese employer and employee. The unifying force was Theory Z.

Theory Z advocates ". . .contend that the Japanese quality edge comes from a management style based on trust and on worker involvement in decisions that affect the product. . . .the assumption is that workers have ideas and if those ideas are heard and used, the result will be a more satisfied, motivated, and productive workforce" (Nichols, 1984, p. 72). This description does not imply that Theory Z, informally called the quality circle, is a loosely organized discussion group; on the contrary, a quality circle is a highly structured activity that is taken quite seriously by all participants. Could this work in higher education flight training program?

Many activities similar to a quality circle have been a part of most academic flight schools for some time. Whether it is called a staff meeting, a breakfast discussion group, or any of many other names, the nucleus is present -- the structure may not be developed. In addition, the collegiate community has one of the largest collections of intelligent as well as creative people as any manager could hope to have in any organization -- better utilization of these talents could provide large dividends.

Conclusions

This document is not attempting to serve solely as a model for the "ideal" collegiate flight training program; as noble as that would be, too many variables exist within the unique constraints of any one organization for that to happen. There are many other theories and techniques that could be effective with the university or college flight school and should be investigated.

Of particular interest for additional reading may be the work of Katz and Kahn (1978), Fiedler's (1967) Leadership Contingency and Situational Leadership, the

Immaturity - Maturity Theory as developed by Argyris (1971), Herzberg's (1966) Motivation - Hygiene Theory, the work of Odiorne (1971) with Managing by Objectives, or the Likert (1967) Four Systems. While there are other authors that are important; the idea is to become better acquainted with many of the business/educational administration models and techniques that are available and then to apply those that seem most appropriate. The results could be a much more effective and efficient organization.

Why should a person administering a flight school expend the time or effort for such a project? Because a flight school is in reality a business. A college or university flight school many times can be considered as "big" business (it is not uncommon for the cash flow for a large operation to extend well into the millions). The trap is that because such an organization exists in a community of scholars, management often loses slight of the fact that it is still a business and must be operated as such an organization.

Academe is not so different from this nation's business world. Our products, and therefore, our management needs improvement. Aviation and flight training are just as in need of the same attention except that the effects of anything less than our finest effort can have a far reaching impact.

(Art/Pub7)

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OBTAINING AND ANALYZING

AVIATION INDUSTRY EMPLOYMENT DATA

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ABSTRACT

Obtaining and Analyzing
Aviation Industry Employment Data
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According to the author's review of a multitude of sources, there are 2,074,190 people working in the civilian aviation industry in 1985. However, in arriving at this figure, 18.7 percent of the data utilized are estimates and not actual counts. Other problems noted in arriving at this estimate include the fact that there is no consistent, across-the-board source of aviation industry employment data. Finally, there are key segments of the industry which do not keep employment statistics for themselves: general aviation, regional airlines, most of government aviation below the federal level, and such miscellaneous aviation related employers as travel agencies.

The author suggests three things to help improve the aviation industry employment data base. First, aviation educators must become more familiar with the present data and its limitations. Second, aviation educators should strive to undertake research projects to establish base data in those parts of the aviation industry where only estimates are possible today. Finally, the aviation industry is encouraged to track its own employment information in order to contribute to better preparation of its employees through aviation education.

Introduction

Article titles like "Pilot Hirings in June Continue at Record Level"[1] and "Pilot Pool is Drying Up"[2] indicate just how the general economy and the aviation industry have changed in the past few years. In a way, it is good, even great news to aviation educators, to hear that the aviation employment market just might transition from a "buyers" market to a "sellers" market. However, before any aviation educator jumps to a conclusion, it is important to provide a framework to analyze the situation. In fact, it is also important to identify data sources for an analysis of the aviation industry employment market. Therefore, once a basic definition of the aviation industry is provided, this paper will describe selected sources of nationwide aviation industry employment information. A secondary thrust of the paper will be to present and qualitatively analyze some of the general employment information shown in these sources for the five key aviation industry segments. A third thrust of the paper will be to focus on some of the problems in analyzing some of the data sources. Finally, some conclusions will be drawn from the analysis presented concerning overall aviation industry employment information sources and trends.

