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Case Study: Using Value Analysis to Mitigate Airfield-Program Funding-Shortfall Risk

By Warren Knoles, PE, AVS

Abstract

The Lexington Blue Grass Airport's Taxiway Safety Enhancement Program was to be phased over a five-year period to match the available federal funding allocated to the airport. Such five-year phasing unavoidably introduces risk that construction costs may rise more than current estimates, and/or out-year allocations of funds may be less than current estimates.

Thus the project design team thought it prudent to identify and develop options for reducing the project costs as a risk-management approach for the airport. The design team subsequently commissioned an internal value analysis workshop (which utilized a compressed value-methodology job plan) to identify and develop such options. This paper summarizes the process and the ensuing results of the value analysis workshop along with some lessons learned and conclusions drawn from this application of the value methodology.

Author

Warren Knoles has over 40 years' experience in the transportation/civil-site engineering industry. Mr. Knoles is currently Senior Consultant and Principal Value Specialist with Crawford, Murphy & Tilly, Inc. (CMT). His responsibilities include senior project advisor; QC/QA reviews; constructability reviews and value studies on highway, bridge, aviation and land development projects; client relations and business development. Professional affiliations include the American Society of Civil Engineers; Institute of Transportation Engineers; International Bridge, Tunnel and Turnpike Association; American Society for Quality Control; and SAVE International.

Introduction

The Lexington Blue Grass Airport's Taxiway Safety Enhancement Program was to be phased over a five-year period to match the available federal funding allocated to the airport. Such five-year phasing unavoidably introduces risk that construction costs may rise more than current estimates, and/or out-year allocations of funds may be less than current estimates.

Thus the project design lead, Crawford, Murphy & Tilly, Inc. (CMT), thought it prudent to identify and develop options that would potentially reduce project costs without degrading essential functionality as a risk-management approach for the airport. An effective way to accomplish this was considered to be a value study of selected key project elements in the program.

FAA Advisory Circular AC 150/5300-15A, *Use of Value Engineering for Engineering and Design of Airport Grant Projects*[1] acknowledges that "VE provides the funding agency and the sponsor of a project the opportunity and means of improving the project and substantially reducing costs." However, since a formal value engineering study was not in the project design scope, CMT performed an informal, internal value study of the project employing the essential elements of the value methodology in a compressed one-day value analysis workshop. This paper summarizes the process and the ensuing results of the value analysis workshop along with some conclusions drawn from this application of the value methodology.

Project Overview

The Taxiway Safety Enhancement Program (TSEP) was intended to enhance safety, operations flexibility and overall capacity of the airfield. The value analysis focused seven key airfield projects as follows and depicted in Figure 1 below.

- New parallel Taxiway A from connector Taxiway A5 to Taxiway A7 400' from Runway 4/22
- New Taxiway C from the terminal apron to new parallel Taxiway A
- New Taxiway D from the General Aviation ramp to new parallel Taxiway A
- Widen existing Taxiway G
- New bypass Taxiway A6
- New connector taxiway between the Terminal A apron and new parallel Taxiway A
- Remove existing conflicting taxiways

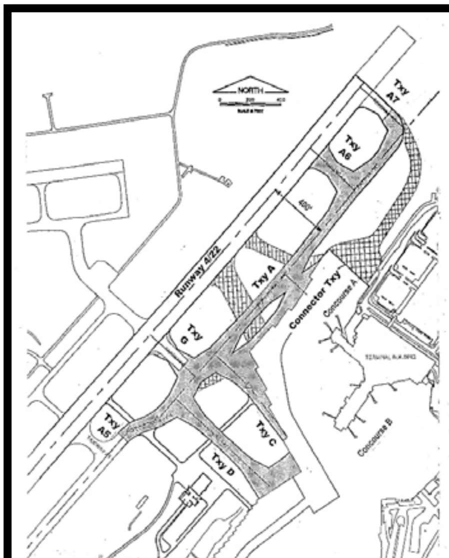

Figure 1. Taxiway Safety Enhancement Program -- Proposed Airfield Geometry

The estimated baseline construction cost for these project elements was $21.6 million.

Value Analysis Workshop

Design Stage. At the time of the value study, a 35% concept design had been developed by the CMT design team and a draft 35% report had been submitted to the airport. Thus, the value study was conducted as a part of the refinement of the 35% concept design for maximum opportunity to identify value analysis alternatives and associated savings, while minimizing the potential for later rework during detailed design.

Workshop Scope. The scope of the workshop focused on the primary airfield project elements and associated cost components of the 35% concept design as identified by the baseline cost model.

Workshop Goals & Objectives. Given the size and scope of this project and the one-day duration of the workshop, the following value analysis goals were thought to be reasonable for this workshop:

- Identify and develop at least 4-5 feasible value analysis concepts.
- Reduce cost of the project by 4-5% of the baseline construction cost while maintaining essential project functionality.

