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# STUDY RESULTS ON KNOWLEDGE REQUIREMENTS FOR ENTRY-LEVEL AIRPORT OPERATIONS AND MANAGEMENT PERSONNEL

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## ABSTRACT

This paper identifies important topical knowledge areas required of individuals employed in airport operations and management positions. A total of 116 airport managers and airfield operations personnel responded to a survey that sought to identify the importance of various subject matter for entry level airport operations personnel. The results from this study add to the body of research on aviation management curriculum development and can be used to better develop university curriculum and supplemental training focused on airport management and operations. Recommendations are made for specialized airport courses within aviation management programs. Further, this study identifies for job seekers or individuals employed in entry level positions those knowledge requirements deemed important by airport managers and operations personnel at different sized airports.

## INTRODUCTION

In a speech given at the fifth annual General Aviation Forecast Conference, then University Aviation Association (UAA) President James E. Crehan called upon the aviation industry to define future personnel needs in terms of entry level qualifications and experiences so that UAA member institutions could respond to those needs. Previously, Lehrer (1992) had brought to the attention of the aviation community the increasing emphasis of university and college accrediting bodies to assess the learning that occurs within an aviation program. He raised the question of what skills, knowledge and values should a well educated aviation graduate possess? His question followed his previous work (1985) of trying to identify an aviation management curriculum for the benefit of students and the industry.

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Documentation of industry needs in flight education has been well developed. Not as well developed is documentation in the aviation management field and, in particular, airport management and operations. Research is still needed to help validate the degree of importance for various knowledge requirements as they apply to specific areas and various types of aviation management. In his critique of aviation management programs, Philips (2004) recommends that the term “aviation management” needs to be better defined and have improved pedagogical development. This paper helps to articulate future personnel knowledge requirements for entry level positions in airport operations, drawing on the assumption that the most common path to the position of airport manager or director begins with entry level airfield operation positions. This assumption is supported by Sackett (1992), Howell (1997), Prather (1999) and Quilty (2004).

Most university curricula have but one course in airport management as a result of guidelines established by the Council on Aviation Accreditation (CAA), an accrediting body for non-engineering university aviation programs. Those guidelines reflect an earlier industry and U.S. Federal Aviation Administration (FAA; 1989) assessment of what was important for a broad aviation management education. The broad education perspective was all inclusive and covered air traffic management, airline management, airport management, general aviation service management, aviation manufacturing management and other service sector management. Invariably, in attempting to cover such broad areas, the recommended courses tended to be generic and left many specific career track topics lacking in the requisite knowledge or skill content necessary to fully understand the intended career track.

The current CAA guidelines (2003) identify a singular course called aviation management. It also calls for singular courses in aviation law, aviation business administration, aviation economics, and aviation safety. Not identified in the guidelines are what specific content or knowledge requirements are to be included in each course title. Quilty (2004) asserted that a single course in aviation management did not adequately prepare students for entry level or career positions in airports. Adequate research study related to the requirements of the airport industry is lacking. The study results included in this paper strive to address the knowledge and topic areas required by the airport industry for an airport management curriculum.

Previous journal articles have sought to quantify and validate knowledge requirements for airport management degree programs at colleges and universities. Lehrer (1985) identified 31 academic course titles and descriptions. He stated in his dissertation that one of the first attempts to define an airport management curriculum was in 1949 (p. 45). Truitt, Hamman, and Palinkas (1994) identified courses important for a graduate program in airport administration. Kaps and Widick (1995) suggested

educational requirements for a career in airport management at the undergraduate level. Fuller and Truitt (1997) surveyed airport consultants about course curriculum matters.

Prather (1998) conducted a study seeking the views of airport managers on the most appropriate fields of study, academic degrees, and aviation courses. Ruiz et al. (2000) conducted a study to determine the degree to which graduates of a university aviation management program perceived the usefulness of the program for their career choices. Kaps and NewMyer (2001) reviewed published material from State Aviation organizations that provided advice to airport managers and identified important and common subject matter material. Quilty (2004) reviewed airport job descriptions over a three year period and identified common knowledge and skill requirements listed in the descriptions.

Most of the studies suggest that skills and knowledge requirements for airport operations and management have changed over the years. Based on these studies, the requirements are becoming more diverse, challenging and technical. While identifying specific courses similar to the CAA guidelines, much of the research is lacking in the more descriptive content knowledge requirements necessary for today's airport management graduates. The research also is lacking in identification of the importance of skills and knowledge for different sized airports.

This paper contributes to the aviation and airport management field by identifying knowledge requirements deemed important by airport managers and employees for those who seek entry level positions in the field of airport operations. This information forms a basis for establishing both performance objectives, learning outcomes, and curriculum content for educational and training programs.

## **METHODOLOGY**

The survey instrument used in the study was targeted toward individuals whose job positions are related to the safe operation of an airfield, such as airfield operation, maintenance and inspection personnel. Surveyed for this study were individuals having responsibility for hiring or supervision of airfield operation employees, and individuals employed in operations positions. The study specifically targeted airfield operations rather than terminal or landside operations as airfield operations is an area of qualified concern for the FAA in light of changes to Part 139 (Certification of Airports), 14 Code of Federal Regulations (CFR).

The survey instrument was developed by identifying 92 knowledge variables derived from Part 139; job descriptions analyzed and used in Quilty's (2004) study; the CAA Accreditation Standards Manual (CAA, 2003); Flouris and Gibson's (2002) survey instrument, curricular material

from various university aviation programs, and a similar knowledge list developed for the National Business Aviation Association (NBAA) Corporate Aviation Management Development Committee (Quilty, 1996). The survey was approved for use by the Human Subject Review Board at Bowling Green State University, Ohio, and was pretested among members of the American Association of Airport Executives (AAAE) Airport Training Committee.

Data were collected from both large-hub, medium-hub, small-hub, non-hub and general aviation airport operators. The airport categories are identified by the FAA National Plan of Integrated Airport System (NPIAS). The hub designation relates to the number of operations and passenger enplanements an airport has over a calendar year time. For the year 2003, there were 31 large-hub airports, 37 medium-hub airports, 68 small-hub airports, 247 non-hub airports, and 2,961 other airports (other commercial service, reliever, general aviation) in the NPIAS (U.S. Department of Transportation, 2004, p. 5).

