Chapter 7 System Capacity Needs and Prioritization

The BOA receives requests for funding airport capital improvements far in excess of the amount of funding they receive from federal and state sources. The BOA prioritizes projects based on their knowledge of the airports in the state system, input from airport sponsors, and the FAA's national priority ranking (NPR) system as referenced in the latest version of the FAA AIP Handbook[12] and defined in the FAA ACIP handbook.[13]

The process through which the BOA can analyze and prioritize projects that provide the greatest operational benefit to the state aviation system was examined. Based on this review, a course of action was recommended to enable the BOA to proficiently identify projects that provide the greatest contribution to the system in terms of operational benefit and project cost.

Approach

- Define performance criteria that enable the BOA to identify projects that provide the greatest system operational benefit.
- Define demand versus capacity at the Commonwealth's key airports
- Develop a simple benefits analysis for proposed projects in terms of their operational contribution to the system.
- Assemble the components of the project contribution analysis into a decision-support matrix.

Performance Criteria

Chapters 3 and 6 defined the amenities and services criteria for "commercial service," "advanced," and "intermediate" airports. The approach to define airport performance criteria for this chapter was based on those findings and illustrated that the key amenities for enhancing an airport's operational contribution include:

- Primary runway length
- A parallel taxiway for the primary runway
- Based and transient aircraft parking apron

Demand-Capacity

The approach to this analysis was to examine the operational contribution of projects based on a ratio of demand versus capacity. Demand was in the form of annual operations and capacity and was determined using the FAA AC 150/5060-5, "Airport Capacity and Delay." The findings were then aggregated into an overall assessment for the "commercial service," "advanced," and "intermediate" classifications to indicate what percentage of the airports within those classifications experience demand versus capacity ratios of:

- ≤40%
- 41-60%
- 61-80%
- ≥80%

[12] FAA Order 5800.38C dated 28-Jun-05

[13] FAA Order 5100-39A, "Airports Capital Improvement Plan," dated 22-Aug-00

These ratios were selected because airport planning rules of thumb are to initiate planning for capacity enhancements when the demand-capacity ratio reaches 60%, and to initiate construction of those improvements when the demand-capacity ratio reaches 80%. The calculation of the operational capacities of the state system airports used for this assessment is further described in the full technical report.

State System Benefits

This analysis resulted in a process that enables the BOA to assess which projects provide the greatest operational benefit to the state aviation system. The approach to identify this process was to examine the operational contribution from capital projects using the following parameters:

- Annual operational capacity of system airports
- Estimates of increases in the operational contribution an airport provides the system from the following types of projects:
  - Runway extensions
  - Parallel taxiways
  - Aircraft parking apron for based aircraft
  - Aircraft parking apron for transient aircraft
- A weighting factor for projects at airports operating closer to their annual capacity limit
- A sponsor checklist to ascertain sponsor and project readiness
- Economic impact in terms of total output[14]

Decision Matrix

The findings from all the Chapter 7 tasks were aggregated into a decision matrix.

Results – Operational Capacity of System Airports

The annual operational capacities or annual service volumes (ASVs)[15] of all Pennsylvania Aviation System airports were calculated and are listed in the full technical report. The ASV metric accounts for differences in physical and operational conditions at airports, such as the airfield configuration, runway surface (paved versus turf/gravel); aircraft operations mix, peaking of operations throughout the day, and weather conditions.

The ASVs of the state's airports range from 50,000 at airports with turf runways and no parallel taxiway to 590,000 at Philadelphia International Airport and 600,000 at Pittsburgh International Airport.

Through this analysis, the total annual operational capacity of the state airport system was calculated to be 18,545,000. The incremental statewide operational contributions of proposed projects were determined using this number as the denominator.

[14] Based on the table of the economic impact each airport provides to the Commonwealth using the 2001 study, "The Economic Impact of Aviation in Pennsylvania"

[15] The ASV methodology is described in FAA Advisory Circular 150/5060-5, "Airport Capacity and Delay".

Results – Capacity Enhancing Projects

Runway Extensions

This analysis determined the types of aircraft that a longer runway could accommodate. For airport planning purposes, aircraft are classified according to the FAA's Airport Reference Code (ARC)[16]. The percent of the fleet of aircraft within each ARC that can be accommodated on runway lengths in increments of 50 feet were determined. This resulted in the ability to define the increased operational benefit that each runway extension would provide, in terms of increased capacity and demand.

Full Parallel Taxiways

The FAA AC 150/5060-5, "Airport Capacity and Delay," contains tables that determine the increase in operational benefit derived from extending an existing partial parallel taxiway or building a new one. These tables were used to define the increased system contribution for five different cases and based on the direction of flow.

