

## Evaluation and Selection of Airport Capital Project Delivery Methods

### DETAILS

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## TABLE OF CONTENTS

AUTHOR ACKNOWLEDGMENTS .....	vi
ABSTRACT .....	vi
EXECUTIVE SUMMARY .....	1
CHAPTER 1 – OVERVIEW .....	3
Introduction .....	3
Research Plan and the Work Accomplished .....	4
Organization of the Report .....	8
CHAPTER 2 – LITERATURE REVIEW AND DEFINITIONS .....	9
Distinguishing Characteristics of Airport Projects .....	9
Evolution of Current Alternative Delivery Methods in Airport Projects .....	14
Definitions of the Delivery Methods .....	14
Legality of Delivery Methods in Various States .....	22
Existing Selection Approaches of Project Delivery Methods .....	22
Timing of Project Delivery Method Selection .....	24
CHAPTER 3 – ANALYSIS OF AIRPORT CASE STUDIES .....	26
Background .....	26
Case Study Data Collection Methodology .....	27
Case Study Analysis .....	29
CHAPTER 4 – ADVANTAGES/DISADVANTAGES OF EACH DELIVERY METHOD .....	47
Introduction .....	47
Purpose .....	48
Project-Level Issues .....	49
Airport-Level Issues .....	56
Public Policy/Regulatory Issues .....	61
Other Issues .....	65
Conclusion .....	66
CHAPTER 5 – TIER 1: ANALYTICAL DELIVERY DECISION APPROACH .....	68
Introduction .....	68
Step 1. Create Project Description .....	71
Step 2. Define Project Goals .....	72
Step 3. Review Go/No-Go Decision Points .....	73
Step 4. Review Project Delivery Method Advantages and Disadvantages .....	76
Step 5. Choose the Most Appropriate Project Delivery Method .....	104
Step 6. Document Results .....	107
Conclusions .....	107
CHAPTER 6 – TIER 2: WEIGHTED-MATRIX DELIVERY DECISION APPROACH .....	108
Introduction .....	108
Step 1. Define Selection Factors .....	110
Step 2. Weight Selection Factors .....	112
Step 3. Score Project Delivery Methods .....	113
Step 4. Choose the Most Appropriate Project Delivery Method .....	117
Step 5. Document Results .....	118
Conclusions .....	118
CHAPTER 7 – EVALUATION OF PROJECT DELIVERY METHOD DECISION TOOL ..	119
Final Validation of PDM Multi-Tier Decision Tool .....	120

CHAPTER 8 – SUMMARY .....	123
APPENDIX A – REFERENCES.....	125
APPENDIX B – INTERVIEW DATA.....	132
APPENDIX C – INTERVIEW BLANK FORM.....	189
APPENDIX D – OVERALL ASSESSMENT BLANK FORM.....	206

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## **ABSTRACT**

This report documents the benefits and disadvantages of various project delivery methods for capital airport projects and provides guidelines for selecting an appropriate delivery method for a specific project. Project delivery methods considered are Design-Bid-Build (DBB), Construction Manager-at-Risk (CMR), and Design-Build (DB). A two-tiered project delivery selection framework is developed that can help the owners to evaluate pros and cons of each delivery method and select the most appropriate for their project. Tier 1 is a qualitative approach that allows the user to document advantages and disadvantages of each competing delivery method. The user can then review the results of this analysis and select the best delivery method. If at the conclusion of this analysis, a clear option does not emerge, the user then moves on to Tier 2. Tier 2 is a weighted matrix approach that allows the user to quantify the effectiveness of competing delivery methods and select the approach based on quantitative analysis. The framework developed requires the decision-makers to follow a logical and consistent procedure for considering all the relevant factors in project delivery selection. The process produces a Project Delivery Decision Report that documents the decision-making process and details relevant decision factors to fine-tune future project delivery decisions.

## EXECUTIVE SUMMARY

### Objective

A variety of project delivery methods is available to the developers of public projects in the United States. While the traditional design-bid-build delivery method remains the most common, there is considerable interest on the part of airports in alternative forms of project delivery and their potential benefits due in part to their potential to save cost and time resulting from the use of alternative delivery methods.

The outcome of this research is culminated in a guidebook to assist airports in evaluating and selecting the most appropriate project delivery method for their projects and documenting this decision in the form of a Project Delivery Decision Report. The guidebook is based on the fundamental premise that there is no *one* best delivery method for all projects, but rather agencies should select the best delivery method for each unique project. This selection should be made by considering the benefits and disadvantages of competing delivery methods for the project under consideration.

The *project delivery method* is the process by which a construction project is comprehensively designed and constructed for an owner including project scope definition, organization of designers, constructors and various consultants, sequencing of design and construction operations, execution of design and construction, and closeout and start-up. With the rapid change in procurement laws, public agencies now share the ability of their private sector counterparts to acquire construction services via alternative project delivery methods, such as construction management, design-build, and other hybrid systems.

### Research Methodology

The approach in developing the project delivery method selection framework was to synthesize relevant literature on project delivery methods and previous work in developing decision support systems for project delivery selection. In addition, face-to-face structured interviews were conducted with nine airports to learn how each project delivery method had been implemented on actual airport projects. The authors traveled to nine selected airports, interviewed project directors and financial planners, and collected data relevant to the airport's project delivery and procurement process. The results of the interviews were then incorporated into a set of *pertinent issues*. These pertinent issues are factors that were found to have profound effect on the choice of project delivery method. These factors in turn were used to develop the project delivery method selection framework described in this report.

## Selection System Framework

A two-tiered project delivery selection system was developed that consists of the following components:

Tier 1 – Analytical Delivery Decision Approach

Tier 2 – Weighted Matrix Delivery Decision Approach

The Tier 1 Analytical Approach provides a framework for airport agencies and their project delivery teams to define project goals and examine the advantages and disadvantages of each delivery method within the context of these goals. The motivation for this approach is to help agencies understand project delivery method attributes and to determine if their specific project goals align with the attributes of a particular delivery method. The Tier 1 approach also provides a “go/no go” review to determine if one or more project delivery methods should be excluded from the examination.

At the completion of Tier 1, the agency may not have a single, clear and logical choice for a project delivery method. If this is the case, the agency moves to the Tier 2 selection process with the best delivery method options from Tier 1 and creates a more detailed analysis to select the final project delivery method. The first tier is designed as a simple and straightforward selection method. It is anticipated that users will find that the Tier 1 analysis is sufficient for most airport projects.

The Tier 2 Weighted-Matrix Approach provides a means for the airport agency to further examine and document a project delivery decision for an individual project. The Tier 2 approach provides the agency with a process to select a delivery method by prioritizing project objectives and selecting the delivery method that best aligns with these objectives. In Tier 2 the user concentrates on a few key parameters that affect the choice of project delivery method, assigns appropriate weights to each parameter and calculates a score for each competing delivery method. The process of selecting each parameter and assigning the proper weight is described in detail in this guide.

The selection system framework will provide the means to document the decision in the form of a Project Delivery Decision Report. This report will provide a transparent and defensible documentation of the decision process. This documentation is extremely important when explaining the use of a project delivery decision to project stakeholders, particularly if an alternative delivery method is selected. The Project Delivery Decision Report format was created to provide agencies with a rigorous documentation format while allowing for maximum flexibility in the choice of delivery methods.

Regardless of how many tiers an agency uses to arrive at a project delivery method selection decision, the framework forces the decision-makers to document their logic as they proceed through the process. This aspect will prove especially helpful as agencies can use these documented decisions in future projects. It is the authors’ belief that this guidebook is a comprehensive resource for helping airports to select the most appropriate project delivery method and to document their decision in a concise and consistent format.

## CHAPTER 1 – OVERVIEW

### Introduction

The objective of this research effort is to develop a guidebook to help airport agencies<sup>1</sup> evaluate and choose the most appropriate project delivery method for their projects. The *project delivery method* (PDM) is the process by which a construction project is comprehensively designed and constructed for an owner including project scope definition, organization of designers, constructors and various consultants, sequencing of design and construction operations, execution of design and construction, and closeout and start-up. Currently available project delivery methods have moved far beyond the traditional design-bid-build method. With the rapid change in procurement laws, public agencies now share the ability of their private sector counterparts to acquire construction services via alternative project delivery methods, such as construction management, design-build, and other hybrid systems which can include maintenance, operations, and/or warranties.

The project team benefited from working on a similar project for transit. A similar effort was led by the same team to develop a guidebook to help transit agencies choose the most appropriate project delivery method. The research team applied the same approach with appropriate modifications to develop a guidebook for the airport agencies. One characteristic of the airports that distinguishes them from transit agencies is their ability to fund some of their capital projects using their own funds. This has allowed much flexibility to the airports compared to more traditional transportation projects such as highway and transit.

This chapter presents the organization of this research report. The chapter will then review the steps envisaged in the original proposal and summarize the work accomplished during this effort. Another major deliverable of this effort is the Guidebook that is prepared separately but contains many parts of this final report. Specifically, Chapters 2, 4, 5, and 6 of this final report are repeated in the guidebook. The guidebook was designed with the objective of developing an easy-to-use and practical tool for airport agencies to help them choose the most appropriate project delivery method (PDM). The guidebook is the deliverable that is going to be used by the practitioners. This final report on the other hand, while containing the essential elements of the guidebook, is prepared with the aim of demonstrating the research approach, the interview data, statistical analysis, lessons learned from the interviews, and the validation process used for testing the system.

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<sup>1</sup> In this report, “Airport”, “Airport Agency”, and “Agency” are used interchangeably.



## Research Plan and the Work Accomplished

Figure 1.1 depicts an overview of the research plan as envisaged in the proposal. Task descriptions below come from the Proposal and are followed by a brief description of the work accomplished.

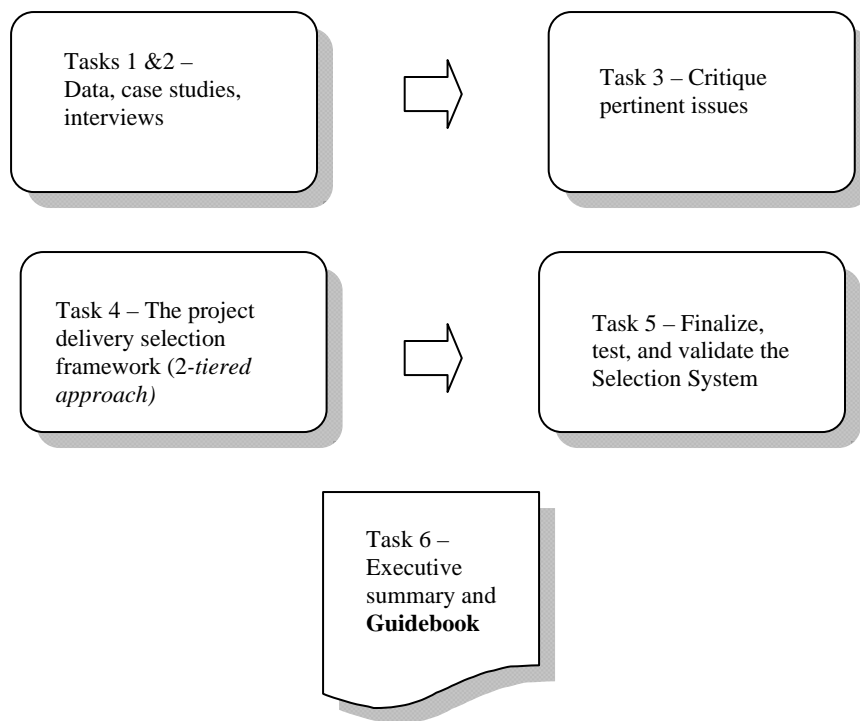


Figure 1-1 - Overview of the Research Plan

**Task 1.** *Collect and review relevant literature, case studies, research findings, and other appropriate material, inside and outside of the airport industry.*

Most of the literature search had already been conducted under a similar research project for transit. Various sources discussing project delivery methods, definitions, and decision support systems had been identified. The team concentrated on airport projects to complement the work already accomplished. The project's oversight panel was also helpful in pointing out some relevant literature that was used in this research. References cited in this report are presented in Appendix A. The results of this task's literature review have been used in Tasks 2 and 3 to confirm findings from the structured interviews and identify trends in the pro/con analysis.

**Task 2.** *Identify airport agencies, suppliers, and individuals with experience in using the various project delivery and contracting methods. Prepare a plan for in-depth interviews that includes a list of proposed interviewees, a draft summary of pertinent interview issues, and an interview guide/protocol. Conduct in-depth interviews with those entities approved by the project panel.*

The project panel directed the research team that the interviews should be geared towards the airports rather than individual projects. Further, only airports were considered that had experience with alternative project delivery methods. The team was able to identify and interview nine projects worth more than \$3.0 billion that represent the cross-section of delivery methods and are located across the United States (Table 1.1). The researchers used a rigorous structured interview methodology to develop an extensive questionnaire and submitted a sample to panel for comments. A copy of the questionnaire is presented in Appendix C. In each case the team members traveled to the airport agency and interviewed a group of highly knowledgeable individuals whose responsibilities included managing financial, contractual, and technical aspects of the airport's capital programs. The results of these structured interviews are reported in Chapter 3 and Appendix B of this report.

**Table 1-1 - Airports Interviewed**

Case #	Airport (Three Letter Code)	Project Delivery Method Experience	Project Size Range Low/High (Typical)
1	Atlanta-Hartsfield-Jackson Int'l (ATL)	DBB, CMR, DB	\$1.0M/\$1.2B (\$10M-\$20M)
2	Boston-Logan Int'l (BOS)	DBB, CMR	\$10K/\$165M (\$2.0M)
3	Port Columbus Int'l (CMH)	DBB, CMR, DB	\$50K/\$165M (\$1.5M)
4	Colorado Springs (COS)	DBB, DB	\$200K/\$36M (<\$1M or \$5-\$9M)
5	Dallas-Fort Worth Int'l (DFW)	DBB, CMR, DB	\$8.0K/\$100+M (\$2-\$5M)
6	Denver Int'l (DEN)	DBB, CMR, DB	\$500K/\$150M (\$2.5M)
7	Memphis Int'l (MEM)	DBB, CMR, DB	\$100K/\$20M (\$5.5M)
8	Mineta -San Jose Int'l (SJC)	DBB, DB	\$2.0K/\$185M (\$4.9M)
9	Tampa Int'l (TPA)	DBB, CMR, DB	\$50K/\$80M (\$2.5M)

Chapter 3 of this report presents the results of analysis of the interview data and a set of conclusions and lessons learned from the interviews. These lessons learned were later used in developing the 2-tier project delivery selection system. Appendix B provides detailed statistics and qualitative data on all the interviewed projects.

**Task 3.** *Describe and critique pertinent issues related to each project delivery method in terms of its application to airport projects in the United States.*

The original proposal contained a proposed listing of 23 pertinent issues divided into five categories. These issues were thought to have an impact on the choice of project delivery method. This list was revised and augmented as a result of literature search, interviews, and discussions with the project oversight panel. The revised list contains 19 issues in four different categories. Each issue in this revised list was carefully evaluated and critiqued in relation to the three main project delivery methods, *i.e.*, DBB, CMR, and DB. A concise set of advantages/disadvantages for each of these critical issues is included in this report in Chapter 4. These pertinent issues became the cornerstone of the project delivery selection system developed in this research project.

**Table 1-2 - Pertinent Issue Critique Matrix**

Pertinent Issue
<p><b>Project-level Issues</b></p> <ol style="list-style-type: none"> <li>1. Project size</li> <li>2. Schedule compression</li> <li>3. Schedule growth control</li> <li>4. Early cost precision</li> <li>5. Cost control</li> <li>6. Risk management / allocation</li> <li>7. Life cycle cost</li> <li>8. Maintainability</li> </ol>
<p><b>Airport-level Issues</b></p> <ol style="list-style-type: none"> <li>9. Airport experience / staff capability</li> <li>10. Airport control of project</li> <li>11. Security</li> <li>12. Control impact on passengers and operations</li> <li>13. Third party stakeholder input to design and construction</li> </ol>
<p><b>Public Policy / Regulatory Issues</b></p> <ol style="list-style-type: none"> <li>14. Competition and local talent</li> <li>15. DBE/small business impact</li> <li>16. Legal and statutory constraints</li> <li>17. Sustainability and LEED certification</li> </ol>
<p><b>Other Issues</b></p> <ol style="list-style-type: none"> <li>18. Adversarial relationships</li> <li>19. Claims</li> <li>Other</li> </ol>

*Task 4. Develop a framework and methodology for analyzing the advantages and disadvantages of the project delivery method for use by airport agencies in evaluating and selecting options. Using the framework developed in this task, document, evaluate, and compare the merits of each respective type of project delivery and contracting method, discussing the advantages and disadvantages of each.*

The research team developed a two-tiered approach to the framework solution, which was based on existing industry standards and the new research being conducted in this study:

- Tier 1 – Analytical Approach
- Tier 2 – Weighted Matrix Approach

The Tier 1 Analytical Approach provides a framework for agencies to define project goals and examine the advantages and disadvantages of each delivery method within the context of these goals. The motivation for this approach is to help agencies understand project delivery method attributes and to determine if their specific project goals align with the attributes of a particular delivery method. The Tier 1 approach also provides a “go/no go” review to determine if one or more project delivery methods should be excluded from the examination.

At the completion of Tier 1, the agency may not have a single, clear and logical choice for a project delivery method. If this is the case, the agency will be advised to move to the Tier 2 selection process with the best delivery method options and create a more detailed analysis to select the final project delivery method. The first tier is designed as a simple and straightforward selection method. Any owner, no matter what their level of experience with alternative project delivery methods, will be able to use this tier. Chapter 5 of this report describes Tier 1 approach.

The Tier 2 Weighted-Matrix Approach provides a means for the agency to further examine and document a project delivery decision for an individual project. In case an obvious choice was not found in the Tier 1 Analytical Approach, the Tier 2 approach provides the agency with a process to select a delivery method by prioritizing project objectives and selecting the delivery method that best aligns with these objectives. The Tier 2 Weighted-Matrix Approach is founded upon successful delivery decision tools developed by academics and professionals over the past 20 years. In tier 2 the user concentrates on a few key parameters that affect the choice of project delivery method, assign appropriate weights to each parameter and calculate a score for each competing delivery method. Chapter 6 of this report describes Tier 2 approach.

The two-tier system described above is the heart of the guidebook and the team strived to explain these tiers with sufficient clarity and depth so that the user can easily follow the procedure. It is understood however, that for airports embarking on their first alternative project delivery use, help of outside experts may prove useful.

*Task 5. Based on the results of Tasks 1 through 4, test and validate the decision matrix at the macro level to guide decision makers on selecting the most appropriate project delivery and contracting method(s) in various airport environments.*

After the 2-tier system was developed, an internal examination and validation of the system was conducted by the research team reviewing and applying the system to a few airport projects. Then one of the team’s associates, experienced with airport, work teamed up with an airport executive to apply the system to a recently completed project in Boston’s Logan International Airport. The choice of the PDM recommended by the selection system was the same as the agency had selected a few years earlier.

External validation consisted of sending the 2-tier system to several airports that the team had earlier interviewed. Three of the airports responded to the review request and submitted their comments. Overall, they felt that the system is quite comprehensive although one felt that Tier 1 might be rather complex for a novice user. There was consensus that the guidebook provided a valuable source of information regarding the choice of the PDM.

Task 6. *Prepare the guidebook, final report and a stand-alone executive summary.*

This task is the subject of the current report and the companion guidebook.

## **Organization of the Report**

This final report is divided into eight chapters and four appendices. The first chapter (the current chapter) provided an overview of the work accomplished in this research project. Chapter 2 presents the results of the literature search by identifying distinguishing characteristics of airport projects, providing clear definitions of various delivery methods, procurement processes, and identifying the appropriate point in time when various delivery methods can be adopted. Chapter 3 provides detailed information about the interviews and gives an analysis of the interview data and describes findings and lessons learned. Chapter 4 describes pertinent issues affecting the choice of project delivery method and the advantages/disadvantages of each project delivery method based on a pro/con analysis of each issue in connection with the delivery method. Chapters 5 and 6 describe the project delivery selection framework for the proposed two tiers. Chapter 7 describes the validation process. Chapter 8 provides a summary of research.

Appendix A contains a reference list. Appendix B contains a detailed account of interview data and statistics. These data may be of interest to researchers for a variety of purposes, and supports the findings described in Chapter 3. In Appendix C a sample questionnaire is presented that was used in interviewing airport executives. Appendix D contains a brief questionnaire that was used for system validation.

## CHAPTER 2 – LITERATURE REVIEW AND DEFINITIONS

### Distinguishing Characteristics of Airport Projects

Before embarking on describing various delivery methods it is important to observe the distinguishing features of airport projects compared to other transportation projects because these features may have an effect on the selection process. Several types of project delivery methods are currently available to the owners/managers of airport projects in the United States. An important decision, especially in the case of large complicated airport projects, is to select the most appropriate project delivery method for a specific project. Contractual relations, contemporary laws and regulations, owner's perception of risks, procurement award mechanisms and the method of payment all contribute to project delivery method selection. It is important to note that this document in no way advocates one project delivery method over another. The expressed purpose of this effort is to assist airport owners in making the project delivery selection decision in a defensible and consistent manner. The authors firmly believe that all project delivery methods can be successfully used by airports and that each project has unique characteristics that when carefully analyzed will lend themselves to being optimally delivered by a given project delivery method. In the subsequent paragraphs, alternative project delivery methods will be compared to traditional design-bid-build (DBB) project delivery, which functions as the benchmark against which all other methods are compared. The literature has found that the use of alternative project delivery can accrue benefits for owners. However, that is usually across a population of projects rather than on an individual basis. Thus, the reporting of benefits found in the literature should not be misconstrued as advocating one project delivery method over another. All project delivery methods have yielded both success and failure. Often the failure is the result of selecting an ineffective project delivery method.

#### *1. Wide Range in Size, Scope and Cost*

One characteristic of airport projects is the wide range of their costs. Airport projects cover a wide variety consisting of both horizontal and vertical projects ranging in cost from few thousand dollars to megaprojects worth hundreds of millions of dollars. For instance, Boston's Logan International Airport projects have ranged in costs from \$10,000 to \$165 million over the past five years.

#### *2. Security*

Security consideration is another important attribute of airport projects. Airport area usually divides into two parts: *air-side* which comprises runways and other facilities beyond the terminals and *land-side* which includes an airport's interface with ground transportation (Reid 2007). Some authors further divide the airport into three parts: *air-side*, *land-side*, and *terminals* (Transportation Security Administration 2006). The air-side is a secured non-public portion of an airport where movement of the construction personnel and equipment is controlled. Further, access to the area adjacent to

runways and taxiways and gates buildings is limited and under strict control. The terminal buildings designed to accommodate the enplaning and deplaning activities of aircraft passengers is the portion with the highest level of security, safety, and operational requirements. The land-side excluding terminals is the non-restricted area which includes area and buildings that both traveling passengers and the non-traveling public have unlimited access to. Construction in secured zone of airports involve difficulties to provide the security which is time consuming and costly. Based on studies, it has been found that the cost of construction in areas beyond the security checkpoints is 15 to 25 percent more than similar projects which are outside the secured area (Adrem *et al* 2006). This cost difference has numerous reasons. Workers must be issued special security badges to enter the secure air-side/terminal regions. This requires specific training and completion of a security clearance process, both of which take time. All vehicles and drivers have to get special licenses. Each morning, the workers are often required to enter the secure zone via static security stations that may be remote from the work site. All materials trucks not only are security checked, but also must be escorted to the work site. Also, because of the existence of the expensive aircraft and flammable material in the air-side, the contractor must take into account the various safety regulations which are not necessary in the land-side projects. All of these issues reduce the daily production rate of construction adding time and money to the airport project.

### *3. Construction during Airport Operation*

Airport projects are usually executed while airport operations are on-going. Because of this, it is important to manage the design and construction in a way that minimizes the impact on the airport operations. For example, construction work is often scheduled during periods of low airport activity. This usually means that much of the construction will proceed at night (Adrem *et al* 2006; Corey 2005). Some airport owners like Los Angeles International Airport try the multi-phased scheduling approach that will phase the project and protract the construction time to minimize delays to flight and passenger processing (ENR, Nov 2007). The appropriate project delivery method should optimize available resources in achieving project goals in an active airport environment. Therefore, choosing the proper project delivery method can play a major role in minimizing the impact on airport operation and flight delays.

### *4. Complexity of Airport Projects*

Another issue that airport owners face is the complexity of the airport projects. “Airport projects have a whole series of special systems which are seen nowhere else, on an enormous scale” (ENR, Dec 2003). For instance, sophisticated security devices (closed-circuit television, explosion detection system, x-ray scanner), electrical and data systems, special fire alarm and fire fighting systems, sophisticated baggage handling systems, spatial and circulation requirements of aircraft and related equipment, and the crowds that ebb and flow throughout the day all add complexity to airport design and construction. Some experts compare an airport to a body with multiple systems of interdependent organs; a failure in one system can shut down the entire terminal. Also, airports usually undergo adding or removing the existing facilities instead of building a new one. This process causes many problems like establishing the terms of contract (allocation of responsibilities to project participants especially the contractors) and ensuring that the new additions are designed in a compatible way with the existing facilities in terms of style and material. The challenge is that the integration of the new and old facilities should be accomplished in an effective manner (Adrem *et al* 2006).

### 5. *Different Stakeholders*

Due to various activities conducted in the airport and the far-reaching effect of some airport projects (such as construction of new or expansion of existing runways) on adjacent communities, there are many different stakeholders in the construction project. All stakeholders want to optimize the design based on their concerns that are sometimes conflicting. Even in the airport proper, stakeholders' concerns can be in conflict. For instance, entities interested in the commercial aspects of the airport operation may prefer a design that exposes the passengers to as many stores as possible, while entities concerned with terminal operations may prefer that passengers take the shortest possible route throughout the airport. Different agents that have specific duties and may not be responsible for the project cost make requisitions which might increase the project cost. This causes challenges for those in charge of project to reach an agreement that may increase the development phase of the project (Adrem *et al*, 2006).

### 6. *Type of Funding*

Major airport financing comes from (1) federal assistance (FAA and TSA), (2) state assistance, (3) bond sales, and (4) airport cash and revenue funding (Airport Council International, 2006). The Airport and Airway Trust Fund established by the Airport and Airway Revenue Act of 1970 provides the revenues used to fund AIP, which assists sponsors, owners, or operators of public-use airports in the development of a nationwide system of airports adequate to meet the needs of civil aeronautics. In 1997, congress enacted new taxes and funded the trust fund that guarantees a stable funding source whereby users pay for the service they receive. When aircraft operators are exempt from paying the aviation taxes, their airport activity would not be included in the justification or design for an AIP project (FAA 2005). Only those AIP projects considered by the FAA Administrator to be necessary to provide for a safe and efficient airport system and to meet the current and projected growth of civil aeronautics will be considered for selection. Although AIP can fund multi-year projects, the funds are released on a yearly basis and based on an agreed-upon payment schedule. Because of this, cash flow and compliance with an AIP approved fund schedule have important roles. Using this fund causes restrictions like competitive pricing of construction services, compliance with Davis Bacon Act, and good faith efforts to include Disadvantaged Business Enterprises (DBE) firms (Airport Council International 2006). In fiscal year 2005, the total amount made available for AIP program was \$3,590,506,982. This budget provided 2,099 grants ranging from \$10,925 to \$38,826,223 with an average value of \$1,710,580 (CFDA 2008). Figure 2-1 depicts the process should be followed by the grantee and the FAA for a typical AIP-funded construction project. Based on the work involved, type of sponsor, project size, *etc.* some steps can be eliminated from this process. AIP funds do not require that accounting procedures be in accordance with Federal Acquisition Regulations (FAR); otherwise for all federal aid that comes from TSA, they needs to follow FAR procedures for accounting (Airport Council International 2006). Another source of funds is Passenger Facility Charges (PFC). These are taxes that is charged on each ticket, collected by the airlines, and given to the airport. The airport has to follow FAA guidelines (such as using these funds for airfield related or terminal related projects) in order to use these funds.

State funding is another source of financing for airport projects. Many states assist capital improvement projects by grants through various programs. Like federal assistance, acceptance of this fund imposes restrictions and compliances such as type of contract and disbursement of the state's fund, competitive pricing of construction services, auditing and monitoring rules, required project record retention, involvement by the state in the airports' selection process of professional consultant services, compliance with Equal Employment Opportunities, Davis Bacon laws, Civil



Rights Acts, American with Disabilities Act, and good faith efforts to include DBEs (Airport Council International 2006).

In bond-funded financing, factors like project definition, cost analysis, budget commitment, and delivery schedule are critical since airport authority wants to buy just the right number and amount of bonds at the right time. It should be noted that highly complex projects without a clear scope are not suitable for bond funding because of inherent risk involved (Airport Council International 2006) and because in this approach the investor's confidence is of paramount importance.

Another potential source of funds is the airport cash and revenue funding; this approach gives the airports that have consistent revenue streams the freedom to choose any delivery method without regard to outside restriction impacts like those in other types of financing. Multi-year projects which need to have significant funding in place as the project commences cannot rely upon this funding.

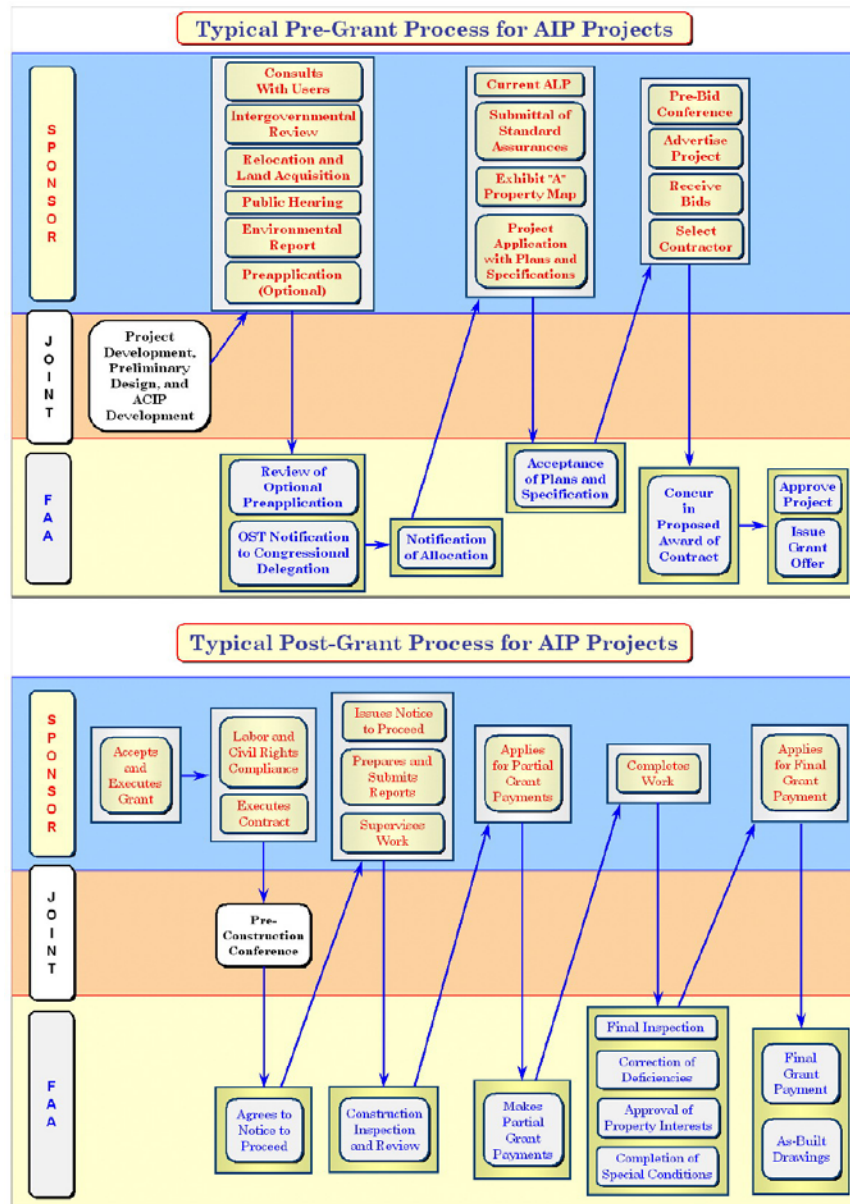


Figure 2-1 - AIP Grant Steps  
 (Adapted from Airport Improvement Program Handbook 2005)

### 7. Revenue Generating Projects

Unlike other transportation projects with no potential for generating revenues, some airport projects have the potential for generating revenue. These include concessions, parking, and real estate activities. This encourages airport agencies to try to take advantage of this characteristic by delivering these projects as fast as reasonable [Tampa International Airport interview 2008; Dallas-Fort Worth International Airport interview 2008]. Therefore, for these types of projects, the delivery method that can expedite the execution is preferred. The risks associated with compressing a project delivery schedule are offset by the early return on investment.

## Evolution of Current Alternative Delivery Methods in Airport Projects

Public procurement law has historically limited public agencies to only use design-bid-build (DBB) project delivery. The wide range of options for project delivery methods that are available today is a relatively recent development for publicly funded projects in the United States. The shaping of the public procurement laws leading to the traditional DBB project delivery method, in part can be traced to the Brooks Act. Enacted in 1972, the Brooks Act (Public Law 92-582) states that design services on federally funded projects in the United States (US) should only be procured on the basis of qualifications. Alternatively, numerous laws and statutes throughout the US have limited the procurement of constructors to the lowest responsible, responsive bidder. The combination of these two procurement practices has helped solidify the proliferation of DBB in the public sector. This method has been the traditional project delivery method in transportation projects until 1996 when the Federal Acquisition Reform Act explicitly authorized the use of design-build (DB) for federal projects. While some transit projects started experimenting with DB delivery method as early as 1994, airports started considering alternative delivery methods after 2000. In 2000, congress established a pilot program for federally funded airport improvement projects which allowed the FAA to test DB contracting and other forms of alternative delivery methods<sup>2</sup> (Loulakis 2003; FAA 2005). Title 49 of the United States Code was amended to add Section 47142, which established DB as an acceptable delivery method under AIP. On June 20, 2001, the FAA issued a memorandum allowing the procurement of DB contracts using either a qualifications-based selection (QBS) or a competitive proposal selection process. Subsequent to the successful experience of using DB in several projects, many states passed new legislation and codes to allow alternative project delivery methods, i.e. DB and Construction Manager-at-Risk (CMR). Adding the responsibility of operation and maintenance to DB projects expanded to another delivery method called Design-Build-Operate-Maintain (DBOM). The difference among delivery methods, the unique characteristics of each project, and the vast variety of parameters affecting the project delivery method selection, has made the delivery method selection decision complicated for many owners. The purpose of this guidebook is to facilitate decision-making by clarifying the differences between the delivery methods and proposing a structured decision-making approach which incorporates all the effective parameters.

## Definitions of the Delivery Methods

Since the early 1980s, owners of construction projects have been putting greater pressure on the architecture/engineering/construction (A/E/C) industry to increase quality, decrease cost, and more importantly compress the period it takes from concept to completion for all manner of public and private facilities. As a result, both owners and industry have experimented with various forms of project delivery with varying degrees of success. The adoption of alternative project delivery methods has added to the challenge of selecting the method most appropriate to the owner's needs and desires as well as the project's technical requirements. As a result, this document provides a set of standard project delivery definitions as a basis for communicating the technical requirements for bringing a new project from the owner's concept to operation and final decommissioning of the project.

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<sup>2</sup> The Wendell H. Ford Aviation and Investment Reform Act for the 21<sup>st</sup> century.

Project delivery method is a term used to refer to all the contractual relations, roles and responsibilities of the entities involved in a project. The AGC (2004) defines project delivery method as “the comprehensive process of assigning the contractual responsibilities for designing and constructing a project. A delivery method identifies the primary parties taking contractual responsibility for the performance of the work.” *Thus, the different project delivery methods are distinguished by the way the contracts between the owner, the designer, and the builder are formed and the technical relationships that evolve between each party inside those contracts.*

The Construction Industry Institute (CII) maintains that there are really only three fundamental project delivery methods: DBB, DB, and CMR (CII - Project Delivery Systems 1997). While there are a multitude of various names for project delivery methods throughout the industry, CII is essentially correct. Therefore, this report will focus its information in those three categories.

The AGC (2004) also distinguishes between the delivery method and the management method. The management method “is the mechanics by which construction is administered and supervised” (AGC 2004). This function is either retained by the owner agency or is out-sourced. An example of out-sourcing the management process is to hire an Agency CM to represent the owner’s interests during design and construction. Theoretically any management method may be used with any delivery method. As an example, the owner may hire an Agency CM to manage a DBB, DB, or even a CMR project.

There is also an important distinction between a *delivery method* and a *procurement method*. A recent Transportation Research Board report breaks procurement methods down into three categories: low bid, qualifications-based, and best value (Scott et al 2006; Bearup et al 2007). These are defined as follows:

- Low Bid: Contract is awarded on the basis of low price alone. No other factors are considered.
- Qualifications-Based: Contract is awarded on the basis of qualifications alone. Price is not considered.
- Best Value: Contract is awarded on a combination of price and other key factors such as qualifications, schedule, technical approach, etc. (Scott et al 2006; Bearup et al 2007).

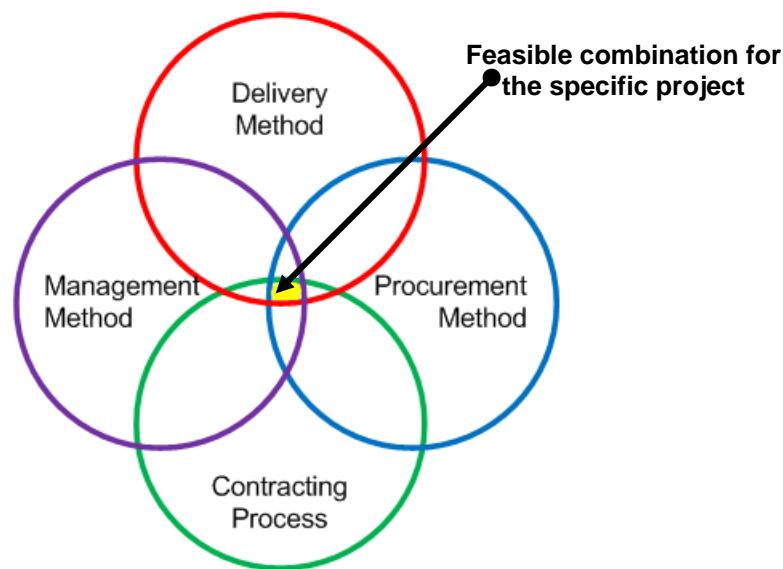
Once again, each of the delivery methods can theoretically be procured by any of the above procurement methods. It is important that the procurement method that will be used be factored into the project delivery method selection decision. The issue here is to ensure that a perceived advantage of a given project delivery method is not in fact turned into a disadvantage by the procurement method used by the owner.

The final issue that must be considered when selecting a project delivery method is the contracting process that will be used to get to a final award. There are three possibilities that are defined as follows:

- One-Step: Competitors are asked to submit all required information at one time. Those submissions are evaluated and an award is made in accordance with the selected procurement methodology.

- Two-Step: Competitors are asked to submit qualifications in the first step which are evaluated to form a short-list of qualified competitors. The second step comprises the submission and evaluation of all other required information. Again the award is made in accordance with the selected procurement methodology.
- Multi-Phase: The project is divided into phases and the winning competitor is selected using the qualifications-based procurement method. Upon selection, the required information is submitted and evaluated on a phase-by-phase basis until the entire project is awarded. (Note: this is a new emerging process with which there has been only anecdotal experience) (Cornell 2007).

Included in each of the above are considerations for the contract type that will be ultimately executed for the project. The literature lists four types that deal with how the owner will compensate the winning competitor: guaranteed maximum price (GMP), cost plus, negotiated lump sum, and lump sum (Bearup et al 2007). Once again the perceived advantages and disadvantages of each candidate project delivery method must be reviewed in the context of the contracting process to ensure that the potential benefits of selecting a given delivery method are not rendered unattainable by the contracting process. Figure 2-2 is conceptual representation of how the various components of project delivery interrelate.



**Figure 2-2 - Graphic Illustration of the Interrelationship of the Components of Project Delivery**  
(adapted from Bearup et al 2007)

The intent of the above discussion is not to overcomplicate the project delivery decision-making process by turning it into a 4-way matrix with a multitude of permutations and combinations of possible outcomes. Airport owner/operators have standing procedures that they use to deliver capital projects and in most cases will continue to use their preferred management, procurement, and contracting processes. The purpose of the discussion is to alert the reader that the project delivery method selection decision cannot be made in a vacuum and that as the analysis of candidate project delivery methods is conducted, it must be undertaken in the context of those components to

ensure that the result is specific to both the project and the airport organization that will ultimately deliver the project. Hence the remainder of the report will focus on its subject, selecting an appropriate project delivery method. It should also be noted that in order to match the project with an appropriate delivery method, services of a “project delivery professional” can be useful in reviewing the owner’s needs to ensure that the best combination of delivery method, procurement system, and implementation procedure is chosen (Warne and Beard 2005).

The definitions and a brief explanation with a graphic displaying the contractual relationships are included below to assist the reader in putting the contents of this report into proper context. Note that the lines of communication shown in the figures represent the ability to exchange information through the use of formal and informal requests for information between various entities in the project.

## 1. Design-Bid-Build (DBB)

DBB is the traditional project delivery method in which an owner retains a designer to furnish complete design services and then advertises and awards the separate construction contract based on the designer’s completed construction documents. The owner is responsible for the details of design and warrants the quality of the construction design documents to the construction contractor.

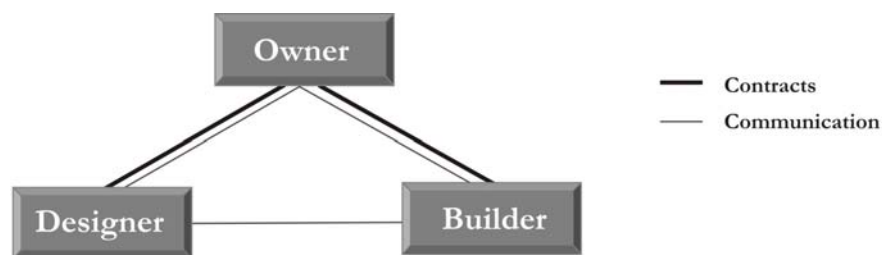


Figure 2-3<sup>3</sup> - Design-Bid-Build

Figure 2-3 shows the basic relationships between project participants in a DBB delivery system. The owner “owns” the details of design during construction and as a result, is financially liable for the cost of any design errors or omissions encountered in construction. This principle is called the “Spearin Doctrine” (Mitchell, 1999). The construction phase of DBB projects is generally awarded on a low bid basis. There is no incentive for the builder to minimize the cost of change orders in this delivery method. In fact, there can be quite the opposite effect. A builder who has submitted a low bid may need to look to post-award changes as a means to enhance profit on the project after bidding the lowest possible margin to win the project. One author states that the defining characteristics of DBB are as follows:

- “There are separate contracts for design and construction;
- Contractor selection is based entirely on cost;

<sup>3</sup> Figures adapted from American Institute of Architects, California Council (1996). *Handbook on Project Delivery*. Sacramento. American Institute of Architects, California Council, Sacramento, CA.

- Design documents are 100% complete” (Bearup et al 2007);

DBB projects can also be awarded on a negotiated basis and a best-value basis (Scott et al 2006). In both cases, the probability that the project will be awarded to a builder who has submitted a mistakenly low bid is reduced. Additionally, the motivation of the builder in both cases is to complete the project in a manner that will get it invited back to do the next negotiated contract or that will reflect well in the next best-value selection. Regardless of the procurement method, DBB is distinguished by less builder input to the design than DB or CMR. Thus, the owner must rely on the designer or agency CM (and not the builder) for constructability review if there is any at all. However, in this method the owner has full control over the details of design which is often a requirement for some complex projects.

DBB is also characterized by the greatest amount of competition in both the design and construction areas. All qualified designers are able to compete for the design without restriction. Additionally, all constructors who are able to furnish the requisite bonding are also able to compete without constraint. Design subconsultants and construction trade subcontractors are also able to compete with minimal restrictions. Finally, as DBB is normally viewed as the traditional project delivery method in the US, it is both well-understood and well-accepted by both owners and members of the design and construction industries.

## **2. Construction Manager-at-Risk (CMR) or Construction Manager/General Contractor (CM/GC)**

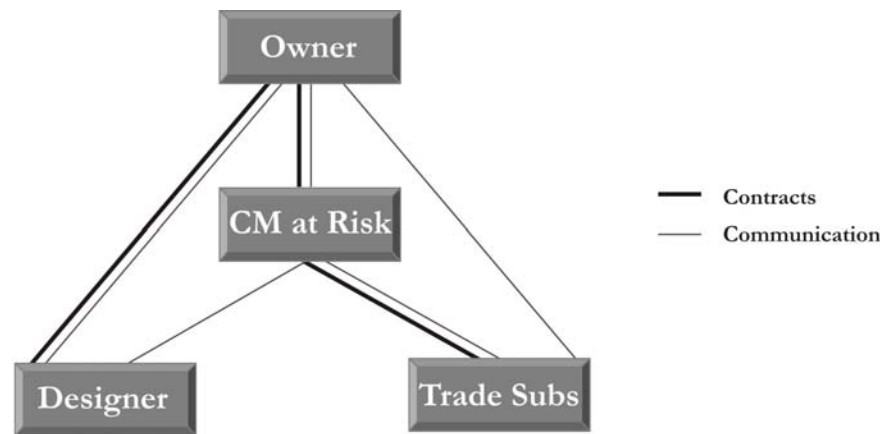
CMR projects are characterized by a contract between an owner and a construction manager who will be at risk for the final cost and time of construction. In this agreement, the owner authorizes the construction manager to handle the details of a project’s life cycle. The idea of CMR is to furnish professional management of all phases of a project’s life to an owner whose organization may not have those capabilities (North Carolina 2005). These projects normally use the qualifications-based procurement method to select the CMR. It is possible to apply best value procurement with the CMR’s qualifications and proposed fees being taken together to form the best value metric.