An initial electronic mailing of the survey was made in July, 2004, to 356 individuals who were identified in the 2003 membership directory of AAAE. Of the initial mailing, 82 e-mail addresses were returned undeliverable and 274 e-mails were successfully transmitted. There were two follow up e-mails requesting responses in August of 2004. Receipt of surveys was stopped in late September. Of the 274 valid e-mails delivered, 116 responses (42.3%) were received and deemed usable for evaluation.

Demographic information collected for this study included the respondent's position and title; whether the respondent was in a supervisory position or an entry level position; the number of years a respondent was employed in the airport profession; gender; the level of formal education received; and the size of the airport.

The survey requested Likert-type responses in two columns. The survey asked individuals employed in airport management and operation positions their perception of those knowledge requirements important for individuals employed in the field of airfield operations or for those individuals having duties for inspection or safety of the airfield. It further asked them to rank the level of knowledge they believed new hires or recent applicants had about the topic areas. This paper reports only on the results from the first column—the ranking of knowledge topics in importance by managers and operations personnel. Participants in the study were given the instructions shown in Table 1.

**Table 1: Instructions given to survey respondents**

In the LEFT COLUMN, identify how important the topic is to an airfield operations person, based on the numbers 1 through 6 below.	In the RIGHT COLUMN, identify how prepared you feel operation new hires or applicants are, using the scale A through E below.
1 - EXTREMELY IMPORTANT 2 - VERY IMPORTANT/ADEQUATELY 3 - SOMEWHAT IMPORTANT 4 - NOT VERY IMPORTANT 5 - NOT AT ALL IMPORTANT 6 - DO NOT KNOW IMPORTANCE	WELL PREPARED - A PREPARED - B SOMEWHAT PREPARED - C LESS THAN PREPARED - D NOT AT ALL PREPARED - E

A mean and standard deviation analyses were accomplished for all 92 variables from which their overall ranking (1 is most important) was determined (Table 3). Statistical analysis was accomplished by the Statistical Consulting Center at Bowling Green State University using SAS programming. Because changes were made by the FAA to 14 CFR Part 139 during the data collection time period, the variable “knowledge of airport certification specifications requirements and content (Table 2, item 11 and Appendix B)” was made obsolete by the changes and therefore was not included in subgroup analysis. Performing a statistical comparison to determine the degree of importance between each of the remaining 91 topic variables would provide an analysis of questionable detail due to the number of variables. A grouping of like topics with a comparison between the groups would have more meaning to practitioners.

Due to the individual statistical processing difficulty, the 91 variables were first grouped into 26 subgroups. Grouping of the 26 variables into topical subject matter was accomplished by the researcher in conjunction with a review of the groups by knowledgeable individuals in the field of airport management. To allow for further statistical analyses, the 26 subgroups were placed into the 7 major groups. The major groupings reflect further similarity of topic areas and are grouped as they may relate to a particular course content or offering within a university department. The 7 major groups and respective subgroups are listed on Table 3. The subgroups are described in Appendix A. The variables listed in Appendix A were randomly listed in the survey.

To determine the degree of reliability and consistency among the multivariate factors that made up each major group, a Cronbach’s Alpha analysis was performed on each group (Table 4). Determination of Cronbach’s Alpha will help to assess whether or not the choice of an included variable in a group is appropriate or not.

In assessing whether significant differences exist among the major group means, a repeated measures analysis of variance was performed. The analysis looked at one major group mean and compared it to the other group means to see whether or not differences exist between the groups. A Tukey analysis was then conducted to identify where those differences occurred (Table 5). The Tukey analysis allows for clusters or groups of variables to be compared to each other to determine significant differences among them.

### **Study Limitations**

This study was limited to AAAE members employed at various airports in the United States. It is unknown how many individuals in management, supervisory or entry level operation positions are not members of AAAE, and therefore were not included in the solicitation. Another limitation is the degree of understanding respondents may have about the meaning behind each of the knowledge topics identified, or the degree of semantic bias individuals may have for the various words used to describe the knowledge topic. The study did not attempt to mitigate these limitations.

Another limitation is the geographic area solicited for the study. For example, responses to some topic variables such as “knowledge of snow and ice control plans and snow removal operations” would receive widely disparate rankings depending upon whether one was employed in the southern or northern part of the United States. The study did not attempt to mitigate this limitation.

A further limitation of the study is the seasonality of the survey. The survey was conducted in the summer months of July to August and so responses may reflect several seasonal factors such as staffing shortages due to vacations, non-winter operations, or heavy construction activity. The study tried to minimize this limitation by seeking response to the survey over a three month period.

Whereas the survey covered different airport hub sizes, errors may exist in applying the findings to specific operations. Differences do exist in the specific duties and responsibilities of airport operation managers or officers depending upon the organizational structure, size of the airport, type of operation, and different forms of ownership/operation. This would impact how one responded in ranking a particular topic.

An example of this would be the rating of environmental law and regulations as very important by an operations officer at one particular airport because he or she is responsible for handling environmental issues associated with aviation fuel tanks, deicing, noise or other. An operations officer at another airport may rate environmental law low because their organization is of such size as to have a separate person or staff function responsible for handling that issue. The survey did not ask if environmental issues actually existed, only the degree of importance from a knowledge

perspective. This particular limitation is minimized to the extent that the study sought to better identify specific knowledge *areas* necessary for entry level positions at airports overall, rather than seeking actual specifics for different sized airports. However, the latter is presented for basic analysis in Appendix B.

One other limitation placed on the study relates to the educational knowledge of the respondents. A respondent's educational background could have an effect on the results in that knowledge or skills learned or practiced are more likely to be implemented or used, and those not learned or practiced will be less likely to be considered a requirement. For example, an individual having an educational background in, or an understanding of, business statistics is more likely to incorporate or recognize its use in airport operations and therefore would consider it more important than someone who did not have similar knowledge or education. Collectively, the study attempts to minimize this limitation through the collection of data from diverse respondents. Of the respondents, 13 had high school degrees, two had 2-year associate degrees, 59 had a 4-year undergraduate degree, 31 had a masters or higher degree, one had military education only, and 10 had military education plus some college course work but no degree.