Workshop Team. The workshop team consisted of five aviation subject matter experts (SMEs) from CMT's aviation business unit in the areas of airport planning; airfield geometrics; airfield pavements; aviation lighting/navaids/utilities; and airfield operations/constructability. The subject matter experts (SMEs) were not a part of the project design team and brought independent expertise and experience from other airports to the workshop. One project design team member was included on the workshop team for background information and to provide administrative support during the workshop. The workshop was organized and facilitated by CMT's principal value specialist, who is a SAVE International-certified associate value specialist (AVS).

Two of the SMEs were from other CMT offices, so to minimize disruption to their unit operations, they participated in the workshop via tele-video from their respective offices.

Workshop Process. The workshop process employed seven of the typical eight-phase job plan described in AC 150/5300-15A as follows:

- Selection Phase
- Information Phase
- Function Analysis Phase
- Creative (Speculation) Phase
- Evaluation Phase
- Development Phase
- Presentation (Recommendation) Phase

Because of the one-day workshop time limitation, some of the traditional process phases were modified or compressed to fit the available time. The workshop job plan is described in more detail in the next section.

Workshop Job Plan

Information Phase. The information phase included distribution of a project information package to each team member a few days in advance of the workshop and a presentation of the project by the CMT project manager.

Function Analysis Phase. During this phase, the workshop facilitator reviewed the basics of value engineering, function analysis and FAST diagrams. The top nine major construction cost items were selected from the construction cost model and were given a letter label. These items were considered the primary value targets for the study.

- A Pavements
- B Earthwork
- C Utilities construction
- D Removals
- E Mobilization
- F Lighting/electrical
- G Drainage
- H MOT & security
- I Bidder's risk/road rehabilitation

The workshop facilitator provided the team a prepared-in-advance list of these cost item/value targets defined with active verbs and measurable nouns. The team then added more two-word functions to this list. Key project functions were later arranged post workshop by the facilitator into Functional Analysis System Technique (FAST) how/why logic diagrams to display the relationship of the major cost item functions to each other and the project as a whole, and thus provide the design team with a more thorough understanding of the value analysis proposals that came from the workshop.

Creative (Speculation) Phase. During this phase, creative ideas were brainstormed, first by each team member individually, then as a group for each assigned value target utilizing the seven basic functional analysis questions: 1) What is it?; 2) What does it do?; 3) What is its cost?; 4) What is its worth?; 5) What else would work?; 6) What does that cost?; 7) Can it be eliminated? Creative ideas were written on adhesive index cards, posted on flip charts and labeled chronologically by value target.

The two off-site team members participating via tele-video each read their creative ideas to the administrative-support member who recorded them on adhesive index cards and posted them on the workshop flip charts. A total of 52 creative ideas were generated by the workshop team.

Evaluation Phase. During this phase, the workshop team members first classified each idea using the 9-cell matrix methodology[2]. This methodology uses the following scale for classifying the effect of an idea on performance and cost:

5 = Increased functionality; decrease in cost. Best scenario. Ideas will be evaluated first.
4 = Same functionality; decrease in cost. Good ideas. Ideas will be evaluated next.
4 = Increase in functionality; same cost. Good ideas. Ideas will be evaluated next.
3 = Same functionality; same cost. No imperative to implement; owner or designer preference.
2+ = Increase in functionality; increase in cost. Project enhancement; additional funds required.
2- = Decrease in functionality; decrease in cost. Scope/function reduction; "practical design" savings.
1 = Decrease in functionality; increase in cost. Reject idea.

Ideas with 1, 2+ and 3 ratings were dropped from consideration. Ideas with 5, 4 and 2- classifications were rated individually by team members on a 1-5 scale (5 = superior, 4 = good, 3 = average, 2 = fair, 1 = poor) and were recorded on a spreadsheet and then sorted by rating to produce a team-rated prioritized list for each of the remaining ideas.

The most promising ideas were then selected from the rating-prioritized list of ideas by team consensus for development into value analysis proposals. Ideas with merit for which there was insufficient time or information to develop into value analysis proposals were categorized as design suggestions recommended for consideration by the design team.

Development Phase. During the Development Phase, the most promising ideas were developed into value analysis proposals. Idea development was recorded on worksheets which include the following components:

- Project name
- Alternative number & title
- Function addressed
- Original concept (description)
- Proposed concept (description)
- Cost impacts (initial and life cycle, if applicable)

- Advantages/risks or disadvantages of proposed concept
- Supplemental discussion
- Calculations and assumptions
- VE alternative sketches (before and after)

The team's value analysis proposals were then tabulated along with a summary of cost savings. In addition, several ideas classified as 2- were developed into deferral alternatives for consideration by the airport to further reduce the cost of the project (if necessary for affordability reasons).