The Aviation Industry

The first task of this paper is to present an overall framework for the analysis of aviation industry employment information. This framework is a basic definition of the aviation industry. For the purposes of this paper, the aviation industry is described in the following manner:

1. The aviation industry includes only civilian aviation, including Department of Defense (DOD) contractors, but omitting the military itself;

2. The civilian aviation industry is made up of five components.[3]

   A. Aviation/Aerospace Manufacturing - Civil (airline and general aviation), military space.

   B. Airlines - majors, nationals, regionals, all cargo.

   C. General Aviation - not including manufacturing, including all flying except that done by the military and by the scheduled airlines.

   D. Government - Federal (Federal Aviation Administration, National Transportation Safety Board, etc.), State and Local.

   E. Miscellaneous: Travel Agents, Consultants, Industry Associations and Supporting Industries for the Aviation Industry.

Sources of Aviation Industry Employment Information

Industry-wide aviation employment information is available at varying levels of quality for each of the four industry segments. Generally, there are industry-wide associations/lobby groups representing the industry segments, or major portions of each of them, which have data available. The information available from these industry associations is generally "order of magnitude" information. These industry associations are, therefore, not placement centers or employment clearing houses. Instead, they merely are presenting these data for public information purposes.

1. Aviation/Aerospace Manufacturing. The best source for industry-wide employment information for aviation/aerospace manufacturing is the

Aerospace Industries Association of America (AIAA) of Washington, D.C. This industry association distributes statistical reports and issues a periodical entitled Aerospace in which it's employment information is presented. The most recent information from AIAA indicates that there are 1,252,000 employees involved in Aviation/Aerospace Manufacturing.[4] Among the largest of the individual companies in this segment is Boeing, with employment in excess of 120,000 (or about ten percent of the segment total). The source for this information is the company itself,[5] although individual company employment information is usually available from annual reports or from such financial industry sources as Moody's and Standard and Poor's.

2. Airlines. There is an excellent source of employment data for the airline segment of the aviation industry, the annual report of the Air Transport Association of America (or ATA). This source reports a 1984 airline employment figure of 345,079[6] for its 29 ATA member airlines.

The following table shows the composition of the ATA employment figure:[7]

Pilots and Copilots	29,962
Other Flight Personnel	7,035
Flight Attendants	60,251
Communications Personnel	764
Mechanics	42,558
Aircraft/Traffic Servicing	100,621
Office Employees	72,369
All Others	31,519
	354,079

In addition to the ATA estimate, which includes the vast majority of major and national airlines, one must also count employment figures for several excluded categories of airlines. These are:

A. Large and Medium Regional Airlines. ATA estimates employment in this category in 1983 at 12,998,[8] but did not provide a 1984 estimate. Becuase of general industry growth in 1984, the author places the 1984 figure at 14,000.

B. All Cargo Airlines. While figures for three all cargo airlines are included in the ATA figures, the majority of such figures are not. Chief among the excluded airlines are Airborne Express, United Parcel Service and DHL Express. The author estimates all cargo airline employment at 10,000 plus the figures already counted for Federal Express, Flying Tiger and Purolator Courier.

C. Excluded National and Regional Jet Carriers. Chief among the airlines in this category are Southwest, America West, New York Air, People Express, Trans America Air and World. This figure is placed at 13,083.

Combining these additional estimates with the ATA figure gives a total airline employment figure of 382,162.

3. General Aviation. For an estimate of employment in the general aviation segment, the General Aviation Manufacturers Association (GAMA) of Washington, D.C. was consulted. They prepared an estimate for an overall public relations brochure in 1979 of 300,000[10] including manufacturing employment (which was counted in the earlier AIAA estimate). Excluding manufacturing employment from the GAMA estimate, there are a total of 240,000 people working in the general aviation field. This figure is composed of the following types or categories of work:

80,000	Sales, Service
20,000	Agricultural
45,000	Corporate Flight Departments

15,000	Industrial Special Uses (pipeline patrol, etc.)
15,000	Self-employed
65,000	General Aviation Sub-components (tires, etc.)
240,000	

4. Government Aviation. The primary federal government agency associated with aviation is the Federal Aviation Administration with an employment total of 45,873.[11] Other federal agencies with significant aviation-related employment are the National Transportation Safety Board, the Department of Defense (particularly civilian employees of DOD on military aviation installations and in Washington, D.C.), Department of Transportation - Office of the Secretary, Department of Interior - Forestry, U.S. Postal Service, and several other federal agencies.[12] Combined employment at these agencies is estimated by the author to be about 10,000 aviation-related people.