Apron Expansions

Statistics were developed for the amount of parking apron required by type of aircraft and whether the aircraft was locally based or transient. From that point, the operational benefit of the new parking apron was derived by multiplying the number of additional aircraft that could park at the airport times the average annual operations that those aircraft typically perform at Pennsylvania's airports.

Results – Weighting of Capacity Projects

The method for weighting the operational benefits provided by the projects listed above was based on an airport's demand-capacity (D/C) ratio. The D/C ratio is found by dividing the annual operations by the ASV. The weighting factors range from 1.0 to 5.4 depending on the D/C ratio at the specific airport.

Results – Demand versus Capacity

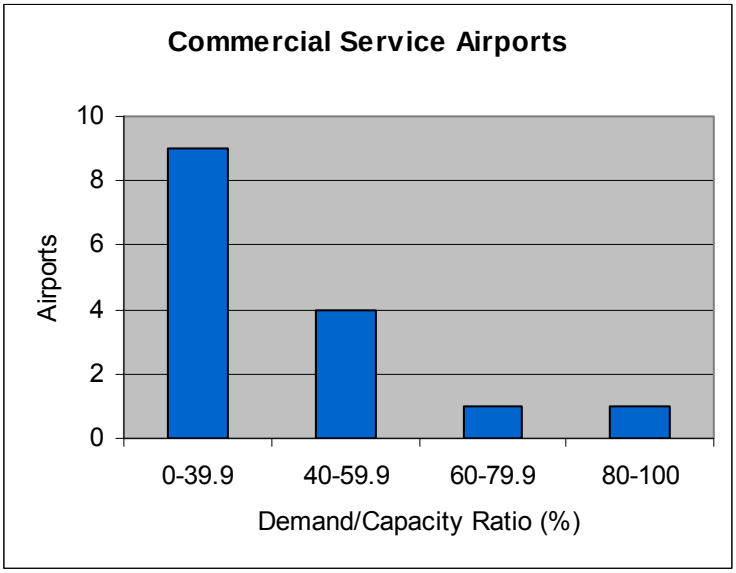
The D/C ratios of the state system airports were reviewed by airport classification. This assessment helped identify whether or not there were notable trends in capacity sufficiency by airport classification. The exhibits below clearly indicate that the vast majority of Commonwealth airports operate at or below 50% of their stated capacity.

Commercial Service Airports

This assessment shows us that with the exception of Philadelphia International (PHL), the Commonwealth's Commercial Service airports operate well below the activity levels that would dictate the need to program capacity enhancing improvements. PHL is in the process of completing a master plan and an environmental impact statement (EIS) for a substantial capacity enhancement program. **Exhibit 7-1** further illustrates this situation.

[16] As described in FAA Advisory Circular 150/5300-13, "Airport Design"

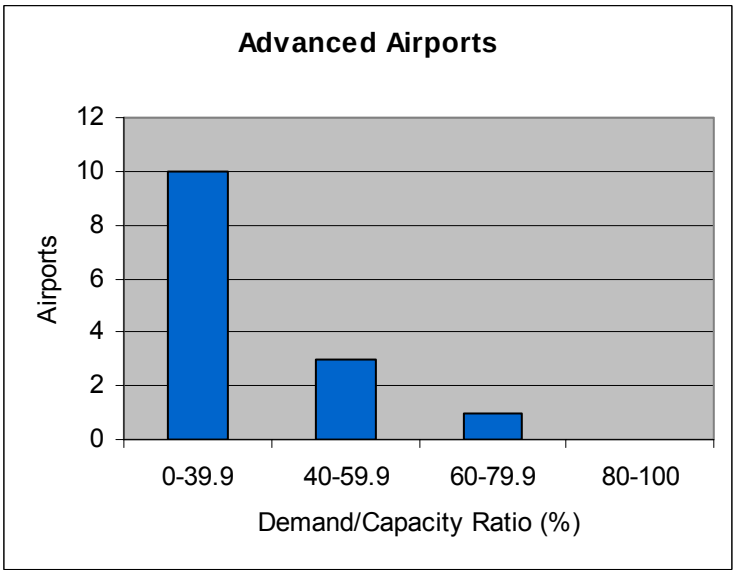
Exhibit 7-1 – Demand/Capacity Ratios – Commercial Service



Advanced Airports

Exhibit 7-2 shows that the Commonwealth's "advanced" airports also operate well below their capacity levels.