Typically, CMR contracts contain a provision in which the CMR stipulates a guaranteed maximum price (GMP) above which the owner is not liable for payment. Often these contracts include incentive clauses in which the CMR and owner can share any cost savings realized below the GMP. Some states, like Oklahoma, take the GMP and convert it to a firm-fixed price contract and administer the construction as if it were a traditional DBB project thereafter (AIA 2005). CMR contracts can contain provisions for the CMR to handle some aspects of design, but generally, the owner retains the traditional responsibility by keeping a separate design contract and furnishing the CMR with a full set of plans and specifications upon which all construction subcontracts are based as seen in Figure 2-4. The CMR will usually be paid for furnishing preconstruction services such as cost engineering, constructability review, and development of subcontractor bid packages. According to AGC (2004) the defining characteristics of the CMR are the following:

- The designer and the CMR hold separate contracts with the owner;
- The CMR is chosen based on criteria other than just the lowest construction cost, such as qualifications and past performance.

Additional defining characteristics are:

- “CMR contracts directly with trades and takes on ‘performance risk’ (cost and schedule commitments);
- Schedule allows for overlapping design and construction;
- Owner procures preconstruction services from the CMR;
- Owner expects CMR to provide Guaranteed Maximum Price (GMP) and to commit to delivery schedule” (Bearup et al 2007);
- “Transparency is enhanced, because all costs and fees are in the open, which diminishes adversarial relationships between components working on the project, while at the same time eliminating bid shopping” (AIA 2005).



**Figure 2-4 - Construction Manager-at-Risk**

Constructability and speed of implementation are the major reasons an owner would select the CMR method (3DI 2008). Additionally, CMR greatly facilitates phased construction if that is a requirement for given project. Unlike DBB, CMR brings the builder into the design process at a stage where definitive input can have a positive impact on the project. “The CM[R] becomes a collaborative member of the project team. Preconstruction services include budgeting, cost estimating, scheduling, constructability reviews and value engineering studies” (3DI 2008). In CMR, the construction manager essentially becomes the general contractor at the time the guaranteed maximum price is established. While some experts attempt to distinguish between CMR and Construction Manager/General Contractor (CM/GC) due to perceived levels of risk, many agencies use these terms more or less interchangeably<sup>4</sup>. The CMR can and is expected to provide realistic project cost estimates early in the project life cycle. It is anticipated that after a certain amount of design is complete and the project is sufficiently defined, the owner will enter into a contract with

<sup>4</sup> According to AGC (2004) there has been some confusion about terms CM-at-risk and CM/GC because of the assumption that the phrase at-risk connotes cost guarantee. Even if there are no cost guarantees, the CM is still at-risk because the CMR holds the trade contracts (warranting the performance of the work). Because of this, some users choose to avoid the debate over the term risk and instead use the term CM/GC (p.8).



the CMR for providing construction services. Many states reserve the right to go out for bids if they think that the CMR's price is not competitive (Minchin *et al* 2007)<sup>5</sup>.

As the design selection process virtually mirrors the same process in DBB, implementing CMR does not inherently restrict competition among designers and design subconsultants (AIA 2005). Owners occasionally require the designer in a CMR project to have previous CMR experience, which will impose a constraint on competition, but only if the owner chooses to do so. As the constructor is selected on a basis of qualifications and past performance and must also have the capability to perform preconstruction services, CMR project delivery can constrain competition to those constructors that have previous CMR experience. Most public CMR laws require competitively bidding out the construction trade subcontract work packages. The central idea of CMR is to get the advantage of price competition in the sub packages combined with the qualifications-based selection of the GC as CMR.

### 3. Design-Build (DB)

Design-Build is a project delivery method in which the owner procures both design and construction services in the same contract from a single, legal entity referred to as the design-builder. A variety of approaches exist for selecting the design-builder. The most common contracting processes are the one-step and the two-step processes. The one-step process provides for competitive evaluation of technical proposals, with the contract award decision based on best value to the owner agency. The best value is based on a combination of technical merit and price (Molenaar *et al* 1999). The two-step process separates the technical proposal from the price. The method typically uses request for qualifications (RFQ)/request for proposal (RFP) procedures rather than the DBB invitation for bids procedures. There are a number of variations on the DB process, but all involve three major components. The owner develops an RFQ/RFP that describes essential project requirements in performance terms. Next is the evaluation of proposals, and finally, with evaluation complete, the owner must engage in some process that leads to contract award for both design and construction services. The DB entity is liable for all design and construction costs and normally, provides a firm, fixed price in its proposal (El Wardani *et al.* 2006, Ibbs *et al.* 2003, Graham 1997).

DB projects can and have been delivered using all three procurement methods. Experience in the highway industry has found that the experience with low bid procurement for DB projects has been less than satisfactory, and the AASHTO Design-Build Procurement Guide specifically recommends against it (AASHTO 2008). The reference recommends the use of two-step, best value procurement as the preferred method for highway transportation projects. Qualifications-based procurement can also be used on DB projects and allows the owner to bring the design-builder on board at an early stage to assist in early project development activities. Indeed a survey of nine airports in the United States by the research team showed that several of these airports have used the qualifications-based procurement process. This is then combined with a negotiated GMP contracting process, which may also use the multi-phase process. This combination has been referred to as "DB progressive GMP." Its aim is to reduce the contingency that is typically contained in a lump sum DB price

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<sup>5</sup> There are two types of CM arrangements, namely *Agency CM* and *CM-at-risk*. Our emphasis in this work is *CM-at-risk*. *Agency CM* is not a project delivery method as the CM is not contractually responsible for delivering the project. Its role is purely consultative and is usually not at risk for the cost and schedule of building the project.

proposal for scope creep during the design phase by not forcing the design-builder to commit to a price until the details of design are reasonably stable.

Figure 2-5 clearly shows that from the owner's standpoint the project's chain of responsibility is considerably simplified. As in CMR, the builder has early constructability input to the design process. As the owner no longer owns the details of design, its relationship with the design-builder must be based on a strong degree of mutual professional trust (Beard et al 2001). The design-builder literally controls this project delivery process. As a result, DB is the delivery method which has the greatest ability to compress the project delivery period and as a result is often used for "fast-track" projects.

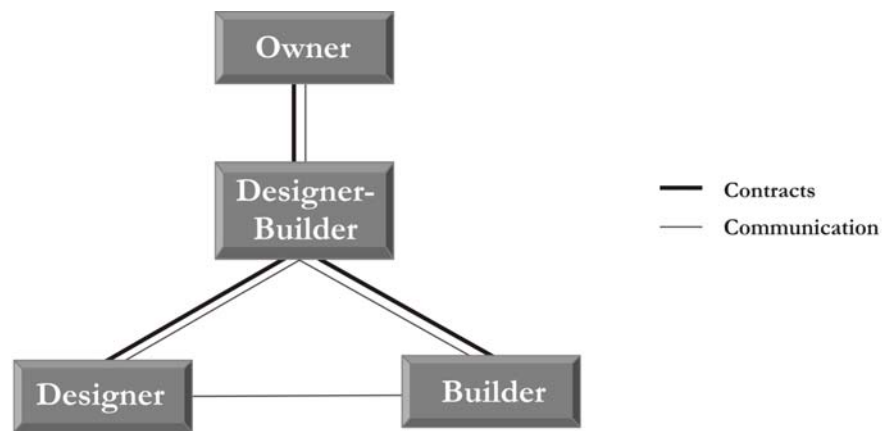


Figure 2-5 - Design-Build

Bearup *et al* (2007) state that the defining characteristics of DB are as follows:

- Single point of responsibility;
- Schedule allows for overlapping design and construction;
- Design-builder furnishes preconstruction services during design;
- Owner expects design-builder to provide a firm fixed price and to commit to delivery schedule.

DB creates that greatest constraint on competition in that all parties to the DB contract are selected using qualifications and past performance as a major selection factor. As the owner transfers responsibility for all design and construction in the DB contract, it also loses the ability to foster competition between design subconsultants and construction trade subcontractors. There is typically no requirement to competitively bid for subcontract work packages and often the scale, complexity and speed at which DB projects are executed precludes firms with no DB experience from being able to participate. Additionally, as the contract is awarded before design is complete, DB can also create an unfavorable risk environment for subcontractors whose cost estimating systems lack the sophistication to be able to price work without completed construction documents.

There are many variations on the DB method. Design-build-operate-transfer, design-build-operate-own (sometimes called lease-back), design-build-operate-maintain, all require the DB contractor to remain with the project after construction is complete. Design-Build-Operate-Maintain (DBOM) is very similar to DB. However, the DB contractor assumes the operation and maintenance risks and is

responsible to operate the new facility according to a set of regulations and codes for a determined duration (Wiss *et al* 2000, Kessler *et al* 2005).

## **Legality of Delivery Methods in Various States**

The traditional method of DBB has been used throughout the United States and state codes of all states give authority to the agencies to use it in their projects. Alternative delivery systems do not have this clear statutory support. Some states do not allow airport entities to use them while some others have given one time authority for a special project. Still another group of states have put some limits on the application of alternative delivery systems. For example, according to current statute for airport projects in Massachusetts, the use of DB is restricted to horizontal projects which are \$5 million and larger and the CMR is applicable only to vertical projects which are \$10 million and larger [Logan Airport interview 2008]. Developing pilot programs is a common method in some states for implementing previously unauthorized project delivery methods and mainly for DB. In order to update information on the legal status of alternative project delivery methods in various states, a thorough literature search needs to be conducted on the laws of all the 50 states, which is beyond the scope of this work. Also, due to frequent changes of the regulations, the authors believe that each airport is in the best position to assess the legality of a certain delivery method locally.

According to Federal laws, FAA plays a minimal role in the procurement process used by airport agencies for the projects that are supported by the AIP. For instance, states as sponsors under Title 49 CFR, Part 18.36 are authorized to use the same procurement system and laws which they use for projects not funded in part or whole by the Federal government. Also, non-state airport sponsors can use their own procurement systems if they comply with state and local laws and regulations, provided that the procurements conform to applicable Federal law and the standards identified in Part 18.36. Requirements for third party contracting, described in Order 5100.38C, are sufficiently flexible to allow the airport sponsors to select their contractors through competitive bidding and/or competitive proposal/RFP (both price and other parameters considered). For the DBB, the Order allows the procurement of services through sealed bidding or competitive negotiations. For DB, the grantees must procure DB services through qualifications-based selection or competitive proposal selection procedures. So it appears that if a specific state or city allows an alternative project delivery method, the federal regulations will not prevent the agency of undertaking such procurement.

## **Existing Selection Approaches of Project Delivery Methods**

Selection of the appropriate alternative project delivery method is a complex decision-making process. The decision should be made as early in the design phase as possible; preferably in the project scoping process and certainly before the final construction estimates of the projects are ready. The decision will occur when the owner still has little information about the outcome of the project and the project plans are not detailed enough to be reliable grounds for judgment about the project. In this environment, having a framework for decision-making is vital for airport projects. This framework should be simple, comprehensive, rational, and objective. The literature review of this research report shows that some experts have concentrated on this issue and have developed a

list of criteria and some decision making frameworks (Airport Council International 2006; Debella *et al.* 2006; Oyetunji *et al.* 2006; Mahdi *et al.* 2005; Garvin 2003; Ibbs *et al.* 2003; Konchar *et al.* 1998; Gordon 1994). Several of these researchers have studied a few projects and have based the selection methodology on the characteristics of those projects.

One can roughly divide the relevant literature into two groups: (1) the papers and reports that compare the delivery methods based on the observed performance measurements, collected from a group of projects, and (2) the papers and reports that give a list of criteria and a framework for decision-making.

One of the best examples for the first group is a paper by Konchar *et al.* (1998) in which a set of criteria is defined for a performance comparison of different delivery methods (i.e. DB, DBB and CMR) in 351 building projects. These criteria are mostly objective and measurable, like *cost growth*, *construction speed*, and *schedule growth*. Some criteria are also defined to incorporate the quality performance of the delivery methods, like *difficulty of facility start up*, *number and magnitude of call backs*, and *operation and maintenance costs*. Based on Konchar *et al.* (1998), “when all other variables were held constant, the effects of project delivery method indicated design/build projects to be at least 5.2% less than design/bid/build projects and 12.6% less than construction management at risk projects on average in terms of cost growth.” The authors of the paper divided the projects into six different groups (such as light industrial, complex office, heavy industrial, *etc*) in order to get clearer trends in each group. Taking this into account, the paper does not have enough data to distinguish between the performances of different delivery methods in airport projects. However, two studies of DB versus DBB project performance in the federal building sector did make direct comparisons. The first compared 54 DBB projects to 34 DB projects and discovered that DB projects had 16.4% less cost growth and 19.0% less time growth than similar DBB projects (Gransberg *et al.* 2003). Another study looked at 110 Navy projects and found that again, DB projects performed better, with 18.0% less cost growth and 60.0% less time growth (Allen *et al.* 2002). Additionally, a recent NCHRP study of best value contracting (Scott *et al.* 2006) also furnished direct comparison of transportation project performance between delivery methods. While that study did not include CMR projects, it included DBB projects awarded on a best value basis which parallels the CMR delivery method. It found that DB projects had 4.7% less cost growth and 9.3% less time growth. Best value projects had 2.0% less cost growth and 18.5% less time growth. Others such as Debella *et al.* (2006) and Ibbs *et al.* (2003) have used a methodology similar to Konchar’s, but they have narrowed down the scope of their research either to special kind of projects or fewer performance measures.

The second group of papers and reports has focused on the decision-making process. These papers propose mechanisms for decision-making and define the necessary criteria and frameworks so that the most important project parameters are defined and used in the decision-making process. The frameworks are primarily intended to be simple, rational, and comprehensive. They range from basic flow chart methods (Airport Council International 2006; Gordon 1994) to more sophisticated processes based on methodologies such as multiple linear regression, the Analytical Hierarchy Process (AHP) (Mahdi & Al-Reshaid 2005), or Simple Multi Attribute Rating Technique with Swing weights (SMARTS) (Oyetunji and Anderson 2006).

Airport Council International-NA (ACI-NA) in an effort with Airport Consultants Council (ACC), and the Associated General Contractors of America (AGC) developed a white paper in 2006 that offers basic guidelines for selecting the most appropriate delivery method for airport projects. The guidelines comprise a list of factors that owners should consider in regard with each delivery

method. Gordon (1994) created a procurement method selection model that uses a flowchart for selecting the best contracting method. Within the flowchart are a number of drivers that direct the owner's attention to the most important issues in delivery method selection. A/E/C Training Technologies (2006) has developed a multimedia education compact disc and delivery selection tool. The tool integrates training on project delivery selection systems with a matrix-style decision framework that owners can complete to make an informed delivery selection. Skitmore and Marsden (1988) presented a multi-attribute analysis technique and a discriminant method for selecting delivery methods. The multi-attribute method uses utility factors to evaluate the suitability of a delivery method with respect to a client's priority criteria. Kumaraswamy and Dissanayaka (1996) propose a client advisory system with an expert system front end, which will gather project information and model the project profile to generate a list of delivery options. Finally, Oyetunji & Anderson (2006) use a SMARTS approach for delivery selection. The approach utilizes a matrix that has 20 criteria each with a given weight. The owner rates these criteria and goes through the required calculation that gives a single rank to each delivery method. The delivery method with the highest rank should be chosen for the project.

Based on both groups of literature, one can find that the number of important parameters that affect the decisions early in the project can be divided into four groups: *project-related parameters*, *agency-related parameters*, *legal parameters* and *life-cycle issues*. Project-related parameters are those parameters that pertain to the duration, estimated cost, quality level, project risks, limits on schedule growth, project complexity, *etc.* Agency-related parameters mainly consist of the legal status of agency, the role of this project in the objectives and plans of the agency, availability of funds, level of experience and competency of the agency's staff, flexibility needs in construction phase, level of risk assumption, importance of preconstruction services, and quality level expectation. Legal parameters mainly cover the legal and contracting issues, such as statutory authority to use alternative project delivery methods and permits needed for the project. Life-cycle issues cover the costs of maintaining and decommissioning the facility as well as the ability to minimize energy usage and negative environmental effects of the project. One emerging requirement is sustainable design and construction which is directly tied to project life-cycle issues.

The ability to transfer project risks to other entities is a characteristic that is related to both the project and the owner agency. It shows the level of risk and uncertainty of the project and also the ability of the owner to assume the risks or transfer them (*risk-prone* or *risk-averse* agency). Delivery methods have different mechanisms for risk distribution among the entities involved. In summary, the existing body of knowledge in this area, along with specific information collected during the airport interviews, provides a solid foundation for developing a new selection system tailored to the needs of airport owners and operators.

## Timing of Project Delivery Method Selection

In selecting a project delivery method, the owner should realize that the window of opportunity will pass for some delivery methods as the project moves through various stages of development. As a result, airport owners should try to make this decision as early as possible. For instance, Logan International Airport decides on the delivery method before design stage, and Tampa International Airport hires DB contractor based on QBS at the beginning of the design and then the design-

builder takes the design to 60% complete while cooperating with the Airport staff. In most airports [San Jose International Airport interview 2008; Hartsfield-Jackson Atlanta International Airport interview 2008], the default delivery method is DBB; based on factors such as schedule compression, cost control, type of funding, control on design, *etc.* some airports may consider an alternative delivery method. Table 2.1 maps project delivery method selection decision against project development phase. Project development has been broken into Conceptual Design (including the scoping), Preliminary Engineering, Final Design, and Construction phases. It can be seen that selecting a project delivery method should be done relatively early. Most of the benefits can be realized by engaging the constructor as soon as possible. The decision point for PDM selection should not be confused with the time that the constructor is engaged. As an example, an owner may decide to engage a DB contractor at the end of Preliminary Engineering or even later in order to clarify the scope and reduce the uncertainty. However, the owner should have decided on the type of delivery (for example DB) much earlier, so that the design documents can be properly developed considering the type of delivery method.

**Table 2-1 - The Timing of PDM Selection**

PDM	At the end of Conceptual Design	At the end of Prelim. Eng.	At the end of Final Design	Construction
DBB	■	■	□	○
CMR	■	□	□	○
DB / DBOM	■	□	○	○

- Desirable
- Feasible
- Not feasible

## CHAPTER 3 – ANALYSIS OF AIRPORT CASE STUDIES

### Background

Based on the results of the literature review, the research team began its case study data collection. The team proposed to identify and analyze eight airports in the United States from across the spectrum of project delivery methods. This study was limited to the U.S. airports due to the limitation in budget and the fact that it was felt that the needs of airport agencies in selecting the most appropriate delivery method can be adequately addressed by focusing on domestic airports. The team was able to identify and gain access to information on nine airports that represent the cross-section of delivery methods. Each of the case study airports had experience with multiple project delivery methods. Thus, the depth and validity of the interviews was enhanced by permitting the interviewers to gain information that compared and contrasted the benefits and constraints of several delivery methods from a single source. Table 3-1 is a summary of the case study airports that were sampled for this research. One can see that the case study airports span from north to south, coast to coast and include the nation's center, as well.

One can also see from looking at Table 3-1 that the case study population includes a good cross-section of both passenger and cargo volumes as well as a broad range in construction budgets and project sizes. The airports all seemed to have one thing in common in this area, and that was they needed to deliver a comparatively large range in project sizes from small projects for as little as a few thousand dollars to multi-year mega-projects that exceed \$100 million in value. This differentiates project delivery in the airport industry from other sectors of the transportation industry. It also makes having a project delivery “tool-box” with a full set of tools very important. The diversity of the projects is also greater in the airport sector than other transportation modes in that airports must deliver significant amounts of both vertical (architectural/building) and horizontal (pavement/utility) projects using the same set of project delivery tools. It is interesting to note in Table 3-1 that regardless of the size of the airport that the typical construction project tends to range from \$1.5 million to \$10 million. For airports with \$500 million annual programs, this translates into lots of projects rather than few large projects and makes selecting a project delivery method an important decision with the potential to have a distinct impact on not only the final quality of the project but also on the airport's technical and contract administration staff.

**Table 3-1 - Summary of Case Study Airports**

Case #	Airport (Three Letter Code)	Location Annual passenger volume (cargo volume in tons)	Project Delivery Method Experience	Annual Construction Budget	Project Size Range Low/High (Typical)
1	Atlanta-Hartsfield-Jackson Int'l (ATL)	Atlanta, GA 86.5M (805K)	DBB, CMR, DB, DBOM	\$500M	\$1.0M/\$1.2B (\$10M-\$20M)
2	Boston-Logan Int'l (BOS)	Boston, MA 28M (358K)	DBB, CMR	\$125M	\$10K/\$165M (\$2.0M)
3	Port Columbus Int'l (CMH)	Columbus, OH 7.7M (6.7K)	DBB, CMR, DB, DBOM*	\$70-\$100M	\$50K/\$165M (\$1.5M)
4	Colorado Springs (COS)	Colorado Springs, CO 2.0M (14K)	DBB, DB	\$20M	\$200K/\$36M (<\$1M or \$5-\$9M)
5	Dallas-Fort Worth Int'l (DFW)	Dallas, TX 60M (758K)	DBB, CMR, DB, DBOM	\$425M	\$8.0K/\$100+M (\$2-\$5M)
6	Denver Int'l (DEN)	Denver, CO 47.3M (645K)	DBB, CMR, DB	\$200M-\$300M	\$500K/\$150M (\$2.5M)
7	Memphis Int'l (MEM)	Memphis, TN 11.0M (3.7M)	DBB, CMR, DB, DBOM*	\$22.0M	\$100K/\$20M (\$5.5M)
8	Mineta -San Jose Int'l (SJC)	San Jose, CA 10.6M (94K)	DBB, DB	\$345M	\$2.0K/\$185M (\$4.9M)
9	Tampa Int'l (TPA)	Tampa, FL 19.3M (102K)	DBB, CMR, DB, DBOM	\$95M - \$170M	\$50K/\$80M (\$2.5M)

B = Billion; K = Thousand; M = Million; T = Tons  
 DBB = Design-Bid-Build; CMR = Construction Manager-at-Risk;  
 DB = Design-Build; DBOM = Design-Build-Operate-Maintain  
 \*No experience yet but planning to use on upcoming project

## Case Study Data Collection Methodology

The research team used the case study method described by Yin (1994) to furnish a rigorous methodology for collecting the data from the projects shown in Table 3-1. Yin maintains that planning the process of accessing and collecting data is essential preparation for efficiently and accurately collecting cogent information. Additionally, it is equally important to carefully select cases that can be compared directly with one another and also offer cross-sectional diversity. The selected sample fulfills this requirement in that there are nine airports with Design-Bid-Build (DBB) experience as would be expected. These allow the team to use DBB as the benchmark against which all other project delivery methods are compared. Next, eight airports have used Design-Build (DB) project delivery and seven airports have experience with Construction Manager-at-Risk (CMR) project delivery. Finally, three airports (ATL, DFW, and TPA) have tried Design-Build-Operate-



Maintain (DBOM) project delivery and two others (CMH and MEM) are in the process of developing their first DBOM projects. Interestingly, all three existing cases involved the delivery of people mover and/or elevator/escalator systems. Thus, with the exception of DBOM, the majority of the case study airports all have some experience with most of the project delivery methods. This lends weight to the case study trend analysis and gives authority to conclusions drawn from the analysis of trends.

While the collection of cases needs to cover the project delivery method spectrum in this research, it is “important that the participant pool remain relatively small” (Colorado State University, 2008). Although fewer cases can sometimes lead to unsubstantiated research based on the probability of atypical case selections, it provides a better opportunity to examine each case in detail without becoming too cumbersome. The sample used here appears to be representative for the various project delivery methods that do not involve post-construction operations and maintenance. DBOM is a delivery method that is not common to the US and therefore the post-construction aspects associated with this project delivery method appear to be of most value to highly technical projects such as the ATL, DFW, and TPA people movers, where the airport must in effect select from competing proprietary technologies and can therefore accrue a benefit by competing the operations and maintenance contract along with the design and construction.

The case studies were collected using structured interviews. The structured interview outlines were developed in accordance with the methodology prescribed by the US General Accounting Office (GAO 1991). The GAO method states that structured interviews can be used where “information must be obtained from program participants or members of a comparison group... or when essentially the same information must be obtained from numerous people for a multiple case-study evaluation” (GAO 1991). Both these conditions apply to this study, and therefore, the tool is appropriate for the research. The process involved developing a questionnaire that was made available to each interviewee prior to the interview and then collecting responses in the same order using the same questions for each interviewee. Time was given per the GAO method to ensure that the interviewee understood each question and that the data collector understood the answer. Additionally, they were also allowed to digress as desired, which allowed the researchers to collect potentially valuable information that was not originally contemplated. The structured interview also used Likert scaling (Garson 2008) to get the airports to assign an ordinal value to each project delivery method’s impact on various aspects of project outcomes and the perceived value of preconstruction service activities. This allowed the assembly of an effectiveness index based on airport perceptions from their collective experiences. This technique allows the researcher to differentiate between collective experiences and be able to develop trends with regard to the specific questions posed during the structured interviews. It also creates quantitative output from the research.

Determining quantitative data, rather than qualitative, is vital to prioritizing needed information. Quantitative data offers factual data that is not subjective, which creates greater viability to the research and potential conclusions. Although case studies have the ability to provide distinctive data that can expand analysis and future results, data points (objectives) sought using the case study should complement other applied research methods to strengthen the overall research (Yin 1994). Thus, to achieve this goal, the structured interviews used to methodically collect case study data included quantitative data points regarding scope, financial and schedule information on each project delivery method. This data allows the comparison of the projects on an objective basis and permits the trends identified from the qualitative data to be validated or refuted by the quantitative

data. A detailed summary of the interview results are provided in Appendix B of this report. The following section presents the results of the analysis of the interview data.

## Case Study Analysis

The analysis of the case study data must necessarily start with a look at case study airport experience to allow the researchers to put their responses in the proper context. Obviously, the information garnered from airports with extensive experience implementing a given project delivery method (PDM) must be given more credence than the same information coming from an airport with only one project's experience. Table 3-2 is a summary of airport experiential information by number of projects delivered using in each PDM. It also includes a second metric regarding the percentage of each airport's construction budget which is delivered by each PDM. Figures 3-1 and 3-2 illustrate the same information. It furnishes a means to determine the level of experience each airport has with each PDM and a rough measure of the depth of that experience through the number projects and budget percentage.

**Table 3-2 - Case Study Airport Experience with Various Project Delivery Methods**

PDM	DBB	CMR	DB	DBOM
<b>Total Airports with Experience</b>	9	7	8	3
<b>Number of Projects</b>				
1-5	0	5	6	3
6-10	0	0	0	0
>10	9	2	2	0
<b>% of Construction Budget</b>				
<10%	0	3	6	3
11-25%	0	3	1	0
26-50%	1	1	0	0
>50%	8	0	1	0

Table 3-2 shows that all 9 airports interviewed have used DBB, seven of the airports have used the CMR, eight airports have used DB and three have used the DBOM (see first row of reported data). This summary information is also presented in Figure 3-1. One can see in Table 3-2 that DBB is the PDM with which all the case study airports have experience, followed by DB and CMR respectively. Three airports have DBOM experience and two more expressed an interest in trying DBOM on upcoming projects. All three DBOM projects were people movers, and of the two airports that plan to use DBOM in the near future, one (MEM) is considering it for an elevator/escalator upgrade project and the other (CMH) will use it for a baggage system. In all five cases, the airport is in the

position of essentially competing one proprietary technology against others and deemed the post-construction operations and maintenance period as a benefit for three reasons. First, it removes the requirement for airport technical personnel to learn how to operate and maintain these systems and puts it in the hands of the company that manufactures the equipment. Next, the post-construction operations and maintenance period effectively becomes a fixed-term warranty for these systems. Finally, as these types of systems are integral to moving passengers and bags within the airport, it furnishes a guarantee that these vital systems will continue to function as designed beyond the typical commissioning period because their care is in the hands of the experts who designed and installed them. This inference is confirmed by the analysis of airport reasons for using given PDMs. The major reason cited and also the one designated as the “driving” reason (*i.e.* the reason used above all others for selecting a given PDM) to use DBOM was to provide a mechanism for follow-on operations and maintenance.

The bottom part of Table 3-2 shows the percentage of construction budget that was expended using different project delivery methods. As an example, by looking at the column headed “CMR”, one can see that three airports used less than 10% of their annual construction budget on CMR projects; three airports used between 11% to 25% of their construction budget on CMR, and one airport expended more than 26% on the CMR. Figure 3-2 shows the same information graphically. One can also see from Table 3-2 that with two exceptions (CMR at DFW and DB at TPA) the majority of an airport’s construction budget is delivered using traditional DBB. Nevertheless, the average annual airport construction budget was around \$200 million and the average project was about \$5 million. So 10% of that sum represents about four projects each year, which is not an insignificant number of projects being delivered using alternative project delivery at the typical airport each year. Additionally, most of the airports in the case study sample have experience with DBB, CMR and DB project delivery though only two in each case have more than five projects using CMR (DFW and MEM) and DB (DEN and TPA) experience. Thus, the use of alternative project delivery methods is still an evolving practice in the airport industry, making the subject of this research project, furnishing guidance on PDM selection, not only important but also very timely. It should also be noted that one of the criteria for choosing airports for the case studies was that the airport should have used an alternative delivery method.

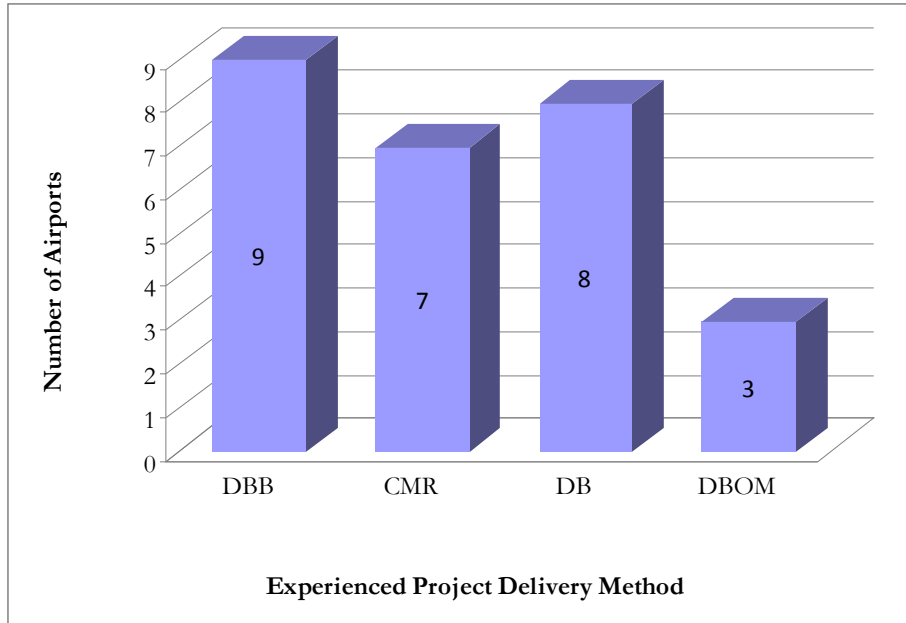


Figure 3-1 - Experienced Delivery Method in Nine Interviewed Airports

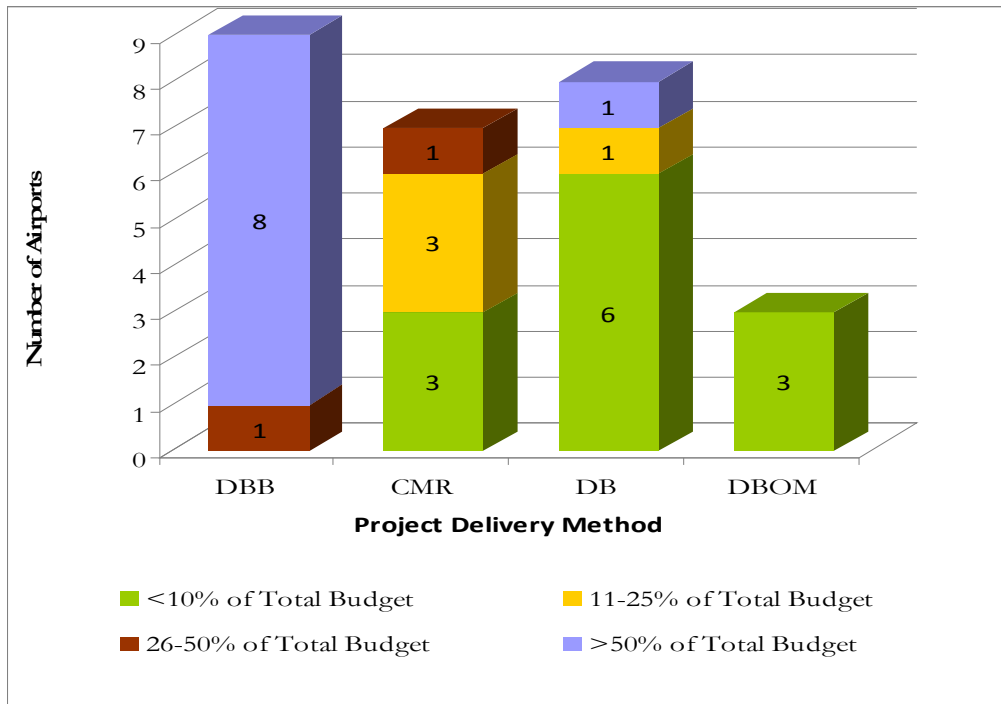


Figure 3-2 - Percent of Budget Expended Using Each Delivery Method in Nine Interviewed Airports

### *Project Delivery Method Selection Rationale*

The initial phase of the structured interview sought to identify those aspects regarding project delivery that are considered when an airport is deciding on a project delivery method. The interviewees were given a list of possible project factors and asked to name those that were considered and additionally, those that drove them to select alternative project delivery. A driving issue was one that was preeminent among all factors considered in the PDM selection decision. The following is the list of PDM considerations that were cited by the majority of the airports:

- Project schedule issues (9 of 9)
- Project monetary size (8 of 9)
- Project technical complexity (8 of 9)
- Project generates revenue (8 of 9)
- Project budget control issues (6 of 9)
- Incentives for obtaining federal or state funding (6 of 9)
- Project life cycle issues (5 of 9)

From the above list the following were cited as factors that drive the selection of an alternative PDM:

- Project schedule issues (7 of 9)
- Project generates revenue (7 of 9)
- Incentives for obtaining federal or state funding (5 of 9)

Thus, it can be inferred from looking at the above two lists, that a project's required delivery date greatly influences an airport to use alternative project delivery. One interviewee (BOS) indicated that reducing a project's delivery period has the added benefit of reducing cost as well. Two others (DFW and MEM) indicated that there is a strong incentive to deliver a project that generates revenue, such as a parking garage, as quickly as possible to begin amortizing the capital investment with new revenue. Another interview (CMH) found that shortened construction schedules translate to reduced impact on airport operations, especially on the demand for special security measures, such as contractor escorts on air-side projects. Finally, though the driving factor data did not show it, the researchers that conducted the interviews developed a strong sense that project monetary size also has an influence on PDM usage with smaller projects usually delivered using DBB project delivery. This is often driven by procurement regulations that specify a certain dollar limit before authorizing alternative project delivery. For instance, BOS cannot use DB unless a project is a horizontal project that is larger than \$5 million and CMR unless it is a building project larger than \$10 million. This drives a decision factor that revolves around the allowable project delivery methods for a given type of funding that relates to the third driving factor on federal or state funding in the above list. In fact, DFW indicated that the type of funding controlled their ability to use CMR. They can only use CMR on bond-funded projects. So constraints imposed by funding type are a very real factor in the airport PDM selection decision.

Table 3-3 displays the output of the second portion of the rationale interview. This section sought to identify the reasons why airports select specific PDMs. The reasons in the table were cited by the majority of the case study airports as evidence of their rationale. DBB should be viewed as the benchmark against which the alternative project delivery methods are compared. Interestingly, the desire to encourage price competition through a competitive bidding process was cited by 8 of 9

airports and 6 of those cited it as the single most important reason for using DBB. All 5 of the airports that either had DBOM experience or were planning on using it chose the same reason: provide a follow-on maintenance and operations. This was also the most significant reason for using DBOM.

**Table 3-3 - Reasons for Selecting a Given Project Delivery Method**

Reason to select a given PDM	DBB	CMR	DB	DBOM
Reduce/compress/accelerate project delivery period		3	8	1
Establish project budget at an early stage of design development	1	5	5	
Get early construction contractor involvement		6	8	
Encourage innovation	1	3	5	1
Facilitate Value Engineering	2	6	6	
Encourage price competition (bidding process)	8	1		
Compete different design solutions through the proposal process			5	
Redistribute risk	1	5	6	
Complex project requirements	1	6	5	
Flexibility needs during construction phase	3	4	5	
Reduce the life cycle cost	2	1	1	
Provide mechanism for follow-on operations and/or maintenance				5
Innovative financing				2
Encourage sustainability	2	2	2	2
Project is a revenue generator		3	4	1

Looking at Table 3-3, one can see that the reasons for using CMR and DB become broader than what was found for DBB and DBOM. The CMR reasons tend to revolve around two issues: the ability to deal with risk brought on by complex project requirements and the ability to involve the contractor in the design process through estimating and value engineering capabilities. DB shared those reasons and added reasons involving compressing the schedule. When the airports were asked to name the single most important reason for choosing a given PDM, the results were as follows:

- DBB: Encourage price competition
- CMR: Establish project budget at early stage of design
- DB: Reduce/compress/accelerate project delivery period
- DBOM: Provide mechanism for follow-on operations and/or maintenance

This leads to the following broad, general inference regarding the use of alternative project delivery, which can be used as a starting point for the complex PDM selection decision:

- Use DB for projects that demand an aggressive schedule.
- Use CMR for complex projects with constrained budgets.
- Use DBOM if post-construction performance is critical.

*Project Delivery Method Issues*

The purpose of the next section of the structured interview is to identify pertinent issues that impact the PDM selection decision. In this section, interviewees were asked to differentiate between various project issues at several different levels. They were asked whether the use of a given PDM would be

considered a potential problem or not with regard to each issue. These were recorded as “pros” and “cons.” The data was then reduced to calculate the total number of each pro/con for every issue in each PDM. The number of cons was then subtracted from the number of pros for each PDM to determine a net perception at each issue level. Tables 3.4 – 3.9 are a summary of this analysis, showing the most frequently cited issues for each PDM and overall totals. So all the issues marked with an “X” are the issues that received the highest number of votes for that specific delivery method. In case of ties, all the issues are listed. As an example, in Table 3-4, four issues received 5 favorable votes (Pro) each in case of the CMR. Note that DBOM is not displayed in this analysis as less than 50% of the airports had experience with this particular PDM, which makes the output anecdotal at best. As a result, DBOM is not considered in the remaining analysis.

**Table 3-4 - Summary of Project Delivery Method Issue Analysis - Project-level Issues**

Issue	DBB		CMR		DB	
	Pro	Con	Pro	Con	Pro	Con
Risk management/ allocation			X			
Schedule compression		X	X		X	
Schedule growth control						
Cost precision			X			
Cost control	X		X	X		X
Total	21	24	30	12	35	10
Net = Pro-Con		-3		18		25

Table 3-4 shows the outcome for project-level issues. These are defined as project-specific issues that ultimately define the success or failure of the individual project. The table shows that the major advantage of DBB was found to be cost control and its major concern was the ability to compress the schedule. DB results were exactly opposite of DBB. For CMR, risk management, schedule compression and cost precision were the major benefits. Cost control was cited in both categories though 5 airports saw it as not creating potential problems whereas 3 disagreed. Looking at the net score leads one to infer that DB and CMR would be preferred over DBB regarding project-level issues.

Table 3-5 summarizes the same analysis for airport-level issues. These are defined as issues that directly impact the airport’s operations and its project delivery staff. DBB’s major benefit at this level was the fact that it is well-understood by the airports’ staff who have plenty of experience in delivering projects using this method. The major draw-back cited was the ability to control the project’s impact on passenger flow during construction. The method was uniformly viewed as the one that had the longest delivery period, and hence would have the greatest impact over time. CMR was felt to give the airport staff good control over the project, but airports were concerned about their staff’s relative inexperience with the PDM. Finally DB was viewed as providing the greatest ability to control project impact on both airport operations and passenger flow as it was viewed as the one where the project delivery period could be compressed to its shortest state. This benefit came with a sense of the airport staff losing control over the project on a day-to-day basis both during design and construction. Looking at the totals and the net score for this level, DBB is found to be preferred with regard to airport-level issues. CMR would be preferred over DB as well. This is

probably due to the fact that in CMR the airport maintains specific contractual control over the design process in a manner that must be delegated in DB project delivery.

**Table 3-5 - Summary of Project Delivery Method Issue Analysis - Airport-level Issues**

Issue	DBB		CMR		DB	
	Pro	Con	Pro	Con	Pro	Con
Airport experience/staff capability	X			X		
Airport control of project			X			X
Control impact on operations					X	
Control impact on passengers		X			X	
Total	34	9	24	9	23	12
Net = Pro-Con	25		15		11	

Table 3-6 summarizes the same analysis for public policy/regulatory issues. These are defined as issues that the airport has little if any ability to change, and include specific legal or governing body policy constraints on PDM use as well as requirements to satisfy legislated requirements for public works projects. DBB was found to furnish a benefit regarding the ability to create a procurement environment of free and open competition. DB was considered to have the opposite impact by limiting competition to those firms that have specific qualifications and past performance. Additionally, because DB was often used on large airport projects, it was also seen as limiting competition by the effective ability to furnish the requisite performance bond. Both CMR and DB were found to encourage disadvantaged business enterprise (DBE)/ small business participation through the qualifications based selection process that is used on both to select the successful competitor. Finally, it should be noted that neither DBB nor CMR had a specific area of concern in this category that was indicated by the majority of the case study airports. In this area, DBB had the least number of constraints and hence would be preferred over the alternative methods.

**Table 3-6 - Summary of Project Delivery Method Issue Analysis - Public Policy/Regulatory Issues**

Issue	DBB		CMR		DB	
	Pro	Con	Pro	Con	Pro	Con
Competition	X					X
DBE/small business impact			X		X	
Total	24	3	14	8	15	10
Net = Pro-Con	21		6		5	

Table 3-7 summarizes the same analysis for life cycle issues. These are defined as issues that relate to the long-term cost of the project to the airport and also speak to various aspects of design and construction sustainability. None of the PDMs had more than 2 airports citing a potential problem with these type issues. DBB was perceived to be the PDM that could be best used to adequately approach life cycle cost issues. Perhaps this is because of the competitive nature implied in the previous paragraph resulting in the lowest possible capital cost for a given project and the fact that the airport controls the details of design and hence can ensure compatibility of equipment and other features of work. Both CMR and DB were found to satisfy the need for post-construction



maintainability. No specific logic was recorded in the interviews behind that rating. In this area, DBB and CMR seem to have a distinct advantage over DB when comparing the net scores.

**Table 3-7 - Summary of Project Delivery Method Issue Analysis - Life Cycle Issues**

Issue	DBB		CMR		DB	
	Pro	Con	Pro	Con	Pro	Con
Life cycle cost	X					
Maintainability			X		X	
Total	20	3	16	1	11	4
Net = Pro-Con	17		15		7	

Table 3-8 summarizes the same analysis for other issues. These are defined as issues not covered in the above lists. The two most frequent were the impact of each PDM on relationships and disputes during and after the project. DBB was found to generate concerns regarding both adversarial relationships and construction claims. CMR was found to have an improved interpersonal environment as did DB, which also was believed to have a positive impact on construction claims. In this category, DB was found to be the preferred PDM. It is also interesting to note that sustainability issues were not generally included in airport PDM deliberations.

**Table 3-8 - Summary of Project Delivery Method Issue Analysis - Other Issues**

Issue	DBB		CMR		DB	
	Pro	Con	Pro	Con	Pro	Con
Adversarial relationship		X	X		X	
Construction claims		X			X	
Total	3	15	8	5	12	4
Net = Pro-Con	-12		3		8	

When all the issues are taken together, the totals of the pros, cons, and the net score are shown in Table 3-9. One can see that the airports in the case study sample are relatively satisfied with all project delivery methods as the pros outnumbered the cons in each case. CMR came in first in terms of the net benefits. It is interesting to note that even though DBB gets the lowest net score, it also has the highest number of issues rated as potential benefits. CMR and DB seem to be too close to warrant any meaningful distinction.

**Table 3-9 - Summary of Project Delivery Method Issue Analysis - All Issues**

Issue	DBB		CMR		DB	
	Pro	Con	Pro	Con	Pro	Con
Total	101	54	92	35	95	40
Net = Pro-Con	47		57		55	

The above discussion leads to the conclusion that airports will tend to see DBB as the default PDM and will select alternative PDMs for specific reasons that apply directly to projects rather than overall construction programs. This conclusion is validated by the fact that several airports (BOS,

DFW, and MEM) stated during their interviews that DBB was indeed their default PDM. It is further confirmed by the fact that alternative PDMs were only found to be preferred over DBB in Tables 3.4 and 3.8 where only “project-level” and “other” issues were considered. So given this conclusion, it is now important to understand how effective each PDM is in delivering quality in the completed project.