The states are also heavily involved in aviation. Several states operate significant parts of their airport systems, notably Hawaii, Maryland, and Rhode Island. Also, 48 of the 50 states have some form of statewide aviation safety regulation including a statewide aviation or aeronautics agency, division or department. Representing these state agencies is the National Association of State Aviation Officials (NASAO), which estimates state aviation employment totals at 1679.[13] The author estimates that another 321 employees are employed at state agencies not covered in the NASAO estimate.

Local governments have an important role in aviation because they operate a majority of the 5000-plus publicly-owned airports in the nation. Some of these local governments employ no aviation-related employees while others employ in the thousands. Most of these people are operations personnel, crash-fire-rescue personnel and other support workers. Management personnel represent a relatively small number of these jobs--probably ten percent or so of the estimated 20,000 people working at local government operated airports. The best information available regarding local government aviation employment data is from the American Association of Airport Executives membership roster and from Air Transport Association studies of the economic impact of individual airports.

5. Miscellaneous. This is the portion of the aviation industry which provides needed support. For example, 13,000 travel agencies nationwide help to market airline services, consultants provide engineering, planning and construction support for airport expansion, industry associations help to lobby for the industry and related industries such as various suppliers, food service companies and travel-related businesses (such as hotels and rental car companies) have aviation-related employees. There are also those of us who are aviation educators! Author's estimates for each category are as follows:

Travel Agenices	104,000[14]
Consultants (includes construction)	10,000
Industry Associations	500
Related Industries	5,000
Aviation Educators	600
Total	120,100

This total figure is only a rough estimate and may change depending upon the definition and further research of the various categories.

Problems with the Data

In compiling the data (see Figure 1) for this report, a number of problems surfaced regarding the quality of aviation industry employment data:

1. There is no consistent, across-the-board source of aviation employment data.

2. Some of the industry segments and sub-segments do not maintain employment data. Notably the problems are:

   A. General Aviation.
   B. Regional Airlines.
   C. Most of Government Aviation below the federal level.
   D. All of the miscellaneous categories (especially travel agencies).

3. It is difficult to compare the existing available data because of variation in how and when the data are collected. Approximately 81.3 percent of the data are directly from industry sources while 18.7 percent of the data are industry or author's estimates. Even the direct industry sources are partial in their coverage or collected irregularly.

4. There are no available forecasts of aviation industry employment data, for the industry as a whole, by segment or by sub-segment. This lack of an available forecast information is understandable since there is firm current data for only a portion of the industry. This lack of available employment forecast information does not preclude such forecasts being made, either on a quantitative or qualitative basis. However, such forecasts must be made with recognition of the limitations in the data base.

There are certainly several bright spots in this "forest" of problems with aviation industry employment data. For example, the Air Transport Association's airline data captures a vast majority of airline employment and their employment data base goes back in time for several decades. Also, the Aerospace Industries Association of America data base has been maintained for years and is considered a strong representation of the aerospace/aviation industry segment. Finally, the Future Aviation

Professionals of America maintain a very strong data base concerning pilots, flight attendant and, more recently, mechanic hiring. Such efforts should be duplicated in the other aviation industry segments and sub-segments.

Recommendations

1. In order for aviation educators to be equipped with the best information possible to provide their students and graduates, it is recommended that aviation educators become more familiar with the existing data and its limitations.

2. Aviation educators are also encouraged to work with industry segments and sub-segments in researching aviation employment data. Aviation educators can help industry establish stronger employment data bases through cooperative research.

3. The aviation industry is encouraged to track its employment information in order to provide the information necessary to understand its manpower trends and needs by segment and by sub-segment. Understanding these trends and needs will assist aviation educators in their efforts to prepare future employees for the aviation industry.

Summary

According to the data presented in this paper, the civilian aviation industry employs approximately 2,074,190 people in five key industry segments. Of this total employment figure 81.3 percent of it is based on industry data, 16.6 percent of it is based on industry estimates and 2.1 percent of it is based on the author's estimate. Even though there are a large number of existing industry data sources covering 97.9 percent of the aviation industry employment (see Figure 2), formats and data management methods vary widely. This lack of consistency in the data, leads to difficulty in using the data. Also, no one has ventured into the area of forecasting aviation industry employment data, possibly because of the weak base data.