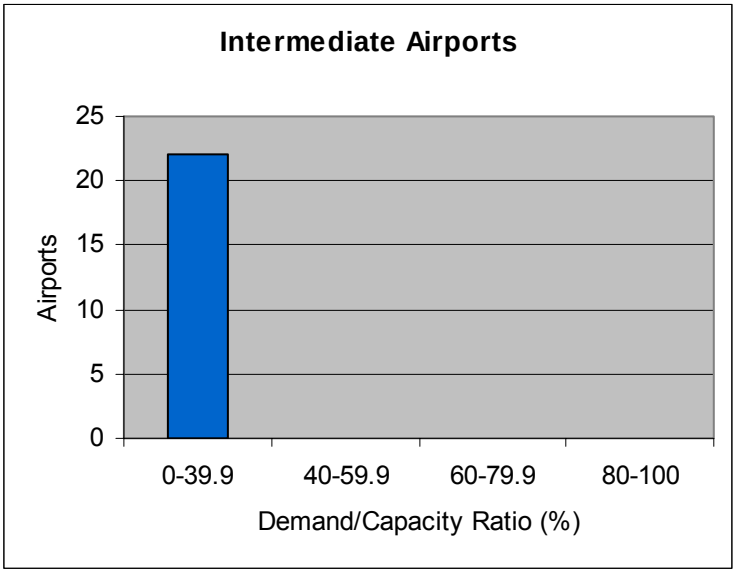
Exhibit 7-2 – Demand/Capacity Ratios – Advanced



Intermediate Airports

Exhibit 7-3 shows that all of the Commonwealth's "intermediate" airports operate well below their capacity levels.

Exhibit 7-3 – Demand/Capacity Ratios – Intermediate



Results – State System Benefits

The basic steps of the benefits analysis and project ranking process are listed below:

- Define the annual service volume (ASV) of individual system airports by classification and of the system as a whole
- Determine the operational contribution derived from these projects in terms of increases to each airport's ASV
- Weight projects at airports with higher demand levels more heavily than at airports with lower demand levels
- Rank projects at airports based on the level of readiness the sponsor can demonstrate based on the amount of basic information they have to prepare advanced studies such as a formal FAA benefit-cost analysis.[17]

These components were then assembled into an operational contribution ranking process. This process ranked projects using an Excel spreadsheet and was named the "Project Contribution Calculator." The spreadsheet includes the columns listed below.

- **Airport** – refers to the airport where the project is located
- **Project Description** – brief description of the project in question
- **Classification** – "commercial service," "advanced," "intermediate," or "basic"
- **Operational Contribution Increase** – a calculated value of the contribution increase derived from that project based on FAA formulas and methodologies
- **D/C Weighting Factor** – based on a value assigned to the D/C ratio as defined in the technical report
- **Weighted Contribution Increase** – multiplies the Operational Contribution Increase by the D/C Weighting Factor

[17] The BOA considers this element in their decision-making, but it is not part of the contribution calculation

- **Weighted Airport Contribution** – divides the Weighted Contribution Increase by Airport ASV resulting in a percent increase in ASV
- **Weighted System Contribution** – divides the Weighted Contribution Increase by state airport system ASV resulting in a percent increase in system capacity
- **Project Cost from CIP** – cost information as listed in the BOA's FYP
- **Project Readiness Ranking** – ranking of a project's readiness based on the FAA's Benefit Cost Analysis guidance and summarized in a readiness checklist[18]
- **Economic Impact** – a listing of the economic impact of the airport as described earlier
- **Cost per Increased Annual Operation** – divides total project cost by Operational Contribution Increases
- **Cost per Weighted Increased Annual Operation** – divides total project cost by Weighted Contribution Increases

The contribution calculator has these five ranking scales:

- Cost per increased annual operation – for both demand and capacity
- Cost per weighted increased annual operation
- Weighted system capacity contribution
- Project readiness ranking[19]
- Economic impact

Three projects from the Approved 2006 FYP were used as a test case. The results of that assessment are shown below and on the next page. These projects were inputted into the Excel spreadsheet for ranking. Projects identified included:

- Penn Valley – extend Runway 17-35 to 4,760 feet
- Butler County – extend Runway 8-26 to 4,805 feet
- Clarion County – extend Runway 6-24 to 5,000 feet

Results from the test case indicate that improvements at Butler County had the lowest cost per increased annual operation, lowest cost per weighted increased annual operation, and offered the best contribution to system capacity.

This relatively small test case was expanded with fictional projects to discover potential flaws in the methodology and the Excel spreadsheet modules. This "beta testing" concluded once the hand calculated results matched the automated spreadsheet results.