### *Pertinent Issues Analysis*

The case study structured interviews asked the airports to identify a series of pertinent issues as either an advantage (pro) or disadvantage (con) for each project delivery method. The output from this section can be used to rank the importance of those issues to the project delivery method decision. To do this, the number of airports that identified a specific issue as either pro or con was totaled. An issue was considered significant if the majority of the sampled airports agreed in either category. If a given pertinent issue had less than 5 votes it was dropped from the ranking analysis as being not significant to the project delivery method selection decision. Table 3-10 is a summary of those issues with five or more votes in either the pro or con column. Next, if one takes Table 3-3 and drops the DBOM column, one can map these reasons to the significant pertinent issues listed in Table 3-10 as shown in Table 3-11.

The project level issues from Tables 3.10 and 3.11 can be related. First several of the project level schedule issues and reasons match up. They can be summarized as follows:

1. Schedule issues:
  - a. DB: Compression (9 pro + 8 reasons); Control growth (7 pro + 4 reasons); No cons
  - b. CMR: Compression (5 pro + 3 reasons); Control growth (3 reasons); No cons
  - c. DBB: Compression (7 con); No cons
2. Cost issues:
  - a. CMR: Control (5 pro + 5 reasons); Precision (5 pro); No cons
  - b. DB: Control (5 pro + 4 reasons); Precision (5 pro); No cons
  - c. DBB: Control (5 pro + 1 reason); Precision (5 con)
3. Risk issues:
  - a. DB: Risk management and allocation (6 pro + 6 reasons); ; No cons
  - b. CMR: Risk management and allocation (5 pro + 5 reasons); No cons
  - c. DBB: No pros 1 reasons; No cons

**Table 3-10 - Pertinent Issues Ranking Analysis: Issue Type and Number of Airports Citing Each Significant Issue**

Issue Category	DBB				CMR				DB			
	Pro	#	Con	#	Pro	#	Con	#	Pro	#	Con	#
<b>Project Level Issues</b>	Cost control	5	Schedule comp	7	Risk mngt/ Allocation	5			Risk mngt/ allocation	6		
			Cost precision	5	Schedule comp	5			Schedule comp	9		
					Cost precision	5			Schedule growth	7		
					Cost control	5			Cost precision	5		
									Cost control	5		
<b>Total</b>		<b>5</b>		<b>12</b>		<b>20</b>		<b>None</b>		<b>32</b>		<b>None</b>
<b>Airport Level Issues</b>	Airport experience	9			Airport project control	5			Control impact on operations	5	Airport project control	5
	Airport project control	8							Control impact on passenger	5		
	3rd party input	6										
<b>Total</b>		<b>23</b>		<b>None</b>		<b>5</b>		<b>None</b>		<b>10</b>		<b>5</b>
<b>Public Policy/Regulatory Issues</b>	Competition	8			DBE impact	5			DBE impact	6	Competition	5
	DBE impact	6										
	Legal Method allowed	5										
		5										
<b>Total</b>		<b>24</b>		<b>None</b>		<b>5</b>		<b>None</b>		<b>6</b>		<b>5</b>
<b>Life Cycle Issues</b>	Life cycle cost	6										
	Maintainability	5			Maintainability	5						
	Sustainable design	5										
<b>Total</b>		<b>16</b>		<b>None</b>		<b>5</b>		<b>None</b>		<b>None</b>		<b>None</b>
<b>Other Issues</b>			Adversarial relations	8	Adversarial relations	5			Adversarial relations	6		
			claims	7					claims	5		
<b>Total</b>		<b>None</b>		<b>15</b>		<b>5</b>		<b>None</b>		<b>11</b>		<b>None</b>

**Table 3-11 - Table 3-3 Revised to Map to Significant Issues shown in Table 3-10.  
(Related significant issue shown in parentheses if not self-explanatory)**

Reason to select a given PDM	DBB	CMR	DB
<i>Schedule Related Reasons</i>			
Reduce/compress/accelerate project delivery period		3	8
Project is a revenue generator (schedule growth control)		3	4
<i>Cost Related Reasons</i>			
Establish project budget at an early stage of design development (cost precision)	1	5	5
Facilitate Value Engineering (cost control)	2	6	6
<i>Risk Issues</i>			
Redistribute risk	1	5	6
Complex project requirements	1	6	5
Get early construction contractor involvement		6	8
<i>Airport issues</i>			
Flexibility needs during construction phase (control of project)	3	4	5
Compete different design solutions through the proposal process	1		5
Encourage innovation	1	3	5
<i>Public Policy Issues</i>			
Encourage price competition	8	1	
<i>Life Cycle Issues</i>			
Reduce the life cycle cost	2	1	1
Encourage sustainability	2	2	2

Looking at the summary, it can be seen that the greatest weight at the project level is given by the airports to schedule issues, specifically the ability to compress the schedule. Risk issues are next in weight and cost issues follow risk.

The airport level issues are summarized as follows:

1. Staff issues:
  - a. DBB: Staff experience with delivery method (9 pros); No cons
  - b. CMR: No pros; no cons
  - c. DB: No pros; no cons
2. Project control issues
  - a. DBB: Control of project (8 pros + 3 reasons); No cons
  - b. CMR: Control of project (8 pros + 4 reasons); No cons
  - c. DB: Control of project (5 cons + 5 reasons); Control impact on operations (5 pros); Control impact on passengers (5 pros)

The ability of the airport to maintain control over the project delivery process carries the greatest weight in this category. Airport staffing issues are next, but one should remember that this is a transient issue. As airport staff gets more experience with alternative project delivery the seemingly heavy weight given to DBB will probably diminish.

Public policy/regulatory issues can be summarized as shown below:

1. Legal/regulatory delivery method constraints
  - a. DBB: Legal (5 pros); Method allowed (5 pros); No cons
  - b. CMR: No pros; no cons
  - c. DB: No pros; no cons
2. Fair/open procurement issues
  - a. DBB: Competition (8 pros + 8 reasons); DBE impact (6 pros); No cons
  - b. DB: DBE impact (6 pros); Competition (5 cons)
  - c. CMR: DBE impact (5 pros + 1 reason); No cons

The ability to maintain fair and open competition appears to be the most highly weighted here. DBB is seen as the method that best facilitates competition while DB is seen as a PDM that limits competition. All methods were found to have no negative impact on DBE requirements. However, the legal issues are go/no-go constraints and therefore, it is not possible to assign them weight.

The summary below for life cycle issues shows that life cycle issues are not considered highly significant at this point in time.

1. Life cycle cost issues
  - a. DBB: Cost (6 pros + 2 reasons); No cons
  - b. CMR: No pros 1 reason; no cons
  - c. DB: No pros 1 reason; no cons
2. Post-construction issues
  - a. DBB: Maintainability (5 pros); Sustainable design (5 pros + 2 reasons); No cons
  - b. CMR: Maintainability (5 pros); Sustainable design (2 reasons); No cons
  - c. DB: Sustainable design (2 reasons); No pros; no cons

Finally, the analysis of other issues brought up in the interviews is shown below. There were no corresponding reasons for selecting a project delivery method. Looking at the summary, it appears that adversarial relationships should carry the greatest weight in this category.

1. Owner-contractor relations
  - a. DB: Adversarial relationships (6 pros); No cons
  - b. CMR: Adversarial relationships (5 pros); No cons
  - c. DBB: Adversarial relationships (8 cons); No pros
2. Claims
  - a. DB: Construction claims (5 pros); No cons
  - b. DBB: Construction claims (5 cons); No pros
  - c. CMR: Construction claims No pros; No cons

Taking the above analysis together yields the following relative ranking of significant pertinent issues in descending order of importance:

1. Schedule compression and control
2. Risk management/allocation
3. Cost control/precision of estimates
4. Airport ability to control project

5. Fair and open competition
6. Avoidance of adversarial relationships and claims

### *Project Delivery Method Effectiveness*

The case study matrices in the previous section all contained a matrix for each airport where the airport rated the effectiveness of each PDM in delivering the required standard for 22 potential project aspects that ranged from quality of design products to quality and accuracy of budgets and schedules. They also included impacts on the airport operations and security during construction (see questionnaire in Appendix C for details of the categories). The process used standard Likert scaling where the interviewee was asked to assign one of the following levels of satisfaction for each aspect:

- Worst = 1
- Worse = 2
- Neutral = 3
- Better = 4
- Best = 5

These ratings can then be converted to an index that measures the perception of the interviewee regarding each specific aspect (Matell and Jacoby 1971). When the indices for each of the airports are added together and averaged, an overall effectiveness index is computed for each PDM. The results are shown in Table 3-12. The table shows that DB is the only PDM that had an overall effectiveness rating less than 3, which would be interpreted as less than effective and this occurred for only two airports, CMH and MEM. Both airports indicated that their DB project delivery experience was in the 1 to 5 projects category. On the other end of the scale, both ATL and BOS indicated a high level of satisfaction with both DBB and CMR project delivery. In the aggregate at the bottom of the table, these two PDMs had the same average effectiveness index of 3.8, and DB had a slightly lower 3.5. Nevertheless all three PDM were rated above the neutral rating of 3.0 leading to the conclusion that overall, each of the PDMs is shown to be effective in delivering the necessary essentials for project success and that no single PDM had a distinct advantage over all others. Please note that we do not have the results of the Denver (DEN) because it was not provided by the airport.

**Table 3-12 - Project Delivery Method Effectiveness Index**

Airport	DBB	CMR	DB
ATL	4.5	4.1	3.6
BOS	4.1	4.6	--
CMH	3.7	3.5	2.9
COS	3.3	--	3.2
DFW	4.0	3.8	3.8
MEM	3.5	3.5	2.6
SJC	3.5	3.2	3.7
TPA	3.8	4.0	4.5
<b>Average</b>	<b>3.8</b>	<b>3.8</b>	<b>3.5</b>

The second portion of this section of the interview sought to measure each PDM's ability to bring value to the process through various aspects of preconstruction services. It is understood that in DBB, these occur during the design phase. The full detail of the rated services is shown in the questionnaire (Appendix C). The Likert ratings were as follows:

- Not valuable = 1
- Some value = 2
- Valuable = 3
- Very valuable = 4
- Of highest value = 5

Table 3-13 is the recapitulation of that analysis. In this case, one can see that CMR had the highest average rating, followed by DB and DBB respectively. Looking at the individual airport ratings one can see that MEM rated all PDMs below 3.0, with CMR getting their highest rating and DB getting their lowest rating for preconstruction service value. Additionally, COS rated DB a full point higher than DBB in this analysis. TPA, the airport that delivers over 50% of its construction program using DB, gave that PDM the highest rating in the table. Coming from one of the most experienced airports in the sample, this is an important fact to note. The remaining airports rated all the PDMs as having the ability to add value through preconstruction services. CMR received the highest overall average index, which perhaps highlights the preconstruction services phase of CMR projects as a desirable aspect of that PDM. Please note that we do not have the results of the Denver (DEN) because it was not provided by the airport.

**Table 3-13 - Project Delivery Method Value Index**

Airport	DBB	CMR	DB
ATL	3.7	4.5	3.3
BOS	3.1	4.1	--
CMH	3.3	3.9	3.9
COS	2.7	--	3.7
DFW	2.8	3.8	3.8
MEM	2.1	2.8	1.9
SJC	3.4	--	4.6
TPA	3.3	4.2	4.7
<b>Average</b>	<b>3.0</b>	<b>3.9</b>	<b>3.7</b>

This analysis reinforces the previous conclusion that all three PDMs are regarded as being able to successfully deliver a typical airport project. That CMR received the highest value index for preconstruction services also reinforces the generalization made at the end of the PDM selection rationale analysis that CMR is a good fit for projects with a constrained budget where early contractor involvement during the design phase accrues benefits to the airport through increased constructability and real-time estimating capability.

### *Procurement Process Analysis*

The final aspect of the case study data collection was to capture information regarding each case study airport's procurement process. This is important because once a PDM decision is made it must be implemented through the airport's procurement process. Thus, the underlying purpose of this analysis is to look for conflicts between PDMs and procurement processes. This project deals with three fundamental procurement processes. A "procurement process" is different from a project delivery method decision in that it primarily deals with the way an airport operator must advertise and award capital improvement projects. The general procurement processes are defined as follows:

- Low Bid (LB): The services required are awarded on the basis of price alone. There is no other consideration, except financial responsibility which is usually defined by the ability to furnish a performance bond.
- Qualifications-Based Selection (QBS): Contract is awarded on the basis of qualifications alone. Price is not considered.
- Best Value (BV): The services required are awarded on the basis of OTHER THAN price alone.
- Indefinite Delivery-Indefinite Quantity (IDIQ): This is a capacity contract for multiple project design and/or construction services where the airport operator procures the services on the basis of qualifications plus some price function such as a multiplier and the actual design and construction services will be priced via negotiation after award. The IDIQ projects are commonly called Task Orders or Job Orders and IDIQ contracts are also called job order contracts.

The structured interview broke up the procurement process for the case study airport into the following three categories:

- Procurement constraints: These are items such as legal or regulatory barriers to being able to use specific procurement processes such as a requirement that all projects must be awarded to the low bidder. This will also include any local policies or political constraints that ultimately impact the airport operator's flexibility to award design and construction projects.
- Procurement preferences: These deal with the airport operator's past experience and institutional comfort level with the different procurement processes. These also may deal with external stakeholders such as airlines that influence the decision made on procurement processes.
- Procurement method award components: These deal with the mechanics of how an award for design and/or construction services is made.

The issue of procurement constraints sought to measure how much freedom of action airports have with respect to selecting an appropriate PDM. This is important because if a public agency does not have the proper tools in its procurement system, its decision to use a given PDM may be handicapped and if it does attempt to procure a project using alternative project delivery, the results it obtains may be doomed from the beginning. For instance a public agency that does not have the authority to use best value selection will have a difficult time successfully implementing DB contracting (Gransberg *et al* 2006). Each airport was asked to identify which of a possible 13 constraints affected their procurement system. The major constraint cited was the need to obtain



federal funding, which constrained the use of best value and qualifications based selection methods. This was cited by the majority of the airports and several specifically mentioned during the interview that federally funded projects virtually forced them to use DBB project delivery. This validates the issue of funding type that was found previously in the project issue analysis. It was interesting to note that most airports are not constrained by state and local laws.

When the issue of procurement preferences was analyzed, the use of low bid procurement appears to be driven by the need to appear fair and objective as well as to justify the selection to outside entities. This was cited by 6 of the 9 airports. Best value and qualifications-based selection procurements were motivated by a desire to control the competence of potential competitors. IDIQ also had this motivation along with a desire to minimize the number of procurement actions which is to be expected for this procurement process.

The various components of each procurement system were also examined. Table 3-14 is a summary of those components that were in use by the majority of the airports for each procurement process. When one evaluates the component with its corresponding PDM, there are no surprises or disconnects. Therefore, this portion of the analysis can confidently conclude that for the most part airports are able to implement all the studied PDMs without serious conflict with their existing procurement systems.

**Table 3-14 - Use of Procurement System Components**

Corresponding Project Delivery Method Procurement System Component	DBB	CMR & DB	DBB	
	LB	BV	IDIQ	
Short-list		X	X	
Financial prequalification		X	X	
Evaluation of qualifications		X	X	X
Schedule evaluation		X	X	
Quality management plan evaluation		X	X	
Price evaluation	X			
Bonding requirements	X	X		X
DBE goals	X	X	X	

Finally, the issue of which procurement system was used to select the design-builder in DB projects was studied separately. The process that each airport used to make the DB award was also checked. Table 3-15 shows the results of that effort. One can see that 5 out of 9 airports use a QBS procurement method to select the winning design-builder. The same 5 also use a 2-step award process where the project’s scope of work, price, and schedule are then negotiated with the best-qualified design-builder. DFW reported that they combined a negotiated GMP in this procedure. This is different from what is normally found in other transportation sectors where 2-Step BV awards are the norm (Touran *et al* 2008, Molenaar *et al* 2005). COS used low bid DB and a 1-step award on their only DB project. ATL used both 2-step low bid and 2-step BV. SJC used both 2-step low bid and 2-step QBS. DEN used 1-step BV, and MEM used 2-step BV.

**Table 3-15 - Use of Procurement System for DB Projects**

Airport	Procurement System			Award Process		
	LB	BV	QBS	One-Step	Two-Step	Multi-Step
Atlanta-Hartsfield-Jackson Int'l (ATL)	X	X			X	
Boston-Logan Int'l (BOS)			X		X	
Port Columbus Int'l (CMH)			X		X	
Colorado Springs (COS)	X			X		
Dallas-Fort Worth Int'l (DFW)			X		X	
Denver Int'l (DEN)		X		X		
Memphis Int'l (MEM)		X			X	
Mineta -San Jose Int'l (SJC)	X		X		X	
Tampa Int'l (TPA)			X		X	

*Emerging Conclusions*

The emerging conclusions from the analysis of the airport interviews are as follows:

1. Airports are satisfied with their ability to deliver projects using DBB. There appears to be no motivation to entirely replace it with alternative PDMs. Most projects will continue to be delivered using DBB as evidenced by the fact that 8 of 9 case study airports are delivering over 50% of their construction program using traditional methods.
2. In the same vein, airports see DBB as the default PDM and will select alternative PDMs for specific reasons that apply directly to projects rather than overall construction programs. The motivation for using CMR and DB springs from project-specific requirements that are more easily satisfied by alternative methods than DBB. Thus, all PDMs are universally considered the tools in an airport’s procurement toolbox.
3. Given a project-specific need to use alternative project delivery, the following are the major factors that drive the selection of an alternative PDM:
  - Project schedule issues
  - Project generates revenue
  - Funding type constraints/need to obtain federal or state funding
4. DBOM is not widely used or accepted. Those airports that have implemented it have found it to be most appropriate for highly technical systems such as people movers, elevators, escalators, and baggage handling systems where the airport is essentially competing one proprietary technology against all others.
5. Based on the results shown in Table 3-12, DBB and CMR had the same average effectiveness index of 3.8, and DB had a slightly lower 3.5. Nevertheless all three PDM were rated above the neutral rating of 3.0. Thus, it can be concluded that each of the PDMs is

shown to be effective in delivering the necessary essentials for project success and that no single PDM had a distinct advantage over all others.

6. The value index analysis reinforces the previous conclusion that all three PDMs are regarded as being able to successfully deliver a typical airport project. That CMR received the highest value index for preconstruction services also reinforces the generalization made at the end of the PDM selection rationale analysis that CMR is a good fit for complex projects with a constrained budget where early contractor involvement during the design phase accrues benefits to the airport through increased constructability and real-time estimating capability.
7. The procurement system analysis shows that with a few minor exceptions airports are able to implement all the studied PDMs without serious conflict with their existing procurement systems.
8. Airports diverge with the rest of the transportation industry by favoring a QBS approach to their DB projects that sometimes includes a negotiated GMP to establish the project price.
9. The majority of the airports utilize a 2-step (RFQ/RFP) procedure to arrive at an award for their DB projects.

## CHAPTER 4 – ADVANTAGES/DISADVANTAGES OF EACH DELIVERY METHOD

### Introduction

There are numerous factors that airports need to consider when deciding to select a project delivery method. These influencing factors and their interactions with different project delivery methods are studied in this chapter in the format of a descriptive pro-con analysis. These factors were identified through literature search, past project delivery research experience, case studies and interviews with airport authorities during this effort. These factors are categorized as follows:

1. Project-level issues,
2. Airport-level issues,
3. Public policy/regulatory issues,
4. Other issues.

Table 4-1 provides a list of these pertinent issues. Each pertinent issue is defined first and then if a delivery method is a favorable choice for that issue, it is considered as “pro”, and if it is an unfavorable choice, it is considered as “con”. The pro/con analysis is based on the trends found in the interviews which are cited using right brackets “[ ]” and is supported by citations from relevant literature. A brief summary is provided at the end of each section which combines the results of interviews and literature search. In this chapter the terms “owner,” “owner agency” and “airport” are used interchangeably. A list of references directly used is provided in Appendix A.

**Table 4-1 - Pertinent Issues for Airport Projects**

Pertinent Issue
<p><b>Project-level Issues</b></p> <ol style="list-style-type: none"> <li>1. Project size</li> <li>2. Schedule compression</li> <li>3. Schedule growth control</li> <li>4. Early cost precision</li> <li>5. Cost control</li> <li>6. Risk management / allocation</li> <li>7. Life cycle cost</li> <li>8. Maintainability</li> </ol>
<p><b>Airport-level Issues</b></p> <ol style="list-style-type: none"> <li>9. Airport experience / staff capability</li> <li>10. Airport control of project</li> <li>11. Security</li> <li>12. Control impact on passengers and operations</li> <li>13. Third party stakeholder input to design and construction</li> </ol>
<p><b>Public Policy / Regulatory Issues</b></p> <ol style="list-style-type: none"> <li>14. Competition and local talent</li> <li>15. DBE/small business impact</li> <li>16. Legal and statutory constraints</li> <li>17. Sustainability and LEED certification</li> </ol>
<p><b>Other Issues</b></p> <ol style="list-style-type: none"> <li>18. Adversarial relationships</li> <li>19. Claims</li> <li>Other</li> </ol>

Readers should note that analysis surrounding the pertinent issues in relation to the various project delivery methods is complex. The results presented in this chapter represent trends and in some cases national averages for each of the pertinent issues. Each project and each owner is unique. While an issue may be a pro for the majority of projects, it can in fact be a con for a unique individual project. The analysis therefore represents the majority of projects, but not all. Furthermore, for DB project delivery method, the effect of procurement system (Best Value vs Qualifications Based Selection) is described for each pertinent issue, if such procurement system has an effect on the project delivery selection decision in the context of that pertinent issue.

## Purpose

The purpose of this chapter is to synthesize the information collected during this research on important factors and to use this information in the selection process. The research team used this information in Tier 1 and Tier 2 of the selection system that was developed in this research.

## Project-Level Issues

Project-level issues are defined as those that are specific to the project under consideration and include such items as project size/complexity, schedule, cost, risk management/allocation, life cycle, and maintainability.

**1) *Project size/Complexity:*** This issue reflects the both the dollar value and complexity of the project based on the type of the airport project. Paving projects, while large in dollar value can be less complex than systems upgrades for luggage handling operations. Airport projects cover a wide variety consisting of both horizontal and vertical projects ranging in cost from a few thousand dollars to megaprojects worth hundreds of millions of dollars. For instance, Boston's Logan International Airport projects have ranged in costs from \$10,000 to \$165 million over the past five years.

Airport projects are sometimes larger than \$100 million in value (e.g. terminals); however, airports most often undertake smaller projects such as the construction of parking garages or the renovation of building facilities. By studying project size and complexity, airports seek to determine which delivery method is suitable for a project with a given size and complexity, and how changing the size may impact the choice of delivery method.

**DBB:** While DBB has been used on projects of all sizes, some of the interviewed airports indicated that they tend to select DBB for smaller sized projects (less than \$10 million) [Logan International Airport; Atlanta International Airport]. At least two airports have been hesitant to use DBB for large and complex projects [Tampa International Airport; Atlanta International Airport].

**CMR:** This delivery method seems to be more suitable for large projects and projects with complex managerial requirements due to the increased focus on project management that is realized through the CMR's preconstruction services, which result in added value to the project (Barnstable, 2007; Kuhn 2007)[Atlanta International Airport]. Some airports have restrictions for the project size to be done with CMR, for example, Logan International Airport applies this method to vertical projects larger than \$10 million.

**DB:** This delivery method is usually selected for large and complex projects (ENR, Nov 2007). Some airports use DB only in projects larger than a certain dollar value [San Jose International Airport]. As an example, DB projects in Logan International Airport must be horizontal and larger than \$5 million. Large and complex projects can benefit from the use of QBS selection with a negotiated price if the airport has experience in negotiating prices on large projects. Best-value procurement shifts more risk for a fixed price on the design-builder on large/complex projects, but airports have successfully procured design and construction projects using this procurement method. One of the airports that were interviewed has used low-bid DB on three relatively simple green-field building projects. It should be noted however, that the use of low-bid DB is not indicated under most circumstances and will not be considered explicitly in this guidebook.

**2) *Schedule compression:*** From the owner's viewpoint, each delivery method affects project schedule in two different aspects: 1) schedule shortening and 2) schedule growth control. This factor

checks the ability of each delivery method in terms of schedule compression. The schedule growth control will be studied in the next section.

**DBB:** Design-bid-build uses a sequential process that makes significant schedule compression difficult. This sequential process results in a longer schedule compared to the two alternative delivery methods due to the need to complete project designs prior to the award of the construction contract. (Walewski *et al*, 2001; Gordon, 1994). Analysis of the interviews show that lack of ability to compress the schedule and control time growth due to delays caused by design errors in DBB has been one of the main reasons for owners to choose other delivery methods. One way of compressing DBB projects is to break the project down into several phases/packages and award each package separately. This potentially creates a problem coordinating the efforts of multiple prime contractors and increases the risk of delay claims due to interference between abutting primes.

**CMR:** A study has shown that CMR has the ability to meet or exceed schedule requirements (Minchin, 2007). It also has been successfully used to deliver airport projects (Fairbanks Alaska Airport) that must be phased due to operational reasons (Storm 2007). This delivery method can also help the owners with projects that are schedule sensitive (Walewski *et al*, 2001) and can save time in the project because of concurrent design and construction (Oregon Public Contracting Coalition, 2000), but some airports have not found this time saving a distinguishing advantage for CMR and do not believe that it can considerably save project time [Logan International Airport].

**DB:** Flexibility in schedule increases in this delivery method because designer and builder are one entity (Oregon Public Contracting Coalition, 2002). Many experts believe that DB results in a faster schedule delivery (Walewski *et al*, 2001; Konchar *et al*, 1998; Gransberg and Molenaar, 2007; Molenaar and Scott, 2003) and has the least schedule growth (Konchar *et al*, 1998, Scott *et al* 2006). The analysis of interviews with airports (9 of 9) shows that this issue has been the most important reason for choosing DB. Schedule compression will not be significantly affected by the design-build procurement process.

**3) Schedule growth control:** This factor shows the ability of each delivery method in controlling and preventing time growth in a project. Schedule growth and project delays have been major problems in construction activities. As an example, according to a recent survey (FMI/CMAA Undated), between 40% and 50% of all construction phases were experiencing schedule growth.

**DBB:** DBB schedule growth tends to be higher compared to other delivery methods. The NCHRP Best-value contracting study found that DBB projects had the greatest average time growth (Scott *et al* 2006). Due to the owner's liability for delays from design errors and the fact that differing site conditions will be found after construction award, DBB furnishes the owner a limited ability to control project time growth, and very little ability to recover the schedule if a delay is realized. The DFW airport uses DBB when it had "no need for speed."

**CMR:** Early involvement of the constructor helps the project team develop a more practical and realistic schedule for the project if construction managers with significant construction experience are selected. Analysis of interviews shows that this delivery method has the best performance in developing an accurate preconstruction schedule and achieving it afterwards. The DFW airport uses CMR when it felt a "need for speed."

**DB:** Many experts believe that DB has the least schedule growth (Konchar *et al*, 1998, Scott *et al* 2006). Another effect of DB is earlier schedule certainty (AASHTO 2008) because the design-builder submits the project schedule at the time of contract award before the design is complete. Another important characteristic of DB for airports is that it obligates design and construction funds before the end of a given fiscal year if a project is awarded through a best-value fixed price option (Gransberg and Molenaar, 2007). This can help the agencies award the project and allocate the available funds to a project without waiting for its design to be complete. The DFW airport uses DB when it believes “speed is of the utmost importance.” With the exception of obligating funds, schedule growth will not be significantly affected by the design-build procurement process.

**4) Early Cost precision:** Early and precise project cost estimation is always sought by airports. This issue studies the ability of each delivery method in terms of predicting an accurate cost estimate.

**DBB:** Basing the engineer’s estimate on a complete design before advertising the project increases the certainty of cost estimates. Additionally, after bids have been received, the owner learns the value of the project’s scope in the context of current market conditions. The owner also has the opportunity to cancel the project or alter the design and scope losing only part of the design cost if the bids exceed its budget. The level of cost certainty increases even more when the payment method is lump-sum.

**CMR:** This delivery method has two main characteristics relevant to project cost: 1) it is usually combined with a GMP payment mechanism and 2) the constructor is involved in the project’s design phase prior to bidding subcontractor work packages. These two characteristics tend to improve the performance cost precision in this delivery method. Usually, the owner can negotiate and set the GMP at about 60% design completion (AGC 2004). If the project involves the services of major trades or specialty subcontractors, they can be brought on board during the design phase to furnish technical input to the design. This way, the project team can benefit from their knowledge and experience and establish a more reliable early budget. The drawback is the loss of the opportunity to seek competitive bids on these packages. Some airports are prohibited by law from hiring subcontractors without going to public bidding. Compared to the traditional DBB method, the owner will know the estimated cost earlier in the project life-cycle [Logan International Airport], but it is somewhat difficult to evaluate the validity of the GMP compared to a traditional bid process. The risk is that in some cases it becomes difficult to agree on a GMP with the CMR. Failure to negotiate the GMP in a timely manner may affect the project schedule and increase the project costs. However, the owner always has the option to cancel the CMR contract, pay the CMR for its preconstruction services, and put the construction project out for bids with the completed design [DFW International Airport].

**DB:** Design-build can be procured through both a best-value firm fixed price or a QBS negotiated price. When design-builders provide a firm fixed price, the airport can establish a firm cost earlier in the process than with the other delivery methods (Walewski *et al*, 2001; Gransberg and Molenaar, 2007). The AASHTO Design-Build Procurement Guide states that DB gives earlier cost certainty and has less cost growth compared to traditional DBB based on the fact that highway agencies use firm fixed-price procurements (AASHTO 2008). When using QBS selection, the airport’s ability to achieve early cost precision is similar to that of



**CMR.** The owner does have one additional advantage with QBS in DB in that the design-builder is liable for designing to cost at a higher standard of care than an engineer in a CMR delivery approach who has no less knowledge of the costs of work that they design. In both cases, the major risk revolves around the owner's ability to precisely define the scope of DB work before awarding the DB contract (Beard et al 2001).

**5) Cost control:** Cost control is a project success criterion and can drive owners to select a particular delivery method according to its ability to 1) reduce total project costs, and 2) minimize project cost overruns.

**DBB:** The owner of a DBB project has a determined cost estimate based on a complete set of designs but potential change orders and errors in design may cause considerable cost overruns. The literature shows that although this delivery method has the best performance in accuracy of quantities and design calculations, its ability to achieve post-award budget is the poorest among the delivery methods (Konchar *et al*, 1998 Scott et al 2006).

**CMR:** This delivery method helps the owner control project costs because of two main characteristics: 1) it is normally awarded with a GMP payment mechanism and 2) the constructor is involved in the project design phase, furnishing real-time cost information to assist the designer with keeping to budget.. These two characteristics directly affect the performance of this delivery method in regards with project cost control. As an advantage, there may be cost savings because of early constructor's input to the project (Oregon Public Contracting Coalition, 2000) and also competitive pricing through "open book" contingency accounts (Irwin, 2003). Usually, the owner can negotiate and set the GMP at about 60% design completion (AGC 2004), although the GMP can be set at other times depending on the nature of project, the amount of detail available about the design, and owner's desire to know the cost as early as possible (CM/GC Guidelines, NASFA & AGC 2007). Phasing the design to permit the CMR to bid out design packages containing materials with volatile prices such as asphalt or structural steel allows the CMR to reduce inflation risk as well as compress the schedule for fabrication and delivery. The analysis of the interviews (5 of 9 airports) shows that this delivery method is often selected for projects with budget constraints. Although this delivery method helps the owner achieve post-award budgets, a close cost monitoring on the project is highly recommended due to the manner in which the GMP is established (Walewski *et al*, 2001). Finally there is a possibility for creating an incentive to control cost by including a shared savings below the GMP clause in the contract (Kuhn 2007).

**DB:** Incomplete design documents at the time of award may result in costly scope changes during the construction phase [Tampa International Airport]. A TCRP study of major transit projects showed that there were fewer cost overruns in DB compared to other delivery methods (TCRP, 2002). Another study shows that DB outperforms CMR in O&M costs, unit cost, and cost growth (Konchar *et al*, 1998). The AASHTO Procurement Guide states that DB gives earlier cost certainty and has less cost growth compared to traditional DBB (AASHTO 2008). DB has also a relatively good performance when there is budget restriction (Gordon & REES LLP., 2005) because it reduces the potential of cost overruns due to claims and delays (Beard et al 2001).

**6) Risk management/allocation:** Each project has some level of uncertainty during various phases of its development. Methods to cope with these uncertainties are inherent to each delivery method. Research in the area of risk management has indicated that the most effective approach in risk allocation is to assign project risks to the parties in the best position to manage them. This means that the party assuming a certain risk should be the party who has the most control over that risk and is also most likely to survive the negative impact of such risk (Touran, *et al*, 1994; Allen and Touran 2005). The main vehicle for risk allocation is the contract. Thus, the project delivery method will have a profound impact on risk allocation. The effect of delivery methods on other aspects of risk management like risk identification, quantification, and mitigation is also different; therefore, selection of a delivery method is dependent upon the owner's risk management approach. These differences are considered under this issue. It should be noted that the effect of risks is prevalent in many of the issues discussed in this chapter and is not limited to this section. It should also be noted that the concise format of this discussion does not allow for an in-depth treatment of risk management and risk allocation.

**DBB:** This delivery method has a long history in terms of statutory laws and standard contracts which entail developed risk management processes. This delivery method can help the owner divide risks between the designer and the constructor, but the risk of additional construction costs resulting from erroneous design remains with the owner (AGC, 2004). When the project scope is clearly definable, the owner of an airport can follow the traditional methods of managing risks in DBB (Gordon, 1994). Although risks and rewards are easy to understand in this method, disputes arise often over authority, responsibility and quality (Walewski *et al*, 2001). In other words having separate contracts for design and construction may or may not help the owner manage the risks of an airport project and the owner's success in mitigation of risks depends upon the proficiency and experience of the owner and its consultants in risk management. For example one airport [Tampa International Airport] recommended not using DBB in a complex project because it does not facilitate the owner's need to manage project risks. DBB can help in risk allocation through the use of unit price bids as the payment method when the project line items and their cost estimates are known but the quantities are not known with certainty [Atlanta International Airport]. This payment method allows the constructor to bid on unit prices rather than the total price. In this way, the constructor does not have the risk of fluctuating quantities, while the owner will not have to pay for constructor's contingencies included in the bid because of quantity uncertainties.

**CMR:** CMR can aid in appropriate risk allocation between the airport and the constructor because the CMR is hired before a price is negotiated. The "risk" in the term (Construction Manager at "Risk" stems from the construction manager holding the trade subcontracts and taking the performance risk of the project (AGC, 2004). The use of a GMP structure can create a mechanism to share cost risk between the constructor and the airport in the hopes of ultimately reducing costs. Although GMP as a means of risk allocation should decrease the owner's risks, there is always a possibility that the owner and the CMR cannot consummate an agreement on the GMP in a timely fashion (for example the CMR asks for more contingency than the owner feels is reasonable [Dallas-Fort Worth International Airport]). The owner in this case will need to terminate the CMR contract and convert it to a DBB project, potentially suffering from the resulting delay for advertising and awarding the construction project and will be subject to the uncertainty of getting higher than expected bids.

Early constructor involvement may result in a better definition and understanding of the project risks allowing a more efficient risk allocation to be achieved [Logan International Airport]. This delivery method is conducive to team work. The constructor shares information with the owner and designer on trade subcontracts, value engineering, *etc.* This is one reason some experts believe that CMR theoretically reduces the risks of every entity involved in the project (Minchin, 2007). Although CMR facilitates risk management, it is not necessarily the best method for risk allocation. Having an experienced constructor on board improves the whole process of risk management including risk allocation but the increase in the number of parties directly involved in the project and some overlaps between their duties may make the risk allocation more difficult (TCRP Guidebook, 2009).

**DB:** Risk allocation and risk management are inherently different in DB delivery compared to DBB and CMR. The risk for errors and omissions in the design is transferred from the owner to the DB contractor. Having single point accountability for design and construction removes the owner from designer versus constructor disputes over responsibility for changes in cost or time of project execution (TCRP, 2002; Riley *et al.*, 2005; Irwin, 2003). From the owner's perspective, the DB approach reduces the size and frequency of change orders (Molenaar *et al.*, 2003; Riley *et al.*, 2005). Agencies should realize that although the risks are contractually transferred to the design-builder, a poorly defined initial scope in the RFP may result in significant cost increases. Also, it is not wise to allocate all risk to the DB contractor because that drastically increases the contingency and constructor's insurance costs which will be transferred to the owner through the bid (AGC, 2004). As the design-builder's scope of work includes project design, it may be required to carry errors and omissions insurance (which is usually required from design firms) in this transfer of risks (AGC, 2004; Irwin, 2003). In essence, the transfer of the risk for errors and omissions to the design-builder creates an economic incentive to better manage the risk than in the DBB system.

A major point of risk allocation in DB delivery involves the choice of procurement and payment system. Risk is involved in both the type of procurement system and the point of time in the project development process in which the procurement system is fixed. When DB is used in conjunction with qualification based selection and a GMP, the risks for costs are similar to CMR (with the exception that the DB holds the risks for errors and omissions in the drawings). When DB delivery is used in conjunction with best-value procurement and a fixed price, the design-builder assumes more risk earlier in the process. Primarily, the design-builder is assuming risk for the details of design and their associated costs from time of award through completion of the project. The design-builder commits to a design and a firm price early in the process and the airport stands at less risk for cost growth.

**7) Life-Cycle Costs:** Effects of delivery methods are extended to the operation and maintenance phase. This issue focuses on the opportunities or barriers that each delivery method provides in regards to life-cycle costs.

**DBB:** The owner is in control of design details and construction quality assurance submittals and can tailor these to project's long-term life-cycle goals. However, DBB allows for little constructor input into life-cycle cost issues.

**CMR:** The owner keeps almost the same level of control over the design of the project and also benefits from constructor's advice regarding future costs of the project. If life-cycle performance criteria are not well understood during the development of the GMP, life-cycle issues may be difficult to incorporate into the final product.

**DB:** The airport can use performance criteria to set life-cycle performance standards and rely on design-builder innovation to achieve these standards. If life-cycle issues are difficult to define through performance criteria, a GMP pricing structure could allow for more owner input than a fixed price option. In the fixed price option, the owner needs to have a close eye on the issue of increasing life cycle costs of the project mainly because the design-builder must design to the budget defined by the project's contract amount. This creates a potential conflict with life cycle costs if the design-builder is struggling to keep the project on budget. In some cases the owner considers multi-year warranties in DB contracts in order ensure the long-term construction quality.

**8) *Maintainability:*** Maintainability is affected by the choice of delivery method in two different ways: level of quality and ease of maintenance. This issue describes positive or negative effects of each delivery method on these two aspects.

**DBB:** The owner can check the maintainability of the finished design before awarding the project. Having check points in the design phase can help the airport assure the quality of the design of the end product. However, there is little constructor input into maintainability issues.

**CMR:** The owner of a CMR project can benefit from all the advantages of DBB and also the constructor's involvement and advice on maintenance of the end product. This is particularly effective if the constructor has previously operated similar facilities [Logan International Airport].

**DB:** As the quality control is transferred to the design-builder and details of the design are not known at the time of award, many owners have some concerns about maintainability and quality of the end product. This has led some owners to require multi-year warranties from DB contractors. In projects where maintainability was a key factor to airport operations like a people-mover project, the interviewed airports used DBOM [DFW International Airport, Atlanta Hartsfield Airport]. The airport can emphasize maintainability issues through performance criteria and best-value award factors. However, if maintainability issues are not well understood at the procurement stage, they will not be incorporated into the DB contract.

## Summary

The results of interviews and the literature review show the important role of project-related issues in selecting a delivery method. Some factors like project schedule, project size and technical complexity and cost control were chosen by almost all the interviewees as factors that directly influence their decision. This section explained the "pros" and "cons" of each delivery method in regards with those issues. It also expanded the discussion to other factors like risk management and

precise cost estimation that are clear distinguishing factors while studying the abilities of each delivery method.

## Airport-Level Issues

Agency-level issues relate to the owner agency. These will include issues related to owner's staff, owner's control over the project, security and third party agreement.

**9) *Airport experience/staff capability:*** This issue focuses mainly on the level of experience, the owner's staffing requirements and their capabilities to properly administer alternative delivery methods. It shows the interaction between the level of experience and comfort and confidence using a specific delivery method. Owners who have used a project delivery method in the past have a higher level of experience with that method. This issue also focuses on the quality and competence of the owner's employees and studies the owner's need to furnish a highly capable staff to complete the duties it must undertake in each delivery method. Also, the availability of the experienced staff until the end of the project should be considered while evaluating the staff capability.

**DBB:** All the interviews show that airports have historically employed DBB project delivery and still use this method more than the other methods. This experience with DBB makes the delivery method a good candidate (TCRP, 2002). This depth of staff experience can be a motivator or a detractor for using alternative delivery methods. Some owners may be looking for ways to improve performance over DBB by involving the constructor earlier in project development and will try alternative methods. Other owners are comfortable with DBB delivery and therefore hesitant in trying new delivery methods [Logan International Airport]. An important issue is the requirement for specific technical expertise required to properly administer a design contract and a construction contract. This creates a larger number of required competencies (TCRP Guidebook, 2009). The owner in a DBB project must administer two separate contracts for design and construction, which requires a relatively large number of owner employees (AGC, 2004; Gordon, 1994). The owner's responsibilities in DBB are spread throughout the project lifecycle (mainly dealing with the designer at the beginning and shifting to the contractor after project award); fluctuation in the number of employees required during the project is minimal.

**CMR:** While most of the interviewed agencies have used CMR in their projects, it is a relatively new method in airport projects [Atlanta International Airport]. Many airports have some experience hiring a construction manager as a consultant (or Agency CM) (Please refer to chapter 2 for a detailed discussion on the CM definition). Nonetheless, airport staff with DBB experience have most of the skills necessary to manage CMR because of the similarities between CMR and DBB, (TCRP Guidebook, 2009). This system can arguably require the least number of owner's employees because the CMR can expand to meet the owner's staffing needs (Gordon, 1994). While the work can be delegated in CMR, airport staff must have the capability to oversee CMR preconstruction services work (TCRP Guidebook, 2009). One missing skill may be negotiating the construction manager's preconstruction services fees and the guaranteed maximum price (GMP) in CMR. The owner must also be able to manage the relationship between the CMR and the designer. As a result, the owner

may need to add specific talent to its staff (either as an employee or consultant) if special expertise (GMP or construction manager's fee negotiation as an example) in managing a CMR contract is desired.

**DB:** There have been several examples of airport projects executed with the DB approach. Many airports as well as other public agencies have managerial experience required for a DB project. A recent research shows that the traditional design and construction engineering tasks performed by public agency professional engineers (e.g. design deliverable approvals, construction inspection) were performed by the same staff in the design-build projects and the owner agencies did not change the size of their staff after implementing DB (Gransberg and Molenaar, 2007). The primary difference is managing a contract that contains the designer and constructor as one entity. This difference affects the manner in which the design-builder is procured (*i.e.*, using best value method or QBS selection instead of bidding based solely on cost), the manner in which design is reviewed, and some aspects of how construction is overseen by the owner. Additionally, airport staff will need to learn how to conduct project oversight without the presence of a completed design for early features of the work. This may require training and change of skills of owner employees which may make DB more difficult to administer (TCRP Guidebook, 2009). A recent study shows that the owners tend to put their most experienced staff on DB projects because they need to be better prepared to understand conceptual designs, conceptual estimates, and performance criteria. These skills typically only reside in the most experienced staff (Gransberg and Molenaar, 2007) or hired expertise (consultants). If a qualifications-based selection is used, the owner will need experience in GMP negotiation and payment procedures similar to CMR.

**10) Airport Control of Project:** Owner's control over the details of design, quality of construction, complexity of project and overall coordination are studied under this issue while cost control and time control are studied elsewhere.

**DBB:** Interviews done in this research show that this delivery method gives the owner the most control over the project. The owner in this delivery method may benefit from checks and balances by having the designer and constructor under two separate contracts. Having periodic decision points in DBB and mainly during the design phase helps the owner control the project's design (TCRP, 2002; Garvin, 2003; Irwin, 2003). Having a specific contract based on completed construction documents helps the owner control construction and material quality. Also, if flexibility is required during construction, DBB allows changes to be made during the design phase at little or no cost. However, changes made during construction are usually accompanied by cost increases.

**CMR:** The owner agency benefits from the involvement of the construction manager in most of the decisions during the design phase. This will mainly help owners of complex projects (Barnstable, 2007). Although the relationship between the owner and construction manager plays an important role in CMR, the owner still has a high level of control in this method. This delivery method gives as much control and flexibility to the owner in implementing changes in the details of design during the design phase as in DBB. Furthermore, having the construction manager on the team during design makes implementing changes during construction more effective compared to DBB as the CMR

will provide a much needed continuity of construction expertise during design and construction phases. (Walewski *et al*, 2001; Minchin *et al*, 2007).