Based on the relatively large percentage of aviation industry employment data which must still be estimated, there is indicated a need for further research to establish a solid aviation industry employment data base. Once these data bases are established, it will be much easier to monitor past trends, establish current needs and develop forecasts of future aviation industry employment.

FIGURE 1

AVIATION INDUSTRY EMPLOYMENT DATA

ARRANGED BY SOURCE

	Industry Data	Industry Estimate	Author's Estimate	TOTALS
Manufacturing	1,252,000	--------	--------	1,252,000
Airlines				
ATA Members (minus all cargo)	291,427	--------	--------	291,427
Regionals	12,998	--------	1,002	14,000
All Cargo	53,652	--------	10,000	63,652
Others	15,138	--------	--------	15,138
General Aviation (minus manufacturing)	--------	240,000	--------	240,000
Government				
Federal Aviation Administration	45,873	--------	--------	45,873
Other Federal	--------	--------	10,000	10,000
State	1,679	--------	321	2,000
Local	13,147	--------	6,853	20,000
Miscellaneous				
Travel Agents	--------	104,000	--------	104,000
Consultants	--------	--------	10,000	10,000
Industry Associations	--------	--------	500	500
Supporting Businesses	--------	--------	5,000	5,000
Aviation Educators	--------	--------	600	600
TOTALS	1,685,914	344,000	44,276	2,074.190
	81.3%	16.6%	2.1%	100%

FIGURE 2

SUMMARY OF
AVIATION EMPLOYMENT DATA SOURCES

Aerospace/Aviation Manufacturing

Aerospace Industries Association of America
General Aviation Manufacturers Association
Individual Company Annual Reports

Airlines

Air Transport Association of America
Regional Airline Association
Individual Company Annual Reports
Future Aviation Professionals of America

General Aviation

General Aviation Manufacturers Association

Government Aviation

Federal Aviation Administration
National Association of State Aviation Officials
American Association of Airport Executives

Miscellaneous

American Society of Travel Agents

FOOTNOTES

[1]"Pilot Hirings in June Continue at Record Levels," Aviation Daily, July 1, 1985, p. 2.

[2]J. A. Donoghue, "Pilot Pool is Drying Up," Air Transport World, June 1985, pp. 32-35.

[3]This general aviation industry overview was originally presented in David A. NewMyer, "Aviation Industry: An Employment Outlook" in the Summer 1981 Journal Studies in Technical Careers, pp. 289-296.

[4]Aerospace Industries Association of America, "Aerospace Economic Indicators," Aerospace Washington, D.C.: AIAA, Spring 1985, p. 17.

[5]Telephone interview, Boeing Public Relations Department, June 27, 1985.

[6]Air Transport Association of America, Air Transport 1985, Washington, D.C.: ATA, June 1984, p. 7.

[7]Ibid.

[8]Air Transport Association of America, Air Transport 1984, Washington, D.C.: ATA, June 1984, p. 7.

[9]Ziff-Davis Publishing, World Aviation Directory Winter 1984-85, pp. 6-46.

[10]General Aviation Manufacturers Association, The General Aviation Story, Washington, D.C.: GAMA, 1979, p. 9.

[11]Federal Register, Vol. 48, No. 137, July 15, 1983, p. 32492.

[12]Walter Zaharevitz, "Aviation Career Series: Government" Aviation Education, Washington, D.C.: DOT/FAA, 1976, pp. 22-25.

[13]Letter from Jean R. Lloyd, National Association of State Aviation Officials, January 1980.

[14]Telephone conversation, Public Information Office, American Society of Travel Agents, July 16, 1985.

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AVIATION TECHNICIAN EDUCATION

AND

THE UNIVERSITY CURRICULA

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ABSTRACT

In this paper, the author discusses the responsibility for aviation technician curricula. By examining the legal basis of technician school regulation, he shows the scope and limitations of the FAA involvement in school operations.

He then addresses problems that are often cited involving Part 147 approved programs. Is Part 147 restrictive, and what should be taught, and to what depth. Citing various regulations, surveys, and a series of recently completed Part 147 workshops, he shows that these do not have to be problems.