Presentation (Recommendation) Phase. At the conclusion of the workshop, the workshop facilitator prepared a brief summary documenting the scope, team, process and results of the value analysis workshop for the use of the project manager and the airport. The project manager presented the results of the analysis to the airport approximately one week following the workshop.

Workshop Results

Results Summary. A total of 52 creative ideas were generated by team during the workshop. Of this number, nine were developed into value analysis proposals during the workshop. One value analysis proposal was developed post workshop making a total of ten. The total estimated savings of the value analysis proposal options were $1,251,000 which represents 5.8% of the baseline construction cost estimate. Thus, the initial goals and objectives of the workshop of 4-5 feasible value analysis concepts and cost savings of 4-5% of construction cost were met.

In addition to value analysis proposals, the team identified two other options to reduce the cost of the project by deferring portions of the work (Taxiway 6 and the north connector taxiway). These deferrals totaled $1,424,000. The total potential savings of value analysis savings and work deferrals is $2,675,000, which represent approximately 12% of the baseline construction cost estimate.

Of the 52 creative ideas, 27 were designated as design suggestions due to not enough time or information to fully analyze them during the workshop, or the ideas were of lower cost savings potential.

Selected Value Analysis Proposals. Three of the larger value analysis proposals are described in this section to illustrate the effect of value analysis on project elements.

A-11 – Provide geometric design for two Aircraft Design Groups (3 & 5). The airport design aircraft is ADG 3 (B737). However, the airport accommodates B747-400 aircraft (Taxiway Design Group 5) on an infrequent basis via special Air Traffic Control Tower (ATCT) operating procedures and a designated taxi route/parking position. The baseline project taxiway pavement thicknesses and geometry were all designed for TDG 5 operations. The value analysis proposal provides pavement thickness and geometry for a dedicated route and parking positions, the balance of the new pavement only accommodates ADG 3 aircraft. This allows the airport to accommodate limited B747-400 operations, while eliminating the excess function in the taxiways that would rarely if ever receive ATG 5 operations. The total potential savings is $421,000.

A-4 – Redesign PCC using CBR (6) vs. baseline CBR (3). The baseline pavement design was based upon an airport "standard" CBR value which is representative of the materials generally available for pavement subgrades. However, CBR values from in-situ samples indicated higher CBR values. This increased soil support allows a reduction in pavement thicknesses yielding a potential estimated savings of $304,000.

A-13P – Relocate apron connector taxiway to north apron edge. The baseline location of the apron Connector Taxiway to Taxiway A is offset from the propose edge of the Concourse A apron. The value analysis proposal relocates the Connector Taxiway to align with the northern edge of the apron. This location reduces taxi-lane adverse travel (back taxiing), increases ease of apron access, shortens taxi distance from the north end of Runway 4/22 and reduces pavement fillet/taper area. The potential estimated savings from elimination of the unneeded pavement is $89,000.

Lessons Learned

The experience use of the value methodology on this project yielded several lessons learned.

- Compressing the value methodology job plan into one day requires additional pre-work, especially for the functional analysis phase.

- Compression of the functional analysis phase is possible by providing some pre-prepared two-word functions for the team's review, supplemented by team contributions during the workshop. Nonetheless, additional time spent on functional analysis and FAST diagram development would likely increase workshop yield.

- With additional time for the workshop, more of the 27 design suggestions may have been developed into value analysis proposals with write-ups and estimated cost savings.

- Post-workshop development of a project FAST diagram can be helpful to the design team in better understanding project functions and the basis for the value analysis alternative concepts.

- It is possible for one or two workshop team members to participate in the workshop via tele-video. This technique requires good internet and tele-video connectivity to the workshop, and, timely provision of workshop materials in advance of the workshop. This technique may also be used for on-call, stand-by subject matter experts who are unable to attend a workshop, or who are only needed for a limited amount of time during the workshop.

Conclusions

In conclusion, the value analysis workshop accomplished the initial workshop goals of identifying 4-5 feasible alternative concepts (10) for consideration by the design team and airport that could reduce the project cost by 4-5% without compromising its essential functions, thereby potentially reducing the cost of the project by approximately $1.25 million (5.8%) in construction costs. In addition, two project element deferrals would further reduce the cost by an additional $1.42 million (6.6%) if needed for affordability reasons.

Thus the airport has at its disposal some contingency proposals that could help mitigate the risk of increased costs or reduced funding in the out-years years of the TESP program.

References

[1]Federal Aviation Administration, Advisory Circular AC 150/5300-15A, *Use of Value Engineering for Engineering and Design of Airport Grant Projects,* September 30, 2008.

[2]Enlign Consultants & Advantage Facilitation services, 2008, Module I Basic Certification Training Workshop Workbook, 125.