**DB:** Although DB arguably provides the owner with the same quality of design and construction as DBB (Konchar *et al*, 1998; FHWA 2006), most professionals and interviewed airports agree that the owner loses control over the details of the design that are not clearly defined in the RFP specifications (Gransberg *et al*, 2006) [Memphis Airport]. Loss of control over the design and lack of check points have the potential to expose the owner to shortcomings in the quality of design and construction (Gordon & REES LLP, 2005; Irwin, 2003; Gransberg *et al*, 2004). The use of a qualifications based selection and a GMP pricing structure can give the airport more control if they are willing to fix the GMP in the later stages of design development. The decision of negotiating the GMP at a later stage should be weighed against the longer period of cost uncertainty for the owner, which can be a concern for some agencies.

**11) Security:** Security imposes another level of technical complexity and a potentially high level of liability on all airport projects. Airport security affects both the design phase and the construction phase. Any change in Transportation Security Administration (TSA) codes and standards may result in changes in a project design while being constructed. A delivery method with high level of flexibility would perform better under such circumstances. Interviews with airports did not reveal a clear advantage or disadvantage for delivery methods with regard to security. But it is expected that liability requirements and the need for employee background checks may reduce bid competition, and daily security checks at the entrance gates for laborers and construction deliveries will increase the schedule and increase project costs. This issue considers the multiple effects of security requirements on an airport project and studies the pros and cons of each delivery method in this respect.

**DBB:** This delivery method gives the highest level of flexibility to the owner during the design phase and facilitates any changes in the design before awarding the construction. Unlike alternative delivery methods, the owner can make changes to design requirements at any point without having to amend its contracts with the constructor.

**CMR:** In many CMR arrangements the design of a project is not complete by the time a not-to-exceed budget has been submitted by the CMR; because of these additional contingencies and allowances may be built into the costs to reduce the risk of changes in security regulations. “However, it is important to make sure that the design of the facility allows for flexibility and potential changes without substantial impact by taking into account future changes in the industry and regulatory requirements.” (Parsons Brinckerhoff, 2002). The analysis of interviews shows that CMR has the best performance in regards with this issue and compliance with tight security controls. This is mainly due to the close collaboration that results between the team members in this approach. Additionally, it provides time during design for the constructors to perform the required employee background checks. In some airports, the GMP is finalized after the design is complete.

**DB:** Coping with changing security codes such as the unexpected enactment of the Aviation and Transportation Security Act (ATSA) in November 2001 is more difficult if a project is based on a fast-track design-build method of construction with a fixed price contract after the schematic design phase was completed. On a positive note, DB also provides time

during design for the constructors to complete employee background checks. The use of a qualifications based selection with a GMP will provide more flexibility in dealing with unexpected security events and will be similar to the CMR.

**12) *Control impact on operations and passengers:*** Ideally airport operations on both airside and landside should not be affected by construction activities. However, direct or indirect short-term interruptions which are caused by new projects are inevitable. Owners prefer to minimize these impacts by selecting a delivery method that can help them control these impacts on operations and the flow of passengers. This issue studies the ability of each delivery method to allow the coordination of construction activities with the airport operations management in order to minimize construction impacts.

**DBB:** The owner can include the requirements for operations management in the design and prepare bid documents and project schedules based on prevailing operating constraints. The airport's control over the design provides the airport with an option to phase the construction and divide the project into several packages in a way that minimizes impact on operation and passenger flow (ENR, Nov 2007).

**CMR:** Having the construction manager's expertise in coordinating subcontractors and negotiating with other involved parties helps the airport decrease the negative impact of construction activities. Allocating impact control responsibilities among the increased number of parties involved in a project is a drawback of this delivery method. The opportunity for the constructor to work with operations earlier in the process is a distinct advantage. Additionally, the enhanced ability to phase the project because there is a guaranteed single construction contractor across all phases allows the airport to optimize the impact of construction with operations and passenger flow.

**DB:** The interviews conducted for this study show that this delivery method has the ability to minimize the project interruptions of airport routine operations [Tampa International Airport]. The design-builder is the single source of responsibility in controlling the impact of the project on airport operations and must directly implement measures to conform to operational constraints in both the project's design and construction schedule. The airport can articulate these requirements as project performance criteria or specifications. Similar to CMR, the opportunity for the constructor to work with operations earlier in the process is a distinct advantage. Additionally, if minimizing operational impact is key to project success, the airport can require such a plan in the DB proposals and use it as a key factor in the evaluation and award process (Beard et al 2001).

**13) *Stakeholder input to design and construction:*** This issue concerns each delivery method's ability to promote coordination and project-specific agreements with third parties, such as political entities, utilities, adjacent communities, *etc.* involved in the project or affected by it. This issue also addresses the opportunities afforded by the delivery method to the owner for coping with community input. The delivery method should strive to leverage stakeholder and community input to achieve project goals in a meaningful and transparent fashion.

**DBB:** Most permitting agencies' procedures were established on the assumption that a 100% design would be available for review prior to permit issuance. Thus, DBB's linear delivery process allows the most time for potentially lengthy negotiations with some project



stakeholders. It gives some flexibility and time during the design process for the owner to obtain needed permits/agreements before construction begins. Third parties on the other hand, will have the ability to examine 100% complete designs before a contractor is hired. The disadvantages of completing designs before hiring a contractor may include a lengthy design schedule (including numerous instances of stakeholder inputs that can disrupt the most generous schedules) and also a lack of construction contractor input into the third party agreements. This also puts the burden of securing all the permits on the owner.

**CMR:** The main advantage of having a construction manager is the constructability advice (for example, construction knowledge and an understanding of construction methods) during the development of third party agreements. This delivery method may have a significant effect on getting third party agreements compared to DBB if the owner makes the responsibility of obtaining these agreements a part of the CMR contract (TCRP Guidebook, 2009). In general, the CMR's knowledge of construction processes and sequencing can help clarify various aspects of project impact on communities and institutions; this will enhance project chances for increasing the community confidence and obtaining community consent and stakeholder agreements.

**DB:** The DB process can move third party agreements to be consummated earlier in the delivery process, often before the design is complete. The airports need to get all the important inputs from stakeholders before issuing a RFP because changes in the project after award are disruptive and potentially costly. Airports have experienced both benefits and drawbacks of having the design-build contractor on the team before all third party agreements are in place. As the design and construction are awarded in one contract, the time required to develop agreements with other parties can be accelerated. Additionally, these agreements must often be written in performance terms because the design is not completed at the time of award. However, the designers and constructors on the DB team often have previous long-standing relationships with many third party stakeholders that they can leverage to the benefit of the project. Constructors have different approaches to negotiating agreements with third parties than owners and these can often be very effective (TCRP Guidebook, 2009). Additionally, the airport can require the DB contractor to include a public information and outreach program in the project to facilitate stakeholder input during design and construction. A caution is that any third party change after the award of a fixed price or the negotiation of a GMP in a DB delivery method can be costly or difficult to negotiate.

## Summary

Airport level issues directly impact the airport's operations and its project delivery staff. Some of these issues such as experience and capability of airport staff play an important role in switching from traditional DBB to its alternatives, CMR and DB. Many airports prefer to utilize DBB unless their goals cannot be readily achieved by this traditional project delivery method. Other issues analyzed in this section are specific to airport projects. For example "control impact on operation and passenger" is mainly about the flexibility provided by each delivery method in terms of project phasing and rescheduling to minimize construction impacts on regular activities of an airport. "Security" as a distinguishing factor of airport projects is another example of an airport-specific

issue. Security codes, tight controls and background checks decrease competition, complicate project scheduling, and increase project cost. However, when considering these issues as a decision making factor, it is mainly about the owner's control over the project and flexibility in design phase. In all cases, the airport's ability to articulate well-defined project objectives and a clear scope using the given delivery method is a key to success.

## Public Policy/Regulatory Issues

Public policy/regulatory issues analyze the choice of project delivery method decision in the face of existing laws, mandated social programs, labor unions, and other factors that establish the legal environment in which the project must be delivered.

**14) Competition and local competencies:** Each delivery method may affect the level of competition. In many cases, airports are operating under a legal requirement which requires “free and open” competition, for example Port Columbus International Airport is required by state law to bid any project more than \$25,000. The owners benefit from a competitive market mainly because of the reduction in bid prices; so if the choice of a certain delivery method reduces the level of competition among bidders (or reduces the number of qualified bidders), it would be considered a disadvantage. Air-side design and construction projects normally have less competition than land-side projects because of specialized knowledge, skills, and experience [Logan International Airport]. Currently, the volatility of bid prices in transportation projects is a major concern for the owners of airport projects. Additionally, alternative project delivery methods may inadvertently lead the airport to package projects in sizes that can effectively reduce competition. Local talent can be a “pro” or “con” for each delivery method based on the available capacity of local companies. For example, availability of general contractors with DB experience in the area where the airport project is executed, should be considered as a “pro” for DB. On the other hand, some airports may be located in areas where there are relatively few firms familiar with CMR or DB contracting, making the use of alternative delivery methods a disadvantage in those areas.

The following paragraphs evaluate the ability of each delivery method to facilitate competition and employ the local talent.

**DBB:** Compared to other delivery methods, availability of a relatively large pool of potentially qualified bidders ensures a high level of competition (Walewski *et al*, 2001; AGC, 2004). The owner can benefit from this market competition and get a low bid for its project. This approach also enables the owner to divide the project into smaller packages and bid them separately to further increase competition. The drawback to the multi-prime approach is that the coordination between various contracts may prove difficult.

**CMR:** Using RFP procedures and taking into consideration qualifications-based factors when evaluating the bidders can help the owners weed out unqualified proposers. The issue in this method is that the selected CMR constructor becomes the *de facto* winner of the construction contract, giving the owner less competitive leverage when pricing the construction (Irwin, 2003). This can be alleviated to some degree by requiring that the project components be bid competitively among various trade subcontractors. The

potentially negative effect of this requirement is that the CM may be reluctant to set a GMP until all the sub-bids are in. The owner can reserve the right to go to regular bidding if it cannot agree on a GMP with the CMR, although that decision may entail some extra cost and schedule delay.

**DB:** The RFP or qualifications-based procurement process can weed out unqualified DB entities but at the same time, the size of the bid package, the experience required to lead a DB team, and the bid preparation costs may reduce the number of qualified bidders (AGC, 2004).

**15) *Disadvantaged Business Enterprise (DBE) Impacts:*** The law imposes requirements and provides guidelines on federally funded airport projects for DBE participation [Atlanta International Airport; Port Columbus International Airport; Colorado Springs Airport; Denver International Airport]. Delivery methods may facilitate fair competition for DBEs for airport contracts and reduce burdens on small businesses. The effect of each delivery method on promoting participation by disadvantaged businesses is evaluated under this issue.

**DBB:** The owner has the chance to include requirements for participation in both design and construction contracts. For example, in the RFP for soliciting design services, the owner may stipulate the nature and extent of DBE participation as part of the design team. In the same way, the owner may require that the general contractor perform a pre-set percentage of construction using DBE subcontractors. Usually, the minimum level (as well as the desired target level) of participation is stipulated in terms of percent of contract price. On the other hand, the low bid environment may force DBE subs to submit dangerously low prices, potentially harming the future viability of these fledgling companies.

**CMR:** A constructor that submits a proposal for a CMR project is usually more sophisticated than a DBB general contractor. Lack of experience is a negative point for DBEs in a qualifications-based selection. One method to ensure DBE participation is to require a pre-set minimum (and target) percentage of the GMP for DBE firms.

**DB:** Lack of experience and sufficient financial strength may not allow a DBE to become the lead contractor but small businesses/DBEs may participate as subcontractors of the design-builder. As the owner is not directly involved in selecting subcontractors and suppliers, requirements for DBE participation as a percentage of the project budget should be included in DB RFP and then in the contract. This should be based on the number of DBEs associated with the various trades that will be required in the project. The design-builder then reports periodically the actual payments to all the DBE subcontractors and suppliers. The use of fixed price procurement early in the project development process will not facilitate the identification of DBE contractors as well as the use of a GMP negotiation later in the process. As the owner has less control in this delivery approach, the enforcement of DBE participation may be more difficult than in DBB or CMR.

**16) *Legal and statutory constraints:*** Based on the research done on federal laws, use of alternative delivery methods is allowed for airports (Title 49, Section 47142). State and local codes may have their own restrictions. Some of the states mandate that airports go through several justification and approval steps before being allowed to use an alternative delivery method. Additionally there may be other legal issues. For example labor union issues, environmental impact permits, and rules for the

bidding process may contradict with the procedures of a delivery method and make it difficult for the owner to use a specific delivery method. Also a well-tested and streamlined procedure for a delivery method, achieved after many applications is considered an advantage for that delivery method. This issue studies the interactions between each delivery method and legal and statutory constraints.

**DBB:** All the state codes accept DBB as a project delivery method for an airport project. Relevant procurement processes are well-developed and details of DBB execution are available nationwide. In this delivery method the contractor hires the laborers directly or through a subcontractor. Union or non-union labor may be used in this approach (unless local conditions and considerations limit constructor's options) and there would be no fundamental opposition to DBB unless the contractor fails to comply with the relevant rules and regulations. The open bid procedure does not contradict the state codes and does not impose any ambiguity or difficulty for the airport if the project is awarded to the lowest bidder. Also the procedures are well-established with a long history of applications.

**CMR:** The at-risk construction manager is usually selected through a qualifications-based process and then the contract price is determined with negotiation between the owner and the CMR. This may contradict the state codes where an open bidding is required for any construction project. The constructor in this delivery method plays a role similar to the general contractor in DBB and there would not be fundamental issues between the unions and the constructor. If there are union issues in the project's location, the CMR's ability to guarantee the maximum price of the project is at risk and it may not be willing to absorb the risks of the labor union issues. Unions may support alternative delivery methods as these methods give more weight to qualifications rather than cost because unions assert they are more qualified than non-union labor (Bearup, *et al* 2007).

**DB:** Design-builder selection can be through a best-value or qualifications-based procedures that typically include factors related to the qualifications of the bidder and the proposal. This may contradict with hard dollar bidding tradition for some airports with no experience with these procedures. Also, the design-build entity on large megaprojects (>\$100 million) are usually joint ventures that dissolve after the end of the project and this may make the process of dealing with unions a bit complicated as the joint venture entity may not be a signatory to the prevailing union agreements in the area. Awarding the design to a design-builder in some cases (California for example) where public design engineers have their own unions may cause them to view the use DB as a threat to their job security. Like in CMR, labor/craft unions may support alternative delivery methods that qualifications rather than cost to make an award as these unions assert they are more qualified than non-union labor (Bearup, *et al* 2007). Procurement method may also affect the ability of some airports, as they may not be allowed to use a QBS procurement system [*e.g.*, Atlanta Hartsfield-Jackson International Airport]. Also, sometimes environmental agencies may require a complete design before issuing the necessary permits. This will create an obstacle for the use of DB.

**17) Sustainability and LEED certification:** Sustainable design and construction features are becoming more common and may become mandatory in the future for public infrastructure projects. Thus, it is important to gauge a project delivery method's ability to include these features in accordance with the owner's needs. The US Green Building Council's Leadership in Energy and Environmental Design (LEED) certification is often used by public agencies as a means to articulate

its desire to design and build both energy efficient and environmentally responsible projects. As an example, Sacramento's preferred concept for the new Central Terminal B includes LEED certification as an objective. Although LEED certification has not become a requirement in airport projects, how each delivery method facilitates this issue can be a benefit or a drawback. For example, one benefit of establishing LEED as a criterion is that it can be used as a metric to evaluate sustainable design and construction options regardless of whether LEED certification is sought for the project. LEED prerequisites (including selection of site, and construction activity pollution prevention) can yield greater environmental benefits while reducing regulatory risk. On the other hand, sustainability requirements may increase project costs because of extra technical features and documentation, as well as the requirement to have certified project personnel. One important fact to remember is that the sustainability standards are evolving. The adoption of LEED criteria as an example may need to be phased to include the most current iteration rather than a particular standard.

**DBB:** The owner has a clear opportunity to define sustainable design intent and shape social and environmental impact. This method presents opportunities to promote and enhance sustainable design criteria by allowing for materials research and the development of strategic stakeholder input. A drawback in this delivery method is the lack of builder input that can limit the opportunity for input into sustainable design and the owner, in certain cases, may not achieve its sustainability goals (e.g. getting LEED certificate for the project).

**CMR:** The owner has a unique opportunity to realize the economic returns for sustainable systems performance as well as using sustainable construction experience as an evaluation factor for the selection of a builder. In this delivery method sustainable construction features are more likely to be implemented considering the cooperative nature of the owner/constructor contracts when using this delivery method. Contractor's early involvement in design process can help to perform meaningful industry based cost benefit analyses for various LEED components.

**DB:** This project delivery method can result in an inherent coordination of design and performance with potential for accelerated economic returns for sustainable systems performance by shortening the project schedule. The owner can clearly articulate expectations regarding sustainability by assigning weight in relation to other factors in the DB evaluation plan. This can be done with either best-value or qualifications based selection. The design schedule could, however, impact public participation thereby limiting social equity issues. Due to the normally time consuming processes associated with municipal and state requirements for mandatory announcement and the convening of public hearings, certain sustainability measures such as wetlands mitigation and avoidance of undeveloped areas raises concerns for eminent domain and brown-fields redevelopment which can impact time performance. There is some evidence that the use of DB may hamper the objective of achieving LEED certification. This is due to the perception of risk by the DB contractor when considering whether to bid on a DB project with LEED goals. The owner needs to be cautious in defining the project scope and goals clearly to ensure reasonable competition, especially if LEED certification is desired.

## Summary

Public policy/regulatory issues are factors that the airport has little if any ability to change, and include specific legal or governing body policy constraints on PDM use as well as requirements to satisfy legislative requirements for public works projects. Many of these issues are essentially a go/no-go factor that may eliminate a delivery method from any further consideration in the process of decision making (e.g. “methods allowed per state statute or local governing ordinance”). While some factors of this section are found to have minimal impacts on decision (e.g. “DBE impacts”) there are some other factors that strongly affect delivery selection. Competition and local talent is one of these factors. The research found that the importance of competition and availability of local talent for decision makers is relatively high and can sometimes become a driving factor.

## Other Issues

The Other Issues category consists of issues that are important to project success but not categorized previously in this chapter.

**18) *Adversarial Relationship:*** Airport projects can be hampered by conflicts between parties to the design and construction contracts. The higher the level of adversarial relationships in a project, the more likely it is that the project will suffer from cost, schedule, and quality problems. Delivery methods define the relationships among all project parties. If the project delivery method encourages project parties to work together as a team to achieve the project goals and characteristics, it is considered a benefit (pro). Conversely, if the project delivery method increases the possibility of adversarial relationships, it is considered a detriment (“con”).

**DBB:** This delivery method can create an adversarial relationship between the parties and mainly between the owner and the construction contractor (Walewski *et al*, 2001; Irwin, 2003; Mahdi *et al*, 2005). Furthermore, the engineer and the contractor may assume adversarial roles as one is in charge of approving the other’s work. The division of responsibilities may also result in these two parties blaming each other in case of project failures or during major disputes (Halpin 2006).

**CMR:** Including construction contractor collaboration during the design phase builds constructive team work and facilitates project team formation (Irwin, 2003; Minchin *et al*, 2007) although it requires extensive coordination of consultants and/or subcontractors.

**DB:** Single point of responsibility for design and construction decreases the potential for conflict between the engineer and constructor (Walewski *et al*, 2001; TCRP, 2002; Halpin 2006). Although there should be less conflict between the designer and the constructor (since they are both on the same team and they are jointly responsible to the owner for the success of the project.), instances of internal disputes are sometimes observed in DB projects (TCRP Guidebook, 2009). It is worth mentioning that design-builders may be deterred from submitting claims to owners who have future DB projects to avoid decreasing their competitiveness for future projects awarded on a qualifications based selection system (QBS) by making the owner angry with a claim.

**19) Construction Claims:** The effect of each delivery method in exposing the airport to potential conflicts and claims is studied under this issue. If a delivery method can reduce the number of construction claims, that delivery method is a favorable choice (“pro”), and if it increases the possibility of construction claims, it is an unfavorable choice (“con”).

**DBB:** This method typically has the highest occurrence of claims & disputes. Disputes arise often over authority, responsibility and quality (Walewski *et al*, 2001). Furthermore, as the owner is responsible for design completeness, errors and omissions claims is a common occurrence in DBB projects. Some contractors may bid low to win a job and try to enhance their final profit margin through claims and change orders, especially if design errors or ambiguities are present in the construction documents. Studies have shown that this delivery method resulted in the highest rate of cost growth which could be an indication of large number of claims (Konchar, 1998).

**CMR:** Assuming a well-structured contract, there is less probability for claims and disputes once a GMP is agreed upon and the contract is signed. As the CMR has been present during the design process there will be less need for information and clarification of the design documents. Some professionals contend that this approach will result in very few construction claims (TCRP Guidebook, 2009). The qualifications-based selection methodology creates an effective deterrent to initiating claims by requiring the CMR to be “successful” on the current contract in order to be competitive for future projects. The qualifications-based selection process may reduce the possibility of hiring litigious contractors.

**DB:** Analysis of interviews conducted for this study shows that design-build is less prone to claims and disputes, assuming a well-structured contract. As an example, claims for design errors, a major source of DBB contractors’ complaints, is reduced considerably in DB. At the same time, early pricing leaves the owner vulnerable to claims for scope that was missing in RFP. The qualifications-based selection methodology creates an effective deterrent to initiating claims by requiring the design-builder to be “successful” on the current contract in order to be competitive for future projects. Another study also showed that the size and frequency of change orders were smaller in DB projects (Riley *et al*, 2005).

## Summary

This section covers two important issues not directly addressed in other sections. Both of these issues are about relations between parties involved in a project. Construction claims and adversarial relation can hamper project success and distract the owner’s focus from project success and quality to dispute resolution.

## Conclusion

The analysis done in this chapter is not deterministic. It only describes the advantages and disadvantages of delivery methods in dealing with each of the pertinent issues discussed, based on

material found in the literature or information gathered during airport interviews. This in turn helps identify strengths or weaknesses of each delivery method in coping with important factors that can affect project goals. This analysis provides a broad picture of the issues affecting project delivery method and develops a basis for a decision system which is introduced later in this research.



## **CHAPTER 5 – TIER 1: ANALYTICAL DELIVERY DECISION APPROACH**

### **Introduction**

No single project delivery method is appropriate for every project. Each project must be examined individually to determine how it aligns with the attributes of each available delivery method. The Tier 1 – Analytical Delivery Decision Approach provides airports with a structured approach to choosing the most appropriate project delivery method for an individual project. The Tier 1 approach has three primary objectives:

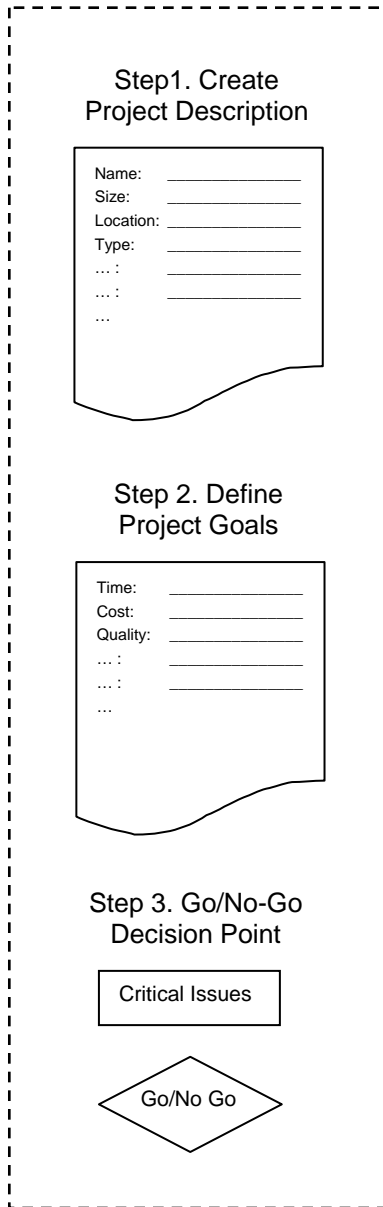
- Present a structured framework to assist airports in examining 19 critical issues involved in the project delivery decision;
- Assist airports in determining if there is a dominant or obvious choice of project delivery methods; and
- Provide a structure for documenting the project delivery decision in the form of a Project Delivery Decision Report.

The Tier 1 approach provides a framework for airports to define project goals and examine the advantages and disadvantages of each delivery method within the context of these goals. The motivation for this approach is to help airports understand project delivery method attributes and to determine if their specific project goals align with the attributes of a particular delivery method. The Tier 1 approach also provides a “go/no go” review to determine if one or more project delivery methods should be excluded from the examination.

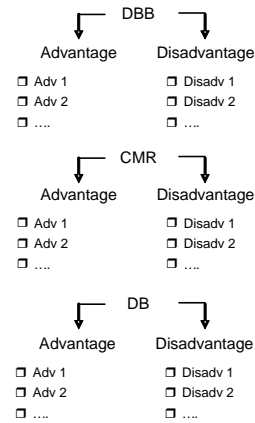
At the completion of Tier 1, there is a possibility that the airport may not have a single, clear and logical choice for a project delivery method. If this is the case, the airport should move to the Tier 2 selection processes with the best delivery method options and create a more detailed analysis to select the final project delivery method.

The Tier 1 approach is comprised of six distinct steps listed below and shown in Figure 5-1

- Step 1. Create Project Description
- Step 2. Define Project Goals
- Step 3. Review Go/No Go Decision Points
- Step 4. Review Project Delivery Method Advantages and Disadvantages
- Step 5. Choose Most Appropriate Project Delivery Method
- Step 6. Document Results



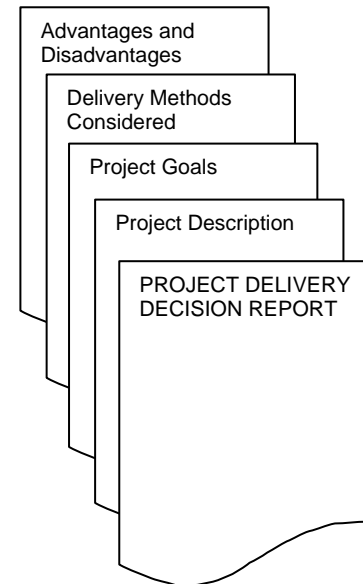
**Step 4. Review Project Delivery Method Advantages/Disadvantages**



**Step 5. Choose Most Appropriate Project Delivery Decision**

PROJECT DELIVERY METHOD ADVANTAGE/DISADVANTAGE SUMMARY			
	DBB	CMR	DB
<b>Project-Level Issues Rating</b>			
1. Project Size/Complexity			
2. Schedule Compression			
3. Schedule Growth Control			
4. Cost Precision			
5. Cost Control			
6. Risk Management/Allocation			
7. Life-Cycle Cost			
8. Maintainability			
<b>Airport-Level Issues Rating</b>			
9. Airport Experience/Staff Capability			
10. Airport Control of Project			
11. Security			
12. Control Impact on Operations & Passengers			
13. Stakeholder Input to Design & Construction			
<b>Public Policy/Regulatory Issues Rating</b>			
14. Competition and Local Competencies			
15. DBE Impacts			
16. Legal and Statutory Constraints			
17. Sustainability and LEED certification			
<b>Other Issues Rating</b>			
18. Adversarial Relationship			
19. Construction Claims			
Other			
Other			
Other			

**Step 6. Document Results**



**Figure 5-1 - Tier 1 Selection Process Overview**

The objective of Step 1 is to create a project description in sufficient detail for documenting the project delivery decision. A template is provided to assist airports in describing the appropriate level of detail (Please refer to Appendix C of the Guidebook). The description is provided to summarize only the key variables and provide a “snapshot” of the project scope at the time in which the project delivery decision was determined.

Research and practical experience have shown that the definition of project goals is a key success factor in the project delivery decision. The objective of Step 2 is to provide guidance to airports on how to write and rank their project goals. The guidance provides general categories for goals.

The objective of Step 3 is to exclude those project delivery methods from consideration that are not viable options. A legal review of project delivery and procurement laws in the United States revealed that some alternative delivery methods are not allowed in all states. There are additional schedule and third party issues that could exclude a delivery method from consideration. Step 3 describes a quick “go/no-go” decision process to determine if certain delivery methods should be excluded from consideration.

Step 4’s primary objective is to present a comprehensive listing of generic *potential* advantages and disadvantages for each delivery method in 19 critical areas. *These potential advantages and disadvantages must be examined in the context of each individual project.* Variations in the *project* characteristics, the *people* involved, and the *processes* in use by the airports will determine if these potential issues are actual advantages or disadvantages for a particular project. Step 4 asks the airports to consider these actual advantages and disadvantages and rate each project delivery method as “most appropriate, appropriate, least appropriate, or not applicable” for each of the 19 issues. A form for this rating and a structure for documenting comments are provided.

The objective of Step 5 is to make the final project delivery choice, given that a dominant or obvious choice exists. Upon transferring the 19 individual ratings from Step 4 into an overall summary, the process asks airports to determine whether there is a dominant choice. Step 5 asks the airports to consider the significant benefit as well as any risks or fatal flaws that might negate a delivery method even though the benefits make it a clear winner. If a dominant method is not apparent, the user will document the Tier 1 analysis and move to Tier 2 with the most applicable methods for further analysis.

The objective of the final step, Step 6, is to clearly document the Tier 1 decision in the form of a Project Delivery Decision Report. The report will provide an archival record for the project delivery decision. It will serve to communicate the decision to interested stakeholders and to justify the decision if issues arise, even years later, as the project is completed. The process organizes the report into sections that follow the five previous steps in the Tier 1 process – project description, project goals, delivery methods considered, advantages and disadvantages, delivery method decision, and any relevant appendices.

## Step 1. Create Project Description

The first step in the delivery selection involves the creation of a concise project description that serves to communicate the important project characteristics to the decision makers and also to document the project scope for the delivery decision report. Projects differ in their scope of work and their major elements (e.g., people involved, physical project characteristics, project duration, project budget, etc.). These distinguishing parameters affect the project delivery method selection. Airports should choose the most appropriate delivery method on the basis of the project requirements and the opportunities that each delivery method can provide for them. Please see Appendix C of the Guidebook for a typical template for project description and goals.

The objective of creating a project description is to explain the project in sufficient details to document the project delivery decision. The project description should be concise and also comprehensive. It should include the necessary information about the project and address all aspects of the project that may influence the project delivery method selection. The intent of the project description is to provide a “snapshot” of the project scope at the time in which the project delivery decision was determined. It will serve to communicate the decision to interested stakeholders and to justify the decision if issues arise years later as the project is completed. Listed below is a checklist of the important project characteristics that should be covered in the project description.

### Project Description

- Project Name
- Location
- Major Features of Work
  - Runway
  - Apron
  - Terminal
  - Other
- Estimated Project Budget
- Estimated Project Delivery Period
- Required Delivery Date (if applicable)
- Source(s) of Project Funding
- Project Site Dimensions or Project Limits
- Security Issues or Concerns
- Rate of Return on Capital Investment/Payback Period (if applicable)
- Major Schedule Milestones
- Major Project Stakeholders
- Labor Union Status
- Major Challenges (as applicable)
  - With Permitting and/or Environmental Approvals
  - During Construction Phase
  - During Operation and Maintenance
- Main Identified Sources of Risk
- Sustainable Design and Construction Requirements

## Step 2. Define Project Goals

Understanding and communicating a concise set of project goals is perhaps the most important element in selecting an appropriate project delivery method. This guidebook cannot overemphasize the importance of project goals in delivery method selection. The definition of project goals is a key success factor in not only the project delivery decision, but also the development of procurement documents and the administration of a project. The project will have technical goals that must be met (e.g., meeting anticipated passenger/cargo throughput, meeting design standards, meeting safety standards, etc.) and will also have performance goals regarding time, cost, quality, maintainability, and sustainability. It is the performance goals that typically drive the project delivery decision.

At project inception, the airport must identify the various performance aspects of the project to meet its requirements. Generally, these will fall into the categories of cost, schedule, and quality as defined by the technical design. Of these three factors, the project will normally have one which is the most important for this project’s ultimate success – the preeminent factor. This preeminent factor is the factor for which the airport will sacrifice pieces of the other two to achieve the goal relating to this factor.

A clear and concise definition of project goals not only assists with selecting an appropriate project delivery method, but also provides a clear measure for project success and clear direction for the construction manager or design-builder to complete the project. These project goals set the stage for decision makers throughout the project life cycle and show them the priorities while analyzing different alternatives. Project goals provide input for choosing the procurement method, risk allocation strategies, contracting, monitoring progress and at the end, evaluating the project success.

To define project goals, thinking in terms of performance categories can be helpful. Time, cost, quality, and suitability are common categories. Table 5-1 below provides some generic goals in these categories.

**Table 5-1 - Examples of Generic Project Goals**

Generic Project Goals	
<p><b>Schedule</b></p> <ul style="list-style-type: none"> <li>• Minimize project delivery time</li> <li>• Complete the project on schedule</li> <li>• Accelerate start of project revenue</li> </ul>	<p><b>Quality</b></p> <ul style="list-style-type: none"> <li>• Meet or exceed project requirements</li> <li>• Select the best team</li> </ul>
<p><b>Cost</b></p> <ul style="list-style-type: none"> <li>• Minimize project cost</li> <li>• Maximize project budget</li> <li>• Complete the project on budget</li> </ul>	<p><b>Sustainability</b></p> <ul style="list-style-type: none"> <li>• Minimize impact on the environment</li> <li>• Achieve LEED Certification</li> </ul>

Choosing the goals that apply to a specific project is a first critical step in an airport’s selection of delivery method. The second, and equally important step, is the ranking of the goals. On every project there are tradeoffs between schedule, cost, and quality. It is to the project’s benefit if the airport, designers, and constructors are in alignment with these project goals. For example, if a project’s first-ranked goal is to accelerate the start of project revenue and the third is to complete the

project on budget, this provides the team with clear direction that an increase in budget may be acceptable if it can accelerate the start of project revenue.

As previously stated, understanding and communicating a concise set of project goals is perhaps the most important element in selecting an appropriate project delivery method. Airports should take the time to identify project goals and achieve consensus on their relative importance. This time will be well spent as it will make the project delivery decision more clear. It will also help to define and communicate overall project success, thereby aligning the designers and constructors with the airport's project performance measures. Please see Appendix C of the Guidebook for a typical template for project description and goals.

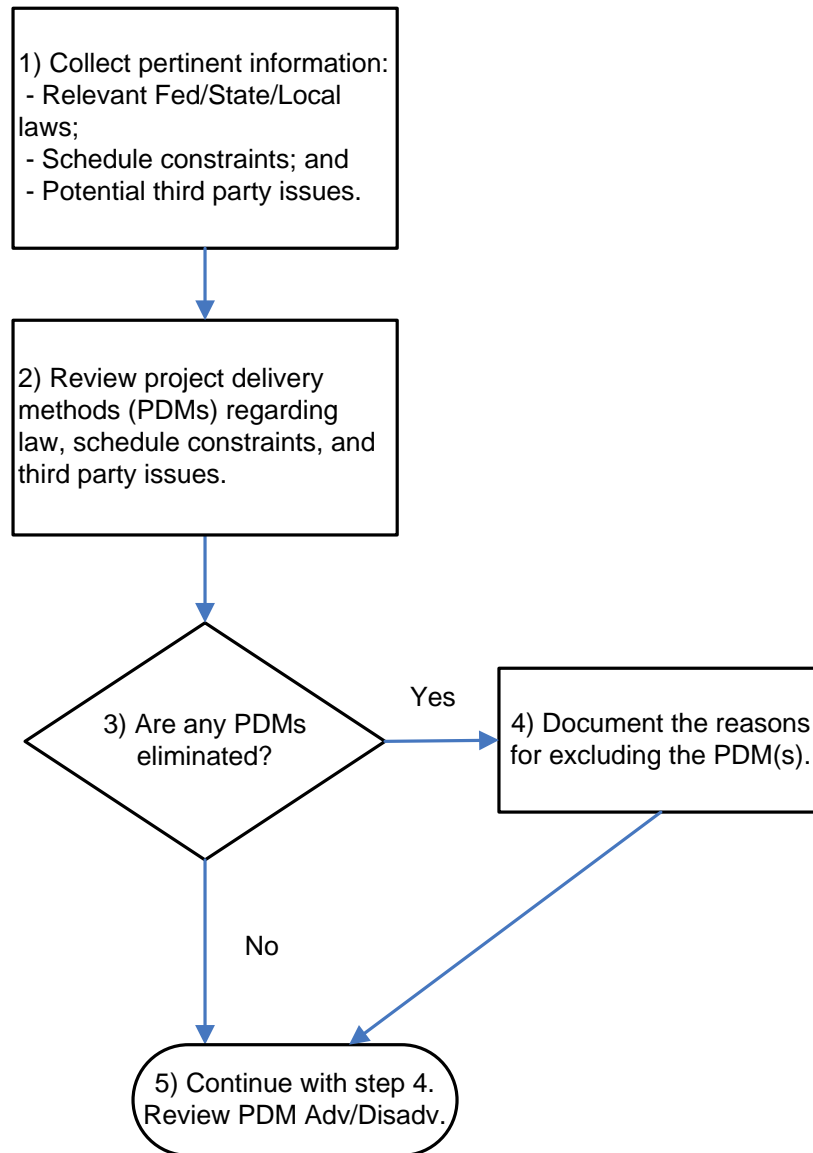
### Step 3. Review Go/No-Go Decision Points

Among the pertinent issues that affect the project delivery decision, there are certain issues that render one or more delivery methods inappropriate. These issues involve project schedule constraints; federal, state, and local laws; third party agreements; and labor unions agreement. These issues and how they relate to the three primary delivery methods are shown in Table 5-2. The airport needs to review these issues to determine if they eliminate any of the delivery methods. In other words, the airport should make a "go/no-go decision" based on these pertinent issues. The result of this go/no-go study is a listing of delivery methods available to the airport and a documentation of those which are not available for further consideration. The flowchart in Figure 5-2 depicts a step-by-step approach to the decision; a description of the approach follows.

**Table 5-2 - Go/No-Go Issue Summary**

	DBB	CMR	DB
Project Schedule Constraints	✓ / X		
Fed/State/Local Laws		✓ / X	✓ / X
Third Party Agreements			✓ / X
Others	✓ / X	✓ / X	✓ / X

Key: ✓ / X = Go/No-Go decision point



**Figure 5-2 - Go/No-Go Decision Points**

As depicted in the flowchart in Figure 5-2, the airport should first conduct research into the pertinent issues of project schedule constraints, federal, state, and local laws, and third party agreements. The airport should review any major milestones that could create schedule constraints which would prohibit a traditional DBB delivery (*e.g.*, an aggressive fixed end date, funding availability windows, *etc.*). Next, federal, state and local laws can be researched by the airport's general counsel to identify any constraints that must be met during the project delivery method selection process. For example, a jurisdiction that has a law that requires award of construction contracts to the low bidder may have to adopt the low-bid DB award method in order to use DB project delivery (this constraint may rule out the use of DB in such circumstances). The airport then needs to determine the third party agreements that will be required (*e.g.*, local municipalities, utilities, permitting, *etc.*).

The airport's next step is to analyze the documents and information in relation to the constraints of each delivery method. As depicted in Table 5-3, each of the issues may exclude one or two of the delivery methods from further consideration. For example, if the project is located in a state where the law does not authorize CMR and the project is using state funding, this airport can eliminate CMR from the list of available options. Details follow for each of the go/no-go issues.

### ***Project Schedule Constraints***

The traditional DBB delivery method is a linear process that requires the longest delivery period of all three methods. If a DBB project delivery will not yield a finish date within the project's constraints, DBB need not be considered further. As mentioned in the previous section on project goals, project schedule can be a preeminent factor in project success. Airports frequently give schedule the first priority of the competing project goals. Shortening of duration is the reason that airports most frequently cite for using alternative methods.

Another case of schedule constraints involves an airport that would like to award construction before the design is complete, which the DBB method will not accommodate. This may occur when the airport has a fiscal year budget for construction and needs to award the project before the design is finished or if the airport has a window of opportunity to complete a portion of the project during an early work window before the design is complete (*e.g.*, beginning construction before the end of the construction season).

### ***Federal/State/Local Laws***

When a project is funded with federal, state or local moneys, it will need to follow the applicable procurement and construction laws. While some states have explicitly given full authorization to airports to use CMR and DB, there are still some states that prohibit the use of one or all alternative methods. In the spectrum between full use and prohibition, some states allow alternative project delivery methods with certain conditions (*e.g.*, requiring extra approvals, putting dollar value limits on the volume of DB or CMR contracts, or putting limits on the number of projects using alternative delivery method in each year). It should also be noted that these laws change frequently and each airport is responsible for checking the relevant state and local laws because of continuous change and evolution of these laws.

### ***Third Party Agreement***

All major airport projects affect third parties and require agreements to manage the impacts. Some third parties require a completed set of construction documents to execute an agreement. In this case, the requirement for a complete design renders DB inappropriate. For example, if the project limits are shared between the project and a local municipality, a full set of drawings may be required by the municipality prior to signing an agreement or a memorandum of understanding (MOU). In such a project, depending on the circumstances and the rigidity of the third party, DB might be eliminated from the list of available options.

### ***Labor Unions***

In the states where public sector labor unions are dominant, this issue may affect the choice of delivery methods. It primarily affects DB delivery in cases where public unions control the operation and maintenance of the airport project. Public labor unions can also affect DB delivery where airports traditionally complete design with public sector designers. In both of these cases,



airport maintenance employees or designers may not allow a delivery method that can outsource jobs to the public sector. In these cases, DBOM or DB may be eliminated from the list of available options.

Upon reviewing these four go/no-go issues, airports will have a list of viable delivery methods to further consider. Additionally, they should document the reasons for excluding any methods from further consideration. Table 5-3 provides a form for summarizing this go/no-go analysis.

**Table 5-3 - Go/No-Go Summary Form**

	DBB	CMR	DB
Project Schedule Constraints			
Fed/State/Local Laws			
Third Party Agreements			
Other			

Key: ✓ Applicable for further study  
 X Not Applicable (discontinue evaluation of this method)

Comments \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

#### Step 4. Review Project Delivery Method Advantages and Disadvantages

Step 4 of the project delivery decision involves a critical examination of the advantages and disadvantages of each remaining delivery method. There is no single project delivery method that is appropriate for every project. The objective of this section is to determine how each project delivery method aligns with the project goals, project characteristics, airport characteristics, policy/regulatory issues and life cycle requirements.

The process involves an examination of 19 separate issues relating to each delivery method. This process uses the 19 issues that were presented in Chapter 3 of this Guidebook, which presents detailed descriptions and references for each of the issues. Upon examining each issue, the process asks users to relatively rate the delivery methods in terms of their appropriateness for each issue. The process can be summarized in the following steps.

- a. **Understand the Issue:** Read the brief description of each issue. Refer to Chapter 3 for an expanded description of the issue if needed.
- b. **Analyze the Delivery Methods:** Read the pertinent issues for each delivery method. After reading the issues, determine if the issue is an *advantage or disadvantage as they apply to the particular project in question*. Please note that an issue may in fact be an advantage or a disadvantage depending on the characteristics of the project, the owner or the market. Again, refer to Chapter 3 for an expanded description of the issue if needed. *Analyze each*

*issue, determine whether the issue is an advantage or disadvantage, and document the determination in the box with any relevant notes from the determination. Note: it is not necessary to label each issue as an advantage or disadvantage – focus on the critical issues for the project in question!*

Also note that one can add to the columns in Tables 4.4 and on. This happens if in a project, the decision maker decides to include more than one type of DB procurement method. Refer to Chapter 2 Section “Definition of Delivery Methods” for procurement options. The Design-Build procurement options considered in Tier 1 are primarily Best-Value Procurement with Fixed Price and DB Qualifications Based Procurement with Negotiated Price. DB Low Bid is an option, but it is not recommended in this Guidebook for the majority of DB projects. If for whatever reason the decision maker decides to consider more than one type of DB, a new column can be added to the table and that option can be evaluated against pertinent issues.

- c. **Complete the Issue Summary Table:** Review the advantages and disadvantages that apply to each delivery method and analyze their implications. Complete the summary advantage/disadvantage table at the end of each section. A key is provided to rate each delivery method:

- - most appropriate
- ◐ - appropriate
- - least appropriate
- X - not applicable

## Project Level Issues

### 1) Project Size/Complexity

This issue reflects both the dollar value and complexity of the project based on the type of the airport project.

DESIGN-BID-BUILD		
Issues	Advantage	Disadvantage
<ul style="list-style-type: none"> <li><input type="checkbox"/> DBB has been shown to work on projects of all sizes and complexity, but the research case studies found that airports tend to select DBB on smaller projects.</li> <li><input type="checkbox"/> As projects grow in size and complexity, the amount of owner staffing required to oversee DBB can become very large.</li> </ul>		

CONSTRUCTION MANAGEMENT AT RISK		
Issues	Advantage	Disadvantage
<input type="checkbox"/> CMR has been shown to work on projects of all sizes and complexity, but the research case studies found that airports tend to select CMR on larger and more complex projects. <input type="checkbox"/> On project of large size and complexity, CMR can use multiple bid packages to optimize responses from proposers, but this approach results in more complex management.		

DESIGN-BUILD		
Please specify procurement system: ( _____ )		
Issues	Advantage	Disadvantage
<input type="checkbox"/> DB has been shown to work on projects of all sizes and complexity, but the research case studies found that airports tend to select DB on larger and more complex projects. <input type="checkbox"/> Some owners have noted that DB can facilitate better management of large projects due to the single source of responsibility. <input type="checkbox"/> As projects grow in size and complexity, there can be large peaks in owner staffing requirements with DB (e.g., during RFP development, during design review, etc.). <input type="checkbox"/> As projects grow in size and complexity, best-value procurement will require design-builders to assume more risk and QBS procurement will become more challenging to negotiate prices.		