Suggestions for upgrading technician education programs are then given, including accreditation, industry involvement and support, less dependence on the FAA, and a unified approach to all aviation education.

INTRODUCTION

The technology of aircraft has advanced at a very rapid pace during the forty years since World War II. As a result, the ability of aviation technician education to meet current technological needs has become a subject of controversy. Many contend that the Federal Aviation Administration (FAA) and Federal Aviation Regulation (FAR) part 147 constitute an obstacle in this regards. Others feel that the aviation industry and/or the schools are guilty of failing to keep curricula up to date. There is general agreement that maintaining up-to-date curriculua is a problem. However, there has been little positive action taken toward formulating a solution.

This paper will summarize the legal basis and history of the development of aviation technician school regulation. It will examine the following questions: Does the FAA, with part 147, act as an obstacle to having current curricula? To what level should a person be trained to become a mechanic? And, what role should industry play in the education process? Suggestions will be made of what possible action schools might take to upgrade technician training, especially those schools at the university level.

* * * * * * *

The FAA requires that all persons performing, supervising the performance of, or approving aircraft maintenance for return to service be certificated. They also require schools preparing individuals for this certification be certified in accordance with FAR part 147. To properly understand part 147, it's legal basis and that of the school product, the A & P mechanic, should be considered.

The FAA receives its authority from congressional legislation, the

FAA/DOT act. This act charges the FAA with promoting the safety of flight by prescribing and revising reasonable rules, regulations, and minimum standards. These rules, etc., are to govern all aspects of what is commonly called aircraft maintenance(1 - sec. 601(3)). The FAA is also empowered to issue airman certificates for those doing such work. In addition, they have the authority to examine and certify schools giving instruction to those pursuing such certificates(1- sec. 607). It is clearly stated that the purpose of such regulation is to provide for safety and must be in the public interest.

The congressional mandate has been answered by the formation of various rules, regulations, or minimum standards. These are Title 14 of the Code of Federal Regulations and are commonly known as the Federal Aviation Regulations.

FAR part 65 (subpart D) sets the requirements for certification, and the privileges and limitations of an A & P(2 - p 7). Certification is achieved by passing written, oral, and practical examinations covering material in each of 43 subject areas. To be eligibile to take these tests the applicant must be a graduate of a certified school, or have 30 months of appropriate experience in aircraft maintenance. Once certified the mechanic has broad privileges. Unlike some aviation personnel, the mechanic does not have type ratings or the requirement for personal experience records. He has the privilege of performing work on any type of aircraft. Before approving any work for return to service he must have previously demonstrated his ability to do such work (2 - sec.65.81). This demonstration of ability can be to another mechanic and does not require documentation. The question of ability is dependent upon the integrity of the mechanic. Does he know what he is doing? Does he have the pertinent information and tools? Has he done it before? It should be noted that major repairs, major alterations, and annual inspections require inspection authorization before approving for return to service. This authorization requires three years experience as a mechanic and an additional written examination. It should also be noted that air carriers, repair stations, and certain other operators are required to have their own approved operating procedures for aircraft maintenance. When working in those operations the mechanic will be performing under their rules and not necessarily under the privileges of his certificate.

The newly certificated mechanic finds a broad area of employment available. Bush flying in Alaska, helicopters on the gulf coast, agricultural aviation, air carrier, corporate aviation, general aviation, or aircraft manufacturing offer equal opportunity as far as his certification is concerned. This breadth of opportunity raises the question of how does the FAA ensure that a person is properly qualified to perform as a mechanic. An answer can be found in the interpretation of "qualified" and "perform". By law the FAA can only prescribe regulations necessary for safety. The examinations required by part 65 are therefore limited in each of the 43 subject areas. The applicant is tested to assure that he has an appropriate level of knowledge and skills to perform safely as an entry level mechanic. Controversy exists in that many feel that the entry level mechanic should be an immediately productive employee. Since the regulation speaks to safety and not productivity, the FAA is limited to requiring only minimums necessary to ensure safety.

The school regulation, part 147, parallels this philosophy. Part 147 requires that a certificated school teach at least the appropriate level of knowledge and skills that will allow the graduate to perform safely as an entry level mechanic. Part 147 also prescribes operating rules within the school to ensure that the quality and quantity of education are achieved. It should be noted that a graduate of a certificated school still must be examined under the provisions of part 65.