## **RESULTS**

Of the 116 responses, 18 (15.6%) were from airport managers, 62 (53.4%) from airport operations supervisors, and 36 (31.0%) from entry level employees. The airport managers were primarily from small-hub, non-hub or general aviation airports because that position was targeted as having more direct involvement in airfield operations.

Responses from large-hub airports numbered 22 (19.0%) of the total, medium-hub airports numbered 19 (16.4%), small-hub airports numbered 16 (13.8%), non-hub airports numbered 31 (26.7%), and general aviation/reliever airports numbered 28 (24.1%) respondents. The demographic responses included 94 males (81.0%) and 22 females (19.0%). These demographics provided a cross section of the airport organizations sought for the study.

Table 2 provides the overall mean ranking of the 91 variables (with shortened titles) identified in the survey. A full description of the knowledge variables listed in Table 2 is provided in Appendix A.

**Table 2: Priority ranking of 92 knowledge variables important for individuals employed in the field of airfield operations or for those individuals having duties for inspection or safety of the airfield**

Rank	Topic	M	SD
1	Ground Vehicle Operation	1.181	0.468
2	Self Inspection	1.198	0.514
3	Lighting	1.216	0.524
4	Airport Emergency Plan	1.224	0.439
5	Notices to Airmen (NOTAMs)	1.250	0.558
6	Part 139 compliance	1.259	0.674
7	Airport Certification Manual	1.293	0.673
8	Acronyms	1.388	0.656
9	Security ID Area	1.422	0.748
10	Construct Activity	1.526	0.751
11	Airport Certification Specifications	1.527	0.955
12	Wildlife	1.569	0.836
13	Airport Security Plan	1.578	0.876
14	Part 77 Obstructions	1.724	0.809
15	Airport Design and Layout	1.802	0.836
16	General Aviation Operations	1.809	0.837
17	Air Traffic Control Operations	1.828	0.738
18	Airport Rescue/Firefighting	1.888	0.967
19	Fueling Operations	1.914	0.830
20	Aircraft Regulations	1.922	0.886
21	Federal Regulations	1.978	0.861
22	Communication Center Operation	2.017	0.995
23	Form 5010 Master Record	2.036	0.914
24	Snow Removal Operation	2.052	1.369
25	Airline Operations	2.078	1.039
26	Management	2.112	0.930
27	Form 7460-1 Obstructions	2.121	1.065
28	Construction Methods	2.155	0.871
29	Air Carrier Security Plan	2.198	1.105
30	Air Traffic Control Equipment	2.241	0.947
31	Word and Spreadsheet Applications	2.296	0.878
32	New Security Technology	2.336	2.336
33	Air Cargo Security Plan	2.345	1.080
34	Public Relations	2.353	0.837
35	Material Safety Data Sheets (MSDS)	2.365	0.911
36	Organizational Communication	2.379	0.939
37	Air Taxi Operations	2.379	0.939
38	Environmental Compliance	2.388	0.892
39	Department of Transportation (DOT) Hazmat	2.397	0.893
40	14 CFR Part 191 Sensitive Security Information (SSI)	2.402	1.135
41	Environmental Laws	2.414	0.781
42	Public Administration	2.417	0.955
43	Pavement Deicing	2.474	1.206
44	Air Cargo Operations	2.483	1.051
45	Occupational Safety and Health Administration (OSHA) regulations	2.483	0.909

**Table 2: Priority ranking of 92 knowledge variables important for individuals employed in the field of airfield operations or for those individuals having duties for inspection or safety of the airfield**

46	Police Procedures	2.491	0.880
47	Noise Requirements	2.500	0.860
48	Capacity/delay Impact	2.578	1.048
49	Speech Communication	2.595	1.004
50	Project Management	2.595	0.942
51	Human Resource Development (HRD) Processes	2.716	0.940
52	American Disability Act (ADA) compliance	2.741	0.915
53	Meteorology	2.750	0.959
54	Military Operations	2.819	0.965
55	Bid Specifications	2.828	1.137
56	Ground Transportation	2.862	1.003
57	Aviation History	2.862	0.932
58	New Airport Technology	2.871	0.860
59	Equipment Operation	2.897	1.281
60	Contract Administration	2.897	0.954
61	Aviation Law	2.930	1.041
62	Facility Maintenance	2.931	0.958
63	Information Systems (MIS)	2.991	0.982
64	Master Planning Process	3.009	0.797
65	Parking Operations	3.043	1.111
66	Aircraft Deicing	3.071	1.124
67	Labor Relations	3.104	0.931
68	Science Principles	3.123	0.933
69	Risk Management	3.138	0.986
70	Accounting	3.157	0.979
71	Travel and Tourism	3.181	0.956
72	Finance	3.190	0.922
73	Property Management	3.328	0.949
74	Electricity Basics	3.345	0.952
75	Contract Law	3.351	1.064
76	Building Codes	3.422	0.815
77	Marketing	3.422	0.886
78	Helicopter Operations	3.452	0.830
79	Building Systems	3.461	0.981
80	Tort Law	3.504	1.045
81	Politics	3.526	0.952
82	Civil Engineering	3.531	0.897
83	Computer Aided Design/Geographical Information System	3.539	1.045
84	Programming	3.638	1.083
85	Architecture	3.693	0.832
86	Social Psychology	3.708	0.820
87	Statistics	3.741	0.878
88	Micro Economics	3.781	0.870
89	Foreign Language	3.796	0.937
90	Socioeconomics	3.796	0.857
91	Macro Economics	3.825	0.905
92	International Commerce	3.895	0.856

*Note.* Rank scale is 1 to 5 with 1 being the most important.

Table 3 identifies the grouping of the 91 variables into 26 topical subject matter subgroups which are further categorized into seven major groups A-F. The grouping allows for better statistical analyses and meaning of the individual variables. The major groupings reflect similarity of topic areas and are grouped as they may relate to a particular course content or offering within a university department. Appendix A provides the descriptive wording used in the survey.