**Table 5-4 - Project Size Advantages/Disadvantage Summary**

	DBB	CMR	DB
1. Project Size/Complexity			

- Key: ● Most appropriate delivery method  
 ● Appropriate delivery method  
 ○ Least appropriate delivery method  
 X Not Applicable (discontinue evaluation of this method)

Comments \_\_\_\_\_  
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## 2) Schedule Compression

From the owner’s viewpoint, each delivery method affects project schedule in two different aspects: 1) schedule shortening and 2) schedule growth control. This factor checks the ability of each delivery method in terms of schedule compression.

DESIGN-BID-BUILD		
Issues	Advantage	Disadvantage
<ul style="list-style-type: none"> <li><input type="checkbox"/> DBB is the base case and will take the longest of the three delivery methods.</li> <li><input type="checkbox"/> If an airport is willing to take on coordination responsibility, DBB projects can be awarded to multiple prime contractors to speed the process.</li> </ul>		

CONSTRUCTION MANAGEMENT AT RISK		
Issues	Advantage	Disadvantage
<ul style="list-style-type: none"> <li><input type="checkbox"/> CMR can be used to facilitate fast-tracking, or the ability to bid multiple design packages.</li> <li><input type="checkbox"/> There is a risk that overlapping design and construction packages may create delays if not properly coordinated.</li> <li><input type="checkbox"/> Fast-tracking schedules require owner effort in design and construction reviews and do not guarantee time savings.</li> <li><input type="checkbox"/> Studies have shown that, <i>on average</i>, CMR is faster than DBB, but slower than DB.</li> </ul>		

DESIGN-BUILD		
Please specify procurement system: ( _____ )		
Issues	Advantage	Disadvantage
<ul style="list-style-type: none"> <li><input type="checkbox"/> Provides a single point of responsibility (DB contractor) for schedule compression.</li> <li><input type="checkbox"/> All case studies showed that airports selected DB with the primary goal of compressing schedule.</li> <li><input type="checkbox"/> Rapid schedule will require airport effort in design and construction reviews.</li> <li><input type="checkbox"/> Studies have shown that, <i>on average</i>, DB is faster than both CMR and DBB.</li> <li><input type="checkbox"/> DB procurement methods do not significantly affect schedule compression.</li> </ul>		

**Table 5-5 - Schedule Compression Advantages/Disadvantage Summary**

	DBB	CMR	DB
2. Schedule Compression			

- Key:
- Most appropriate delivery method
  - ◐ Appropriate delivery method
  - Least appropriate delivery method
  - X Not Applicable (discontinue evaluation of this method)

Comments \_\_\_\_\_  
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**3) Schedule Growth Control**

This factor shows the ability of each delivery method in controlling and preventing time growth in a project.

DESIGN-BID-BUILD		
Issues	Advantage	Disadvantage
<ul style="list-style-type: none"> <li><input type="checkbox"/> DBB is likely to yield the highest schedule growth due to change orders based on project delivery research.</li> <li><input type="checkbox"/> There is a lack of opportunity to compress schedule if problems occur due to the linear nature of DBB.</li> </ul>		

CONSTRUCTION MANAGEMENT AT RISK		
Issues	Advantage	Disadvantage
<ul style="list-style-type: none"> <li><input type="checkbox"/> CMR facilitates fast-tracking, or the ability to bid multiple design packages, which can be helpful in limiting schedule growth if problems occur during project development.</li> <li><input type="checkbox"/> There are risks that overlapping design and construction packages may create schedule growth if not properly coordinated.</li> <li><input type="checkbox"/> Studies have shown that, <i>on average</i>, CMR has less schedule growth than DBB, but more than DB.</li> </ul>		

DESIGN-BUILD		
Please specify procurement system: ( _____ )		
Issues	Advantage	Disadvantage
<ul style="list-style-type: none"> <li><input type="checkbox"/> Provides a single point of responsibility (DB contractor) to combat schedule growth.</li> <li><input type="checkbox"/> DB projects using a lump sum contract typically fix project end dates early in the project development process when compared to DBB or CMR.</li> <li><input type="checkbox"/> Unlike DBB and CMR, owners will be shielded from schedule-related change orders stemming from errors and omissions in plans.</li> <li><input type="checkbox"/> Rapid schedule will require airport effort in design and construction reviews.</li> <li><input type="checkbox"/> Studies have shown that, <i>on average</i>, DB has less schedule growth both CMR and DBB.</li> <li><input type="checkbox"/> DB procurement methods do not significantly affect schedule growth control.</li> </ul>		

**Table 5-6 - Schedule Growth Control Advantages/Disadvantage Summary**

	DBB	CMR	DB
3. Schedule Growth Control			

- Key:
- Most appropriate delivery method
  - Appropriate delivery method
  - Least appropriate delivery method
  - X Not Applicable (discontinue evaluation of this method)

Comments \_\_\_\_\_

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**4) Early Cost Precision**

Early and precise project cost estimation is always sought by airports. This issue studies the ability of each delivery method in terms of predicting an accurate cost estimate.

DESIGN-BID-BUILD		
Issues	Advantage	Disadvantage
<ul style="list-style-type: none"> <li><input type="checkbox"/> Construction costs are not fixed (or locked in) until design is 100% complete, but costs are known at bid time, before construction begins.</li> <li><input type="checkbox"/> Constructability advice and contractor innovations are not available to save cost until post bid.</li> <li><input type="checkbox"/> The DBB process is prone to change orders and cost growth after award.</li> </ul>		

CONSTRUCTION MANAGEMENT AT RISK		
Issues	Advantage	Disadvantage
<ul style="list-style-type: none"> <li><input type="checkbox"/> CMR can be used in conjunction with a GMP pricing structure, which can be useful in negotiating and controlling costs.</li> <li><input type="checkbox"/> Costs will be known earlier when compared to DBB.</li> <li><input type="checkbox"/> CMRs generally have experienced estimating and construction staff that can help to develop reliable estimates earlier in the process.</li> <li><input type="checkbox"/> If a GMP pricing structure is used, owners should have experience in estimating and negotiating prices.</li> <li><input type="checkbox"/> If the airport/funding agency requires that the subs be selected thru low bid procurement, construction manager may be unwilling to agree to GMP before all subs bids have been received.</li> </ul>		

DESIGN-BUILD		
Please specify procurement system: ( _____ )		
Issues	Advantage	Disadvantage
<input type="checkbox"/> Costs will be known earlier in the project delivery process when compared to DBB or CMR. <input type="checkbox"/> If a lump sum pricing structure is used, costs will be fixed early in the project development process, but constructors must develop prices before plans are 100% complete and therefore must assume some risk in pricing. <input type="checkbox"/> If a GMP pricing structure is used, owners should have experience in estimating and negotiating prices. <input type="checkbox"/> If the airport/funding agency requires that the subs be selected through low bid procurement, construction manager may be unwilling to agree to GMP before all subs bids have been received.		

Table 5-7 - Early Cost Precision Advantages/Disadvantage Summary

	DBB	CMR	DB
4. Early Cost Precision			

- Key:
- Most appropriate delivery method
  - Appropriate delivery method
  - Least appropriate delivery method
  - X Not Applicable (discontinue evaluation of this method)

Comments \_\_\_\_\_

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**5) Cost Control**

Cost control is a project success criterion and can drive owners to select a particular delivery method according to its ability to 1) reduce total project costs, and 2) minimize project cost overruns.



DESIGN-BID-BUILD		
Issues	Advantage	Disadvantage
<ul style="list-style-type: none"> <li><input type="checkbox"/> With the exception of change orders, costs are known at bid time, before construction begins.</li> <li><input type="checkbox"/> DBB is likely to yield the highest cost growth due to change orders on average, based on project delivery research.</li> </ul>		

CONSTRUCTION MANAGEMENT AT RISK		
Issues	Advantage	Disadvantage
<ul style="list-style-type: none"> <li><input type="checkbox"/> CMR can be used in conjunction with a GMP pricing structure, which can be useful in negotiating and controlling costs.</li> <li><input type="checkbox"/> If open book pricing can be used, all costs will be known by the owner.</li> <li><input type="checkbox"/> If multiple bid packages are used, the overall project cost could grow if later bid packages cost more than estimated.</li> <li><input type="checkbox"/> Early constructor involvement or construction advice can lead to cost savings through value engineering and constructability reviews.</li> <li><input type="checkbox"/> If a GMP pricing structure is used, owners should have experience in estimating and negotiating prices.</li> </ul>		

DESIGN-BUILD		
Please specify procurement system: ( _____ )		
Issues	Advantage	Disadvantage
<ul style="list-style-type: none"> <li><input type="checkbox"/> Studies have shown that, <i>on average</i>, DB has been shown to have lower average cost growth than DBB or CMR.</li> <li><input type="checkbox"/> Unlike DBB and CMR, owners will be shielded from cost-related change orders stemming from errors and omissions in plans.</li> <li><input type="checkbox"/> If open book pricing can be used, all costs will be known by the owner.</li> <li><input type="checkbox"/> The integrated nature of design-build teams can lead to cost savings through inherent team value engineering and constructability reviews.</li> <li><input type="checkbox"/> If a GMP pricing structure is used, owners should have experience in estimating and negotiating prices.</li> </ul>		

**Table 5-8 - Cost Control Advantages/Disadvantage Summary**

	DBB	CMR	DB
5. Cost Control			

- Key:
- Most appropriate delivery method
  - ◐ Appropriate delivery method
  - Least appropriate delivery method
  - X Not Applicable (discontinue evaluation of this method)

Comments \_\_\_\_\_

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**6) Risk Management/Allocation**

The issue details methods to cope with project uncertainties that are inherent to each delivery method. The overarching goal should be to select the project delivery method with the best ability to allocate project risks to the parties in the best position to manage them.

DESIGN-BID-BUILD		
Issues	Advantage	Disadvantage
<ul style="list-style-type: none"> <li><input type="checkbox"/> Provides historically well defined and well understood risk allocation.</li> <li><input type="checkbox"/> Prescriptive designs and specifications allow for greater detail in risk allocation.</li> <li><input type="checkbox"/> Constructor cannot participate in risk management or risk allocation decisions during design.</li> <li><input type="checkbox"/> Conflicts can exist in risk allocation between separate design and construction contracts.</li> <li><input type="checkbox"/> Constructor's ability to manage risk is constrained by low-bid procurement.</li> </ul>		

CONSTRUCTION MANAGEMENT AT RISK		
Issues	Advantage	Disadvantage
<ul style="list-style-type: none"> <li><input type="checkbox"/> Construction manager understands and participates in risk allocation and management process during design.</li> <li><input type="checkbox"/> Prescriptive designs and specifications allow for greater detail in risk allocation.</li> <li><input type="checkbox"/> Risk management process can be more complex due to separate design, construction, and construction management contracts.</li> <li><input type="checkbox"/> Risks for costs can be shared by construction manager and airport through the use of a GMP structure.</li> </ul>		

DESIGN-BUILD		
Please specify procurement system: ( _____ )		
Issues	Advantage	Disadvantage
<ul style="list-style-type: none"> <li><input type="checkbox"/> Single point of responsibility for risk management in design and construction.</li> <li><input type="checkbox"/> Design-builder owns risk for design errors and omissions.</li> <li><input type="checkbox"/> Risks must be allocated through conceptual design and performance specifications, so owner may lose some ability to participate in the risk management process.</li> <li><input type="checkbox"/> Risks for costs can be shared by construction manager and airport through the use of a GMP structure.</li> <li><input type="checkbox"/> Airport risks for scope creep and cost growth can be transferred to design-builder through best-value fixed price procurement.</li> </ul>		

**Table 5-9 - Risk Management/Allocation Advantages/Disadvantages Summary**

	DBB	CMR	DB
6. Risk Management/Allocation			

- Key:
- Most appropriate delivery method
  - Appropriate delivery method
  - Least appropriate delivery method
  - X Not Applicable (discontinue evaluation of this method)

Comments \_\_\_\_\_

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### 7) Life-Cycle Cost

Delivery methods can influence costs in the operation and maintenance phase. This issue focuses on the opportunities or barriers that each delivery method provides in regards to life-cycle costs.

DESIGN-BID-BUILD		
Issues	Advantage	Disadvantage
<input type="checkbox"/> The airport can controls life-cycle costs through completed design and performance specifications. <input type="checkbox"/> There is little opportunity for constructor input into life-cycle costs.		

CONSTRUCTION MANAGEMENT AT RISK		
Issues	Advantage	Disadvantage
<input type="checkbox"/> CMR has all benefits of DBB, plus the airport can leverage construction manager's input into life-cycle costs. <input type="checkbox"/> If life-cycle performance criteria are not well understood during the development of the GMP, life-cycle issues may be difficult to incorporate into the final product.		

DESIGN-BUILD		
Please specify procurement system: ( _____ )		
Issues	Advantage	Disadvantage
<input type="checkbox"/> The airport can use performance criteria to set life-cycle performance standards and rely on design-builder innovation to achieve these standards. <input type="checkbox"/> If life-cycle issues are difficult to define through performance criteria, a GMP pricing structure could allow for more owner input than a fixed price option.		

**Table 5-10 - Life-Cycle Costs Advantages/Disadvantages Summary**

	DBB	CMR	DB
7. Life-Cycle Cost			

- Key: ● Most appropriate delivery method  
 ● Appropriate delivery method  
 ○ Least appropriate delivery method  
 X Not Applicable (discontinue evaluation of this method)

Comments \_\_\_\_\_  
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### 8) Maintainability

Similar to life-cycle issues, there can be advantages and disadvantages to each delivery method with regard to how maintainability is achieved. This issue describes these advantages and disadvantage as it relates to the owner’s ability to specific quality and ease of maintenance.

DESIGN-BID-BUILD		
Issues	Advantage	Disadvantage
<ul style="list-style-type: none"> <li><input type="checkbox"/> The opportunity to view completed plans before award allows airports to review maintenance issues in designs.</li> <li><input type="checkbox"/> There is little opportunity for constructors to have input into maintenance issues.</li> </ul>		

CONSTRUCTION MANAGEMENT AT RISK		
Issues	Advantage	Disadvantage
<ul style="list-style-type: none"> <li><input type="checkbox"/> CMR has all benefits of DBB, plus the airport can leverage construction manager’s input into maintenance issues.</li> <li><input type="checkbox"/> If maintainability issues are not well understood during the development of the GMP, they may be difficult to incorporate into the final product.</li> </ul>		

DESIGN-BUILD		
Please specify procurement system: ( _____ )		
Issues	Advantage	Disadvantage
<ul style="list-style-type: none"> <li><input type="checkbox"/> The airport can use performance criteria to set maintainability performance standards and rely on design-builder innovation to achieve these standards.</li> <li><input type="checkbox"/> The airport can emphasize maintainability issues through performance criteria and best-value award factors.</li> <li><input type="checkbox"/> If maintainability issues are not well understood at the procurement stage, they will not be incorporated into the DB contract.</li> <li><input type="checkbox"/> Some DB contracts can incorporate maintenance warranties from the design-builder.</li> </ul>		

**Table 5-11 - Maintainability Advantages/Disadvantages Summary**

	DBB	CMR	DB
8. Maintainability			

- Key: ● Most appropriate delivery method  
 ● Appropriate delivery method  
 ○ Least appropriate delivery method  
 X Not Applicable (discontinue evaluation of this method)

Comments \_\_\_\_\_  
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**Airport Level Issues**

**9) Airport Experience/Staff Capability**

This issue focuses mainly on the airport’s experience, the owner’s staffing requirements and their capabilities to properly administer alternative delivery methods.

DESIGN-BID-BUILD		
Issues	Advantage	Disadvantage
<ul style="list-style-type: none"> <li><input type="checkbox"/> Since this is the traditional method of project delivery, owners will likely have the most experience with this method.</li> <li><input type="checkbox"/> As projects grow in size, more experienced staff is required.</li> <li><input type="checkbox"/> Owner’s typically have different staff to oversee design and construction processes.</li> <li><input type="checkbox"/> DBB typically requires a larger owner staff than the other delivery methods.</li> </ul>		

CONSTRUCTION MANAGEMENT AT RISK		
Issues	Advantage	Disadvantage
<ul style="list-style-type: none"> <li><input type="checkbox"/> CMR is similar to DBB in many key aspects where airports have experience (e.g., separation of design and construction).</li> <li><input type="checkbox"/> The CMR can augment an owner's capabilities with his own staff.</li> <li><input type="checkbox"/> Airports experience is needed with GMP pricing or the negotiation that can be difficult.</li> <li><input type="checkbox"/> Airports experience is needed in the use of multiple bid packages to facilitate fast-track construction.</li> <li><input type="checkbox"/> The CMR alternative can use the least number of owner staff if the CMR is allowed to take on the traditional owner tasks.</li> </ul>		

DESIGN-BUILD		
Please specify procurement system: ( _____ )		
Issues	Advantage	Disadvantage
<ul style="list-style-type: none"> <li><input type="checkbox"/> Airports can take advantage of the sole point of responsibility for design and construction to leverage their experience.</li> <li><input type="checkbox"/> DB can reduce the overall number of required owner staff.</li> <li><input type="checkbox"/> DB can create peaks in owner staffing needs, particularly during procurement and design review periods.</li> <li><input type="checkbox"/> While fewer owner staff is needed, more experienced staff is required.</li> <li><input type="checkbox"/> Airport experience is needed in the area of developing procurement documents and performance criteria.</li> <li><input type="checkbox"/> If a GMP is used, airports experience is needed with GMP pricing or the negotiation that can be difficult.</li> <li><input type="checkbox"/> Airports experience is needed in the area of administering DB contracts, particularly in the area of design review and administration.</li> <li><input type="checkbox"/> DB necessitates experienced staff to manage design and construction under one contract.</li> </ul>		

**Table 5-12 - Airport Experience/Staff Capability Advantages/Disadvantages Summary**

	DBB	CMR	DB
9. Airport Experience/Staff Capability			

- Key:
- Most appropriate delivery method
  - ◐ Appropriate delivery method
  - Least appropriate delivery method
  - X Not Applicable (discontinue evaluation of this method)

Comments \_\_\_\_\_

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**10) Airport Control of Project**

The owner’s ability to control the detail of design and construction varies with each project delivery method. (Note that cost control and time control are described in other issues).

DESIGN-BID-BUILD		
Issues	Advantage	Disadvantage
<ul style="list-style-type: none"> <li><input type="checkbox"/> The use of prescriptive specifications and complete designs at the time of award provides airports with the most control over the project.</li> <li><input type="checkbox"/> Separate design and construction contracts provide clear checks and balances.</li> <li><input type="checkbox"/> With additional control can come added activities and responsibility for airport staff.</li> </ul>		

CONSTRUCTION MANAGEMENT AT RISK		
Issues	Advantage	Disadvantage
<ul style="list-style-type: none"> <li><input type="checkbox"/> The CMR method benefits from early constructor involvement, but still has the benefit of separate design and construction contracts that gives owner control over design details.</li> <li><input type="checkbox"/> Airport control of CMR delivery requires more effort due to the use of multiple design packages and the need for a GMP pricing structure.</li> </ul>		



DESIGN-BUILD		
Please specify procurement system: ( _____ )		
Issues	Advantage	Disadvantage
<input type="checkbox"/> The transfer of design liability lessens the need for airport control over design. <input type="checkbox"/> Award at a conceptual design level may mean that the airport will lose control over the details of the final design depending on the owner involvement program. <input type="checkbox"/> Use of a qualifications based selection and a GMP pricing structure can give the airport more control if willing to fix the GMP in the later stages of design development.		

**Table 5-13 - Airport Control of Project Advantages/Disadvantages Summary**

	DBB	CMR	DB
10. Airport Control of Project			

- Key: ● Most appropriate delivery method  
 ● Appropriate delivery method  
 ○ Least appropriate delivery method  
 X Not Applicable (discontinue evaluation of this method)

Comments \_\_\_\_\_  
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**11) Security**

Security imposes another level of technical complexity and a potentially high level of liability on all airport projects. Airport security affects both the design phase and the construction phases. This issue considers the multiple effects of security requirements on an airport project and each delivery method in this respect.

DESIGN-BID-BUILD		
Issues	Advantage	Disadvantage
<input type="checkbox"/> The highest level of flexibility to the owner during the design phase. <input type="checkbox"/> The low-bid award can make security related changes difficult to negotiate during construction.		

CONSTRUCTION MANAGEMENT AT RISK		
Issues	Advantage	Disadvantage
<input type="checkbox"/> The ability of the CMR to work with the designer can allow for efficiency and flexibility in addressing security issues. <input type="checkbox"/> The point at which the GMP is negotiated can influence the efficiency and flexibility.		

DESIGN-BUILD		
Please specify procurement system: ( _____ )		
Issues	Advantage	Disadvantage
<input type="checkbox"/> The integration of designer and constructor can allow for efficiency and flexibility in addressing security issues. <input type="checkbox"/> In a fixed-price DB process, security related changes may be difficult to negotiate during construction. <input type="checkbox"/> If a GMP is used, the point at which the GMP is negotiated can influence the efficiency and flexibility.		

**Table 5-14 - Security Advantages/Disadvantages Summary**

	DBB	CMR	DB
11. Security			

- Key:
- Most appropriate delivery method
  - Appropriate delivery method
  - Least appropriate delivery method
  - X Not Applicable (discontinue evaluation of this method)

Comments \_\_\_\_\_

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**12) Control Impact on Operations and Passengers**

This issue studies the ability of each delivery method to allow the coordination of construction activities with the airport operations management in order to minimize construction impacts.

DESIGN-BID-BUILD		
Issues	Advantage	Disadvantage
<ul style="list-style-type: none"> <li><input type="checkbox"/> The airport's control over the design and construction packaging can help to minimize impacts on operation and passenger flow.</li> <li><input type="checkbox"/> Post-award changes in the construction schedule due to airport operations may be difficult to negotiate.</li> </ul>		

CONSTRUCTION MANAGEMENT AT RISK		
Issues	Advantage	Disadvantage
<ul style="list-style-type: none"> <li><input type="checkbox"/> Additional CMR experience in design can help minimize impacts on operation and passenger flow.</li> <li><input type="checkbox"/> Having one CMR contract to oversee multiple bid packages may assist the airport in appropriately phasing the project to minimize impact.</li> <li><input type="checkbox"/> Agency and CMR must have a clear understanding of roles and responsibilities regarding these controls.</li> </ul>		

DESIGN-BUILD		
Please specify procurement system: ( _____ )		
Issues	Advantage	Disadvantage
<ul style="list-style-type: none"> <li><input type="checkbox"/> Provides a single source of responsibility in controlling the impact of the project on airport operations that can be tied to performance criteria in both the project's design and construction schedule.</li> <li><input type="checkbox"/> Airport will have less control over the constructor than in the other methods.</li> <li><input type="checkbox"/> If a GMP is used, the point at which the GMP is negotiated can influence the airport's input into operations.</li> </ul>		

**Table 5-15 - Control Impact on Operations and Passengers Advantages/Disadvantages Summary**

	DBB	CMR	DB
12. Security			

- Key:
- Most appropriate delivery method
  - Appropriate delivery method
  - Least appropriate delivery method
  - X Not Applicable (discontinue evaluation of this method)

Comments \_\_\_\_\_

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**13) Stakeholder Input to Design and Construction**

This issue concerns each delivery method’s ability to promote coordination and project-specific agreements with third parties, such as political entities, utilities, adjacent communities, *etc.* involved in the project or affected by it. This issue also addresses the opportunities afforded by the delivery method to the owner for coping with community input.

DESIGN-BID-BUILD		
Issues	Advantage	Disadvantage
<ul style="list-style-type: none"> <li><input type="checkbox"/> Separate design and construction phase gives opportunity to get stakeholders’ inputs before the commencement of construction.</li> <li><input type="checkbox"/> The use of complete plans and prescriptive specifications facilitates third party agreements.</li> <li><input type="checkbox"/> The opportunity for stakeholder changes in design can cause delay in the project and add to the costs in the form of change orders.</li> <li><input type="checkbox"/> Expediting third party agreements in the DBB process can be cumbersome if it is required.</li> </ul>		

CONSTRUCTION MANAGEMENT AT RISK		
Issues	Advantage	Disadvantage
<ul style="list-style-type: none"> <li><input type="checkbox"/> The construction experience of the construction manager can help facilitate stakeholder input.</li> <li><input type="checkbox"/> Construction managers can help facilitate third party agreements.</li> <li><input type="checkbox"/> Stakeholder input can make GMP negotiation troublesome if not managed correctly.</li> <li><input type="checkbox"/> Construction managers typically do not guarantee costs that stem from problems with third party agreements.</li> </ul>		

DESIGN-BUILD		
Please specify procurement system: ( _____ )		
Issues	Advantage	Disadvantage
<input type="checkbox"/> The owner can require the DB contractor to include a public information and outreach program to facilitate communities' inputs. <input type="checkbox"/> Design-builders can be innovative in helping gain community involvement. <input type="checkbox"/> Any third party change after the award of a fixed price or the negotiation of a GMP can be costly or difficult to negotiate. <input type="checkbox"/> Design-builders can use innovative methods to assist in obtaining third party agreements.		

**Table 5-16 - Stakeholder Input to Design and Construction Advantages/Disadvantages Summary**

	DBB	CMR	DB
13. Stakeholder Input to Design and Construction			

- Key: ● Most appropriate delivery method  
 ● Appropriate delivery method  
 ○ Least appropriate delivery method  
 X Not Applicable (discontinue evaluation of this method)

Comments \_\_\_\_\_  
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**Public Policy/Regulatory Issues**

**14) Competition and Local Competencies**

Each delivery method may affect the level of competition. This concerns the evaluation of facilitating effects of each method on competition in hopes of leveraging local competition.

DESIGN-BID-BUILD		
Issues	Advantage	Disadvantage
<input type="checkbox"/> Owner benefits from large pool of potential bidders and high level of competition. <input type="checkbox"/> There may be issues that follow low bid procurement such as a higher probability of request for change orders, disputes and claims.		

CONSTRUCTION MANAGEMENT AT RISK		
Issues	Advantage	Disadvantage
<input type="checkbox"/> Qualifications-based selection factors can be applied to select only the most highly qualified construction managers. <input type="checkbox"/> Presence of a constructor early in the project may give the owner less competitive leverage when pricing construction.		

DESIGN-BUILD		
Please specify procurement system: ( _____ )		
Issues	Advantage	Disadvantage
<input type="checkbox"/> Qualifications-based selection factors can be applied to select only the most qualified design-builders. <input type="checkbox"/> Proposal package size and bid preparation costs can decrease the number of qualified bidders. <input type="checkbox"/> Opposition from public sector employees, unions or other interested parties can exclude the DB method from consideration (see Step 3 Review Go/No-Go Decision Points).		

**Table 5-17 - Competition and Local Competencies Advantages/ Disadvantages Summary**

	DBB	CMR	DB
14. Competition and Local Competencies			

- Key:
- Most appropriate delivery method
  - Appropriate delivery method
  - Least appropriate delivery method
  - X Not Applicable (discontinue evaluation of this method)

Comments \_\_\_\_\_  
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**15) Disadvantaged Business Enterprise DBE Impacts**

Delivery methods may facilitate fair competition for DBEs for airport contracts and reduce burdens on small businesses. The effect of each delivery method on promoting participation by disadvantaged businesses is evaluated under this issue.

DESIGN-BID-BUILD		
Issues	Advantage	Disadvantage
<ul style="list-style-type: none"> <li><input type="checkbox"/> Airports can include DBE requirements in both design and construction requirements.</li> <li><input type="checkbox"/> DBE involvement is known at time of award for design and construction.</li> <li><input type="checkbox"/> Low bidding environment may harm future viability of DBE companies.</li> </ul>		

CONSTRUCTION MANAGEMENT AT RISK		
Issues	Advantage	Disadvantage
<ul style="list-style-type: none"> <li><input type="checkbox"/> Airports can include DBE requirements in both design and construction requirements.</li> <li><input type="checkbox"/> DBE involvement is known at time of award for design and construction.</li> <li><input type="checkbox"/> Due to the phased nature of CMR contracts, the final DBE involvement may not be known until the project is ultimately completed.</li> </ul>		

DESIGN-BUILD		
Please specify procurement system: ( _____ )		
Issues	Advantage	Disadvantage
<ul style="list-style-type: none"> <li><input type="checkbox"/> Airports can include DBE requirements in the procurement selection factors for design and construction requirements.</li> <li><input type="checkbox"/> Owners can set DBE requirements, but because all subcontractors are not known at the time of award, there is a risk that design-builders may not achieve the DBE goals they specify in their proposals.</li> <li><input type="checkbox"/> The use of a fixed price procurement process early in the project development process will not facilitate the identification of DBE contractors as well as the use of a GMP negotiation later in the process.</li> </ul>		

**Table 5-18 - DBE Impacts Advantages/Disadvantages Summary**

	DBB	CMR	DB
15. DBE Impacts			

- Key:
- Most appropriate delivery method
  - ◐ Appropriate delivery method
  - Least appropriate delivery method
  - X Not Applicable (discontinue evaluation of this method)

Comments \_\_\_\_\_

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**16) Legal and Statutory Constraints**

This issue studies the interactions between each delivery method and governing regulations. Due to constant changes in state and local laws, each airport should check all the relevant codes in order to find out the legality of each delivery method at the time when possible delivery methods are studied for a project.

DESIGN-BID-BUILD		
Issues	Advantage	Disadvantage
<input type="checkbox"/> All states are authorized to use DBB. <input type="checkbox"/> Labor agreements are generally not an issue. <input type="checkbox"/> Open bidding procedures are typically not constrained by public law.		

CONSTRUCTION MANAGEMENT AT RISK		
Issues	Advantage	Disadvantage
<input type="checkbox"/> Some states allow more flexible procurement regulations with CMR, which can be advantageous in appropriate situations to expedite project development. <input type="checkbox"/> Some state airports are not authorized to use CMR or need to get extra approvals (see Step 3 Review Go/No-Go Decision Points).		



DESIGN-BUILD		
Please specify procurement system: ( _____ )		
Issues	Advantage	Disadvantage
<input type="checkbox"/> Some states allow more flexible procurement regulations with DB, which can be advantageous in appropriate situations to expedite project development. <input type="checkbox"/> Some state airports are not authorized to use DB or need to get extra approvals (see Step 3 Review Go/No-Go Decision Points).		

**Table 5-19 - Legal and Statutory Constraints Advantages/ Disadvantages Summary**

	DBB	CMR	DB
16. Legal and Statutory Constraints			

- Key:
- Most appropriate delivery method
  - Appropriate delivery method
  - Least appropriate delivery method
  - X Not Applicable (discontinue evaluation of this method)

Comments \_\_\_\_\_

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**17) Sustainability and LEED Certification**

Sustainable design is becoming ever more important in achieving overall sustainability goals for the projects. The effect of delivery method in facilitating the process of implementing sustainability issues in the design is the focus of this issue. Each project delivery method has some inherent abilities to include features that will help in obtaining LEED Certification in accordance with the owner’s needs.

DESIGN-BID-BUILD		
Issues	Advantage	Disadvantage
<ul style="list-style-type: none"> <li><input type="checkbox"/> Airports can work with designers to incorporate sustainable designs into complete designs through prescriptive specifications.</li> <li><input type="checkbox"/> Airports can assume liability when prescribing construction methods.</li> <li><input type="checkbox"/> The process provides little opportunity for constructability reviews to ensure that sustainable designs can be constructed efficiently and are not cost prohibitive.</li> <li><input type="checkbox"/> There is little opportunity or incentive for constructor to do more than what is specified in terms of sustainable construction practices.</li> </ul>		

CONSTRUCTION MANAGEMENT AT RISK		
Issues	Advantage	Disadvantage
<ul style="list-style-type: none"> <li><input type="checkbox"/> CMR has all benefits of DBB, plus the airport can leverage construction manager's input into sustainable design issues.</li> <li><input type="checkbox"/> The use of separate bid packages can create barriers in the integration of sustainable solutions if not approached correctly.</li> </ul>		

DESIGN-BUILD		
Please specify procurement system: ( _____ )		
Issues	Advantage	Disadvantage
<ul style="list-style-type: none"> <li><input type="checkbox"/> The airport can emphasize sustainable design issues through performance criteria and best-value or qualifications-based selection award factors.</li> <li><input type="checkbox"/> Integration of the design and construction team can enhance constructability of designs.</li> <li><input type="checkbox"/> If sustainable design issues are not well understood at the procurement stage, they will not be incorporated into the DB contract.</li> <li><input type="checkbox"/> The airport may not be involved in all design decisions.</li> </ul>		

**Table 5-20 - Sustainability and LEED Certification Design Goals Advantages/Disadvantages Summary**

	DBB	CMR	DB
17. Sustainability and LEED Certification			

- Key:
- Most appropriate delivery method
  - Appropriate delivery method
  - Least appropriate delivery method
  - X Not Applicable (discontinue evaluation of this method)

Comments \_\_\_\_\_  
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**Other Issues**

**18) Adversarial Relationship**

The extent to which a delivery method can avoid adversarial relationships on the project team varies depending upon the nature of the project and the owner’s experience with the delivery methods.

DESIGN-BID-BUILD		
Issues	Advantage	Disadvantage
<ul style="list-style-type: none"> <li><input type="checkbox"/> Roles and responsibilities in DBB contract are well understood in the industry.</li> <li><input type="checkbox"/> DBB can create an adversarial relationship between the parties; primarily between the owner and construction contractor.</li> </ul>		

CONSTRUCTION MANAGEMENT AT RISK		
Issues	Advantage	Disadvantage
<ul style="list-style-type: none"> <li><input type="checkbox"/> Inclusion of the construction manager in the design process can align team members and lessen adversarial relationships.</li> <li><input type="checkbox"/> Negotiation of GMP can create an adversarial situation if the process is not well understood and well managed.</li> </ul>		

DESIGN-BUILD		
Please specify procurement system: ( _____ )		
Issues	Advantage	Disadvantage
<input type="checkbox"/> Inclusion of the designer and constructor on the same team can lessen adversarial relationships. <input type="checkbox"/> Due to the loss of control over the details of design, DB requires a high level of trust between the owner and design-builder. Without this trust, design-build can become adversarial.		

**Table 5-21 - Adversarial Relationship Advantages/Disadvantages Summary**

	DBB	CMR	DB
18. Adversarial Relationship			

- Key:
- Most appropriate delivery method
  - Appropriate delivery method
  - Least appropriate delivery method
  - X Not Applicable (discontinue evaluation of this method)

Comments \_\_\_\_\_

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**19) Construction Claims**

The effect of each delivery method in exposing the airport to potential conflicts and claims is addressed under this issue.

DESIGN-BID-BUILD		
Issues	Advantage	Disadvantage
<input type="checkbox"/> DBB has well understood legal precedent for construction claims. <input type="checkbox"/> DBB historically has the highest occurrence of claims and disputes, which often occur in the areas of authority, responsibility and quality. <input type="checkbox"/> The low bid environment can provide incentives for constructor to file claims – particularly if any ambiguity in plans exist.		

CONSTRUCTION MANAGEMENT AT RISK		
Issues	Advantage	Disadvantage
<ul style="list-style-type: none"> <li><input type="checkbox"/> Having the constructor on the team early during design can lessen the likelihood for disputes and claims regarding designs.</li> <li><input type="checkbox"/> Since design and construction contracts are separate, the potential for disputes and claims regarding design still exist.</li> <li><input type="checkbox"/> If multiple bid packages are not managed correctly, the coordination of these bid packages can result in claims.</li> </ul>		

DESIGN-BUILD		
Please specify procurement system: ( _____ )		
Issues	Advantage	Disadvantage
<ul style="list-style-type: none"> <li><input type="checkbox"/> The single source for design and construction eliminates claims for design errors or omissions from the airport's perspective.</li> <li><input type="checkbox"/> There is potential for claims with regard to scope definition if the form of the DB contract is not well understood.</li> <li><input type="checkbox"/> The size and frequency of change orders are smaller in DB.</li> </ul>		

Table 5-22 - Construction Claims Advantages/Disadvantages Summary

	DBB	CMR	DB
19. Construction Claims			

- Key:
- Most appropriate delivery method
  - Appropriate delivery method
  - Least appropriate delivery method
  - X Not Applicable (discontinue evaluation of this method)

Comments \_\_\_\_\_

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### Step 5. Choose the Most Appropriate Project Delivery Method

Steps 1-4 of the process provide all the individual pieces of the information to make a project delivery decision. The final step involves combining this information into a final comprehensive format that will aid in the decision. Table 5-23 presents a format to summarize the advantages and

disadvantages. Following the table is an outline for documenting the final decision. Step 5 requires the following steps:

- a. **Review Project Goals:** Review the project goals documented in Step 2 to be certain that any project delivery method selection is in alignment with the goals.
- b. **Transfer Issue Summary Ratings:** Transfer the summary ratings from end of each issue analysis to Table 5-23 to provide a complete picture of the analysis.
- c. **Review Table 5-23 for Dominant Delivery Method:** Upon completing Table 5-23, a delivery method may rise to be dominant. A dominant delivery method will contain a large number of “Most Appropriate” ratings in areas that align with the project goals. A dominant method will also have few or no “Least Appropriate” ratings. **Counting or translating the ratings should be avoided.** If needed, review any comments from the pertinent issues analysis (Chapter 5) to help with the delivery decision.

**Note:** If dominant method exists, make delivery choice and move to Step 6.

- d. **Review “Least Appropriate” Ratings:** Review any “Least Appropriate” ratings to determine if any of the issues create red flags or problems that would make a delivery method significantly less desirable.
- e. **Choose Delivery Methods to Study in Tier 2:** If a dominant method is not apparent, remove any inappropriate methods, document the decision as described in Step 6, and move to Tier 2 for a more detailed analysis.

Table 5-23 - Project Delivery Method Advantage/Disadvantage Summary

<b>PROJECT DELIVERY METHOD ADVANTAGE/DISADVANTAGE SUMMARY</b>			
	DBB	CMR	DB
<b>Project-Level Issues Rating</b>			
1. Project Size/Complexity			
2. Schedule Compression			
3. Schedule Growth Control			
4. Early Cost Precision			
5. Cost Control			
6. Risk Management/Allocation			
7. Life-Cycle Cost			
8. Maintainability			
<b>Airport-Level Issues Rating</b>			
9. Airport Experience/Staff Capability			
10. Airport Control of Project			
11. Security			
12. Control Impact on Operations & Passengers			
13. Stakeholder Input to Design & Construction			
<b>Public Policy/Regulatory Issues Rating</b>			
14. Competition and Local Competencies			
15. DBE Impacts			
16. Legal and Statutory Constraints			
17. Sustainability and LEED certification			
<b>Other Issues Rating</b>			
18. Adversarial Relationship			
19. Construction Claims			
Other			
Other			
Other			

- Key: ● Most appropriate delivery method  
 ● Appropriate delivery method  
 ○ Least appropriate delivery method  
 X Not Applicable (discontinue evaluation of this method)

Project Delivery Advantages and Disadvantages Summary

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## Step 6. Document Results

### *Project Delivery Decision Report*

The final step in the Tier 1 decision process is to document the results in a Project Delivery Decision Report. Whether one delivery method rises to be the dominant choice or none of the three delivery methods are eliminated from consideration in the process, documentation is a vital step. Documentation will assist in developing procurement and contracting strategies for the ultimate project delivery method. It will also serve to communicate the project delivery choice to interested stakeholders.

The six-step process forms the basis for the Project Delivery Decision Report. Steps 1 to 5 can be combined for a complete report. The advantage/disadvantage checklist and the related comments will be important to documentation. An executive summary should be added to the beginning of the report to summarize the decision. Any pertinent data or research (e.g., schedule constraint calculations, delivery code research, etc.) should be added as appendices. A report outline is offered below.

- Project Delivery Decision Report Outline
  - Executive Summary
  - Project Description
  - Project Goals
  - Delivery Methods Considered
  - Advantages and Disadvantages
  - Delivery Method Decision
  - Appendices

## Conclusions

The Tier 1 Analytical Delivery Decision Approach provides airports with a structured approach to choosing the most appropriate project delivery method for each individual project. At the end of Step 5, there may be a single, clear and logical choice for a project delivery method. If this is the case, choose that delivery method and document the decision through a Project Delivery Decision Report. If at the end of this stage, a dominant choice does not appear, the airport should document the results and move to the Tier 2 selection process for a more detailed analysis of the remaining delivery methods.



## CHAPTER 6 – TIER 2: WEIGHTED-MATRIX DELIVERY DECISION APPROACH

### Introduction

The Tier 2 Weighted-Matrix Delivery Decision Approach provides a means for airports to further examine and document a project delivery decision for an individual project. In the case that an obvious choice was not found in the Tier 1 Analytical Delivery Decision Approach, the Tier 2 approach provides airports with a process to select a delivery method by prioritizing project objectives and selecting the delivery method that best aligns with these objectives. The Tier 2 Weighted-Matrix Delivery Approach is founded upon successful delivery decision tools developed by academics and professionals over the past 20 years (Loulakis 2000; CII 2003; Skitmore & Marsden 1988).

Airports should complete a Tier 1 review before conducting a Tier 2 review. The Tier 1 review provides airports with two key pieces of information. First, Tier 1 requires airports to define their project goals in terms of cost, schedule, quality, maintainability, sustainability, and other options. These project goals are critical to the Tier 2 review. Second, Tier 1 provides a shortlist of available project delivery options. Only those project delivery methods that are feasible and which have the best potential for successful application will pass through the Tier 1 filtering process. The filtering process involves an examination of go/no-go issues and also an examination of 19 critical issues involved in the project delivery decision. Knowledge of these critical issues will be helpful in the Tier 2 decision-making process.

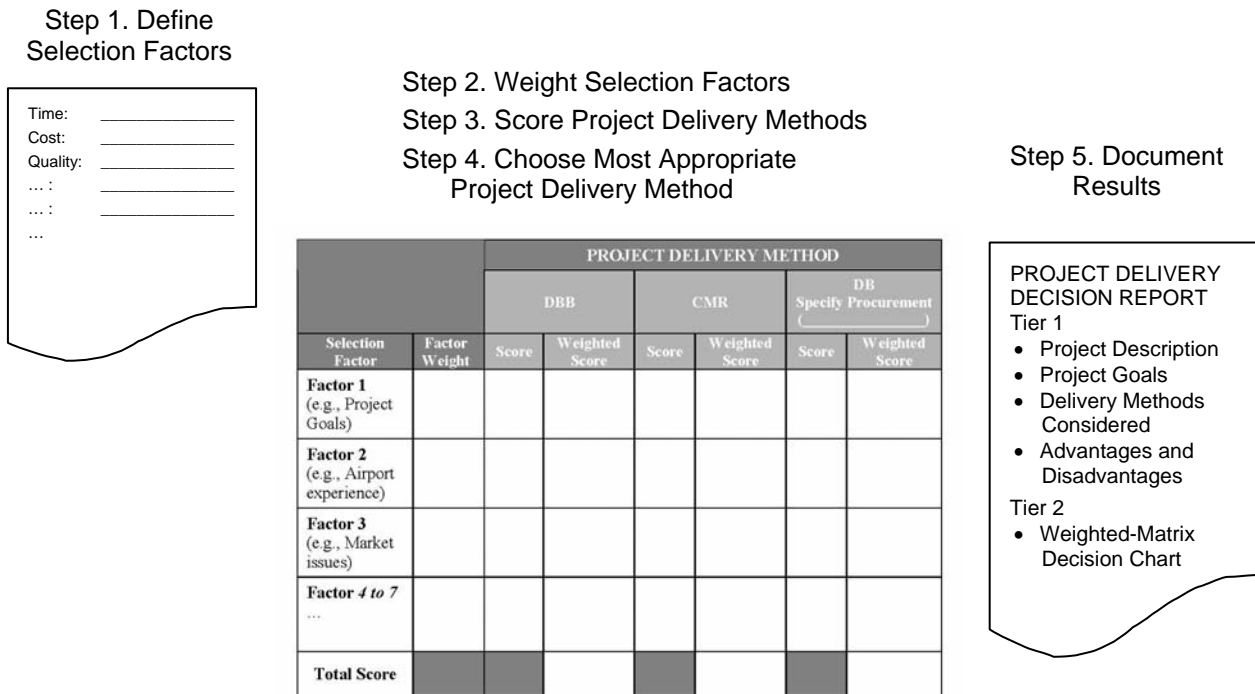
The Tier 2 approach has three primary objectives:

- Present a structured framework to assist agencies in prioritizing their unique project goals and delivery selection issues;
- Assist airports in aligning their unique goals and issues with the most appropriate project delivery method; and
- Further document the project delivery decision in the Project Delivery Decision Report established in Tier 1.

The Tier 2 approach provides a framework for airports to prioritize their project goals and select the project delivery method that best aligns with these goals. The motivation for this approach is to capture the fact that priorities for project goals and critical selection issues are unique to each project. Likewise, the delivery methods vary in their ability to achieve these goals and deal with these issues. The Tier 2 approach will align these two facets of the delivery decision.

The Tier 2 approach is comprised of five distinct steps listed below and shown in Figure 6-1.

- Step 1. Define Selection Factors
- Step 2. Weight Selection Factors
- Step 3. Score Project Delivery Methods
- Step 4. Choose Most Appropriate Project Delivery Method
- Step 5. Document Results



**Figure 6-1 - Tier 2 Selection Process Overview**

Step 1 of the Tier 2 process begins by defining a concise set of selection factors. These selection factors consist of the project goals and any additional critical issues examined in Tier 1 (see Chapter 5 for Tier 1). The Tier 1 process asks airports to establish their project goals at the beginning of the process. The first step in Tier 2 asks the airports to develop a concise set of selection factors by combining their project goals with the most important of the 19 critical issues examined in Tier 1. The Tier 2 method will use these selection factors throughout the process.