The current era of technician training began on May 2, 1970 when a major revision of part 147 became effective. A major part of this revision was based upon a survey conducted in 1965 by a national advisory committee. This was the first of three phases of "A National Survey of Aviation Mechanics Occupation". The survey was under the direction of Dr. David Allen, of UCLA, and is commonly referred to as the "Allen Study".

In phase I the committee conducted a survey of mechanics working in the field. Fifty-two tasks or areas were identified and 401 companies, representing over 18,000 mechanics, were surveyed (3 - p 26-29). The survey was concerned with the number performing each task, the frequency of performance, the knowledge and skill level required, the time factor involved in the task, and the amount of industry training available. This data was analyzed and a suggested core curriculum (subject matter and level) developed for aviation mechanic training. This material was utilized by the FAA in determining the curriculum subject and level requirements of the revised part 147.

The Allen Study in phase II identified, through experimental research, ways to implement the core curriculum utilizing current instructional techniques (4 - pl).

Phase III of the Allen Study consisted of two parts. The first involved teacher training and curriculum development based upon the results of phases I and II. The material from phase III was intended to serve as a model curriculum which would comply with revised part 147. The individual school was expected to make modifications or adaptations which would be necessary to meet their own needs (4 - pl).

The second part of phase III consisted of a resurvey of 30% of the original companies surveyed in phase I. The objectives were to update the core curriculum and to test a method by which the FAA could update it periodically. In relation to the latter it should be noted that Dr. Allen conducted a resurvey in 1973 (5). Little attention appears to have been given to either of these resurveys.

A major provision of the revised part 147 was that all schools then certificated, were to be recertificated by May 1972. It was during this period that the Allen Study, Phase III - Model Curriculum, was mistakenly interpreted by many as the only way to comply. This misinterpretation, which still exists today in many areas, has cast a negative image on the entire Allen Study. Because of this image the Allen Study's full potential has never been realized.

Part 147 is basically the same today as in 1970 as only minor changes of an operational nature have been made.

The validity and relevancy of part 147 has frequently been questioned. As the decade of the 1970s drew to a close questions became more frequent. The question of when is the FAA going to update part 147 was often asked. After having indications that revision and updating were imminent, the Aviation Technician Education Council (ATEC) was surprised to learn that nothing was planned. At the 1982 ATEC Conference, Leo Weston of the FAA Airworthiness Office stated that the FAA is satisfied with part 147. They feel it is adequate and does not need to be changed. He also stated that if the organization (ATEC) felt there was a problem, they should petition for change under FAR part 11.

In an attempt to make sense out of a confused situation ATEC commissioned a survey. The survey was conducted by Johnson and Ziegler through the facilities of the Aviation Research Laboratory at the University of Illinois (6). A questionaire was sent to aviation technician school administrators and instructors, of which 163 responded. The results indicated displeasure with part 147 but did not provide any specifics on what should be done. For virtually every recommendation a counter remark could be found. A task force was created to work with the part 147 problem. After further analysis the task force concluded that many of respondents did not understand part 147. To test this conclusion another survey form was sent out only to school administrators. In the results of this survey twenty-nine of ninety-one (32%) respondents answered that they thought serious problems existed with part 147. Forty-four of ninety-two (48%) responded that they thought serious problems existed with the interpretation, utilization, or enforcement of part 147. Those responding that there were problems were asked if they felt that these could be rectified by minor changes and better interpretation. Forty-four answered yes with only five saying no (7).

With these results and further study of 147, the ATEC task force was able to conclude that part 147, as written, is adequate and effective. It was recognized that problems did exist in the form of misunderstanding and variation of interpretation among the geographical regions. These problems did appear to have an influence upon the ability of many schools to update their curricula.

ATEC then submitted a proposal for funding from the FAA to conduct ten workshops on FAR 147 standardization. These workshops were funded and took place during the period of March 1 to May 31, 1985. The major purpose of the workshops was to evaluate part 147 as written. A major question was does flexibility exist to allow individual schools to meet their unique needs.