**Table 3: Identification of seven major groups of knowledge combining the 26 subgroups of the 91 knowledge variables important for individuals employed in the field of airfield operations or for those individuals having duties for inspection or safety of the airfield**

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<u>Group A - 22 variables subgrouped as:</u>	
	Lighting signs and markings (1.22)
	Self-Inspection (1.49)
	Part 139 Regulation (1.52)
	ARFF and Emergency Plan (1.56)
	Wildlife (1.58)
	Part 77 Obstructions (2.03)
	Ground Vehicle Operation (2.19)
	Hazardous Material (2.22)
	Snow and Ice Removal (2.24)
<u>Group B - 7 variables subgrouped as:</u>	
	Security (2.11)
<u>Group C - 19 variables subgrouped as:</u>	
	Aviation general (2.48)
	Aircraft Characteristics (2.50)
	Record management (3.12)
	Science (3.13)
<u>Group D - 17 variables subgrouped as:</u>	
	Environment and Noise (2.42)
	Master Planning and Design (2.47)
	Ground Transportation (2.96)
	Building Systems (3.21)
<u>Group E - 8 variables subgrouped as:</u>	
	Project Management/Construction (2.64)
	Communication (2.70)
	Management and Supervision (2.91)
<u>Group G - 8 variables subgrouped as:</u>	
	Administration (2.98)
	Contracts and Law (3.10)
<u>Group F- 10 variables subgrouped as:</u>	
	Marketing (3.21)
	Finance and Accounting (3.35)
	Economics (3.71)

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*Note.* Mean (M) of the subgroup is in parenthesis.

Table 4 represents the ranking of the knowledge groups deemed important for individuals holding positions in airfield operations at U.S. airports. The ranking is based upon the mean (M). The standard deviation

(SD) is provided to give an indication of the range of responses from the mean.

A Cronbach's Alpha analysis (Table 4) was performed on each major group to determine the degree of reliability and correlation among the multivariate factors comprising each group. Determination of Cronbach's Alpha will help to assess whether or not the choice of an included variable in a group is appropriate or not. A correlation of 0.700 or higher is acceptable for this study. Due to the multidimensionality of the variables making up each group, standardized index values were used.

Of the seven groups, only Group E had individual topic variables having less than 0.700. Reliability in Group E was weak due to low Alpha's for the variables speech communication, management, and human resource and development. This means these three topic variables should be included in a new or different group.

**Table 4: Means and standard deviation for the major groups of knowledge important for individuals employed in the field of airfield operations or for those individuals having duties for inspection or safety of the airfield**

Variable	Mean	Standard Deviation	Cronbach's Alpha
Group A	1.906	0.398	0.821
Group B	2.109	0.698	0.836
Group C	2.721	0.458	0.806
Group D	2.713	0.455	0.793
Group E	2.793	0.573	0.744
Group F	3.430	0.603	0.866
Group G	3.078	0.708	0.871

*Note.* Alpha deemed reliable for values > 0.700

In assessing whether significant differences exist among the major group means a repeated measures analysis of variance was performed. The analysis compared one major group mean and to the other group means to see whether or not differences existed between the groups. A Tukey analysis was then conducted to identify where those differences occurred. The Tukey analysis allows for comparing clusters or groups of variables to each other to determine significant differences among them.

Table 5 shows the difference between groups resulting from the Tukey analysis. Where a major group shows a significant difference to another group (marked by X), an argument can be made that the groups can be treated as distinct content areas to be addressed in an education or training curriculum.

**Table 5: Tukey analyses identifying significant differences between major groups of knowledge important for individuals employed in the field of airfield operations or for those individuals having duties for inspection or safety of the airfield**

	<i>Group A</i>	<i>Group B</i>	<i>Group C</i>	<i>Group D</i>	<i>Group E</i>	<i>Group F</i>	<i>Group G</i>
Group A		X	X	X	X	X	X
Group B			X	X	X	X	X
Group C				O	O	X	X
Group D					O	X	X
Group E						X	X
Group F							X
Group G							

*Note.* Tukey critical value  $w = q_{.05}(7,672) \approx 0.158$ .

X = column and row means are significantly different.

O = no difference between column and row means.

Appendix B lists the responses to the survey according to airport size of large-hub, medium-hub, small-hub, non-hub, and general aviation reliever as defined by the U.S. Department of Transportation (2004). The data are listed in both value and graphic form. The graphic form breaks the responses into groups of 15, except for the last group of 17. It assists in comparing the rank of importance for the 91 variables between the different airport sizes. Statistical analysis using airport size is not supported due to the small number of responses in each category. However, the breakout does allow for some interpretation of what is important at the different sized airports.

### DISCUSSION

Group A from Table 3 is primarily made up of the operational requirements of Subpart D of 14 CFR Part 139 Certification of Airports. Subpart D of Part 139 spells out the required inspection and safety measures necessary for compliance with the federal regulation. It is not surprising that Group A is the most important subject matter grouping. The means of each subgroup in Group A is more important than the means for any other subgroup except security (Group B). These rankings would reflect the 76 percent response rate received from airports with airport certification requirements. If an airport is certificated under 14 CFR Part 139, it is also required to have an airport security plan under 14 CFR Part 1542.

Cronbach's Alpha is valuable in ascertaining the degree to which the variables contained in the major groups are linked or consistent with one another. While the reliability of the variables within each group is shown to exist for all (Table 4), Group E has marginal reliability or consistency. This means the topic variables contained in Group E are better treated as separate

topics. Otherwise, the other groups show consistency of their topic variables and allows for further analysis.

The Tukey analysis is valuable in ascertaining the degree to which the variables contained in the major groups are distinct from one another. With the exception of Group C and Group D, the remaining groups appear to be made up of variables that can be treated as having distinct degrees of importance from the other groups (Table 5). The variables in Group C and Group D do not show the same degree of distinction and require reconstitution.

The distinction of the major group is of value in that they identify the overall degree of importance of the knowledge and content areas within the industry and they can be used to identify content to be included in a particular course. For instance, the content of Group A could be included in a single course or split into two. The content in Group B could also be a singular course. While Group C and Group D would need to be reconstituted, general aviation principles and aircraft characteristics (Group C) could be taught as one course, and environmental, master planning and ground transportation (Group D) could make up either a single or dual course as well. Within Group E, Group G and Group F, each subgroup is easily recognized as a current course at many colleges and universities.

For those who provide training seminars and workshops to the industry, the first two groups of variables shown in Appendix A (subgroups 1-11) and B (top 15 topics) should receive the most attention. Developing a university curriculum focusing on airport management and operations, however, may be a little more difficult to address. This is because colleges and universities are expected to provide a broad skill and knowledge set balanced with specialized skills and knowledge.