Step 2 asks airports to rank and then weight selection factors. The project goals may overlap with the critical issues, in which case they can be combined. Other critical issues will stand alone for analysis. Step 2 will result in a list of up to seven project goals and critical issues for further analysis.

Step 3 requires airports to score each delivery method in terms of the selection factors. A further examination of the advantages and disadvantages for each delivery methods will form the basis for these scores. Since some of the scores will by nature be subjective, the airports will need to be diligent in documenting the reasons for the scores.

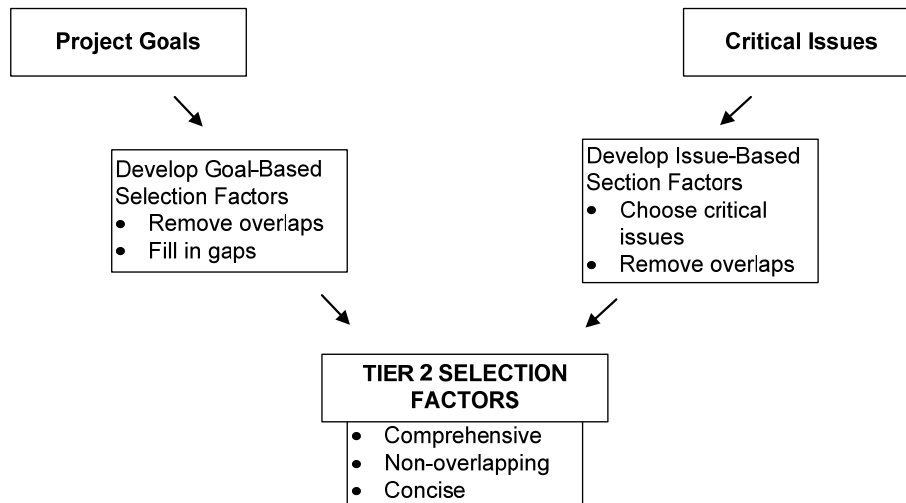
Step 4 involves a determination of the most appropriate delivery method through the completion of the weighted decision matrix. Airports will make the determination by multiplying the selection factor weights by the project delivery scores and then summing the values. The delivery method with the highest score will indicate the best choice. However, since the scores will be subjective, the airports will be encouraged to review the totals to determine if the values are logical and defensible on the basis of their professional judgment.

Step 5 supplements the documentation of the Project Delivery Decision Report developed in Tier 1. The Tier 1 report will provide project description, project goals, delivery methods considered, advantages and disadvantages, delivery method decision, and any relevant appendices. The Tier 2 documentation will include a documentation of the weighted decision matrix to supplement the archival record for the project delivery decision. It will serve to communicate the decision to interested stakeholders and to justify the decision if issues arise years later as the project is completed.

## **Step 1. Define Selection Factors**

As stated in Step 1 of Tier 1, understanding and communicating a concise set of project goals is perhaps the most important element in selecting an appropriate project delivery method. The definition of project goals is a key success factor in not only the project delivery decision, but also the development of procurement documents and the administration of a project. It is the performance goals (e.g., time, cost, quality, maintainability, and sustainability) that typically drive the project delivery decision.

The first step in Tier 2 requires airports to combine the project goals and critical issues into a set of selection factors for use in the weighted decision matrix. This step requires a review and filtering of the project goals and critical issues for use as selection factors. Figure 6-2 depicts this process.



**Figure 6-2 - Tier 2 Selection Factor Development**

To create the goal-based selection factors, airports should review the project goals that were established in Tier 1. The Tier 1 review of the delivery method advantages and disadvantages may have revealed overlaps or gaps in the originally established project goals. While the original project goals should not change, these overlaps and gaps will need to be removed for the development of the Tier 2 selection factors. Step 1 in the Tier 2 decision process invites edits to these goals as they are rewritten into selection factors. In developing the selection factors from the project goals, airports should consider the following questions:

- Are there significant overlaps in the project goal statements that can be revised to make them more independent?
- Are there missing goal statements that are needed to define the ultimate project success?
- Can any of the goals be stated more concisely?

The Tier 1 process provided an opportunity to review 19 critical project delivery issues. However, the Tier 1 process treated all of the issues as equally important. Upon reviewing the issues, airports will certainly find that all of the issues are not of equal importance. A small number of these issues will likely be critical to the final project delivery decision. The next task in Step 1 is to select up to seven of the most critical issues to examine to develop as selection factors. The airport should select the most critical issues based on the following criteria:

- The critical issue should be independent of the project goals;
- The critical issues should be independent of each other; and
- No more than seven critical issues should be chosen.

The final task of Step 1 is to provide a consolidated list of the goals-based and issue-based selection factors into one comprehensive list. The intent is to limit the total number of factors in this consolidated list to seven, so depending on the number of goals chosen, some of the critical issues may be eliminated in the final analysis. The next step in the Tier 2 process involves a ranking of the goals and critical issues; therefore one combined list is required. Figure 6-3 provides an example

listing of selection factors for a hypothetical project. This example will be used throughout the Tier 2 process description that follows.

The list of selection factors in this example illustrates a concise set of criteria that can be used for selecting the appropriate project delivery method. The list below shows examples of project goals relating to time, cost and sustainability and a critical issue regarding the agency staffing. While other issues of technical quality, maintainability, security, etc., undoubtedly exist on the project, the list below constitutes the primary goals and issues that will measure the success of the project at its completion and can thereby be used as selection factors.

*Project Name:* Example Project

- Project complete by November 1, 20XX.
- Cost not to exceed \$200 million.
- Minimize impact on operations and passengers.
- Minimize staffing requirements during design and construction.

Figure 6-3 - Example Listing of Selection Factors

## Step 2. Weight Selection Factors

The Tier 2 process is based on the premise that airports can establish a unique hierarchy of selection factors. In other words, each project will define success differently and the criteria for success can be described by a few key selection factors. The objective of Step 2 is to weight the list of selection factors.

Step 2 involves a process of first ranking and then weighting the selection factors. There are numerous methods to achieve a weighted ranking of the factors. The most straight-forward method is a direct ranking and weighting through a discussion and consensus-building meeting with project decision makers. The decision will by nature be somewhat subjective, so a group decision with diligent documentation should be applied.

To achieve the weighted ranking, airports should apply the following steps:

- a. List the selection factors in rank order from their highest to the lowest influence on project success.
- b. Include a minimum of four (4) and a maximum of seven (7) factors.
  - Remove factors not ranked in the top seven (7).
- c. Using 100 total points, weight the factors according to their influence on project success.
  - Avoid equal weighting of factors.
  - Remove any factors with a value of less than five (5) of the 100 points and redistribute points.

The result of Step 2 will be a weighted ranking of up to seven (7) selection factors. A maximum of seven is selected because research has found that it is difficult to distinguish beyond more than seven variables (Miller 1956). The weightings should total 100 points. Equal factor weightings are not recommended because distinguishing the importance between factors (goals and critical issues) is necessary for the decision process. Additionally no single factor should have a point value of less than five (5) because it will not have a sufficiently significant influence on the final decision and may in fact make the selection more difficult. The next steps will involve combining the weighted rankings with a scoring of the project delivery methods to arrive at a final selection of the most appropriate delivery method. Figure 6-4 continues the previous example by providing weighted rankings for factors.

The list below shows examples of project goals and issues that have been weighted to reflect their influence on success for the given project. These weightings are project dependent and should be agreed upon by key airport team members.

*Project Name:* Example Project

Weight	Goal/Issue
50	Project complete by November 1, 20XX.
25	Cost not to exceed \$200 million.
15	Minimize impact on operations and passengers.
10	Minimize staffing requirements during design and construction.
100	<b>Total</b>

Figure 6-4 - Example of Weighted Ranking for Selection Factors

### Step 3. Score Project Delivery Methods

The third step involves a scoring of the alternative delivery methods that survived the screening process of Tier 1 analysis. Each of these delivery methods will have a bearing or influence on the selection factors, which stem from the project goals and critical issues. The key decision makers must translate this influence into a score to arrive at a decision. To achieve the total scores for each delivery method, airports should apply the following steps:

- a. Using the scale in Table 6-1, assign a score to each delivery method as they relate to the selection factor. Score all delivery methods for each factor before moving to the next factor.
- b. Repeat step “a” for each selection factor.
- c. When all delivery methods have been scored, multiply the factor weight by the score to achieve a weighted score for each delivery method.
- d. Sum all of the weighted scores to arrive at a total score for each delivery method.

Table 6-1 provides a scale for scoring each delivery method as they relate to the selection factor. The scores range from 1 to 10 so that, when they are multiplied by the factor weight, the total score will range from 0 to 1000. The scores are subjective, so a detailed definition for each is provided adjacent to the score. When scoring the delivery methods, airports should discuss the advantages and disadvantages of each delivery method (see Chapter 4 and Tier 1, Step 4). The alignment of these advantages and disadvantages with the selection factors forms the basis for the scoring. In assigning the scores, the airport should work in a team, build a consensus decision, and carefully document the reasons for choosing each individual score. Consideration should be given to the relative scores for each delivery method to ensure consistency.

**Table 6-1 - Project Delivery Scoring Scale (adapted from Saaty 1990)**

SCORE	DEFINITION
10	The evidence that the delivery method positively aligns with the project objective or issue is of the highest possible order of affirmation.
8	The delivery method strongly aligns with the objective or issue and is demonstrated in practice. There is a slight risk that the objective or issue may not be beneficial.
6	Experience and judgment point to the delivery method strongly aligning with the objective or issue. There is a mild risk that the objective may not be beneficial.
4	Experience and judgment slightly points to the delivery method aligning with the objective or issue. There is a strong risk that the objective will be negatively affected.
2	There is little benefit to applying the delivery method for this goal or objective. There is a strong likelihood that the object will not be achieved.
9,7,5,3,1	Intermediate values between two adjacent judgments.

Similar to the development of factor weights, the scoring can be done simply through a group discussion among key airport team decision makers.

Table 6-2 provides a weighted decision matrix template. The matrix shown contains three delivery methods. However, more or less than three delivery methods can be analyzed, depending upon the results of Tier 1. As an example, two types of DB delivery methods with various procurement methods could be competing in this matrix. The matrix can also contain up to seven selection factors for each project.

**Table 6-2 - Weighted-Matrix Template**

		PROJECT DELIVERY METHOD					
		DBB		CMR		DB Specify Procurement ( ) <sup>1</sup>	
Selection Factor	Factor Weight	Score	Weighted Score	Score	Weighted Score	Score	Weighted Score
<b>Factor 1</b> (e.g., Project Goals)							
<b>Factor 2</b> (e.g., Airport experience)							
<b>Factor 3</b> (e.g., Market issues)							
<b>Factor 4 to 7</b> ...							
<b>Total Score</b>							

The result of Step 3 will be a scored ranking of the delivery methods in question. The delivery method with the highest total score will be the most appropriate method for the given project. The next steps involve documenting the individual scores and creating a Project Delivery Selection Report. Figure 6-5 continues the previous example by scoring the delivery methods as they relate to each selection factor. A very brief documentation for the scoring follows the table.

<sup>1</sup> Refer to Chapter 2 Section “Definition of Delivery Methods” for procurement options. The Design-Build procurement options considered in Tier 2 are primarily Best-Value Procurement with Fixed Price and DB Qualifications Based Procurement with Negotiated Price. DB Low Bid is an option, but it is not recommended in this Guidebook for the majority of DB projects.



The table below provides an example of how an airport might score the project delivery methods for a particular project. Note that only the CMR and DB project delivery methods made it through the Tier 1 filter for further consideration in Tier 2. Also note that the scores in the example below are project dependent and they will certainly change from project to project.

**Example Project Decision Matrix**

		PROJECT DELIVERY METHOD			
		CMR		DB (Qualifications-Based Selection)	
Selection Factors	Factor Weight	Score	Weighted Score	Score	Weighted Score
<b>Project complete by November 1, 20XX</b>	50	6	300	8	400
<b>Cost not to exceed \$200 million</b>	25	6	150	8	200
<b>Minimize impact on operations and passengers during construction</b>	15	10	150	6	90
<b>Minimize staffing requirements during design and construction</b>	10	8	80	6	60
<b>Total Score</b>	100		<b>680</b>		<b>750</b>

Explanation of Scores

*Project completion factor:* The project completion factor relates to a project goal. In this case the project has a fixed end date of November 1, 20XX. The airport believes that CMR delivery can achieve the completion date. The airport also believes that CMR will require the use of multiple bid packages to achieve the schedule, which adds a risk for meeting the schedule date (CMR = 6 in this case). Design-Build delivery provides for a single entity to coordinate design and construction. Design-Build also allows for an airport to specify a fixed end date in the procurement documents and the contract. The airport is confident by what has been demonstrated in practice that the end date can be achieved through a DB delivery (DB = 8 in this case).

*Cost containment factor:* The cost containment factor relates to a project goal. The project has a maximum budget of \$200 million. Design-Build delivery has demonstrated in practice that a fixed price can be negotiated early in the project development process and it has also been demonstrated that DB provides the lowest average cost growth of the two methods in question (DB = 8 in this case). CMR also provides the ability to meet a fixed price, but the airport is not as confident that they will be able to negotiate a fixed price as early in the process as they can with DB (CMR = 6 in this case).

*Impact on operations and passengers factor:* This factor stems from a critical issues analysis from Tier 1. The project involves work on an operating airport. The airport desires to keep operations and passengers flowing smoothly throughout the construction of the project. In this case, the airport has met with designers who can help define operational goals that can be achieved through their independent designs if they are hired directly by the airport. The CMR delivery method will provide for a direct contract between the airport and the designer to ensure that the goals are achieved (CMR = 10). While the airport can develop DB performance criteria related to operations and passenger impacts, they are not as confident that they can accurately articulate their goals in the performance criteria and they believe there is a risk that the goals will not be fully achieved (DB = 6).

*Airport staffing factor:* The airport staffing factor relates to a critical issue examined in Tier 1. The airport does not have a large staff and desires to minimize staffing requirements during design and construction. The CMR option will allow the airport to supplement their staff during both design and construction, either with the designer or with the CMR. The airport is confident that qualified professionals exist to meet their staffing needs, but is slightly concerned about exactly how the working relationship will be executed between the CMR and the airport (CMR = 8). The DB option will require the airport to mass its resources (or build up for a short time) during the procurement and design review process. The airport believes that they can supplement their staff with a general engineering consultant, but they are not confident that the DB option will be as effective as the CMR option (DB = 6).

Figure 6-5 - Example of Weighted Ranking for Project Goals and Critical Issues

#### Step 4. Choose the Most Appropriate Project Delivery Method

At this point, choosing the appropriate delivery method is simply a matter of reviewing the total scores and making the project delivery decision. Since the factor weighting and the scores are subjective, the airport should review the totals and confirm that they are logical and defensible. If upon further discussion, a factor weight or project delivery score appears to be incorrect or overly influence the selection, it is acceptable to make changes and create a new total project score. The key is to document the reasons for each change. If the airport is not confident in a particular weight or score, they can conduct more research about a particular delivery method and revisit the scoring after gathering more information.

## Step 5. Document Results

### *Project Delivery Decision Report*

As in Tier 1, documentation of the delivery decision is a key portion of the process. Whether one delivery method clearly achieves the highest score or no dominant choice appears, documentation is a vital step. Documentation will assist in developing procurement and contracting strategies for the ultimate project delivery method. It will also serve to communicate the project delivery choice to interested stakeholders.

Documentation of results includes the Project Delivery Decision Report developed in Tier 1. It should also contain the weighted matrix of Tier 2 and a detailed documentation of the reasoning that was used to assign each criterion weight and project delivery score. A report outline is offered below:

- Project Delivery Decision Report Outline
  - Executive Summary
  - Project Description
  - Project Goals
  - Delivery Methods Considered
  - Selection Factors
  - Weight Selection Factors
  - Score Project Delivery Methods
  - Delivery Method Decision
  - Appendices

## Conclusions

The Tier 2 Weighted-Matrix Delivery Decision Approach extends the structured Tier 1 approach through an examination of how project delivery methods align with project goals and critical issues as defined through selection factors. The weighted ranking of project selection factors requires decision makers to examine their priorities and make a closer examination of the attributes for each delivery that passed the Tier 1 filter. At the end of Step 4, there should be a single, clear and logical choice for a project delivery method and the choice can be documented through a Project Delivery Decision Report.

## CHAPTER 7 – EVALUATION OF PROJECT DELIVERY METHOD DECISION TOOL

The structured interviews and airport case studies followed the methodology of Yin (2004) and Oppenheim (1992). According to Yin, case studies are appropriate to use for exploratory or explanatory questions, such as *what project characteristics can be matched with project delivery method advantages to make an effective project delivery method selection decision for airport facility projects?* Case studies are also appropriate when the researcher does not require control over the events and when the research focuses on contemporary events. Both of these conditions apply to the study.

To assure the quality of the case study design and evaluation, the following measures recommended by Yin were included:

- **Construct validity:** The team submitted the case study data collection and interview guide to the ACRP panel to establish that correct operational measures were used. This study included multiple sources of evidence by interviewing more than one expert in each airport, as well as having the experts review the key information included in the Interim Report. Additionally, a pilot study was conducted initially to refine data collection procedures.
- **Internal validity:** to establish a causal relationship between the critical factors and the strategies and techniques, this study applied the hypotheses to (1) a number of airports of various size and experience, 2) a range of project types, settings, and conditions, 3) a range of different project delivery methods, 4) a range of project performance outcomes (both positive and negative). In essence, the pertinent issues used in the developed decision support system were collected from literature, but evaluated by various airport agencies through our extensive interviews. Additionally, a draft of the Tier 1 and 2 decision tool was applied by an outside team consisting of a CM professional and a former airport manager (whom we had earlier interviewed) to a large (\$217 million) project at a major airport (BOS). First, it demonstrated that the decision tool could be applied conveniently by expert users and secondly, it confirmed the utility of the tool by comparing the PDM selected by the tool with the PDM that was favored by the agency at the time of project development. We have listed this effort under internal validation because we used this exercise to revise the system before sending it out to other interviewed airports.
- **External validity:** the research oversight panel meeting in Washington DC provided an opportunity to test the validity of the research and was used to confirm the findings from the case studies. Input from the panel meeting helped to focus the research on the delivery methods covered by the decision tool. Once the tool had been developed it was given to the case study airports who were asked to run through the process and if possible, compare the results with one of their projects. One issue raised at the meeting was the level of PDM experience an airport had to have to be able to effectively utilize the tool. Thus, the airports were selected on that

basis and range from small airport with minimal alternative PDM experience (only one DB project) to a large airport with extensive experience with all the PDMs.

### Final Validation of PDM Multi-Tier Decision Tool

The above validation discussion shows how the research team was careful to validate its work both before and during the study. Figure 7.1 demonstrates the process that was followed to achieve final internal and external validation.

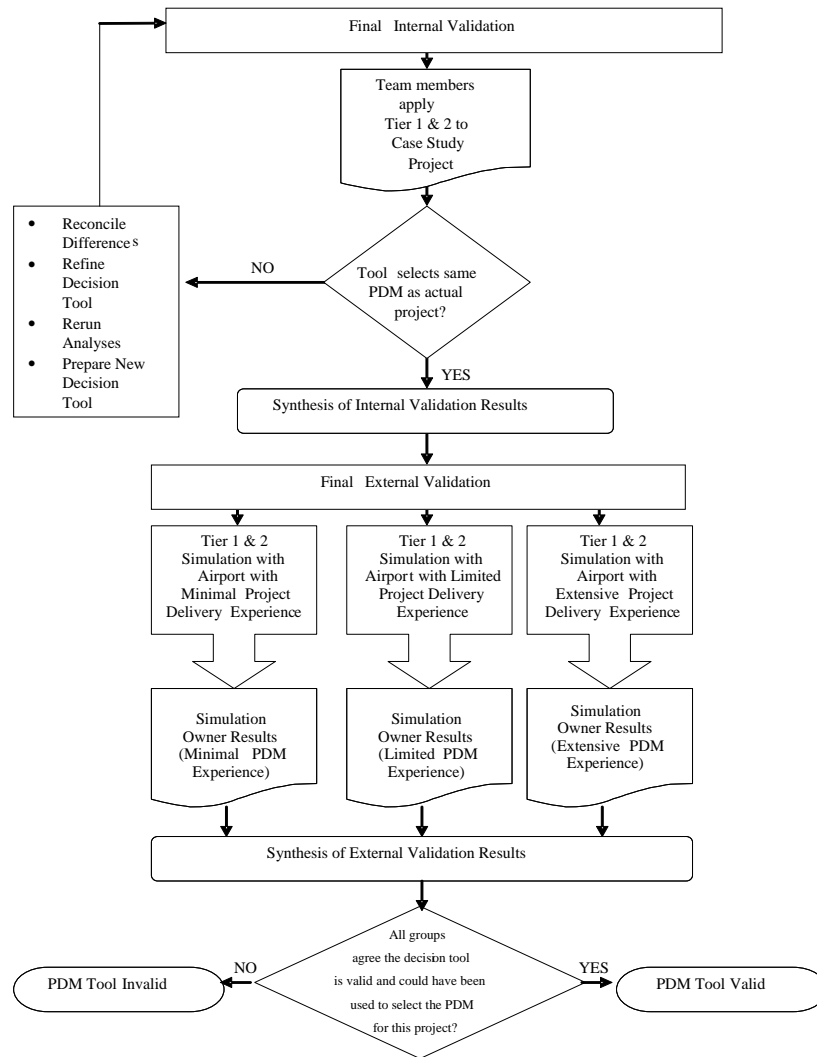


Figure 7-1 - Project Delivery Decision Tool Final Internal and External Validation Flow Chart

In essence, the process was to first apply Tiers 1 and 2 to an actual airport project by an associate of the research team and an airport manager, who was very familiar with the project’s issues, to identify if the tool was working as designed and identify the gaps in the process that needed to be filled. The

process was successful and the decision tool selected the PDM that was compatible with what the airport agency had done. Based on the feedback received from the evaluation team, the guidebook was revised to clarify some aspects of Tier 1. Once Tier 1 was revised, the tool was distributed to six of the case study project agencies (There were nine airports that were interviewed. Two of the agencies were represented on the project panel and one was represented by the evaluation team just described). They were asked to apply the tool to a project that they felt had been successfully delivered using the appropriate PDM. They were then asked to compare the resulting PDM from the tool with the PDM that had been used on the test project. The tool is deemed to be valid if the internal and external parties determine that the tool led them to the logical PDM for the project characteristics that were considered.

#### *Final Internal Validation*

As previously stated, the initial draft of the Tier 1 and 2 PDM decision tool was applied to an upcoming project at Boston Logan airport. The project was a \$217 million Logan International Airport Central Parking Garage Renovation and Expansion. The tool yielded a strong indication for CMR project delivery, which coincided with the airport staffs' professional judgment. The effort was fruitful in that it pointed out some minor weakness in the Tier 1 logic and Tier 2 confirmed the Tier 1 results. The major issue was the need for a multi-disciplinary group to collaboratively apply the PDM tool to ensure that critical aspects of design, construction, and operations are all adequately represented in consensus ratings of project issues. The effort is summed up by this comment from the evaluation team:

“CMR was rated better than DBB for 14 of the 19 issues. Based on this, the airport selected CMR as the project delivery method to be used on the project. Beyond the criteria, the airport felt confident in its selection of CMR because it felt that CMR would promote a stronger team atmosphere, builder input during design would be extremely advantageous, and the airport had a bad experience on a previous large (\$400Million) DBB project.”

#### *Final External Validation*

As previously discussed, the Tier 1 and 2 decision tool was furnished to six of the case study airports. At the time this report is being prepared, three airports have responded. One of those airports requested that their identity be not disclosed. Therefore, as the sample of case study agencies is small, no agencies will be identified in the subsequent paragraphs to comply with that reasonable request and prevent inadvertently identifying the agency by process of elimination. One of the respondents is a major airport and one is a relatively smaller regional airport with limited experience with alternative project delivery methods. The third respondent was an average size airport that falls between the first two in terms of size and volume. Each agency was asked to apply the tool to a specific project that was either upcoming or had been completed. The purpose for this suggestion was that it was the team's belief that the selection system works best when the user can carefully define project objectives and goals. It was felt that if the agencies had a specific project in mind they would be in a position to better define project characteristics and goals.

Additionally, each agency was asked to rate the effectiveness of the tool in the following categories (see Appendix C for a copy of the questionnaire and rating form):

- Comprehensiveness
- Clarity

- Applicability to real projects
- Contribution to resulting in a transparent and defensible decision
- Overall satisfaction

The possible ratings were from 1 (poor) to 5 (excellent). In all three cases, the tool was deemed to be valid. No poor ratings were recorded. The specific adjectival evaluations in the specific categories are as follows:

- Comprehensiveness: 3 excellent;
- Clarity: 1 very good; 1 good; 1 satisfactory
- Applicability to real projects: 2 very good; 1 good
- Contribution to decision: 1 excellent; 2 very good;
- Overall satisfaction: 1 very good; 1 good

Specific comments were primarily directed at the Tier 1 process. All users, regardless of experience level, found it to be comprehensive. Two airports felt that a differentiation between vertical and horizontal projects would be helpful. One felt that it was very valuable on vertical projects but less so on horizontal ones. Finally, one of the agencies indicated that the tool might be hard for an airport with little alternative project delivery experience to apply because they may not “have a good understanding of whether DB or CMR will be an advantage or disadvantage with respect to a particular issue.” It should be noted that the respondents had received copies of Chapter 4 (Pros/Cons), Chapter 5 (Tier 1), and Chapter 6 (Tier 2) for evaluation. The guidebook also has a comprehensive chapter discussing each PDM in general and highlighting the strength and weakness of each *vis-à-vis* various project conditions. While this material (Chapter 2 of this report) may be common knowledge to experts and experienced airports, it can be valuable to novice users and smaller airports.

Overall comments regarding the validity of the tool from each of the three agencies are as follows:

- “Excellent system. It fits well with our internal project development flow chart.”
- “I found the selection system to be very comprehensive but difficult to apply for a relative novice.”
- “No question, however, that if one does commit to working through, one will come out with a solid result.”

Thus, the Tier 1 and 2 PDM decision tool framework is found to be valid in accordance with the procedures established by the research team and approved by the ACRP oversight panel.

## CHAPTER 8 – SUMMARY

The objective of this research was to study alternative project delivery methods (PDM) for airport projects and to develop a guidebook for selecting the most appropriate delivery method for an airport project. The delivery methods considered were the traditional design-bid-build (DBB), CM-at-risk (CMR) or CM/GC, and design-build (DB). Although the most common mode of project delivery remains the traditional design-bid-build, it was found that larger airports have extensive experience with alternative PDMs, partly due to the fact that many airports have their own source of revenue and are less restricted in the ways they can spend their funds. Also, due to recent changes in procurement laws and regulations, legal impediments in using alternative delivery methods have been removed to a large degree and this has provided much flexibility in the choice of project delivery and contracting method. Nine airport agencies were interviewed and much information and data was collected on their contracting practices. Relevant literature on project delivery methods, decision support systems, public transportation and airport projects were reviewed. A comprehensive list of pertinent issues that can affect the project delivery decision was compiled and studied. The research conducted by the authors concluded that no single project delivery method was superior to all others and that airports need to carefully analyze the characteristics of the given project and seek to find the project delivery method whose benefits are most closely aligned to project requirements. It also showed that the most common reason for choosing an alternative project delivery method was scheduling issues. When the airports were asked to name the single most important reason for choosing a given PDM, the results were as follows:

- DBB: Encourage price competition
- CMR: Establish project budget at early stage of design
- DB: Reduce/compress/accelerate project delivery period

Airports should carefully study the risks, costs and benefits associated with each project delivery method for the project under consideration and select the project delivery method that best suits legal, technical, and business environment in which the project must be built. This effort resulted in a 2-tier approach for project delivery method selection. The user goes through the two tiers sequentially and narrows down the viable delivery methods by a process of eliminating the inferior choices.

In Tier 1 or the Analytical Delivery Decision Approach, this is accomplished by evaluating the viability of each delivery method against a number of pertinent issues that can be of vital importance for the project's success in achieving its goals and objectives. Among the pertinent issues that affect the project delivery decision, there are certain issues that may render one or more delivery method inappropriate. These issues involve project schedule constraints; federal, state, and local laws; third party agreements; and labor union agreements. The airport needs to review these issues to determine if they eliminate any of the delivery methods. In other words, the agency should make a "go/no-go decision" based on these pertinent issues. After this stage, the user examines the remaining project



delivery choices against a list of pertinent issues and rates each delivery method based on its advantages and disadvantages in coping with each pertinent issue. The summary of these ratings is compiled in a table and studied to see if a decision can be made based on the overall capabilities of competing delivery methods in dealing with these pertinent issues. If a clear winner emerges at this point, a report can be generated that describes the reasons for the choice of delivery method.

If more than one delivery method remains viable after going through Tier 1, the user should move to Tier 2 or Weighted-Matrix Delivery Decision Approach. In this Tier a select subset of goals and pertinent issues will be identified that are of profound importance to the airport. Each goal or issue is weighted according to the clear instructions that are provided and an overall score is computed for each delivery method. Again, a report can be generated that documents the decision-making process.

The delivery selection system was tested and validated by three airport agencies. The overall assessment was positive and the users found the process to be comprehensive and informative. The authors believe that the guidebook developed as a product of this research is a valuable tool for airport agencies.

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## **APPENDIX B – INTERVIEW DATA**

## Case Study Matrix

The following section contains a standardized matrix which displays the salient information on each case study project in a consistent format to permit ease of understanding and comparison. The matrix consists of the following components:

1. Airport identification data: Qualitative
2. Airport traffic volume data: Quantitative
3. Airport construction program data: Quantitative
4. Airport project delivery method experience data: Quantitative
5. Airport project delivery method rationale data: Qualitative
6. Airport risk analysis process data: Qualitative
7. Airport procurement process data: Quantitative
8. Airport issue data: Qualitative
9. Airport project delivery method value data: Quantitative

In addition to the data obtained using the structured interview questionnaire, detailed notes of the interviews were taken and used to furnish the basis for explanatory details on the standard questionnaire responses. As a whole, the interviews went very well with the minimum of inconsistencies. In all cases, the interviews were conducted with members of the agency's project delivery team for each airport. Thus, the information collected was received first hand.

Project delivery method data that was collected at the interview was validated by data obtained in the literature review which comprises Yin's "converging lines of information" and the "use of multiple sources." Multiple sources help alleviate lack of trust, increase viability, and frequently provide supplementary realms of thought and research that strengthens results. "Case studies are likely to be much more convincing and accurate if they are based on several different sources of information, following a corroborating mode" (Colorado State University, 2006). This goal was achieved in all cases.

The remainder of this section contains the specific case study data collected for each airport displayed in the standard matrix format. The format is a synthesis of the structured interview questionnaire output in a manner that permits both comparison and contrast. The cases are grouped by airport being listed consecutively in the order shown in Table 3.1 (see Chapter 3).

## Case 1 - Atlanta-Hartsfield-Jackson International Airport

### *Airport Information*

Airport Name: Atlanta-Hartsfield-Jackson International Airport  
 Three-letter Code: ATL  
 Name of Agency:  
 Type of Organization: City Government  
 Location: Atlanta, Georgia

### *Airport Traffic Volume Information*

Number of annual operations (take-offs and landings): 967,303  
 Annual passenger throughput: 86,466,000  
 Annual cargo throughput: 805,476 tons

### *Airport Construction Program Information*

Annual construction budget: \$500 million  
 Average annual number of projects: 30- 40  
 Project monetary size range: \$1.0 million to \$1.2 billion (a CMR project)  
 Average monetary size of a typical project: \$10 to \$20 million  
 Number of professional design/construction staff: 200

### *Airport Project Delivery Method Experience Information*

	Design-Bid-Build	Construction Manager-at-Risk	Design-Build	Design-Build- Operate-Maintain
Number of Projects	>10	1-5	1-5	1
Percentage of Construction Budget	>50%	11-25%	<10%	<10%

### *Airport Project Delivery Method Rationale Information*

#### **Airport Project Delivery Decision-making Process**

- Design/construction personnel make the decision and recommend this decision to the Airport General Manager for approval. The city council will also have to approve the decision and may have questions about an alternative delivery system.
- Usually DBB is used based on tradition and also based on the understanding that it spreads the funding in best possible way among design and construction community.
- If for some reasons the airport decides to depart from traditional approach then they have to start the decision process very early in design, and come up with the justification. The reasons for this decision are presented to the Director and if he is convinced, the decision is presented to the airport General Manager for approval.
- They usually do not need to justify the choice of delivery method if it is DBB.

- In case of CMR, usually the GMP is negotiated with the contractor at 60% design complete.

**Project Factors Considered in Project Delivery Decision**  
*(Italics indicate airport furnished factor)*

Project factors considered in project delivery decision	Drives use of alternative delivery method
Project monetary size: Smaller (<\$10M) done with DBB	
Project budget control issues	
Project schedule issues	
Project technical complexity	
Project technical content	
Project security issues (outside secure zone vs. inside secure zone)	
Project location (landside, airside, or terminal)	
Project environmental issues	
Project third party interface issues	
Project life cycle issues (maintenance/operations)	
Project generates revenue	✓
<i>Scope control</i>	✓
<i>Technical innovation</i>	✓

**Reasons for Selecting Project Delivery Method**  
*(\*most significant reason; Italics indicate airport furnished factor)*

Reason	DBB	CMR	DB	DBOM
Reduce/compress/accelerate project delivery period		✓	✓*	✓
Establish project budget at an early stage of design development		✓*	✓	
Get early construction contractor involvement		✓*	✓	
Encourage innovation			✓*	
Facilitate Value Engineering		✓		
Encourage price competition (bidding process)	*✓			
Compete different design solutions through the proposal process			✓	
Redistribute risk		✓	✓	
Complex project requirements	✓	✓	✓	✓
Flexibility needs during construction phase	✓	✓		
Reduce life cycle costs	✓			
Provide mechanism for follow-on operations and/or maintenance				*✓
Innovative financing	NA			
Encourage sustainability	✓	✓	✓	✓
Project is a revenue generator			✓	
<i>Encourage constructability</i>			✓	
<i>Scope control</i>	*✓	✓		
<i>Need for coordination between various construction components</i>		✓		

**Workforce-Related Reasons for Selecting Project Delivery Method**

Airport does not consider workforce related reasons when making the project delivery method decision.

***Airport Risk Analysis Process Information***

**Formal Risk Analysis Areas:** None

**Project Cost Estimate Uncertainty Analysis:** None; *But at least in one project, the schedule involved Monte Carlo simulation analysis*

**Risk Identification Techniques Used:**

- Brainstorming
- Scenario planning
- Expert interviews
- Influence or risk diagramming

**Risk Assessment Techniques:**

- Qualitative: Risk matrix
- Quantitative: Monte Carlo per above

**Risk Management Techniques:** None in planning stages but after start of construction phase, they develop a list for potential change orders, their expected costs, etc. in order to manage and control cost overrun

**Risk Technique used to Draft Contract:** In each project, they develop a list of major risks, study those risks and allocate those to the party in best position to control those risks. This process is usually accomplished through brainstorming.

***Airport Procurement Process Information***

Procurement Constraint	Low-bid	Best Value	Qualifications-based	IDIQ	Remarks
Requirement to meet DBE goals					The city of Atlanta requires EBO (Equal Business Opportunity). This means that for each project there should be a joint venture with a DBE firm. In addition to this joint venture requirement, the team needs to achieve the pre-set DBE goal that can be higher than 40% of contract value.

Procurement Preference	Low-bid	Best Value	Qualifications-based	IDIQ	Remarks
Desire to eliminate firms with poor past records from competition		✓	✓	✓	
Desire to encourage firms with good past records to compete		✓	✓	✓	
Need to ensure selection of well-qualified designers and/or builders		✓	✓	✓	
Need to minimize front-end effort				✓	
Need to appear fair and objective	✓		✓		
Need to be able to justify selection to higher authorities	✓		✓		
Need to be able to justify selection to the public	✓		✓		Low bid for contractor & Best Value for Designer
Need to minimize the number of procurement actions				✓	
Need to be able to rapidly move from concept to construction				✓	

Procurement Method Award Component	Low-bid	Best Value	Qualifications-based	IDIQ	Remarks
Short-list			✓	✓	
Financial prequalification	✓	✓	✓	✓	Bonds
Evaluation of qualifications			✓	✓	
Schedule evaluation	✓	✓	✓	✓	
Quality management plan evaluation	✓	✓	✓	✓	
Environmental plan evaluation	✓	✓	✓	✓	General conditions req'ts
Security plan evaluation	✓	✓	✓	✓	
Safety plan evaluation	✓	✓	✓	✓	
Price evaluation	✓	✓	✓	✓	
Bonding requirements	✓	✓	✓	✓	
DBE goals	✓	✓	✓	✓	

***Airport Project Delivery Method Issue Information***

Issues	DBB	CMR	DB	DBOM	Comments
<b>Project-level:</b> <i>Benefit</i>	<ul style="list-style-type: none"> <li>• Cost control</li> <li>• LEED</li> </ul>	<ul style="list-style-type: none"> <li>• Risk</li> <li>• Sched comp</li> <li>• Sched control</li> <li>• Cost prec</li> <li>• LEED</li> </ul>	<ul style="list-style-type: none"> <li>• Risk</li> <li>• Sched comp</li> <li>• Sched control</li> <li>• Cost prec</li> </ul>	<ul style="list-style-type: none"> <li>• Risk</li> <li>• Sched comp</li> <li>• Sched control</li> <li>• Cost prec</li> </ul>	
<b>Project-level:</b> <i>Constraint</i>	<ul style="list-style-type: none"> <li>• Large project</li> <li>• Sched comp</li> <li>• Shed control</li> <li>• Cost prec</li> </ul>	<ul style="list-style-type: none"> <li>• Small project</li> <li>• Cost control</li> </ul>	<ul style="list-style-type: none"> <li>• Cost control</li> <li>• LEED</li> </ul>	<ul style="list-style-type: none"> <li>• Cost control</li> <li>• LEED</li> </ul>	
<b>Agency-level:</b> <i>Benefit</i>	<ul style="list-style-type: none"> <li>• Airport staff exp</li> <li>• Airport proj control</li> <li>• 3<sup>rd</sup> party input</li> </ul>		<ul style="list-style-type: none"> <li>• Airport staff exp</li> </ul>		
<b>Agency-level:</b> <i>Constraint</i>		<ul style="list-style-type: none"> <li>• Airport staff exp</li> <li>• Airport proj control</li> <li>• 3<sup>rd</sup> party input</li> </ul>	<ul style="list-style-type: none"> <li>• Airport proj control</li> <li>• 3<sup>rd</sup> party input</li> </ul>		Airport staff still learning with CMR
<b>Public Policy/Regulatory:</b> <i>Benefit</i>	<ul style="list-style-type: none"> <li>• Competition</li> </ul>	<ul style="list-style-type: none"> <li>• Competition</li> </ul>			
<b>Public Policy/Regulatory:</b> <i>Constraint</i>			<ul style="list-style-type: none"> <li>• Competition</li> </ul>	<ul style="list-style-type: none"> <li>• Competition</li> </ul>	
<b>Life Cycle:</b> <i>Benefit</i>	<ul style="list-style-type: none"> <li>• Life cycle cost</li> <li>• Maintenance</li> <li>• Sustainable design</li> </ul>	<ul style="list-style-type: none"> <li>• Life cycle cost</li> <li>• Maintenance</li> <li>• Sustainable design</li> </ul>		<ul style="list-style-type: none"> <li>• Life cycle cost</li> <li>• Maintenance</li> </ul>	
<b>Life Cycle:</b> <i>Constraint</i>			<ul style="list-style-type: none"> <li>• Life cycle cost</li> <li>• Maintenance</li> <li>• Sustainable design</li> </ul>		
<b>Other:</b> <i>Benefit</i>		<ul style="list-style-type: none"> <li>• Adversarial Relationships</li> </ul>	<ul style="list-style-type: none"> <li>• Adversarial Relationship</li> <li>• Claims</li> </ul>		
<b>Other:</b> <i>Constraint</i>	<ul style="list-style-type: none"> <li>• Adversarial Relationship</li> <li>• Claims</li> </ul>	<ul style="list-style-type: none"> <li>• Claims</li> </ul>			

**Airport Project Delivery Method Value Information**

**Effectiveness in delivering quality in project aspects**

Color Code	Blank = Does not apply	Below Standard = 1&2	Meets Standard = 3	Exceeds Standard = 4&5
Project Aspects	DBB	CMR	DB	DBOM
Completeness of final design deliverables	5	4	3	3
Accuracy of design calculations	4.5	4.5	3	3
Accuracy of quantities	4.5	4.5	3	3
Acceptance of design deliverables				
Accuracy of specifications	5	4	2	2
Accuracy of as-built documents	4		5	
Accuracy/applicability of O&M manuals, etc	5	4	3	3
Implementation of approved QA/QC plans	5	3	5	
Accuracy of preconstruction cost estimates	3	4	5	5
Ability to achieve post-award budgets	3	4	5	5
Accuracy of preconstruction schedules	3	4	5	5
Ability to achieve post-award schedules	3	4	5	
Material quality	5	4	3	
Workmanship quality	5	4	4	
Aesthetics	5	4	2	
Sustainability	5	4	3	
Maintainability	5	4	3	4
Operability	5	4	3	4
Security during construction				
Aircraft operations during construction	5			
Passenger traffic flow during construction	5			
Interest to potential bidding community	5	5	3	2
<b>Effectiveness Index</b>	<b>4.5</b>	<b>4.1</b>	<b>3.6</b>	<b>3.5</b>

**Effectiveness in delivering value in preconstruction phase**

Color Code	Blank = Does not apply	Not Valued = 1	Valued =2&3	Highly Valued = 4&5
Preconstruction Tasks	DBB	CMR	DB	DBOM
Conceptual estimating	3	5	3	
Value analysis/value engineering	3	5	3	
Design charrettes	5	5	3	
Design reviews	5	4	3	3
Regulatory reviews				
Security impact studies				
Environmental studies				
Early contractor involvement	2	5	4	4
Cost engineering reviews	2	5	4	4
Constructability reviews	2	5	4	4
Biddability reviews	5	4	3	3
Operability reviews	5	3	3	5
Life cycle cost analysis	5	4	3	
<b>Value Index</b>	<b>3.7</b>	<b>4.5</b>	<b>3.3</b>	<b>3.8</b>



## Case 2 - Boston-Logan International Airport

### *Airport Information*

Airport Name: Boston-Logan International Airport  
 Three-letter Code: BOS  
 Name of Agency:  
 Type of Organization: Public Airport Operator  
 Location: Boston, Massachusetts

### *Airport Traffic Volume Information*

Number of annual operations (take-offs and landings): 400,000  
 Annual passenger throughput: 28,000,000  
 Annual cargo throughput: 358,000 tons

### *Airport Construction Program Information*

Annual construction budget: \$125 million  
 Average annual number of projects: 100 per year  
 Project monetary size range: \$10,000 to \$165 million  
 Average monetary size of a typical project: >\$2.0 million  
 Number of professional design/construction staff: 70

### *Airport Project Delivery Method Experience Information*

	Design-Bid-Build	Construction Manager-at-Risk	Design-Build	Design-Build- Operate-Maintain
Number of Projects	>10	1-5	0	0
Percentage of Construction Budget	>50%	11-25%	0	0

### *Airport Project Delivery Method Rationale Information*

#### **Airport Project Delivery Decision-making Process**

Decision is made before design by the airport design/construction personnel. They might ask Agency CM help them to choose designer. There is no written procedure. They make the decision through a group meeting which has six members consist of: project manager, program manager, Department Director and three others. It usually needs several meetings conducted over several weeks.

**Project Factors Considered in Project Delivery Decision**

Project Factor Considered in Project Delivery Decision	Drives use of alternative delivery method
Project monetary size	
Project budget control issues	
Project schedule issues	
Project technical complexity	✓
Project type (vertical vs horizontal)	
Project technical content	
Project environmental issues	
Project air traffic control issues	
Project life cycle issues (maintenance/operations)	
Project generates revenue	✓

**Reasons for Selecting Project Delivery Method  
(\* most significant reason)**

Reason	DBB	CMR	DB	DBOM
Get early construction contractor involvement		*✓		
Encourage innovation		✓		
Facilitate Value Engineering		✓		
Compete different design solutions through the proposal process		✓		
Redistribute risk		✓		
Complex project requirements		*✓		
Flexibility needs during construction phase		✓		
<i>Because of state regulations, the CMR process tends to get longer!</i>				

**Workforce-Related Reasons for Selecting Project Delivery Method:** None

***Airport Risk Analysis Process Information***

**Formal Risk Analysis Areas:** Informal risk analysis is used

**Project Cost Estimate Uncertainty Analysis:** Use of 25% contingency in planning and design and 5% contingency for bid stage.