The workshops showed quite conclusively that interpretation varied among regions and schools (8). There was general agreement that part 147 as it is written, if properly interpreted, does have flexibility. Although there was informal agreement on many issues of interpretation during these workshops, formal policy has yet to be established. Both the FAA and ATEC are currently analyzing the workshop data in order to formuate formal policy and/or change.

The only change contemplated is that necessary to allow all schools to benefit from the flexibility that has been shown to exist. The workshops would appear to have lessened the role of the FAA as a scapegoat for lack of curriculum updating.

A second question often asked is what should be taught and to what depth? The first priority must be to teach the appropriate levels as required by part 147. As long as part 65, mechanic certification, is unchanged, the schools will continue to need to teach all subjects. Many question the need of teaching wood working or dope and fabric. It is pointed out that many of these items require a low level of achievment. A major concern of many is that teaching to a lower level is dangerous. They fear that the student will over estimate his abilities. Opponents of this viewpoint cite part 65.81. The mechanic must have demonstrated his ability before approving for return to service. They also stress that teaching the student his limitations as a mechanic are an essential part of the course.

Once the FAA requirements are met a school can spend the remainder of its program time in going into more depth in areas of its choice. This will often be dictated by geographical location or unique school needs. To illustrate this point we will refer to an ATEC survey (7). When schools were asked how many hours were spent in teaching wood, the responses ranged from a low of 3 to a high of 65 with a mean of 22.7. The school with 65 was a high school program with a total program length of 2500 hours. One reason for the high number of hours in woods is that it is a good medium to teach hand skills.

A second area asked about was aircraft covering (fabric). The range of hours in this area was from a low of 10 to a high of 120 with a mean of 34.6. The school with 120 hours is a community college with the minimum number of total hours (1900) located in the state of Alaska. Alaska has a large number of fabric covered aircraft.

These two examples illustrate how a school can provide more in depth instruction. In the first case the school has more than minimum total hours in its curriculum. It is teaching more than required depth in wood to meet needs unique to it and it's students. In the second case the school is teaching the minimum number of total hours. However, it is still able to teach in more depth a subject that it's graduates will possibly be utilizing once employed.

Approved part 147 curricula are found in high schools, trade and technical schools, two year colleges, and four year universities. It should be evident that such a range of institutional types would have a similar variation of student abilities and maturity. Regardless of instituional type, part 147 requires that the school offer at least 1900 hours. For some schools with high school programs or "open-door" admission policies the 1900 hours is not enough. Additional hours are required to meet the FAA standards. Other schools may be able to comfortably teach the required material in the 1900 hours and have time left over for more in depth instruction. Thus what to teach, above part 147 requirements, is a matter for the individual school to decide.

The role of industry in training technicians must also be considered in determining what to teach. The national survey that was used to determine curriculua requirements used the amount of industry training available as a criteria. The logic was that if industry provided training the schools could place less emphasis on it. Conversely if industry was not providing training then the schools should ensure that the student received it. This logic is as valid today as it was in 1965. While many will point to the fact that technology has advanced tremendously since 1970, a similar point could also be made for industry training. Many advisory committees suggest that the schools concentrate on the basics and let industry teach specialized knowledge and skills as needed.

There are those that contend that the schools should turn out job ready mechanics, so that industry would not have to provide training. John Griffin Jr., President of East Coast Aero Tech, comments that "an MBA fresh out of school, gets a job making fifty to sixty thousand a year and the first thing he does is go into a training program". To state it another way, industry training is not unique to aviation. There will always be a need for industry training. The real question is where will the schools stop and industry take over.

If part 147 is not a major obstacle to curriculum development, the schools find themselves in a position of responsibility for the future of technician education. It is suggested that the four year universities, with approved part 147 curricula, should be leaders in this area. The reasons for this suggestion are university tradition and mission, staff qualifications and loads, admission policies providing students of higher academic ability, and an increasing demand for graduates with bachelor degrees and A & P certificates.

Suggested areas for action include the following: (1) changing the image of a school with an approved part 147 curricula as being only a "mechanic or A & P" school, (2) changing the concept that all 147 approved schools have similar programs, (3) development of accreditation for aviation technician schools, (4) involvement of the aviation industry as a full partner with the schools in curriculum development, (5) development of industry support for aviation education similar to that in other disciplines, (6) development of innovative and more efficient teaching methods, (7) reduction of schools dependence upon the FAA, and (8) development of better coordination and mutual goals for all facets of aviation education.