The data show several of the courses normally associated with university curricula in management were rated very low. For instance, micro and macro economics, business statistics, and marketing ranked in the lower portion of the list (Appendix B). Yet a basic management curriculum accredited by the American Assembly of Collegiate Schools of Business (AACSB) or CAA calls for a knowledge foundation in those courses (AACSB, 1993; CAA 2003). It is difficult to imagine that in practice an entry level position does not utilize the basic theories and concepts in those courses, but entry level airport position descriptions detail more aviation specific knowledge concepts (Prather, 1998; Quilty, 2004).

The reason for the low rankings of the traditional courses is not clear. They could have been ranked low simply because they are considered fundamental compared to the other topics. Respondents may have had the expectation that an individual would have certain basic knowledge to have made it to the level of consideration for an airfield operations position. A second reason could be that theory and concepts taught in those courses are

not well discerned in practice. This has implications for developing a university aviation management curriculum where the basic knowledge concepts of economics, statistics and other similar courses need to be incorporated into courses such as airport operations, regulatory compliance, and security.

The comparison of topics found in 14 CFR Part 139 to traditional business and aviation courses is new in the research. Except for in Kaps and NewMyer's 2001 study, the other research referenced in this paper focused primarily on the traditional course offerings in their rankings. Results from those studies can be used to gauge the relative importance of traditional courses.

Clearly of importance for entry level airport positions, however, is knowledge about the operations of an airport, generally delineated in 14 CFR Part 139, but also applied to general aviation airports. Evidence presented by Quilty (2004) indicates current post secondary courses related to aviation management do not adequately address the skill development or knowledge acquisition identified in this study. The results of this study can be used to develop a matrix of knowledge requirements that would be addressed within an overall curriculum on airport operation and management. Combined with information culled from other studies mentioned in this paper, the academic community can better respond to the needs of the airport industry by incorporating the content identified into course offerings, or by developing more specialized course offerings.

A positive aspect of the identification of specialized courses is that they can better prepare an individual for the needs and demands of the airport industry. The drawback that exists for specialized course offerings is that they often are at the expense of other skills and knowledge area development due to the limitation placed on the number of total credit hours allowed at most universities. For this reason, it is important for the aviation academic community and CAA to think through at what level courses should be taught and what skills and knowledge should be addressed at each level. This raises the question then of what is the proper balance of courses that will result in a reasonable number of credit hours, meet university accreditation and policy requirements, and satisfy the needs of the industry? This question corresponds to the issues raised by Quilty (2004).

Based on the study results, it is recommended that a course titled "Aviation Management" be dropped from aviation curricula and be replaced by a title indicating the specific study area of management to be taught, such as airport management, airline management, air cargo management, fixed base operations (FBO) management, small airport management, or aviation service management. The term "aviation management" should refer to the collective offering of courses and material that will develop the skills and knowledge of an individual for the purpose of ensuring the safety of the

aviation system and furthering its economic and social benefits. Within a college or university program, an aviation management curriculum should have identifiable tracks or study areas that address the more specific study areas mentioned.

Appendix B provides insight into the relative importance of the topic variables between the different sized airports. The reporting of response data by airport size is of value in that it is generally the general aviation, non-hub and small-hub airports that hire recent graduates, based upon a review of job listings posted over the years by AAAE. The qualifications for medium-hub and large-hub airports generally require several years of experience for consideration. Many airport position announcements seek or prefer at least one year of experience in airport operations (Howell, 1997; Quilty, 2004).

There is unanimous agreement on the 12 top ranked variables for all airport sizes, with the notable exception of airfield lighting, signs and marking for general aviation airports (Appendix B). Within the top 13 ranked topics is a notable variable of interest: knowledge of airport certification specifications. Airport certification specifications are no longer a component of federal regulation, having been discontinued in February of 2004 with revision to 14 CFR Part 139. The purpose of airport certification specifications was to address safety and operation of airports receiving limited air carrier service. It is understandable that many respondents still view the purpose as being important.

Below the rank of 13, the topics have varying degrees of importance among the different sized airports. The variations generally reflect the type and nature of airport operations at the different sized airports. For instance, general aviation operations is a knowledge requirement ranked 16 for all but large-hub airports, which have very little general aviation activity. Therefore, one would not expect it to have as much importance overall. Knowledge about air traffic control equipment is ranked higher by non-hub airports most likely because those airports have locally operated and supported navigational aids, or have contract control towers in operation that require the airport to operate and maintain.

Some topic variables, such as snow removal operations, airline operations, air cargo operations, pavement deicing, impact of capacity and delay issues, and speech communication are mitigated in importance because of the geographic location of the airport or its size. For instance, pavement deicing and air cargo operations carry less importance at general aviation airports, most likely because of a lack of financial resources for deicing and the lack of pavement or air cargo activities, respectively. Environmental compliance and knowledge of police procedures will receive varied response depending on the organizational structure, personnel staffing, expertise available, and location of the airport. An analysis of the standard deviations listed in Table 2 provides some explanation for the varied ranking.

## CONCLUSION AND RECOMMENDATIONS

The study results included in this paper strive to address the knowledge and topic areas required by the airport industry for a curriculum in airport management. While providing support for the generalized knowledge requirements identified by the CAA, this study provides insight into the degree of importance for the knowledge areas sought by the industry. This information is of value to universities and accrediting bodies in improving airport management degree programs. The study reported in this paper can assist academicians, human resource directors, and airport managers in understanding basic knowledge requirements deemed important for individuals seeking employment in the field of airport operations and safety.

From the ranking of knowledge requirements, course content can be refined to include and address the most important topics. Drawing on the assumption that the most common path to the position of airport manager or director begins with entry level airfield operation positions, current aviation management programs do not adequately address the needs of the airport industry. The position that most educational programs claim they prepare an individual for—that of airport manager or director—is not normally an entry level position. Based on the results from the survey, academicians and trainers can better prepare aspiring individuals for careers in airport operations and, subsequently, management. The research results also provide insight into the importance of skills and knowledge for different sized airports, as this data is lacking in previous studies.