**Risk Identification Techniques Used:**

- Brainstorming
- Scenario planning
- Expert interviews

**Risk Assessment Techniques:** None, but they consider the change in price of some materials like oil, steel, etc.

**Risk Management Techniques:** None

**Risk Technique used to Draft Contract:** None

***Airport Procurement Process Information***

Procurement Constraint	Low-bid	Best Value	Qualifications-based	IDIQ	Remarks
	None		Prequalify contractors on security projects.	Use unit price based on hourly rates and materials for IDIQ	

Procurement Preference	Low-bid	Best Value	Qualifications-based	IDIQ	Remarks
Desire to eliminate firms with poor past records from competition		✓			
Desire to encourage firms with good past records to compete		✓			Massport has the ability to not award the contract!
Need to appear fair and objective	✓				
Need to be able to justify selection to higher authorities	✓				
Need to be able to justify selection to the public	✓				
Need to minimize the number of procurement actions				✓	
Other: Specify					<ul style="list-style-type: none"> <li>• IDIQ is low bid. There is really no choice here, always low bid!</li> <li>• They should go through the DCAM (Division of Capital Asset Management) process which is for certifying contractors in vertical projects.</li> <li>• If there is a good justification provided to DCAM, Massport may receive the authorization for not awarding the contract to the low-bidder.</li> <li>• IDIQ is mostly unit price or something very similar.</li> </ul>

Procurement Method Award Component	Low-bid	Best Value	Qualifications-based	IDIQ	Remarks
Short-list		✓	✓		
Evaluation of qualifications	✓	✓	✓	✓	Massport requires that bidders meet DCAM certification for vertical projects.
Schedule evaluation		✓	✓		After bid
Quality management plan evaluation		✓	✓		
Environmental plan evaluation		✓	✓		
Bonding requirements	✓	✓	✓	✓	Bonds; DCAM pre-qualification.
DBE goals	✓	✓	✓	✓	If the low bidder cannot provide target DBE goals in his bid, it is given 5 days to meet that goal or justify its position.

***Airport Project Delivery Method Issue Information***

Issues	DBB	CMR	DB	DBOM	Comments
<b>Project-level:</b> <i>Benefit</i>	<ul style="list-style-type: none"> <li>• LEED</li> </ul>	<ul style="list-style-type: none"> <li>• Project Size</li> <li>• Cost Prec</li> <li>• Cost control</li> <li>• LEED</li> </ul>	<ul style="list-style-type: none"> <li>• Project Size</li> <li>• Sched comp</li> <li>• Sched control</li> </ul>		Risk depends on project.
<b>Project-level:</b> <i>Constraint</i>	<ul style="list-style-type: none"> <li>• Cost Prec</li> <li>• Cost control</li> </ul>	<ul style="list-style-type: none"> <li>• Risk</li> <li>• Sched comp</li> <li>• Sched control</li> </ul>			
<b>Agency-level:</b> <i>Benefit</i>	<ul style="list-style-type: none"> <li>• Airport staff exp</li> <li>• Airport proj control</li> <li>• Security</li> <li>• 3<sup>rd</sup> party input</li> </ul>	<ul style="list-style-type: none"> <li>• Airport proj control</li> <li>• Security</li> <li>• Impact on ops</li> <li>• Impact on passengers</li> <li>• 3<sup>rd</sup> party input</li> </ul>			
<b>Agency-level:</b> <i>Constraint</i>	<ul style="list-style-type: none"> <li>• Impact on ops</li> <li>• Impact on passengers</li> </ul>	<ul style="list-style-type: none"> <li>• Airport staff exp</li> </ul>			DBB has a negative impact on operations and passengers if the contractor is not a good contractor.
<b>Public Policy/Regulatory:</b> <i>Benefit</i>	<ul style="list-style-type: none"> <li>• Competition</li> <li>• DBE</li> <li>• Legal</li> </ul>	<ul style="list-style-type: none"> <li>• DBE</li> </ul>	<ul style="list-style-type: none"> <li>• DBE</li> </ul>		
<b>Public Policy/Regulatory:</b> <i>Constraint</i>		<ul style="list-style-type: none"> <li>• Competition</li> <li>• Legal</li> </ul>	<ul style="list-style-type: none"> <li>• Competition</li> </ul>		

Issues	DBB	CMR	DB	DBOM	Comments
<b>Life Cycle:</b> <i>Benefit</i>	<ul style="list-style-type: none"> <li>Life cycle cost</li> <li>Sustainability</li> </ul>	<ul style="list-style-type: none"> <li>Life cycle cost</li> <li>Maintenance</li> <li>Sustainability</li> </ul>			
<b>Life Cycle:</b> <i>Constraint</i>	<ul style="list-style-type: none"> <li>Maintenance</li> </ul>				
<b>Other:</b> <i>Benefit</i>		<ul style="list-style-type: none"> <li>Adversarial Relationship</li> <li>Claims</li> </ul>			
<b>Other:</b> <i>Constraint</i>	<ul style="list-style-type: none"> <li>Adversarial Relationship</li> <li>Claims</li> </ul>				

**Airport Project Delivery Method Value Information**

**Effectiveness in delivering quality in project aspects**

Color Code	Blank = Does not apply	Below Standard = 1&2	Meets Standard = 3	Exceeds Standard = 4&5
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Project Aspects	DBB	CMR	DB	DBOM
Completeness of final design deliverables	4	5		
Accuracy of design calculations	4	5		
Accuracy of quantities	4	5		
Acceptance of design deliverables	4	4		
Accuracy of specifications	4	4		
Accuracy of as-built documents	5	5		
Accuracy/applicability of O&M manuals, etc.	4	4.5		
Implementation of approved QA/QC plans	4	4.5		
Accuracy of preconstruction cost estimates	4	5		
Ability to achieve post-award budgets	4	5		
Accuracy of preconstruction schedules	4	5		
Ability to achieve post-award schedules	4.5	5		
Material quality	4	4		
Workmanship quality	4	4.5		
Aesthetics				
Sustainability	4	5		
Maintainability	4	5		
Operability	4	5		
Security during construction	4	5		
Aircraft operations during construction	4	4		
Passenger traffic flow during construction	4	4.5		
Interest to potential bidding community	5	3		
<b>Effectiveness Index</b>	<b>4.1</b>	<b>4.6</b>		

**Effectiveness in delivering value in preconstruction phase**

Color Code	Blank = Does not apply	Not Valued = 1	Valued =2&3	Highly Valued = 4&5
Preconstruction Tasks	DBB	CMR	DB	DBOM
Conceptual estimating	4	5		
Value analysis/value engineering	3	5		
Design charrettes	3	4		
Design reviews	3	4		
Regulatory reviews	3.5	4		
Security impact studies	3	3		
Environmental studies	3	3		
Early contractor involvement		5		
Cost engineering reviews	3	4		
Constructability reviews	3	4		
Biddability reviews	3	4		
Operability reviews	3	4		
Life cycle cost analysis	3	4		
<b>Value Index</b>	<b>3.1</b>	<b>4.1</b>		

### Case 3 - Port Columbus International Airport

#### *Airport Information*

Airport Name: Port Columbus International Airport, Rickenbacker International Airport, and Bolton Field Airport;  
 Three-letter Code: CMH, LCK, TZR  
 Name of Agency:  
 Type of Organization: Public Airport Operator  
 Location: Columbus, Ohio

#### *Airport Traffic Volume Information*

Number of annual operations (take-offs and landings): CMH/173,984; LCK/71,340; and TZR/43,233  
 Annual passenger throughput: CMH/7.7 million; LCK/<10,000; and TZR/none.  
 Annual cargo throughput: CMH/6,750 tons; LCK/110,000 tons; and TZR/none

#### *Airport Construction Program Information*

Annual construction budget: \$70-100 million  
 Average annual number of projects: 50-70  
 Project monetary size range: \$50,000 to \$165 million  
 Average monetary size of a typical project: \$1.5 million  
 Number of professional design/construction staff: 15

#### *Airport Project Delivery Method Experience Information*

	Design-Bid-Build	Construction Manager-at-Risk	Design-Build	Design-Build-Operate-Maintain
Number of Projects	>10	1-5	1-5	0
Percentage of Construction Budget	>50%	<10%	<10%	0

#### *Airport Project Delivery Method Rationale Information*

##### **Airport Project Delivery Decision-making Process**

Airport authority management ultimately makes the project delivery method decision. It starts with an evaluation process to determine the need to compress schedule. If so, then DB is normally chosen. If there is a strong need to control cost then CMR is selected. All others go DBB. If the airport is unfamiliar with the operations and maintenance requirements for a specific project then DBOM is considered ... they have no DBOM experience but are planning to use on an upcoming baggage equipment project.

**Project Factors Considered in Project Delivery Decision**

Project Factor Considered in Project Delivery Decision	Drives use of alternative delivery method
Project monetary size	
Project budget control issues	✓
Project schedule issues	✓
Project technical content	✓
Project life cycle issues (maintenance/operations)	
Project sustainability issues	
Incentives for obtaining federal or state funding	✓
Project generates revenue	✓

**Reasons for Selecting Project Delivery Method**  
*(\*most significant reason)*

Reason	DBB	CMR	DB	DBOM
Reduce/compress/accelerate project delivery period			*✓	
Establish project budget at an early stage of design development		*✓		
Get early construction contractor involvement		✓	✓	
Facilitate Value Engineering		✓	✓	
Encourage price competition (bidding process)	*✓			
Compete different design solutions through the proposal process	✓			
Redistribute risk	✓	✓	✓	
Provide mechanism for follow-on operations and/or maintenance				*✓
Innovative financing				✓
Project is a revenue generator		✓	✓	

**Workforce-Related Reasons for Selecting Project Delivery Method:** None

***Airport Risk Analysis Process Information***

**Formal Risk Analysis Areas:**

- Project Scope
- Project Schedule
- Project Cost
- Contracting Risk

**Project Cost Estimate Uncertainty Analysis:** None

**Risk Identification Techniques Used:**

- Brainstorming
- Expert interviews



**Risk Assessment Techniques:**

- Qualitative: Rare occasions on very large project
- Quantitative: None

**Risk Management Techniques:** None

**Risk Technique used to Draft Contract:** Milestones in schedule clause

*Airport Procurement Process Information*

Procurement Constraint	Low-bid	Best Value	Qualifications-based	IDIQ	Remarks
State law		✓	✓		Competitive bid >\$25
Need to obtain federal funding		✓	✓		
Process used to obtain funding	✓	✓	✓		\$ must be paid back by tenant revenues
Requirement to meet DBE goals	✓	✓	✓		Federal restriction
Security requirements	✓				Proprietary security equipment
Other: Specify					Only have design IDIQ contracts

Procurement Preference	Low-bid	Best Value	Qualifications-based	IDIQ	Remarks
Desire to not change past procurement methods	✓				
Desire to eliminate firms with poor past records from competition		✓	✓		
Desire to encourage firms with good past records to compete			✓		
Need to ensure selection of well-qualified designers and/or builders		✓	✓		
Need to minimize front-end effort	✓				
Need to appear fair and objective	✓				
Need to be able to justify selection to higher authorities	✓				
Need to be able to justify selection to the public	✓				
Need to be able to justify selection to third party stakeholders	✓				
Need to minimize the number of procurement actions		✓	✓		
Need to be able to rapidly move from concept to construction		✓	✓		

Procurement Method Award Component	Low-bid	Best Value	Qualifications-based	IDIQ	Remarks
Short-list		✓	✓		
Evaluation of qualifications			✓		
Evaluation of design approach		✓	✓		
Schedule evaluation		✓	✓		
Quality management plan evaluation	✓	✓	✓		
Price evaluation	✓	✓			
DBE goals	✓	✓	✓		

***Airport Project Delivery Method Issue Information***

Issues	DBB	CMR	DB	DBOM	Comments
<b>Project-level:</b> <i>Benefit</i>	<ul style="list-style-type: none"> <li>• Project size</li> </ul>	<ul style="list-style-type: none"> <li>• Project size</li> <li>• Risk</li> <li>• Shed control</li> <li>• Cost prec</li> <li>• Cost control</li> </ul>	<ul style="list-style-type: none"> <li>• Project size</li> <li>• Risk</li> <li>• Sched Comp</li> <li>• Sched control</li> <li>• Cost prec</li> <li>• Cost control</li> </ul>	No experience	LEED not applicable in all PDMs
<b>Project-level:</b> <i>Constraint</i>	<ul style="list-style-type: none"> <li>• Risk</li> <li>• Sched Comp</li> <li>• Cost prec</li> <li>• Cost control</li> </ul>			No experience	
<b>Agency-level:</b> <i>Benefit</i>	<ul style="list-style-type: none"> <li>• Airport staff exp</li> <li>• Airport proj control</li> <li>• Control ops impact</li> <li>• 3<sup>rd</sup> party input</li> </ul>			No experience	
<b>Agency-level:</b> <i>Constraint</i>		<ul style="list-style-type: none"> <li>• Airport staff exp</li> <li>• Airport proj control</li> <li>• Control ops impact</li> <li>• 3<sup>rd</sup> party input</li> </ul>	<ul style="list-style-type: none"> <li>• Airport staff exp</li> <li>• Airport proj control</li> <li>• Control ops impact</li> <li>• 3<sup>rd</sup> party input</li> </ul>	No experience	
<b>Public Policy/Regulatory:</b> <i>Benefit</i>	<ul style="list-style-type: none"> <li>• Competition</li> <li>• DBE</li> <li>• Legal</li> <li>• Method allowed</li> </ul>	<ul style="list-style-type: none"> <li>• DBE</li> </ul>	<ul style="list-style-type: none"> <li>• DBE</li> </ul>	No experience	
<b>Public Policy/Regulatory:</b> <i>Constraint</i>		<ul style="list-style-type: none"> <li>• Competition</li> <li>• Legal</li> <li>• Method allowed</li> </ul>	<ul style="list-style-type: none"> <li>• Competition</li> <li>• Legal</li> <li>• Method allowed</li> </ul>	No experience	
<b>Life Cycle:</b> <i>Benefit</i>	<ul style="list-style-type: none"> <li>• Sustainability</li> </ul>	<ul style="list-style-type: none"> <li>• Maintenance</li> <li>• Sustainability</li> </ul>	<ul style="list-style-type: none"> <li>• Maintenance</li> <li>• Sustainability</li> </ul>	<ul style="list-style-type: none"> <li>• Life cycle cost</li> <li>• Maintenance</li> <li>• Sustainability</li> </ul>	
<b>Life Cycle:</b> <i>Constraint</i>	<ul style="list-style-type: none"> <li>• Life cycle cost</li> <li>• Maintenance</li> </ul>	<ul style="list-style-type: none"> <li>• Life cycle cost</li> </ul>	<ul style="list-style-type: none"> <li>• Life cycle cost</li> </ul>		
<b>Other:</b> <i>Benefit</i>				No experience	
<b>Other:</b> <i>Constraint</i>	<ul style="list-style-type: none"> <li>• Adversarial Relationship</li> <li>• Claims</li> </ul>	<ul style="list-style-type: none"> <li>• Adversarial Relationship</li> <li>• Claims</li> </ul>	<ul style="list-style-type: none"> <li>• Adversarial Relationship</li> <li>• Claims</li> </ul>	No experience	

**Airport Project Delivery Method Value Information**

**Effectiveness in delivering quality in project aspects**

Color Code	Blank = Does not apply	Below Standard = 1&2	Meets Standard = 3	Exceeds Standard = 4&5
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Project Aspects	DBB	CMR	DB	DBOM
Completeness of final design deliverables	5	4	2	3
Accuracy of design calculations	5	4	2	3
Accuracy of quantities	5	4	2	3
Acceptance of design deliverables	5	4	2	3
Accuracy of specifications	5	4	2	3
Accuracy of as-built documents	3	3	3	3
Accuracy/applicability of O&M manuals, etc.	3	3	3	3
Implementation of approved QA/QC plans	3	3	3	3
Accuracy of preconstruction cost estimates	1	5	2	3
Ability to achieve post-award budgets	2	4	4	3
Accuracy of preconstruction schedules	4	5	5	3
Ability to achieve post-award schedules	4	5	5	3
Material quality	5	2	2	3
Workmanship quality	3	3	3	3
Aesthetics	5	2	2	3
Sustainability	3	3	3	3
Maintainability	3	3	3	4
Operability	3	3	3	4
Security during construction	3	3	3	3
Aircraft operations during construction	4	3	3	3
Passenger traffic flow during construction	4	3	3	3
Interest to potential bidding community	3	3	3	3
<b>Effectiveness Index</b>	<b>3.7</b>	<b>3.5</b>	<b>2.9</b>	<b>3.1</b>

**Effectiveness in delivering value in preconstruction phase**

Color Code	Blank = Does not apply	Not Valued = 1	Valued =2&3	Highly Valued = 4&5
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Preconstruction Tasks	DBB	CMR	DB	DBOM
Conceptual estimating	1	5	5	5
Value analysis/value engineering	1	5	5	5
Design charrettes	3	3	3	3
Design reviews	5	5	5	5
Regulatory reviews	5	5	5	5
Security impact studies	5	5	5	5
Environmental studies	5	5	5	5
Early contractor involvement	3	3	3	3
Cost engineering reviews	3	3	3	3
Constructability reviews	3	3	3	3
Biddability reviews	3	3	3	3
Operability reviews	3	3	3	3
Life cycle cost analysis	3	3	3	3
<b>Value Index</b>	<b>3.3</b>	<b>3.9</b>	<b>3.9</b>	<b>3.9</b>

### **Summary Comments**

This case study applies to a single agency with responsibility for multiple airports.

## Case 4 - Colorado Springs Airport

### *Airport Information*

Airport Name: Colorado Springs Airport;  
 Three-letter Code: COS  
 Name of Agency:  
 Type of Organization: Public Airport Operator  
 Location: Colorado Springs, Colorado

### *Airport Traffic Volume Information*

Number of annual operations (take-offs and landings): 40,150  
 Annual passenger throughput: 2 million  
 Annual cargo throughput: 14,000 tons

### *Airport Construction Program Information*

Annual construction budget: \$20 million  
 Average annual number of projects: 8 – 14  
 Project monetary size range: \$200k to \$36 million  
 Average monetary size of a typical project: \$ < 1 mil or between \$5-9 million  
 Number of professional design/construction staff: 8

### *Airport Project Delivery Method Experience Information*

	Design-Bid-Build	Construction Manager-at-Risk	Design-Build	Design-Build-Operate-Maintain
Number of Projects	>10	0	1-5	0
Percentage of Construction Budget	>50%	0	<10%	0

### *Airport Project Delivery Method Rationale Information*

#### **Airport Project Delivery Decision-making Process**

COS airport staff makes recommendation to City of Colorado Springs contracting office and the decision is made in partnership. The FAA Airport Improvement Program (AIP) may override some delivery decisions if they are not comfortable with the proposed delivery methods.

**Project Factors Considered in Project Delivery Decision**  
*(Italics indicate airport furnished factor)*

Project factors considered in project delivery decision	Drives use of alternative delivery method
Project monetary size	✓
Project schedule issues	✓
Project technical complexity	
Project type (vertical vs. horizontal)	✓
Project security issues (outside secure zone vs. inside secure zone)	✓
Project location (landside, airside, or terminal)	
Project quality assurance requirements	
Project life cycle issues (maintenance/operations)	
Incentives for obtaining federal or state funding	✓
Project generates revenue	
<i>COS uses design-build for specialty work e.g., prefab metal building and airport signage.</i>	✓

**Reasons for Selecting Project Delivery Method**  
*(\*most significant reason; Italics indicate airport furnished factor)*

Reason	DBB	CMR	DB	DBOM
Reduce/compress/accelerate project delivery period			*✓	
Establish project budget at an early stage of design development			✓	
Get early construction contractor involvement			✓	
Encourage innovation			✓	
Facilitate Value Engineering			✓	
Encourage price competition (bidding process)	*✓			
Compete different design solutions through the proposal process			✓	
Redistribute risk			✓	
Complex project requirements	✓			
Flexibility needs during construction phase			✓	

**Workforce-Related Reasons for Selecting Project Delivery Method:** None

***Airport Risk Analysis Process Information***

**Formal Risk Analysis Areas:** None

**Project Cost Estimate Uncertainty Analysis:** They try to work into the 5-8% range with contingency.

**Risk Identification Techniques Used:** None

**Risk Assessment Techniques:** None

**Risk Management Techniques:** None

**Risk Technique used to Draft Contract:** None

***Airport Procurement Process Information***

Procurement Constraint	Low-bid	Best Value	Qualifications-based	IDIQ	Remarks
Need to obtain federal funding		✓		✓	FAA prefers low bid, but it is not a firm constraint.

Procurement Preference	Low-bid	Best Value	Qualifications-based	IDIQ	Remarks
Desire to not change past procurement methods					They are seeking flexibility
Desire to eliminate firms with poor past records from competition		✓			
Desire to encourage firms with good past records to compete		✓			
Need to ensure selection of well-qualified designers and/or builders		✓		✓	
Need to minimize front-end effort	✓				
Need to appear fair and objective	✓				Can be achieved with BV and IDIQ, but not absolutely necessary.
Need to be able to justify selection to higher authorities	✓				In some cases for state and federal funding.
Need to be able to justify selection to the public	✓	✓		✓	All very defensible.
Need to be able to justify selection to third party stakeholders	✓				
Need to minimize the number of procurement actions	✓				
Need to be able to rapidly move from concept to construction		✓			



Procurement Method Award Component	Low-bid	Best Value	Qualifications-based	IDIQ	Remarks
Short-list		✓			
Financial prequalification		✓			Bonding requirements on all projects.
Evaluation of qualifications		✓		✓	Primarily in BV.
Alternative design concepts		✓			
Evaluation of design approach		✓			
Schedule evaluation	✓	✓		✓	
Quality management plan evaluation		✓			
Security plan evaluation	✓				
Safety plan evaluation	✓	✓			
Price evaluation	✓	✓		✓	
Bonding requirements	✓	✓		✓	
DBE goals	✓				Only on federal contracts.
<i>Availability of funding</i>	✓			✓	Bids need to be in hand for some federal funding (low bids). IDIQ can work well with uncertain funding scenarios.

*Airport Project Delivery Method Issue Information*

Issues	DBB	CMR	DB	DBOM	Comments
<b>Project-level:</b> <i>Benefit</i>	<ul style="list-style-type: none"> <li>• Cost Control</li> </ul>		<ul style="list-style-type: none"> <li>• Risk</li> <li>• Sched Comp</li> <li>• Sched control</li> <li>• Cost Control</li> </ul>		
<b>Project-level:</b> <i>Constraint</i>	<ul style="list-style-type: none"> <li>• Risk</li> <li>• Sched Comp</li> <li>• Shed control</li> <li>•</li> </ul>				
<b>Agency-level:</b> <i>Benefit</i>	<ul style="list-style-type: none"> <li>• Airport staff exp</li> <li>• Airport proj control</li> <li>• Security</li> <li>• Impact on ops</li> <li>• 3<sup>rd</sup> party input</li> </ul>		<ul style="list-style-type: none"> <li>• Security</li> <li>• Impact on ops</li> <li>• Impact on passengers</li> </ul>		
<b>Agency-level:</b> <i>Constraint</i>	<ul style="list-style-type: none"> <li>• Impact on passengers</li> </ul>		<ul style="list-style-type: none"> <li>• Airport staff exp</li> <li>• Airport proj</li> </ul>		
<b>Public Policy/Regulatory:</b> <i>Benefit</i>	<ul style="list-style-type: none"> <li>• Competition</li> <li>• DBE</li> </ul>				
<b>Public Policy/Regulatory:</b> <i>Constraint</i>			<ul style="list-style-type: none"> <li>• DBE</li> </ul>		
<b>Life Cycle:</b> <i>Benefit</i>	<ul style="list-style-type: none"> <li>• Life cycle cost</li> <li>• Maintenance</li> </ul>		<ul style="list-style-type: none"> <li>• Life cycle cost</li> <li>• Maintenance</li> </ul>		Sustainability N/A
<b>Life Cycle:</b> <i>Constraint</i>					
<b>Other:</b> <i>Benefit</i>			<ul style="list-style-type: none"> <li>• Adversarial Relationship</li> <li>• Claims</li> </ul>		
<b>Other:</b> <i>Constraint</i>	<ul style="list-style-type: none"> <li>• Adversarial Relationship</li> <li>• Claims</li> </ul>				

**Airport Project Delivery Method Value Information**

**Effectiveness in delivering quality in project aspects**

<b>Color Code</b>	<b>Blank = Does not apply</b>	<b>Below Standard = 1&amp;2</b>	<b>Meets Standard = 3</b>	<b>Exceeds Standard = 4&amp;5</b>
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Project Aspects	DBB	CMR	DB	DBOM
Completeness of final design deliverables	5		2	
Accuracy of design calculations	5		3	
Accuracy of quantities	5		3	
Acceptance of design deliverables	5		3	
Accuracy of specifications	5		2	
Accuracy of as-built documents	2		4	
Accuracy/applicability of O&M manuals, etc.	2		4	
Implementation of approved QA/QC plans	5		3	
Accuracy of preconstruction cost estimates	2		4	
Ability to achieve post-award budgets	2		4	
Accuracy of preconstruction schedules	2		4	
Ability to achieve post-award schedules	3		4	
Material quality	3		3	
Workmanship quality	4		3	
Aesthetics	3		3	
Sustainability	3		3	
Maintainability	3		3	
Operability	3		3	
Security during construction	3		3	
Aircraft operations during construction	3		3	
Passenger traffic flow during construction	3		3	
Interest to potential bidding community	2		4	
<b>Effectiveness Index</b>	<b>3.3</b>		<b>3.2</b>	

**Effectiveness in delivering value in preconstruction phase**

<b>Color Code</b>	<b>Blank = Does not apply</b>	<b>Not Valued = 1</b>	<b>Valued =2&amp;3</b>	<b>Highly Valued = 4&amp;5</b>
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Preconstruction Tasks	DBB	CMR	DB	DBOM
Conceptual estimating	3		4	
Value analysis/value engineering	3		4	
Design charrettes	3		3	
Design reviews	4		4	
Regulatory reviews	3		3	
Security impact studies	3		3	
Environmental studies	3		3	
Early contractor involvement	2		4	
Cost engineering reviews	3		4	
Constructability reviews	2		4	
Biddability reviews	2		4	
Operability reviews	2		4	
Life cycle cost analysis	2		4	
<b>Value Index</b>	<b>2.7</b>		<b>3.7</b>	

**Case 5 - Dallas-Fort Worth International Airport**

***Airport Information***

Airport Name: Dallas Fort Worth International Airport  
 Three-letter Code: DFW  
 Name of Agency:  
 Type of Organization: Public Airport Operator  
 Location: Dallas, Texas

***Airport Traffic Volume Information***

Number of annual operations (take-offs and landings): 779,000  
 Annual passenger throughput: 60 million  
 Annual cargo throughput: 758,000 tons

***Airport Construction Program Information***

Annual construction budget: \$425 million  
 Average annual number of projects: 135  
 Project monetary size range: \$8,000 to \$100+ million  
 Average monetary size of a typical project: \$2- 5 million  
 Number of professional design/construction staff: 120

***Airport Project Delivery Method Experience Information***

	Design-Bid-Build	Construction Manager-at-Risk	Design-Build	Design-Build-Operate-Maintain
Number of Projects	>10	>10	1-5	1
Percentage of Construction Budget	>50%	26-50%	<10%	<10%

***Airport Project Delivery Method Rationale Information***

**Airport Project Delivery Decision-making Process**

Department convenes a group and selects PDM based on “speed” – urgency of need to get construction completed and source of project funds. If there is no “need for speed” then DBB is the preferred method. CMR is preferred if “need for speed” and DB is used if “speed is of the utmost importance.” Can only use CMR if bonds are funding project.

**Project Factors Considered in Project Delivery Decision**

Project factors considered in project delivery decision	Drives use of alternative delivery method
Project monetary size	✓
Project schedule issues	✓
Project technical complexity	
Project security issues (outside secure zone vs. inside secure zone)	
Project location (landside, airside, or terminal)	
Project environmental issues	✓
Project third party interface issues	
Project air traffic control issues	
Project quality assurance requirements	
Project life cycle issues (maintenance/operations)	✓
Project sustainability issues	✓
Incentives for obtaining federal or state funding	✓
Project generates revenue	✓

**Reasons for Selecting Project Delivery Method**  
*(\*most significant reason)*

Reason	DBB	CMR	DB	DBOM
Reduce/compress/accelerate project delivery period		*✓	*✓	
Establish project budget at an early stage of design development		✓	✓	
Get early construction contractor involvement		✓	✓	
Encourage innovation		✓	✓	✓
Facilitate Value Engineering		✓	✓	
Encourage price competition (bidding process)	*✓			
Compete different design solutions through the proposal process			✓	
Complex project requirements		✓		
Flexibility needs during construction phase		✓	✓	
Provide mechanism for follow-on operations and/or maintenance				*✓
Encourage sustainability	✓	✓	✓	✓
Project is a revenue generator		✓	✓	✓

**Workforce-Related Reasons for Selecting Project Delivery Method:** None

***Airport Risk Analysis Process Information***

**Formal Risk Analysis Areas:** None

**Project Cost Estimate Uncertainty Analysis:** Yes, financial analysis with risk consideration

**Risk Identification Techniques Used:**

- Brainstorming
- Scenario planning
- Expert interviews
- Collaboration, coordination & communication is their motto

**Risk Assessment Techniques:** None

**Risk Management Techniques:**

- Risk register or risk charter
- Risk management plan
- Risk mitigation plan

**Risk Technique used to Draft Contract:** Yes, if necessary...diesel escalation clause or other project-specific cost or schedule risk.

***Airport Procurement Process Information***

Procurement Constraint	Low-bid	Best Value	Qualifications-based	IDIQ	Remarks
Local law		✓	✓		
State law		✓	✓		
Need to obtain federal funding		✓	✓		
Process used to obtain funding		✓	✓		

Procurement Preference	Low-bid	Best Value	Qualifications-based	IDIQ	Remarks
Desire to encourage firms with good past records to compete	✓	✓	✓	✓	
Need to ensure selection of well-qualified designers and/or builders		✓		✓	
Need to be able to rapidly move from concept to construction			✓		

Procurement Method Award Component	Low-bid	Best Value	Qualifications-based	IDIQ	Remarks
Short-list	✓	✓	✓		DBB-sometimes for special purpose equipment
Financial prequalification		✓	✓		
Evaluation of qualifications		✓	✓		
Alternative design concepts		✓	✓		
Evaluation of design approach		✓	✓		
Schedule evaluation	✓	✓	✓		
Security plan evaluation		✓	✓		
Price evaluation	✓	✓			
Bonding requirements	✓	✓	✓		
DBE goals	✓	✓	✓		

**Airport Project Delivery Method Issue Information**

Issues	DBB	CMR	DB	DBOM	Comments
<b>Project-level:</b> <i>Benefit</i>	<ul style="list-style-type: none"> <li>• Project Size</li> <li>• Risk</li> <li>• Sched Comp</li> <li>• Sched control</li> <li>• Cost Prec</li> <li>• Cost control</li> </ul>	<ul style="list-style-type: none"> <li>• Sched Comp</li> <li>• Sched control</li> <li>• Revenue generator</li> </ul>	<ul style="list-style-type: none"> <li>• Sched Comp</li> <li>• Sched control</li> <li>• Revenue generator</li> </ul>		1 DBOM for people mover
<b>Project-level:</b> <i>Constraint</i>	<ul style="list-style-type: none"> <li>• Revenue generator</li> </ul>	<ul style="list-style-type: none"> <li>• Project Size</li> <li>• Risk</li> <li>• Cost Prec</li> <li>• Cost control</li> </ul>	<ul style="list-style-type: none"> <li>• Project Size</li> <li>• Risk</li> <li>• Cost Prec</li> <li>• Cost control</li> </ul>		Size – if GMP must be set early in design process, then CMR/DB puts in too much contingency
<b>Agency-level:</b> <i>Benefit</i>	<ul style="list-style-type: none"> <li>• Airport staff exp</li> <li>• Security</li> <li>• Impact on ops</li> <li>• Impact on passengers</li> <li>• 3<sup>rd</sup> party input</li> </ul>	<ul style="list-style-type: none"> <li>• Airport staff exp</li> <li>• Airport proj control</li> <li>• Security</li> <li>• Impact on ops</li> <li>• Impact on passengers</li> <li>• 3<sup>rd</sup> party input</li> </ul>	<ul style="list-style-type: none"> <li>• Airport staff exp</li> <li>• Airport proj control</li> <li>• Security</li> <li>• Impact on ops</li> <li>• Impact on passengers</li> <li>• 3<sup>rd</sup> party input</li> </ul>	<ul style="list-style-type: none"> <li>• Airport staff exp</li> <li>• Airport proj control</li> <li>• Security</li> <li>• Impact on ops</li> <li>• Impact on passengers</li> <li>• 3<sup>rd</sup> party input</li> </ul>	
<b>Agency-level:</b> <i>Constraint</i>	<ul style="list-style-type: none"> <li>• Airport proj control</li> </ul>				
<b>Public Policy/Regulatory:</b> <i>Benefit</i>	<ul style="list-style-type: none"> <li>• Competition</li> <li>• DBE</li> <li>• Legal</li> <li>• Method allowed</li> </ul>	<ul style="list-style-type: none"> <li>• DBE</li> </ul>	<ul style="list-style-type: none"> <li>• DBE</li> </ul>	<ul style="list-style-type: none"> <li>• DBE</li> </ul>	
<b>Public Policy/Regulatory:</b> <i>Constraint</i>		<ul style="list-style-type: none"> <li>• Competition</li> <li>• Legal</li> <li>• Method allowed</li> </ul>	<ul style="list-style-type: none"> <li>• Competition</li> <li>• Legal</li> <li>• Method allowed</li> </ul>	<ul style="list-style-type: none"> <li>• Competition</li> <li>• Legal</li> <li>• Method allowed</li> </ul>	
<b>Life Cycle:</b> <i>Benefit</i>	DFW Asset Development Sustainability Initiative				
	<ul style="list-style-type: none"> <li>– happens before PDM decision</li> <li>– Sets standards for sustainability</li> <li>– Used on people mover DBOM</li> </ul>				
<b>Life Cycle:</b> <i>Constraint</i>					
<b>Other:</b> <i>Benefit</i>	<ul style="list-style-type: none"> <li>• Adversarial Relationship</li> <li>• Claims</li> </ul>			<ul style="list-style-type: none"> <li>• Adversarial Relationship</li> <li>• Claims</li> </ul>	
<b>Other:</b> <i>Constraint</i>		<ul style="list-style-type: none"> <li>• Adversarial Relationship</li> <li>• Claims</li> </ul>	<ul style="list-style-type: none"> <li>• Adversarial Relationship</li> <li>• Claims</li> </ul>		DFW had BAD experience on major CMR project. Felt that CMR was not

Issues	DBB	CMR	DB	DBOM	Comments
					owner's advocate. Strong distrust of contractors observed.

*Airport Project Delivery Method Value Information*

**Effectiveness in delivering quality in project aspects**

Color Code	Blank = Does not apply	Below Standard = 1&2	Meets Standard = 3	Exceeds Standard = 4&5
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Project Aspects	DBB	CMR	DB	DBOM
Completeness of final design deliverables	4	4	4	
Accuracy of design calculations	4	4	4	
Accuracy of quantities	4	4	4	
Acceptance of design deliverables	4	4	4	
Accuracy of specifications	4	4	4	
Accuracy of as-built documents	3	4	4	
Accuracy/applicability of O&M manuals, etc.	4	4	4	
Implementation of approved QA/QC plans	4	4	4	
Accuracy of preconstruction cost estimates	5	3	3	
Ability to achieve post-award budgets	4	4	4	
Accuracy of preconstruction schedules	4	3	3	
Ability to achieve post-award schedules	4	4	4	
Material quality	4	3	3	
Workmanship quality	4	3	3	
Aesthetics	4	4	4	
Sustainability	4	4	4	
Maintainability	4	4	4	
Operability	4	4	4	
Security during construction	4	4	4	
Aircraft operations during construction	4	4	4	
Passenger traffic flow during construction	4	4	4	
Interest to potential bidding community	4	3	3	
<b>Effectiveness Index</b>	<b>4.0</b>	<b>3.8</b>	<b>3.8</b>	



**Effectiveness in delivering value in preconstruction phase**

Color Code	Blank = Does not apply	Not Valued = 1	Valued =2&3	Highly Valued = 4&5
Preconstruction Tasks	DBB	CMR	DB	DBOM
Conceptual estimating	4	4	4	
Value analysis/value engineering	3	4	4	
Design charrettes	2	4	4	
Design reviews	3	4	4	
Regulatory reviews	3	3	3	
Security impact studies	3	4	4	
Environmental studies	3	3	3	
Early contractor involvement	1	4	4	
Cost engineering reviews	3	4	4	
Constructability reviews	3	4	4	
Biddability reviews	3	4	4	
Operability reviews	3	4	4	
Life cycle cost analysis	3	3	3	
<b>Value Index</b>	<b>2.8</b>	<b>3.8</b>	<b>3.8</b>	

**Summary Comments**

Major issues on PDM is the color of money...they have restrictions on certain types of money that prevent them from using all the PDMs. They relegate the life cycle issues to the front-end planning and development process before the PDM is selected. So by process it can't influence the decision.

## Case 6 - Denver International Airport

### *Airport Information*

Airport Name: Denver International Airport  
 Three-letter Code: DEN  
 Name of Agency:  
 Type of Organization: Public Airport Operator  
 Location: Denver, Colorado

### *Airport Traffic Volume Information*

Number of annual operations (take-offs and landings): 610,000  
 Annual passenger throughput: 47.3 million  
 Annual cargo throughput: 645,000 tons

### *Airport Construction Program Information*

Annual construction budget: \$200-300 million  
 Average annual number of projects: 20  
 Project monetary size range: \$500,000 to \$150 million  
 Average monetary size of a typical project: \$2-3 million  
 Number of professional design/construction staff: 75 + general engineering consultant

### *Airport Project Delivery Method Experience Information*

	Design-Bid-Build	Construction Manager-at-Risk	Design-Build	Design-Build-Operate-Maintain
Number of Projects	>10	1-5	>10	0
Percentage of Construction Budget	>50%	<10%	<10%	0

### *Airport Project Delivery Method Rationale Information*

#### **Airport Project Delivery Decision-making Process**

Airport design/construction personnel ultimately make the project delivery method selection decision based on the following logic:

- Control over the selection of the contractor is a key concern. When they are doing a project where they need more highly qualified contractors, they would like to have more control over who they work with. Example of Concourse C was given that due to size and complexity, they only wanted to work with the best.
- Nature of the contract size and complexity are main drivers.
- If it is a sole source contract, they do need to do a justification.

**Project Factors Considered in Project Delivery Decision**  
*(Italics indicate airport furnished factor)*

Project factors considered in project delivery decision	Drives use of alternative delivery method
Project monetary size	✓
Project budget control issues	
Project schedule issues	✓
Project technical complexity	✓
Incentives for obtaining federal or state funding	✓
<i>City and regional politics</i>	

**Reasons for Selecting Project Delivery Method**  
*(\*most significant reason; Italics indicate airport furnished factor)*

Reason	DBB	CMR	DB	DBOM
Reduce/compress/accelerate project delivery period			*✓	
Establish project budget at an early stage of design development	✓			
Get early construction contractor involvement			✓	
Facilitate Value Engineering	✓			
Encourage price competition (bidding process)	*✓			
Compete different design solutions through the proposal process			✓	
Complex project requirements		*✓	✓	
Flexibility needs during construction phase			✓	
<i>Augment staff</i>		✓	✓	

**Workforce-Related Reasons for Selecting Project Delivery Method**

DIA uses CMR and DB to augment existing workforce during program funding spikes.

***Airport Risk Analysis Process Information***

**Formal Risk Analysis Areas:** None

**Project Cost Estimate Uncertainty Analysis:** Yes, range cost estimates

**Risk Identification Techniques Used:** None

**Risk Assessment Techniques:** None

**Risk Management Techniques:** None

**Risk Technique used to Draft Contract:** None

***Airport Procurement Process Information***

Procurement Constraint	Low-bid	Best Value	Qualifications-based	IDIQ	Remarks
Local law					They are owned by the City and County of Denver. They have traditionally used low-bid, but they are able to think outside the box without much constraint. <u>They have not been constrained in the choice of procurement method by any of our referenced constraints.</u> Additionally, because such a low level of funding comes from taxes (e.g., their funding comes from airport revenues vs. taxes) they are a state “enterprise” vs. a state “agency.” State enterprises are much less constrained by state procurement regulations and laws.
Need to obtain federal funding					DBEs come into play, but they are not constrained. However with Federal funds they typically use low-bid, but again, they do not feel that they are constrained in any way.

Procurement Preference	Low-bid	Best Value	Qualifications-based	IDIQ	Remarks
Desire to not change past procurement methods	✓				History has a lot to do with they do things today.
Desire to eliminate firms with poor past records from competition		✓	✓	✓	Not eliminate firms, but to ensure the best firm is selected.
Desire to encourage firms with good past records to compete		✓	✓	✓	
Need to ensure selection of well-qualified designers and/or builders		✓	✓	✓	
Need to minimize front-end effort		✓	✓	✓	
Need to appear fair and objective	✓				
Need to be able to justify selection to higher authorities	✓				
Need to be able to justify selection to the public	✓				
Need to minimize the number of procurement actions				✓	
Need to be able to rapidly move from concept to construction			✓	✓	

Procurement Method Award Component	Low-bid	Best Value	Qualifications-based	IDIQ	Remarks
Short-list			✓	✓	
Financial prequalification	✓	✓	✓	✓	For contracts over \$750k they have a board of prequalification. Contractors are prequalified for 7 different categories of construction and 8 financial thresholds.
Evaluation of qualifications	✓	✓	✓	✓	
Schedule evaluation					Schedules are very constrained on their projects.
Quality management plan evaluation		✓	✓		
Environmental plan evaluation		✓	✓		
Security plan evaluation					Security plans are provided and compliance is ensured.
Price evaluation	✓				
Bonding requirements	✓	✓	✓	✓	
DBE goals					Only for Federally funded projects.