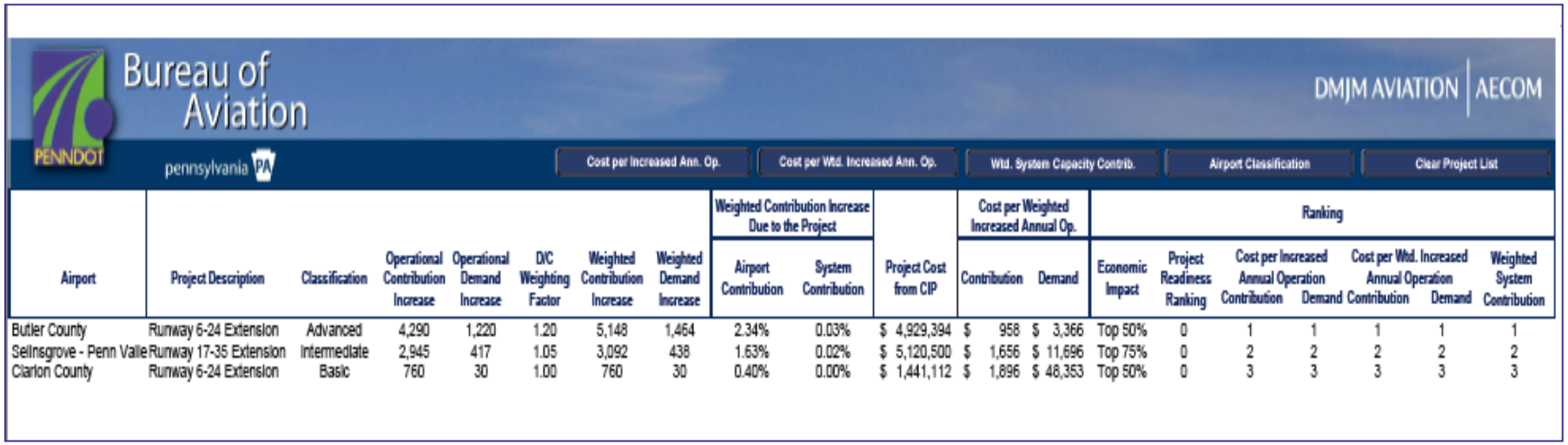
Findings – Decision Matrix

The decision matrix tool proposed for the BOA is the automated spreadsheet described above and shown on the next page.

[18] The weighting factor for the project benefits ranking is based on the amount of items a sponsor can complete on the project benefits checklist (Appendix 3). The ranking is a percent complete of the checklist items where 90% is an A, 80% is a B, 70% is a C, 60% is a D, and less than 60% is an F.

[19] Note that the project readiness ranking was not completed for this example since it relies on feedback from the sponsor. The checklist is shown on page 33.

This screen capture is from the contribution calculator developed using the processes described in this chapter. The user has a prompt screen for entry of the project data. Buttons on this summary page allow the user to have the spreadsheet automatically calculate the project rankings.



Airport	Project Description	Classification	Operational Contribution Increase	Operational Demand Increase	D/C Weighting Factor	Weighted Contribution Increase	Weighted Demand Increase	Weighted Contribution Increase Due to the Project: Airport Contribution	Weighted Contribution Increase Due to the Project: System Contribution	Project Cost from CIP	Cost per Weighted Increased Annual Op.: Contribution	Cost per Weighted Increased Annual Op.: Demand	Ranking: Economic Impact	Ranking: Project Readiness Ranking	Ranking: Cost per Increased Annual Operation: Contribution	Ranking: Cost per Increased Annual Operation: Demand	Ranking: Cost per Wtd. Increased Annual Operation: Contribution	Ranking: Cost per Wtd. Increased Annual Operation: Demand	Ranking: Weighted System Contribution
Butler County	Runway 6-24 Extension	Advanced	4,290	1,220	1.20	5,148	1,464	2.34%	0.03%	$ 4,929,394	$ 958	$ 3,366	Top 50%	0	1	1	1	1	1
Selinsgrove - Penn Valle	Runway 17-35 Extension	Intermediate	2,945	417	1.05	3,092	438	1.63%	0.02%	$ 5,120,500	$ 1,656	$ 11,696	Top 75%	0	2	2	2	2	2
Clarion County	Runway 6-24 Extension	Basic	760	30	1.00	760	30	0.40%	0.00%	$ 1,441,112	$ 1,896	$ 48,353	Top 50%	0	3	3	3	3	3

Conclusions

The objective of Chapter 7 was to develop a process that enabled PENNDOT to clearly select the most cost-effective system enhancements in terms of operational contribution to the system. This chapter identified a process for prioritizing the operational benefit or contribution that projects provide to the airport system that is easy to understand, implement, and replicate. This process relies almost exclusively on FAA procedures for calculating the operational increases. Relying on FAA procedures was important as it serves as the basis for being able to replicating the findings. Where assumptions were needed for these FAA procedures, those assumptions were based on industry best practices and expertise. They are well-documented in the full technical report.

Then, by developing the contribution calculator, the ability for the BOA to quantify the operational benefit of various projects was simplified. The calculator allows the BOA to perform “gaming” analyses where projects can be tested in the early programming process to help identify the best projects from a system standpoint before they are entered into the FYP or any funding commitments are made to the sponsors.