Based on the study results, it is suggested that the need exists for a specialized track or study area in airport management that contains the following dedicated courses: airport operations that cover in detail 14 CFR Part 139; emergency planning; airport security; general aviation operations; environment and noise; and airport design and construction. A recommendation is made to eliminate any course titled aviation management and reserve that term for describing an overall aviation program. Within the aviation management program would be specific tracks or study areas with more specialized courses addressing each area. The term “aviation management” is suggested to be defined as the collective offering of courses and material that will develop the skills and knowledge of an individual for the purpose of ensuring the safety of the aviation system and furthering its economic and social benefits.

The CAA (1992) states in its criteria for aviation management:

Care must be taken to avoid preparation in a field that is too narrow; however, without adequate depth of study in a specific area, the student is not likely to have the special expertise that will set him or her apart from others. (p. 27)

Answering the question of what is the proper balance of courses that will result in a reasonable number of credit hours, meet university accreditation and policy requirements, and satisfy the needs of the industry requires further dialogue and debate among academicians and the industry. This paper contributes to the dialogue by identifying topics to be included in an airport operations and management curriculum. Colleges and universities preparing individuals for entry level positions at airports should undertake a review and modification of their curriculum and courses to address important knowledge areas.

Still in question is at what educational level should these courses be taught and to what degree of specialization? In his 2004 issue paper, Quilty proposed a performance outcome model that provides a simple analogy for what skill, ability and knowledge attainment should be addressed at different institutional levels. He suggested a graduate of a 2-year associate program would have skills and knowledge to obtain entry level positions but would require supervision and direction, while a graduate from a 4-year institution would be able to function more autonomously, and a graduate program would allow students to move directly into supervisory positions.

Further dialogue and debate should be centered around the mission and role of an aviation program at the 2-year or 4-year undergraduate level, and around how to balance the needs of university accreditation requirements against the need for specialized training and education in aviation. Should the role be that of preparing an individual with the specific skills needed or a broad educational perspective? It is a specialized training versus general education debate that should be continued within the industry by practitioners, academicians, and the accrediting bodies of aviation programs. The results from this study would indicate a need exists within the airport industry for more specialization.

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**APPENDIX A**

Identification of subgroups and applicable survey ranking stems for 91 knowledge variables important for individuals employed in the field of airfield operations or for those individuals having duties for inspection or safety of the airfield

**Subgroup 1 - Part 139 Regulation**

Knowledge of 14 CFR Part 139 requirements and airfield operations responsibilities.  
 Knowledge of Airport Certification Manual Requirements and Contents.  
 Knowledge of federal regulatory and enforcement process.

**Subgroup 2 - Self Inspection**

Knowledge of FAA Form 5010.  
 Knowledge of airport self-inspection components and techniques.  
 Knowledge of airport condition reporting and issuance of NOTAMs.

**Subgroup 3 - Lighting, Signs, Marking**

Knowledge of airfield lighting, signage and marking requirements and maintenance.

**Subgroup 4 - Wildlife**

Knowledge of wildlife hazard mitigation problems and techniques.

**Subgroup 5 - Vehicle Operation**

Ability to operate light and/or heavy vehicles and equipment .  
 Knowledge of ground vehicle operation and radio procedures.  
 Knowledge of bid specifications related to equipment and other purchases.  
 Knowledge of air traffic control operations and procedures.

**Subgroup 6 - Snow and Ice**

Knowledge of Snow and Ice Control Plans and snow removal operations .  
 Understanding of the application and use of deice and anti-ice compounds for pavements.

**Subgroup 7 - Part 77 Obstructions**

Knowledge of air traffic navigational equipment and operation.  
 Knowledge of 14 CFR Part 77 Objects Affecting Navigable Airspace.  
 Use of FAA Form 7460-1 Notice of Construction and/or Alteration.

**Subgroup 8 - ARFF and Emergency Plan**

Knowledge of Aircraft Rescue/Firefighting techniques and application.  
 Understanding of the Airport Emergency Plan (AEP) and response capabilities.

**Subgroup 9 - Hazardous Material**

Knowledge of the DOT hazardous substances and materials markings and placards.  
 Knowledge of material data safety sheet information.  
 Knowledge of fueling operations and fuel storage tanks/trucks safety.

**Subgroup 10 - Aviation General**

Understanding of acronyms, terms and common phrases used in aviation and on the airfield.  
 Understanding of airport history and development.  
 Understanding of aviation law application to airports and aircraft operations.  
 Knowledge of meteorology and flight planning.

**Subgroup 11 - Security**

Knowledge of airport security plan responsibilities under TSA Part 1542 (former Part 107).  
 Knowledge of air carrier security plan requirements under TSA Part 1544 (former Part 108).  
 Knowledge of air cargo security plan requirements under TSA Part 1546 (former Part 109).  
 Knowledge of SIDA, access control, and identification procedures.

Knowledge of new security technology and its application on airports.  
 Knowledge of 14 CFR Part 191 security disclosure requirements.  
 Understanding of police and law enforcement procedures.

**Subgroup 12 - Master Plan and Design**

Understanding of airport design and layout.  
 Understanding of airport and transportation master planning processes.  
 Understanding of airport capacity, delay and transportation impacts.

**Subgroup 13 - Aircraft Characteristics**

Knowledge of helicopter and V/STOL operations.  
 Knowledge and understanding of general aviation operations and regulations.  
 Knowledge and understanding of air taxi/charter operations and regulations.  
 Knowledge and understanding of airline operations and regulations.  
 Knowledge and understanding of air cargo/freight operations, regulations and logistics.  
 Knowledge of requirements and procedures for airlines/aircraft deicing.  
 Knowledge of military operations and activity on airports.  
 Knowledge of aircraft operations and regulations.

**Subgroup 14 - Environment and Noise**

Understanding of noise, noise measurement and laws related to aviation noise.  
 Understanding of environmental laws and regulations.  
 Knowledge of Environmental Acts, compliance and audits affecting airports.

**Subgroup 15 - Ground Transportation**

Understanding of ground transportation (taxis, limos, buses, shuttles, etc.) operations.  
 Understanding of parking garage/lot function and operations.

**Subgroup 16 - Building Systems**

Knowledge of building system operation (heating, air conditioning, utility, plumbing).  
 Knowledge of facility maintenance methods and processes.  
 Knowledge of American Disability Act (ADA) regulations and their applicability to airports.  
 Knowledge of architectural principles and practices.