The implication of image is not intended to be degrading to "mechanic" schools. The reference is to the concept held by some that a school with a part 147 curriculum is only teaching mechanics. This concept is probably valid for approved programs found in specialized aviation trade schools, vocational high schools, and area vo-tech institutes. The latest directory of approved schools (9) shows that 53% of the approved programs are offered by community colleges or four year universities. Many of these programs include more than the required subject matter of part 147. There are 21 programs associated with four year universities. In these one would find many students preparing for a career in management or engineering that utilizes their technical training.

All approved programs contain a core of part 147 material. The point to be made is that some schools go well beyond this level. Therefore all programs are not similar. Typical thinking of some is illustrated by the following incident. A state higher education commission requested information from a four year school and a two year school in regards to the similarity of their programs. The two schools pointed out that they had different admission requirements, different lengths of program (2 yr vs. 4 yr.), and different career goals among the students. They also stated that upon initial counseling, it was not uncommon to advise students to attend the other school to better meet their needs. The commission's report listed the two schools as having similar programs!

Perhaps the major need of part 147 programs in institutions of higher education is accreditation. At the present there is no suitable program for aviation technician curricula. Although many use the criteria of part 147 for this purpose, it contains only minimum standards and in no way compares with ABET, or similar agencies. The issue of accreditation has been addressed by ATEC which has 70% of all certified schools among its members. The need for accreditation is of major concern to those schools associated with higher education. It is suggested that ATEC and UAA make a joint effort in development of an valid and meaningful accreditation program for aviation curriculua. Such a program could be developed under the auspices of an existing agency or a new agency.

Curriculum development should be a joint effort with industry saying what and the school determining how. Another important consideration of such action would be the determination of where the schools stop and industry starts training. The need for and development of "add-on" advanced programs in some schools should be investigated. The potential use of school personnel and facilities for industry training also deserve consideration. The key to this situation is improved communication between the schools and industry.

Industry support is a sensitive subject. Many in industry acknowledge their support for education. However, while other schools are receiving donations of complete laboratories, aviation schools are getting discounts on manuals and surplus parts. Lack of support similar to other disciplines is regarded by many school administrators as lack of need for the program. Avenues other than direct economic support also need to be investigated. As an example, many companies are very generous with allowing school personnel to attend their training sessions at no charge. The problem is that many schools do not have resources for travel that would allow their staff to attend. As a suggestion, perhaps industry could provide occasional "teacher" training programs on a regional basis, allowing more to benefit.

Innovative and new teaching methods in aviation technology have been discouraged by perceptions of limitations in part 147. As a result riveting is still being taught the same as it was when "Rosie the Riveter" was building B-17s. With an ever increasing technology, and the need to continue to teach some degree of the old, the development of more efficient teaching methods needs little explanation. The university programs would be more likely to have the flexibility that would allow time for experimentation and development. These methods could then be made available to all schools.

A major obstacle to the advancement of aviation education has been the tendency to wait for the FAA to tell the schools what to do. The FAA has set minimums and by law is restricted to that position. It is time for the schools to accept the responsibility of aviation education. This includes compliance with the FAA minimum requirements.

The last suggestion is difficult to quantify and is largely based on observation. An outside observer of "aviation education" would probably observe many different entities, operating in diverse manners, and calling themselves aviation education. He would find little coordination among these groups. In some cases he would find activities that are in opposition with other groups, most probably due to lack of knowledge as to what others are doing. Aviation education faces adequate competition from other educational disciplines without having to resort to internal problems. The phrase "there is strength in numbers" may be overused but is none the less valid. All facets of aviation education would benefit from a coordinated effort.

Conclusion

The aviation technician schools need to take control of their destiny. FAA requirements only set, and are restricted to, minimums and in no way prohibit going beyond. There is no standard curriculum other than the subject material required by part 147. Each school has the ability to determine a curriculum consistent with its needs as long as the provisions of part 147 are met.

It is the duty and responsibility of the schools to create and maintain excellence in aviation technician education. The university schools should be leaders in this effort.

Future success is dependent upon the establishiment of good relationships with industry and the FAA. Equally important is the need for all facets of aviation education to work together.

APPENDIX A

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