**Subgroup 17 - Communication**

Ability to speak, read and understand a second languages.  
 Knowledge of speech and public communication principles and application.  
 Knowledge of interpersonal, group and organizational communication.  
 Understanding of a communications center function and operation.

**Subgroup 18 - Management and Supervision**

Understanding of general supervision and management principles.  
 Knowledge of human resource and employee development processes.  
 Understanding of labor relations.  
 Understanding of social psychology principles and application.

**Subgroup 19 - Administration**

Understanding of political science and organization politics.  
 Knowledge of airport/public administration principles and practices.

**Subgroup 20 - Economics**

Understanding of micro economics (local or national activity).  
 Understanding of macro economics (global activity).  
 Understanding of geographic and socioeconomic principles.  
 Knowledge of civil engineering principles and practices.

**Subgroup 21 - Project Management and Construction**

Knowledge of airfield construction methods and processes.  
 Understanding of project management practices.  
 Knowledge of building construction codes, methods and processes.  
 Knowledge of airport construction activity monitoring and practices.

**Subgroup 22 - Marketing**

Understanding of public relations and information dissemination.

Understanding of marketing practices and principles.  
 Understanding of the travel and tourism industry.  
 Knowledge of international commerce relations, business practices and handling processes.

**Subgroup 23 - Contracts and Law**

Understanding of contract and lease administration.  
 Understanding of property and real estate management.  
 Understanding of risk management and insurance administration.  
 Understanding of contract law application to airports.  
 Understanding of tort law application to airports.  
 Knowledge of OSHA regulations and insurance requirements.

**Subgroup 24 - Finance and Accounting**

Knowledge of finance and capital funding methods and processes.  
 Knowledge of accounting and budgeting methods and processes.  
 Knowledge of applied business statistics.

**Subgroup 25 - Record Management**

Understanding of records management and management information system manipulation.  
 Use of computer science skills associated with programming.  
 Use of computer skills associated with word, draw and spreadsheet applications.  
 Use of computer skills associated with Autocad and GIS application.

**Subgroup 26 - Science**

Understanding of basic electricity and electronic principles and application at airports.  
 Knowledge of new technology development and application at airports.  
 Knowledge of science principles and their application to airport operations.

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*Note.* The variable “Knowledge of airport certification specifications requirements and content” was not included in the statistical final rankings due to revisions to 14 CFR Part 139 during the study making it obsolete as a knowledge requirement.

**APPENDIX B**

Ranking of 92 knowledge variables important for individuals employed in the field of airfield operations or for those individuals having duties for inspection or safety of the airfield, by airport size using visual and numeric coding.

Overall Rank	Visual Code	Topic	Airport size rank distribution					Visual rank distribution				
			LH	MH	SH	NH	GA	LH	MH	SH	NH	GA
1	XXX	Ground Vehicle Operation	2	7	2	6	5	XXX	XXX	XXX	XXX	XXX
2	XXX	Self Inspection	6	3	1	3	1	XXX	XXX	XXX	XXX	XXX
3	XXX	Lighting	7	1	5	4	16	XXX	XXX	XXX	XXX	XXX
4	XXX	Airport Emergency Plan	11	11	6	1	2	XXX	XXX	XXX	XXX	XXX
5	XXX	NOTAMs	1	6	7	9	3	XXX	XXX	XXX	XXX	XXX
6	XXX	14 CFR Part 139 compliance	4	2	4	2	4	XXX	XXX	XXX	XXX	XXX
7	XXX	Airport Certification Manual	3	4	9	5	8	XXX	XXX	XXX	XXX	XXX
8	XXX	Acronyms	9	8	11	7	10	XXX	XXX	XXX	XXX	XXX
9	XXX	Security ID Area	5	9	3	8	6	XXX	XXX	XXX	XXX	XXX
10	XXX	Construct Activity	13	5	12	13	7	XXX	XXX	XXX	XXX	XXX
11	XXX	Airport Certification Specifications	8	13	10	12	14	XXX	XXX	XXX	XXX	XXX
12	XXX	Wildlife	10	12	13	10	15	XXX	XXX	XXX	XXX	XXX
13	XXX	Airport Security Plan	14	10	17	18	12	XXX	XXX			XXX

Overall Rank	Visual Code	Topic	LH	MH	SH	NH	GA	LH	MH	SH	NH	GA
14	XXX	Part 77 Obstructions	17	15	14	19	19		XXX	XXX		
15	XXX	Airport Design and Layout	23	24	22	17	20					
16		GA Operations	20	14	8	11	11		XXX	XXX	XXX	XXX
17		Air Traffic Control Operations	21	18	15	14	17			XXX	XXX	
18		Airport Rescue/Firefighting	12	25	18	22	9	XXX				XXX
19		Fueling Operations	18	22	19	15	28				XXX	
20		Aircraft Regulations	29	23	25	21	13					XXX
21		Federal Regulations	25	16	21	16	26					
22		Communication Center Operations.	22	17	24	20	27					
23		Form 5010	15	28	16	25	21	XXX				
24		Snow Removal Operations.	27	44	31	24	35		***	***		***
25		Airline Operations	30	31	40	23	23		***	***		
26		Management	33	20	26	27	36	***				***
27		Form 7460-1 Obstructions	28	29	29	42	41				***	***
28		Construction Methods	26	26	20	26	39					***
29		Air Carrier Security Plan	31	34	27	30	38	***	***			***
30		Air Traffic Control Equipment	32	33	23	46	18	***	***		√√√	
31	***	Word and Spreadsheet Applications	24	43	43	45	24		***	***	***	
32	***	New Security Technology	16	19	33	35	42			***	***	***
33	***	Air Cargo Security Plan	48	21	28	37	50	√√√			***	√√√
34	***	Public Relations	19	30	44	36	30			***	***	
35	***	Material Safety Data Sheets	53	27	46	39	32	√√√		√√√	***	***
36	***	Organizational Communication	36	47	34	29	37	***	√√√	***		***
37	***	Air Taxi Ops.	49	48	37	40	34	√√√	√√√	***	***	***
38	***	Environment Compliance	44	32	30	38	59	***	***		***	√√√
39	***	Department of Transportation Hazmat	42	37	41	28	45	***	***	***		***
40	***	Part 191 Sensitive Security Information	47	40	38	34	46	√√√	***	***	***	√√√
41	***	Environmental Regulations	38	35	32	41	31	***	***	***	***	***
42	***	Public Administration	39	36	65	32	49	***	***	----	***	√√√
43	***	Pavement Deicing	41	38	51	49	29	***	***	√√√	√√√	
44	***	Air Cargo Operations	37	39	54	47	25	***	***	√√√	√√√	
45	***	Occupational Safety Health regulations	40	50	53	43	47	***	√√√	√√√	***	√√√
46	√√√	Police Procedures	34	66	45	52	33	***	----	***	√√√	***
47	√√√	Noise Requirements	35	41	48	31	40	***	***	√√√	***	***
48	√√√	Capacity/delay Impact	45	52	55	62	57	***	√√√	√√√	----	√√√
49	√√√	Speech Communications	43	58	36	50	22	***	√√√	***	√√√	
50	√√√	Project Management	54	45	47	44	62	√√√	***	√√√	***	----
51	√√√	Human Resource Department Processes	58	63	39	33	43	√√√	----	***	***	***
52	√√√	ADA Requirements.	57	46	35	60	51	√√√	√√√	***	√√√	√√√
53	√√√	Meteorology	46	51	56	55	74	√√√	√√√	√√√	√√√	----
54	√√√	Military Operations	68	42	42	56	61	----	***	***	√√√	----
55	√√√	Bid Specifications	52	55	66	51	48	√√√	√√√	----	√√√	√√√

Overall Rank	Visual Code	Topic	LH	MH	SH	NH	GA	LH	MH	SH	NH	GA
56	√√√	Ground Transport	56	54	52	63	58	√√√	√√√	√√√	----	√√√
57	√√√	Airport History	61	53	67	48	70	----	√√√	----	√√√	----
58	√√√	New Airport Technology	51	49	57	59	44	√√√	√√√	√√√	√√√	***
59	√√√	Equipment Operations	50	64	61	54	55	√√√	----	----	√√√	√√√
60	√√√	Contract/Lease Administration	71	62	50	61	64	----	----	√√√	----	----
61	----	Aviation Law	66	56	59	53	60	----	√√√	√√√	√√√	√√√
62	----	Facility Maintenance	63	60	60	65	69	----	√√√	√√√	----	----
63	----	Management Information Systems	55	68	49	64	72	√√√	----	√√√	----	----
64	----	Master Plan Process	64	65	58	57	52	----	----	√√√	√√√	√√√
65	----	Parking Operations	60	72	68	71	53	√√√	----	----	----	√√√
66	----	Aircraft Deicing	67	59	69	69	56	----	√√√	----	----	√√√
67	----	Labor Relations	72	70	64	58	54	----	----	----	√√√	√√√
68	----	Science Principles	65	71	63	74	67	----	----	----	----	----
69	----	Risk Management	70	57	75	67	75	----	√√√	----	----	----
70	----	Accounting	84	67	62	79	76	\$\$\$	----	----	\$\$\$	\$\$\$
71	----	Travel and Tourism	69	83	73	73	81	----	\$\$\$	----	----	\$\$\$
72	----	Finance	83	69	71	70	78	\$\$\$	----	----	----	\$\$\$
73	----	Property Management	77	78	79	72	79	\$\$\$	\$\$\$	\$\$\$	----	\$\$\$
74	----	Electricity Basics	62	87	70	75	68	----	\$\$\$	----	----	----
75	----	Contract Law	59	76	82	76	73	√√√	\$\$\$	\$\$\$	\$\$\$	----
76	\$\$\$	Building Codes	92	74	78	80	63	\$\$\$	----	\$\$\$	\$\$\$	----
77	\$\$\$	Marketing	81	61	84	77	66	\$\$\$	----	\$\$\$	\$\$\$	----
78	\$\$\$	Helicopter Operations	73	79	74	66	77	----	\$\$\$	----	----	\$\$\$
79	\$\$\$	Building Systems	82	82	72	78	80	\$\$\$	\$\$\$	----	\$\$\$	\$\$\$
80	\$\$\$	Tort Law	86	89	83	68	65	\$\$\$	\$\$\$	\$\$\$	----	----
81	\$\$\$	Politics	89	77	85	82	86	\$\$\$	\$\$\$	\$\$\$	\$\$\$	\$\$\$
82	\$\$\$	Civil Engineering	75	88	80	85	71	----	\$\$\$	\$\$\$	\$\$\$	----
83	\$\$\$	Computer Aided Design/GIS	90	73	77	83	82	\$\$\$	----	\$\$\$	\$\$\$	\$\$\$
84	\$\$\$	Programming	91	85	76	81	87	\$\$\$	\$\$\$	\$\$\$	\$\$\$	\$\$\$
85	\$\$\$	Architecture	80	75	89	90	85	\$\$\$	----	\$\$\$	\$\$\$	\$\$\$
86	\$\$\$	Social Psychology	76	84	81	84	83	\$\$\$	\$\$\$	\$\$\$	\$\$\$	\$\$\$
87	\$\$\$	Statistics	87	91	87	88	88	\$\$\$	\$\$\$	\$\$\$	\$\$\$	\$\$\$
88	\$\$\$	Micro Economics	88	90	86	86	90	\$\$\$	\$\$\$	\$\$\$	\$\$\$	\$\$\$
89	\$\$\$	Foreign Language	78	81	92	91	91	\$\$\$	\$\$\$	\$\$\$	\$\$\$	\$\$\$
90	\$\$\$	Socioeconomics	85	80	88	89	84	\$\$\$	\$\$\$	\$\$\$	\$\$\$	\$\$\$
91	\$\$\$	Macro Economics	74	86	91	92	92	----	\$\$\$	\$\$\$	\$\$\$	\$\$\$
92	\$\$\$	International Commerce	79	92	90	87	89	\$\$\$	\$\$\$	\$\$\$	\$\$\$	\$\$\$

Note. All airports N = 116; LH = Large-Hub (n = 22), Medium-Hub = MH (n = 19); Small-Hub = SH (n = 16); Non-Hub = NH (n = 31); General Aviation/Reliever = GA (n = 28).