*Airport Project Delivery Method Issue Information*

Issues	DBB	CMR	DB	DBOM	Comments
<b>Project-level:</b> <i>Benefit</i>	<ul style="list-style-type: none"> <li>Sched control</li> <li>Cost Prec</li> <li>Cost control</li> </ul>	<ul style="list-style-type: none"> <li>Large project</li> <li>Sched Comp</li> </ul>	<ul style="list-style-type: none"> <li>Sched Comp</li> </ul>		
<b>Project-level:</b> <i>Constraint</i>	<ul style="list-style-type: none"> <li>Sched Comp</li> </ul>	<ul style="list-style-type: none"> <li>Sched control</li> <li>Cost control</li> </ul>	<ul style="list-style-type: none"> <li>Sched control</li> <li>Cost control</li> </ul>		
<b>Agency-level:</b> <i>Benefit</i>	<ul style="list-style-type: none"> <li>Airport staff exp</li> <li>Airport proj control</li> </ul>	<ul style="list-style-type: none"> <li>Airport staff exp</li> <li>Airport proj control</li> </ul>	<ul style="list-style-type: none"> <li>Airport staff exp</li> </ul>		
<b>Agency-level:</b> <i>Constraint</i>			<ul style="list-style-type: none"> <li>Airport proj control</li> </ul>		
<b>Public Policy/Regulatory:</b> <i>Benefit</i>		<ul style="list-style-type: none"> <li>Competition</li> <li>Legal</li> </ul>	<ul style="list-style-type: none"> <li>Competition</li> <li>Legal</li> </ul>		
<b>Public Policy/Regulatory:</b> <i>Constraint</i>	<ul style="list-style-type: none"> <li>Competition</li> <li>Legal</li> </ul>				One civil contractor wins all the DBB work because they are mobilized
<b>Life Cycle:</b> <i>Benefit</i>					No life cycle issues
<b>Life Cycle:</b> <i>Constraint</i>					
<b>Other:</b> <i>Benefit</i>		<ul style="list-style-type: none"> <li>Adversarial Relationship</li> <li>Claims</li> </ul>	<ul style="list-style-type: none"> <li>Adversarial Relationship</li> <li>Claims</li> </ul>		
<b>Other:</b> <i>Constraint</i>	<ul style="list-style-type: none"> <li>Adversarial Relationship</li> <li>Claims</li> </ul>				

***Airport Project Delivery Method Value Information***

**Effectiveness in delivering quality in project aspects:** Not provided by the airport.

<b>Color Code</b>	<b>Blank = Does not apply</b>	<b>Below Standard = 1&amp;2</b>	<b>Meets Standard = 3</b>	<b>Exceeds Standard = 4&amp;5</b>
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<b>Project Aspects</b>	<b>DBB</b>	<b>CMR</b>	<b>DB</b>	<b>DBOM</b>
Completeness of final design deliverables				
Accuracy of design calculations				
Accuracy of quantities				
Acceptance of design deliverables				
Accuracy of specifications				
Accuracy of as-built documents				
Accuracy/applicability of O&M manuals, etc.				
Implementation of approved QA/QC plans				
Accuracy of preconstruction cost estimates				
Ability to achieve post-award budgets				
Accuracy of preconstruction schedules				
Ability to achieve post-award schedules				
Material quality				
Workmanship quality				
Aesthetics				
Sustainability				
Maintainability				
Operability				
Security during construction				
Aircraft operations during construction				
Passenger traffic flow during construction				
Interest to potential bidding community				
<b>Effectiveness Index</b>				

**Effectiveness in delivering value in preconstruction phase:** Not provided by the airport.

<b>Color Code</b>	<b>Blank = Does not apply</b>	<b>Not Valued = 1</b>	<b>Valued =2&amp;3</b>	<b>Highly Valued = 4&amp;5</b>
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<b>Preconstruction Tasks</b>	<b>DBB</b>	<b>CMR</b>	<b>DB</b>	<b>DBOM</b>
Conceptual estimating				
Value analysis/value engineering				
Design charrettes				
Design reviews				
Regulatory reviews				
Security impact studies				
Environmental studies				
Early contractor involvement				
Cost engineering reviews				
Constructability reviews				
Biddability reviews				
Operability reviews				
Life cycle cost analysis				
<b>Value Index</b>				

## Case 7 - Memphis International Airport

### *Airport Information*

Airport Name: Memphis International Airport  
 Three-letter Code: MEM  
 Name of Agency: Memphis Shelby County Airport  
 Type of Organization: Public Airport Operator  
 Location: Memphis, Tennessee

### *Airport Traffic Volume Information*

Number of annual operations (take-offs and landings): 385,000  
 Annual passenger throughput: 11 million  
 Annual cargo throughput: 3.7 million tons

### *Airport Construction Program Information*

Annual construction budget: \$22 million  
 Average annual number of projects: 20-30  
 Project monetary size range: \$100,000 - \$20 million  
 Average monetary size of a typical project: \$5 – 6 million  
 Number of professional design/construction staff: 7

### *Airport Project Delivery Method Experience Information*

	Design-Bid-Build	Construction Manager-at-Risk	Design-Build	Design-Build-Operate-Maintain
Number of Projects	>10	>10	1-5	0
Percentage of Construction Budget	>50%	11-25%	<10%	0

No DBOM experience but planning on doing a DBOM for elevators, escalators and people mover

### *Airport Project Delivery Method Rationale Information*

#### **Airport Project Delivery Decision-making Process**

Airport authority management ultimately makes the project delivery method selection decision. Then the following process is followed:

First project magnitude considered – if small, director makes decision

1. perception of “need for speed” – must parallel design and construction
2. design for early contractor involvement
3. type of funding – federal DBB; bonds CMR...recommend alternative to director
4. Need to control the project during construction



**Project Factors Considered in Project Delivery Decision**  
*(Italics indicate airport furnished factor)*

Project factors considered in project delivery decision	Drives use of alternative delivery method
Project monetary size	
Project budget control issues	
Project schedule issues	✓
Project technical complexity	
Project type (vertical vs. horizontal)	✓
Project technical content	
Project location (landside, airside, or terminal)	
Project quality assurance requirements	
Incentives for obtaining federal or state funding	
Project generates revenue	✓
<i>Type of funding – federal, state, or local</i>	✓

**Reasons for Selecting Project Delivery Method**  
*(\*most significant reason; Italics indicate airport furnished factor)*

Reason	DBB	CMR	DB	DBOM
Reduce/compress/accelerate project delivery period		*✓	✓	
Establish project budget at an early stage of design development		✓	✓	
Get early construction contractor involvement		✓	✓	
Facilitate Value Engineering		✓	✓	
Encourage price competition (bidding process)	*✓	✓		
Redistribute risk		✓	*✓	
Complex project requirements		✓	✓	
Flexibility needs during construction phase	✓			
Provide mechanism for follow-on operations and/or maintenance				✓
<i>Federal funds available for special type projects – like seismic retrofit – designer writes the grant thus DBB or CMR is must</i>	✓	✓		

**Workforce-Related Reasons for Selecting Project Delivery Method:** None

***Airport Risk Analysis Process Information***

**Formal Risk Analysis Areas:** Project Schedule

**Project Cost Estimate Uncertainty Analysis:** Yes, range cost estimate

**Risk Identification Techniques Used:**

- Brainstorming
- Scenario planning
- Expert interviews

**Risk Assessment Techniques:**

- Qualitative: Risk list
- Quantitative: Schedule analysis

**Risk Management Techniques:** Risk management plan

**Risk Technique used to Draft Contract:** Yes, schedule analysis used to set “date-certain” delivery milestones in construction. Also design contract clauses requiring redesign to budget as well as a design quality clause that puts 10% of the design fee at risk for design quality issues.

*Airport Procurement Process Information*

Procurement Constraint	Low-bid	Best Value	Qualifications-based	IDIQ	Remarks
Need to obtain federal funding		✓	✓		
Airport procurement regulations	✓				Can disqualify bidder if pending legal action
Requirement to meet DBE goals		✓	✓		

Procurement Preference	Low-bid	Best Value	Qualifications-based	IDIQ	Remarks
Desire to not change past procurement methods	✓				
Desire to eliminate firms with poor past records from competition			✓		CMR- get GC on quals
Need to ensure selection of well-qualified designers and/or builders		✓	✓		
Need to minimize front-end effort	✓				

Procurement Method Award Component	Low-bid	Best Value	Qualifications-based	IDIQ	Remarks
Short-list		✓	✓		
Financial prequalification	✓	✓	✓		
Evaluation of qualifications		✓	✓		
Alternative design concepts	✓	✓	✓		Have used ATC one time on Low bid
Schedule evaluation		✓			
Price evaluation	✓	✓			
Bonding requirements	✓	✓	✓		
DBE goals	✓	✓	✓		

***Airport Project Delivery Method Issue Information***

Issues	DBB	CMR	DB	DBOM	Comments
<b>Project-level:</b> <i>Benefit</i>	<ul style="list-style-type: none"> <li>• Project Size</li> <li>• Risk</li> <li>• Sched control</li> <li>• Cost control</li> </ul>	<ul style="list-style-type: none"> <li>• Project Size</li> <li>• Risk</li> <li>• Sched Comp</li> <li>• Sched control</li> <li>• Cost Prec</li> <li>• Cost control</li> </ul>	<ul style="list-style-type: none"> <li>• Project Size</li> <li>• Risk</li> <li>• Sched Comp</li> <li>• Cost Prec</li> <li>• Cost control</li> </ul>		
<b>Project-level:</b> <i>Constraint</i>	<ul style="list-style-type: none"> <li>• Sched Comp</li> <li>• Cost Prec</li> </ul>		<ul style="list-style-type: none"> <li>• Sched control</li> </ul>		
<b>Agency-level:</b> <i>Benefit</i>	<ul style="list-style-type: none"> <li>• Airport staff exp</li> <li>• Airport proj control</li> <li>• Security</li> <li>• Impact on ops</li> <li>• Impact on passengers</li> <li>• 3<sup>rd</sup> party input</li> </ul>	<ul style="list-style-type: none"> <li>• Airport staff exp</li> <li>• Airport proj control</li> <li>• Security</li> <li>• Impact on ops</li> <li>• Impact on passengers</li> <li>• 3<sup>rd</sup> party input</li> </ul>	<ul style="list-style-type: none"> <li>• Security</li> <li>• Impact on ops</li> <li>• Impact on passengers</li> <li>• 3<sup>rd</sup> party input</li> </ul>		
<b>Agency-level:</b> <i>Constraint</i>			<ul style="list-style-type: none"> <li>• Airport staff exp</li> <li>• Airport proj control</li> </ul>		
<b>Public Policy/Regulatory:</b> <i>Benefit</i>	<ul style="list-style-type: none"> <li>• Competition</li> <li>• DBE</li> <li>• Legal</li> <li>• Method allowed</li> </ul>	<ul style="list-style-type: none"> <li>• Competition</li> <li>• DBE</li> <li>• Legal</li> <li>• Method allowed</li> </ul>	<ul style="list-style-type: none"> <li>• DBE</li> <li>• Legal</li> <li>• Method allowed</li> </ul>		
<b>Public Policy/Regulatory:</b> <i>Constraint</i>			<ul style="list-style-type: none"> <li>• Competition</li> </ul>		
<b>Life Cycle:</b> <i>Benefit</i>	<ul style="list-style-type: none"> <li>• Life cycle cost</li> <li>• Maintenance</li> </ul>	<ul style="list-style-type: none"> <li>• Life cycle cost</li> <li>• Maintenance</li> </ul>	<ul style="list-style-type: none"> <li>• Life cycle cost</li> <li>• Maintenance</li> </ul>		
<b>Life Cycle:</b> <i>Constraint</i>					
<b>Other:</b> <i>Benefit</i>		<ul style="list-style-type: none"> <li>• Adversarial Relationship</li> </ul>	<ul style="list-style-type: none"> <li>• Adversarial Relationship</li> </ul>		
<b>Other:</b> <i>Constraint</i>	<ul style="list-style-type: none"> <li>• Adversarial Relationship</li> </ul>				

*Airport Project Delivery Method Value Information*

**Effectiveness in delivering quality in project aspects**

Color Code	Blank = Does not apply	Below Standard = 1&2	Meets Standard = 3	Exceeds Standard = 4&5
Project Aspects	DBB	CMR	DB	DBOM
Completeness of final design deliverables	4	4	2	
Accuracy of design calculations	3	3	2	
Accuracy of quantities	4	4	3	
Acceptance of design deliverables	3	3	2	
Accuracy of specifications	3	3	2	
Accuracy of as-built documents	4	3	3	
Accuracy/applicability of O&M manuals, etc.	4	4	3	
Implementation of approved QA/QC plans	3	3	2	
Accuracy of preconstruction cost estimates	2	3	3	
Ability to achieve post-award budgets	4	4	3	
Accuracy of preconstruction schedules	4	4	1	
Ability to achieve post-award schedules	4	4	1	
Material quality	4	4	3	
Workmanship quality	4	4	3	
Aesthetics	4	4	2	
Sustainability	3	3	3	
Maintainability	3	3	3	
Operability	3	3	3	
Security during construction	3	3	3	
Aircraft operations during construction	3	3	3	
Passenger traffic flow during construction	3	3	3	
Interest to potential bidding community	4	4	4	
<b>Effectiveness Index</b>	<b>3.5</b>	<b>3.5</b>	<b>2.6</b>	

**Effectiveness in delivering value in preconstruction phase**

Color Code	Blank = Does not apply	Not Valued = 1	Valued =2&3	Highly Valued = 4&5
Preconstruction Tasks	DBB	CMR	DB	DBOM
Conceptual estimating	3	4	3	
Value analysis/value engineering	2	3	3	
Design charrettes	4	4	2	
Design reviews	3	2	2	
Regulatory reviews	4	4	3	
Security impact studies	1	1	1	
Environmental studies	1	1	1	
Early contractor involvement	2*	4	4	
Cost engineering reviews	1	4	1	
Constructability reviews	1*	4	1	
Biddability reviews	3	4	2	
Operability reviews	1	1	1	
Life cycle cost analysis	1	1	1	
<b>Value Index</b>	<b>2.1</b>	<b>2.8</b>	<b>1.9</b>	

\* Airport hires a CM to do constructability reviews on DBB projects during design

## Case 8 - Mineta - San José International Airport

### *Airport Information*

Airport Name: Norman Y. Mineta San José International Airport  
 Three-letter Code: SJC  
 Name of Agency:  
 Type of Organization: Aviation Consultant  
 Location: San José, California

### *Airport Traffic Volume Information*

Number of annual operations (take-offs and landings): 184,914  
 Annual passenger throughput: 10.7 million  
 Annual cargo throughput: 94,162 tons

### *Airport Construction Program Information*

Annual construction budget: \$345 million  
 Average annual number of projects: 70  
 Project monetary size range: \$2000 to \$185.5 million  
 Average monetary size of a typical project: \$5.0 million  
 Number of professional design/construction staff: 100

### *Airport Project Delivery Method Experience Information*

	Design-Bid-Build	Construction Manager-at-Risk	Design-Build	Design-Build-Operate-Maintain
Number of Projects	>10	0	1-5	0
Percentage of Construction Budget	>50%	0	11-25%	0

### *Airport Project Delivery Method Rationale Information*

#### **Airport Project Delivery Decision-making Process**

The Airport Director, in consultation with the San José Director of Public Works, makes the design build delivery method decision with the approval of the City of San José City Council. The process of choosing the project delivery method for a typical project includes considering the following factors:

1. The schedule available to complete the project based on the need for the project.
2. The funding available for the project, including the FAA funding availability.
3. The airports available resources to support and manage the project.
4. The resources in the engineering and construction community to complete the project.
5. The City of San José charter.
6. The airport's desire to maintain control over the design and construction process.

7. The default delivery method is design-bid-build.

Consideration of each of these factors visa vie the advantages and disadvantages of each of the four alternative delivery methods result in a recommended delivery method which is taken to the Airport Director. The Airport Director, in consultation with the San José Director of Public Works, makes the design build delivery method decision with the approval of the City of San José City Council.

- Their one large DB program has unique characteristics.
- Their first DB project was done in 2001.
- Anything less than \$5 m should be DBB.
- For the DB project, first they develop the “Basis of Design”. They call this document “Program Criteria Document” (≈ 10% design complete). They chose the DB contractor based on Qualifications only. The budget was fixed but schedule and scope were variable. The intention was to spend the budget in the most effective way possible.
- The DB competitive consisted of four DB contractors participating. The work went to the second best because the first chosen declined to provide full information about their finances (they were a privately-held company).

**Project Factors Considered in Project Delivery Decision**  
*(Italics indicate airport furnished factor)*

Project Factor Considered in Project Delivery Method Decision	Drives use of alternative delivery method
Project monetary size	
Project budget control issues	✓
Project schedule issues	✓
Project technical complexity	✓
Project quality assurance requirements	
Project sustainability issues	
Incentives for obtaining federal or state funding	✓
Project generates revenue	✓
<i>Risk evaluation</i>	

**Reasons for Selecting Project Delivery Method**

(\*most significant reason; *Italics indicate airport furnished factor*)

Reason	DBB	CMR	DB	DBOM
Reduce/compress/accelerate project delivery period			✓	
Establish project budget at an early stage of design development		✓		
Get early construction contractor involvement			✓	
Encourage innovation			✓	
Facilitate Value Engineering	✓		✓	
Encourage price competition (bidding process)	✓			
Compete different design solutions through the proposal process			✓	
Redistribute risk			✓	
Complex project requirements			✓	
Flexibility needs during construction phase	✓		✓	
Provide mechanism for follow-on operations and/or maintenance				✓
Innovative financing				✓

**Workforce-Related Reasons for Selecting Project Delivery Method**

SJC uses DB to augment existing workforce during program funding spikes.

***Airport Risk Analysis Process Information***

**Formal Risk Analysis Areas:** None

**Project Cost Estimate Uncertainty Analysis:**

- Contingency on construction scope of work (Unforeseen Conditions).
- Escalation of subcontract which have not been procured.
- Estimating contingency for unit pricing and quantity takeoff (varies based on the type of project).

**Risk Identification Techniques Used:**

- Brainstorming
- Expert interviews

**Risk Assessment Techniques:**

- **Qualitative risk assessment:** based upon the specific characteristics of the project element.

**Risk Management Techniques:** None

**Risk Technique used to Draft Contract:** Risk assessment is used to assign risk via contract structure.



*Airport Procurement Process Information*

Procurement Constraint	Low-bid	Best Value	Qualifications-based	IDIQ	Remarks
Need to obtain federal funding		✓	✓	✓	

Procurement Preference	Low-bid	Best Value	Qualifications-based	IDIQ	Remarks
Desire to not change past procurement methods	✓				
Desire to eliminate firms with poor past records from competition			✓	✓	SJC is not prohibited, but does not use this method.
Desire to encourage firms with good past records to compete		✓	✓	✓	
Need to ensure selection of well-qualified designers and/or builders		✓	✓		
Need to minimize front-end effort				✓	
Need to appear fair and objective	✓				
Need to be able to justify selection to higher authorities	✓	✓	✓		
Need to be able to justify selection to the public	✓				
Need to be able to justify selection to third party stakeholders	✓				
Need to minimize the number of procurement actions	✓			✓	
Need to be able to rapidly move from concept to construction			✓		

Procurement Method Award Component	Low-bid	Best Value	Qualifications-based	IDIQ	Remarks
Short-list			✓		Best value not used
Financial prequalification			✓		
Evaluation of qualifications			✓		
Alternative design concepts			✓		
Evaluation of design approach			✓		
Schedule evaluation			✓		
Quality management plan evaluation			✓		
Environmental plan evaluation			✓		
Security plan evaluation			✓		
Safety plan evaluation			✓		
Price evaluation	✓				
Bonding requirements	✓				
DBE goals	✓		✓		

*Airport Project Delivery Method Issue Information*

Issues	DBB	CMR	DB	DBOM	Comments
<b>Project-level:</b> <i>Benefit</i>	<ul style="list-style-type: none"> <li>Sched control</li> <li>Cost Prec</li> </ul>	<ul style="list-style-type: none"> <li>Risk</li> <li>Cost Prec</li> <li>Cost control</li> </ul>	<ul style="list-style-type: none"> <li>Risk</li> <li>Sched Comp</li> <li>Sched control</li> <li>Cost Prec</li> <li>Cost control</li> </ul>	<ul style="list-style-type: none"> <li>Risk</li> <li>Sched Comp</li> <li>Sched control</li> <li>Cost Prec</li> <li>Cost control</li> </ul>	Projects less than \$5 million are never design build.
<b>Project-level:</b> <i>Constraint</i>	<ul style="list-style-type: none"> <li>Risk</li> <li>Sched Comp</li> <li>Sched control</li> </ul>	<ul style="list-style-type: none"> <li>Sched Comp</li> <li>Sched control</li> </ul>	<ul style="list-style-type: none"> <li>Small size</li> </ul>	<ul style="list-style-type: none"> <li>Small size</li> </ul>	
<b>Agency-level:</b> <i>Benefit</i>	<ul style="list-style-type: none"> <li>Airport staff exp</li> <li>Airport proj control</li> </ul>		<ul style="list-style-type: none"> <li>Airport staff exp</li> <li>Impact on ops</li> <li>Impact on passengers</li> </ul>		
<b>Agency-level:</b> <i>Constraint</i>	<ul style="list-style-type: none"> <li>Impact on ops</li> <li>Impact on passengers</li> </ul>				
<b>Public Policy/Regulatory:</b> <i>Benefit</i>	<ul style="list-style-type: none"> <li>Competition</li> <li>Method allowed</li> </ul>		<ul style="list-style-type: none"> <li>Competition</li> <li>DBE</li> <li>Method allowed</li> </ul>		
<b>Public Policy/Regulatory:</b> <i>Constraint</i>	<ul style="list-style-type: none"> <li>DBE</li> </ul>				
<b>Life Cycle:</b> <i>Benefit</i>	<ul style="list-style-type: none"> <li>Life cycle cost</li> <li>Maintenance</li> <li>Sustainability</li> </ul>				
<b>Life Cycle:</b> <i>Constraint</i>					
<b>Other:</b> <i>Benefit</i>	<ul style="list-style-type: none"> <li>Local talent/expertise</li> </ul>		<ul style="list-style-type: none"> <li>Adversarial Relationship</li> <li>Claims</li> <li>Local talent/expertise</li> </ul>		
<b>Other:</b> <i>Constraint</i>	<ul style="list-style-type: none"> <li>Adversarial Relationship</li> <li>Claims</li> </ul>			<ul style="list-style-type: none"> <li>Local talent/expertise</li> </ul>	

*Airport Project Delivery Method Value Information*

**Effectiveness in delivering quality in project aspects**

Color Code	Blank = Does not apply	Below Standard = 1&2	Meets Standard = 3	Exceeds Standard = 4&5
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Project Aspects	DBB	CMR	DB	DBOM
Completeness of final design deliverables	5		4	4
Accuracy of design calculations	5		4	4
Accuracy of quantities	5		4	3
Acceptance of design deliverables	5		4	4
Accuracy of specifications	5		4	4
Accuracy of as-built documents	3		3	5
Accuracy/applicability of O&M manuals, etc.	3		3	4
Implementation of approved QA/QC plans	3		5	4
Accuracy of preconstruction cost estimates	3		5	5
Ability to achieve post-award budgets	2		5	4
Accuracy of preconstruction schedules	2	4	4	4
Ability to achieve post-award schedules	3	3	5	4
Material quality	3	3	2	5
Workmanship quality	3	4	3	5
Aesthetics	5	3	5	4
Sustainability	5	3	4	5
Maintainability	3	3	3	5
Operability	3	3	3	5
Security during construction	2	4	2	4
Aircraft operations during construction	2	2	2	4
Passenger traffic flow during construction	2	3	2	4
Interest to potential bidding community	5	3	5	4
<b>Effectiveness Index</b>	<b>3.5</b>	<b>3.2</b>	<b>3.7</b>	<b>4.3</b>

**Effectiveness in delivering value in preconstruction phase**

Color Code	Blank = Does not apply	Not Valued = 1	Valued = 2&3	Highly Valued = 4&5
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Preconstruction Tasks	DBB	CMR	DB	DBOM
Conceptual estimating	5		5	
Value analysis/value engineering	5		4	
Design charrettes	4		5	
Design reviews	5		5	
Regulatory reviews	3		4	
Security impact studies	5		5	
Environmental studies	5		5	
Early contractor involvement	1		5	
Cost engineering reviews	3		5	
Constructability reviews	2		4	
Biddability reviews	2		4	
Operability reviews	2		5	
Life cycle cost analysis	2		4	
<b>Value Index</b>	<b>3.4</b>		<b>4.6</b>	

## Case 9 - Tampa International Airport

### *Airport Information*

Airport Name: Tampa International Airport  
 Three-letter Code: TPA  
 Name of Agency:  
 Type of Organization: Public Airport Operator  
 Location: Tampa, Florida

### *Airport Traffic Volume Information*

Number of annual operations (take-offs and landings): 260,400  
 Annual passenger throughput: 19.3 million  
 Annual cargo throughput: 101,600 tons

### *Airport Construction Program Information*

Annual construction budget: \$95 - \$170 million  
 Average annual number of projects: 35  
 Project monetary size range: \$50,000 to \$80 million  
 Average monetary size of a typical project: \$2.5 million  
 Number of professional design/construction staff: 55

### *Airport Project Delivery Method Experience Information*

	Design-Bid-Build	Construction Manager-at-Risk	Design-Build	Design-Build-Operate-Maintain
Number of Projects	>10	1-5	>10	1
Percentage of Construction Budget	26 - 50%	<10%	>50%	<10%

### *Airport Project Delivery Method Rationale Information*

#### **Airport Project Delivery Decision-making Process**

Airport authority management ultimately makes the project delivery method selection decision. Process begins with Planning & Development deciding on the delivery method informally and making a recommendation. The recommendation with reasons why, are listed in a brief memo and sent to Executive Director (Management) for approval. So the whole process is informal. Their approval in DB is as follows:

- 1- Hire DB contractor QBS at the beginning of the design. The DB takes design to 60% complete while cooperating with the Airport. At 60% a GMP is

negotiated for the rest of design and construction. This way, the owner remains involved in most of design which helps in scope definition, *etc.*

- 2- For some projects, they put the project to bid at 60% complete design. The contractors that have been prequalified, will be selected based on lowest price alone in this case.

**Project Factors Considered in Project Delivery Decision**

Project Factor Considered in Project Delivery Decision	Drives use of alternative delivery method
Project schedule issues	✓
Project technical complexity	✓
Project third party interface issues	
Project generates revenue	✓

**Reasons for Selecting Project Delivery Method (*most significant reason*)**

	DBB	CMR	DB	DBOM
Reduce/compress/accelerate project delivery period			*✓	
Establish project budget at an early stage of design development			✓	
Get early construction contractor involvement		✓	✓	
Encourage innovation	✓	✓	✓	
Facilitate Value Engineering		✓	✓	
Encourage price competition (bidding process)	✓			
Redistribute risk		✓	✓	
Complex project requirements		✓	✓	
Flexibility needs during construction phase		✓	✓	
Reduce life cycle costs	✓	✓	✓	
Project is a revenue generator		✓	✓	
1- They have had great success with DB in value engineering. They share the savings with DB contractor. 2- In revenue generating project, it is important to move as expeditiously as possible. 3- Try not to do complex projects using DBB because of large risks.				

**Workforce-Related Reasons for Selecting Project Delivery Method:** None

***Airport Risk Analysis Process Information***

**Formal Risk Analysis Areas:** None – Form for insurance is filled out.

**Project Cost Estimate Uncertainty Analysis:** None.

**Contingency:**

- 1- Preconstruction Contingency which is 5% of value of contract,
- 2- Construction contingency covered by owner which is 10% of construction estimate.

**Risk Identification Techniques Used:**

- Brainstorming
- Scenario planning

**Risk Assessment Techniques:** None

**Risk Management Techniques:** None

**Risk Technique used to Draft Contract:** None

***Airport Procurement Process Information***

Procurement Constraint	Low-bid	Best Value	Qualifications-based	IDIQ	Remarks
State law	✓	No Best Value	✓	Only used for maintenance; no capital projects	
Need to obtain federal funding	✓				
Process used to obtain funding	✓				
Requirement to meet DBE goals	✓		✓		
Other:	<ul style="list-style-type: none"> <li>• DB is strictly QBS. The DB is chosen at the beginning of design strictly based on qualifications. Then the DB prepares the design up to 60% design and then a GMP is negotiated for the rest of design and contracts.</li> <li>• Sometimes, they put the project to bid at 60% design complete.</li> </ul>				

Procurement Preference	Low-bid	Best Value	Qualifications-based	IDIQ	Remarks
Desire to encourage firms with good past records to compete			✓		
Need to ensure selection of well-qualified designers and/or builders			✓		
Need to minimize the number of procurement actions			✓		
Need to be able to rapidly move from concept to construction			✓		

Procurement Method Award Component	Low-bid	Best Value	Qualifications-based	IDIQ	Remarks
Short-list			✓		
Financial prequalification	✓		✓		
Evaluation of qualifications	✓		✓		
Alternative design concepts			✓		
Evaluation of design approach			✓		
Schedule evaluation			✓		
Price evaluation	✓				

***Airport Project Delivery Method Issue Information***

Issues	DBB	CMR	DB	DBOM	Comments
<b>Project-level:</b> <i>Benefit</i>	<ul style="list-style-type: none"> <li>• Project Size</li> </ul>	<ul style="list-style-type: none"> <li>• Project Size</li> <li>• Risk</li> <li>• Sched Comp</li> <li>• Cost control</li> </ul>	<ul style="list-style-type: none"> <li>• Project Size</li> <li>• Risk</li> <li>• Sched Comp</li> <li>• Sched control</li> <li>• Cost Prec</li> <li>• Cost control</li> </ul>		<p>In DB projects, size did not affect PDS.</p> <p>In DB projects, due to changes, cost could go up.</p>
<b>Project-level:</b> <i>Constraint</i>	<ul style="list-style-type: none"> <li>• Risk</li> <li>• Sched Comp</li> <li>• Sched control</li> <li>• Cost Prec</li> <li>• Cost control</li> </ul>				
<b>Agency-level:</b> <i>Benefit</i>	<ul style="list-style-type: none"> <li>• Airport staff exp</li> <li>• Airport proj control</li> <li>• Security</li> </ul>	<ul style="list-style-type: none"> <li>• Airport proj control</li> <li>• Security</li> <li>• Impact on ops</li> <li>• Impact on passengers</li> <li>• 3<sup>rd</sup> party input</li> </ul>	<ul style="list-style-type: none"> <li>• Airport proj control</li> <li>• Security</li> <li>• Impact on ops</li> <li>• Impact on passengers</li> <li>• 3<sup>rd</sup> party input</li> </ul>		
<b>Agency-level:</b> <i>Constraint</i>	<ul style="list-style-type: none"> <li>• Impact on ops</li> <li>• Impact on passengers</li> <li>• 3<sup>rd</sup> party input</li> </ul>	<ul style="list-style-type: none"> <li>• Airport staff exp</li> </ul>	<ul style="list-style-type: none"> <li>• Airport staff exp</li> </ul>		
<b>Public Policy/Regulatory:</b> <i>Benefit</i>	<ul style="list-style-type: none"> <li>• Competition</li> <li>• DBE</li> <li>• Legal</li> <li>• Method allowed</li> </ul>	<ul style="list-style-type: none"> <li>• Competition</li> <li>• DBE</li> <li>• Legal</li> <li>• Method allowed</li> </ul>	<ul style="list-style-type: none"> <li>• Competition</li> <li>• DBE</li> <li>• Legal</li> <li>• Method allowed</li> </ul>		
<b>Public Policy/Regulatory:</b> <i>Constraint</i>					
<b>Life Cycle:</b> <i>Benefit</i>	<ul style="list-style-type: none"> <li>• Life cycle cost</li> <li>• Maintenance</li> <li>• Sustainability</li> </ul>	<ul style="list-style-type: none"> <li>• Life cycle cost</li> <li>• Maintenance</li> <li>• Sustainability</li> </ul>	<ul style="list-style-type: none"> <li>• Life cycle cost</li> <li>• Maintenance</li> <li>• Sustainability</li> </ul>		
<b>Life Cycle:</b> <i>Constraint</i>					
<b>Other:</b> <i>Benefit</i>		<ul style="list-style-type: none"> <li>• Adversarial Relationship</li> <li>• Claims</li> </ul>	<ul style="list-style-type: none"> <li>• Adversarial Relationship</li> <li>• Claims</li> </ul>		
<b>Other:</b> <i>Constraint</i>	<ul style="list-style-type: none"> <li>• Adversarial Relationship</li> <li>• Claims</li> </ul>				



### Airport Project Delivery Method Value Information

#### Effectiveness in delivering quality in project aspects

Color Code	Blank = Does not apply	Below Standard = 1&2	Meets Standard = 3	Exceeds Standard = 4&5
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Project Aspects	DBB	CMR	DB	DBOM
Completeness of final design deliverables	5	4	3	
Accuracy of design calculations	5	4	4	
Accuracy of quantities	5	4	4	
Acceptance of design deliverables				
Accuracy of specifications	5	4	4	
Accuracy of as-built documents	3	4	5	
Accuracy/applicability of O&M manuals, etc.	5	4	4	
Implementation of approved QA/QC plans	4	4	5	
Accuracy of preconstruction cost estimates	2	4	5	
Ability to achieve post-award budgets	3	4	5	
Accuracy of preconstruction schedules	3	4	5	
Ability to achieve post-award schedules	3	4	5	
Material quality	3	4	5	
Workmanship quality	3	4	5	
Aesthetics	3	4	5	
Sustainability	3	4	5	
Maintainability	5	4	4	
Operability	5	4	4	
Security during construction	3	4	5	
Aircraft operations during construction	4	4	4	
Passenger traffic flow during construction	4	4	5	
Interest to potential bidding community	4	5	4	
<b>Effectiveness Index</b>	<b>3.8</b>	<b>4.0</b>	<b>4.5</b>	

#### Effectiveness in delivering value in preconstruction phase

Color Code	Blank = Does not apply	Not Valued = 1	Valued =2&3	Highly Valued = 4&5
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Preconstruction Tasks	DBB	CMR	DB	DBOM
Conceptual estimating	3	4	5	
Value analysis/value engineering	3	4	5	
Design charrettes	4	4	4	
Design reviews	4	5	5	
Regulatory reviews	3	4	5	
Security impact studies	4	4	5	
Environmental studies	4	4	5	
Early contractor involvement	1	4	5	
Cost engineering reviews	2	4	4	
Constructability reviews	3	5	5	
Biddability reviews	3	4	4	
Operability reviews	4	4	5	
Life cycle cost analysis	5	4	4	
<b>Value Index</b>	<b>3.3</b>	<b>4.2</b>	<b>4.7</b>	

## APPENDIX C – INTERVIEW BLANK FORM

## ACRP A01-05 Airport Project Delivery Guide

### Structured Interview Questionnaire

CONDITIONS: This interview can either be conducted in person or via telephone. The following protocol shall be followed during its administration:

1. The questionnaire shall be sent to the respondent at least 2 weeks prior to the interview via email.
2. Two days prior to the interview, a follow-up message with the questionnaire attached will be sent to confirm the date and time of the interview.
3. To maximize the quality and quantity of information collected, the primary respondent should be encouraged to invite other members of his/her organization to be present during the interview. Thus, a single “airport operator” response can be formulated and recorded.
4. The interviewer will set the stage with a brief introduction that emphasizes the purpose of the research, the type of information expected to be collected, and the ground rules for the interview.
5. Once the interviewees indicate that they understand the process at hand, the interview will commence.
6. The interviewer will read each question verbatim and then ask if the interviewee understood the question before asking the interviewee to respond.
7. Each question contains a specific response that must be obtained before moving to the next question. Once that response is obtained, the interviewer can record as text additional cogent information that may have been discussed by the interviewees in working their way to the specific response.
8. Upon conclusion of the interview, the interviewer will ask the interviewees if they have additional information that they would like to contribute and record those answers as text.
9. The interviewer will assemble a clean copy of the final interview results and return them to the interviewee for verification.

**STRUCTURED INTERVIEW:****Date:** \_\_\_\_\_**Interviewees:** \_\_\_\_\_**I. General Information:**

1. City and state in which the respondent is employed:
2. Name of Airport: \_\_\_\_\_ ; Three-letter code: \_\_\_\_\_
3. Number of annual operations (take-offs and landings): \_\_\_\_\_
4. Annual passenger throughput: \_\_\_\_\_
5. Annual cargo throughput: \_\_\_\_\_
6. What type of organization do you work for?  
 Public Airport Operator    Other public transportation agency    Other; Please describe: \_\_\_\_\_
7. Number of professional design/construction staff: \_\_\_\_\_
8. Annual construction budget: \_\_\_\_\_
9. Average annual number of projects: \_\_\_\_\_
10. Project monetary size range: \$ \_\_\_\_\_ to \$ \_\_\_\_\_
11. Average monetary size of a typical project \$ \_\_\_\_\_

### Project Delivery Method Experience

Project Delivery Experience	Design-Bid-Build	CM-at-Risk	Design-Build	Design-Build w/OM
<p><b>1</b>     <i>Has your airport awarded a project under one of these project delivery methods?</i></p> <p><input type="checkbox"/> A. If yes, how many projects?</p> <p><input type="checkbox"/> B. If yes, what percentage of your total construction budget?</p>	<p><input type="checkbox"/> Yes <input type="checkbox"/> No</p> <p>A. <input type="checkbox"/> 1-5 <input type="checkbox"/> 6-10 <input type="checkbox"/> &gt;10</p> <p>B. <input type="checkbox"/> &lt;10% <input type="checkbox"/> 11-25% <input type="checkbox"/> 26-50% <input type="checkbox"/> &gt;50%</p>	<p><input type="checkbox"/> Yes <input type="checkbox"/> No</p> <p>A. <input type="checkbox"/> 1-5 <input type="checkbox"/> 6-10 <input type="checkbox"/> &gt;10</p> <p>B. <input type="checkbox"/> &lt;10% <input type="checkbox"/> 11-25% <input type="checkbox"/> 26-50% <input type="checkbox"/> &gt;50%</p>	<p><input type="checkbox"/> Yes <input type="checkbox"/> No</p> <p>A. <input type="checkbox"/> 1-5 <input type="checkbox"/> 6-10 <input type="checkbox"/> &gt;10</p> <p>B. <input type="checkbox"/> &lt;10% <input type="checkbox"/> 11-25% <input type="checkbox"/> 26-50% <input type="checkbox"/> &gt;50%</p>	<p><input type="checkbox"/> Yes <input type="checkbox"/> No</p> <p>A. <input type="checkbox"/> 1-5 <input type="checkbox"/> 6-10 <input type="checkbox"/> &gt;10</p> <p>B. <input type="checkbox"/> &lt;10% <input type="checkbox"/> 11-25% <input type="checkbox"/> 26-50% <input type="checkbox"/> &gt;50%</p>
<p><b>2</b>     <i>Does your airport use alternative project delivery methods for one of these workforce-oriented reasons?</i></p> <p><input type="checkbox"/> A. To augment existing workforce during program funding spikes?</p> <p><input type="checkbox"/> B. To reduce the number of professional engineers on the airport's staff?</p> <p><input type="checkbox"/> C. To reduce the size of the airport's full-time staff?</p>	<p>A. <input type="checkbox"/> Yes <input type="checkbox"/> No</p> <p>B. <input type="checkbox"/> Yes <input type="checkbox"/> No</p> <p>C. <input type="checkbox"/> Yes <input type="checkbox"/> No</p>	<p>A. <input type="checkbox"/> Yes <input type="checkbox"/> No</p> <p>B. <input type="checkbox"/> Yes <input type="checkbox"/> No</p> <p>C. <input type="checkbox"/> Yes <input type="checkbox"/> No</p>	<p>A. <input type="checkbox"/> Yes <input type="checkbox"/> No</p> <p>B. <input type="checkbox"/> Yes <input type="checkbox"/> No</p> <p>C. <input type="checkbox"/> Yes <input type="checkbox"/> No</p>	<p>A. <input type="checkbox"/> Yes <input type="checkbox"/> No</p> <p>B. <input type="checkbox"/> Yes <input type="checkbox"/> No</p> <p>C. <input type="checkbox"/> Yes <input type="checkbox"/> No</p>

**II. Case Study Airport Project Delivery Method Decision-making Information**

2. Who ultimately makes the project delivery method selection decision:  
 Airport design/construction personnel  Airport authority management  
 Entity outside the airport operator’s organization; Explain:
3. What project factors are considered when making the project delivery method decision?

Project Factor	Considered in decision	Drives use of alternative delivery method
Project monetary size	<input type="checkbox"/>	<input type="checkbox"/>
Project budget control issues	<input type="checkbox"/>	<input type="checkbox"/>
Project schedule issues	<input type="checkbox"/>	<input type="checkbox"/>
Project technical complexity	<input type="checkbox"/>	<input type="checkbox"/>
Project type (vertical vs. horizontal)	<input type="checkbox"/>	<input type="checkbox"/>
Project technical content (i.e. IT, seismic features, navigational equipment, etc.)	<input type="checkbox"/>	<input type="checkbox"/>
Project security issues (outside secure zone vs. inside secure zone)	<input type="checkbox"/>	<input type="checkbox"/>
Project location (landside, airside, or terminal)	<input type="checkbox"/>	<input type="checkbox"/>
Project environmental issues	<input type="checkbox"/>	<input type="checkbox"/>
Project third party interface issues	<input type="checkbox"/>	<input type="checkbox"/>
Project air traffic control issues	<input type="checkbox"/>	<input type="checkbox"/>
Project quality assurance requirements	<input type="checkbox"/>	<input type="checkbox"/>
Project life cycle issues (maintenance/operations)	<input type="checkbox"/>	<input type="checkbox"/>
Project sustainability issues	<input type="checkbox"/>	<input type="checkbox"/>
Incentives for obtaining federal or state funding	<input type="checkbox"/>	<input type="checkbox"/>
Project generates revenue	<input type="checkbox"/>	<input type="checkbox"/>
Other:	<input type="checkbox"/>	<input type="checkbox"/>
Other:	<input type="checkbox"/>	<input type="checkbox"/>

4. Which of the following were reasons that your airport uses to select each of the following delivery methods? Check all that apply. Which of the below is the **single** most significant reason for selecting each delivery method? (circle the check box)

Reason	Design-Bid-Build	CM-at-Risk	Design-Build	Design-Build w/OM
Reduce/compress/accelerate project delivery period	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Establish project budget at an early stage of design development	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Get early construction contractor involvement	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Encourage innovation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Facilitate Value Engineering	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Encourage price competition (bidding process)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Compete different design solutions through the proposal process	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Redistribute risk	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Complex project requirements	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Flexibility needs during construction phase	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Reduce life cycle costs	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Provide mechanism for follow-on operations and/or maintenance	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Innovative financing	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Encourage sustainability	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Project is a revenue generator	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Other:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

5. Please explain the process that you use to choose the project delivery method for a typical project.

6. Is a formal risk analysis conducted on a typical project in any of the following areas?
- Project Scope
  - Project Schedule
  - Project Cost
  - Contracting Risk
7. Do your project cost estimates involve an analysis of uncertainty (i.e. was a range cost estimate developed)?
- Yes       No
8. Do you employ any of the following risk identification techniques during the project delivery method selection decision process? Check all that apply.
- Brainstorming
  - Scenario planning
  - Expert interviews
  - Delphi methods
  - Influence or risk diagramming
  - Other risk identification techniques Explain:
9. Do you employ either of the following?
- Qualitative risk assessment techniques - If yes, please describe.
- Quantitative risk analysis techniques - If yes, please describe.  
Examples include: Monte Carlo simulation, expected values, etc.
10. Do you use any of the following risk management techniques?
- Risk register or risk charter
  - Risk management plan
  - Risk mitigation plan
  - Other risk tracking techniques Explain:
11. Do you employ any formalized risk allocation techniques to draft the contract provisions?
- Yes       No If yes, please describe:



### III. Case Study Airport Procurement Process Information:

This project will deal with four fundamental procurement processes. A Procurement process is different from a project delivery method decision in that it primarily deals with the way an airport operator must advertise and award capital improvement projects. The general procurement processes are defined as follows:

- ◆ Low Bid: The services required are awarded on a basis of price alone. There is no other consideration, except financial responsibility which is usually defined by the ability to furnish a performance bond.
- ◆ Best Value: The services required are awarded on a basis of OTHER THAN price alone.
- ◆ Qualification Based Selection: This would select a designer where no price is considered.
- ◆ Indefinite Delivery-Indefinite Quantity: This is a capacity contract for multiple project design and/or construction services where the airport operator procures the services on a basis of qualifications plus some price function such as a multiplier and the actual design and construction services will be priced via negotiation after award. The IDIQ projects are commonly called Task Orders or Job Orders and IDIQ contracts are also called job order contracts.

The following questions will break up the procurement process for the case study airport into the following three categories:

- ◆ Procurement constraints: These are items such as legal or regulatory barriers to being able to use specific procurement processes such as a requirement that all projects must be awarded to the low bidder. This will also include any local policies or political constraints that ultimately impact the airport operator's flexibility to award design and construction projects.
- ◆ Procurement preferences: These deal with the airport operator's past experience and institutional comfort level with the different procurement processes. These also may deal with external stakeholders such as airlines that influence the decision made on procurement processes.
- ◆ Procurement method award components: These deal with the mechanics of how an award for design and/or construction services are made.

**Procurement Constraints:**

Which of the following constrain the use of each of the four procurement processes?

<b>Constraint</b>	<b>Low-bid</b>	<b>Best Value</b>	<b>Qual-based</b>	<b>IDIQ</b>	<b>Remarks</b>
Local law	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
State law	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Need to obtain federal funding	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Airport procurement regulations	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Airport commission rules	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Process used to obtain funding	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Political need to ensure local firms are utilized	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Requirement to meet DBE goals	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Third party stakeholder policies	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Security requirements	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Operations requirements	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Maintenance requirements	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Sustainability requirements	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Other:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Other:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Other:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

**Procurement Preferences:**

Which of the following airport operator preferences drive the use of the four procurement processes?

Preference	Low-bid	Best Value	Qual-based	IDIQ	Remarks
Desire to not change past procurement methods	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Desire to eliminate firms with poor past records from competition	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Desire to encourage firms with good past records to compete	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Need to ensure selection of well-qualified designers and/or builders	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Need to minimize front-end effort	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Need to appear fair and objective	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Need to be able to justify selection to higher authorities	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Need to be able to justify selection to the public	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Need to be able to justify selection to third party stakeholders	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Need to minimize the number of procurement actions	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Need to be able to rapidly move from concept to construction	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Other:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Other:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Other:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

**Procurement method award components:**

Which of the following award method algorithms are used for awarding each type of procurement method?

Component	Low-bid	Best Value	Qual-based	IDIQ	Remarks
Short-list	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Financial prequalification	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Evaluation of qualifications	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Alternative design concepts	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Evaluation of design approach	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Schedule evaluation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Quality management plan evaluation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Environmental plan evaluation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Security plan evaluation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Safety plan evaluation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Price evaluation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Bonding requirements	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
DBE goals	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Other:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Other:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
Other:	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

**Project Delivery Issues:**

The purpose of this section is to identify pertinent issues that impact the project delivery method selection decision. Mark with a check whether the given issue is considered “pro” (not considered a potential problem in the given project delivery method) or “con” (considered a potential problem in the given project delivery method)

Issue Type	Project Delivery Method	DBB		CMR		DB		DB w/OM	
		Pro	Con	Pro	Con	Pro	Con	Pro	Con
<b>Project-level Issues</b>	<ul style="list-style-type: none"> <li>• Project Size</li> <li>• Risk management/ allocation</li> <li>• Schedule compression</li> <li>• Schedule growth control</li> <li>• Cost precision</li> <li>• Cost control</li> <li>• LEED certification</li> <li>• Other:</li> <li>• Other:</li> </ul>								
	Notes on above								

Issue Type	Project Delivery Method	DBB		CMR		DB		DB w/OM	
		Pro	Con	Pro	Con	Pro	Con	Pro	Con
<b>Airport-level Issues</b>	<ul style="list-style-type: none"> <li>• Airport experience/ staff capability</li> <li>• Airport control of project</li> <li>• Security</li> <li>• Control impact on operations</li> <li>• Control impact on passengers</li> <li>• Third party stakeholder input to design and construction</li> <li>• Other:</li> </ul>								
	Notes on above								

Issue Type	Project Delivery Method	DBB		CMR		DB		DB w/OM	
		Pro	Con	Pro	Con	Pro	Con	Pro	Con
Public Policy/ Regulatory Issues	<ul style="list-style-type: none"> <li>• Competition</li> <li>• DBE/small business impact</li> <li>• Legal constraints</li> <li>• Method allowed per state statute or local governing ordinance</li> <li>• Other:</li> <li>• Other:</li> </ul>								
Life Cycle Issues	<ul style="list-style-type: none"> <li>• Life cycle cost</li> <li>• Maintainability</li> <li>• Sustainable design goals</li> <li>• Sustainable construction goals</li> <li>• Other:</li> <li>• Other:</li> </ul>								

Issue Type	Project Delivery Method	DBB		CMR		DB		DB w/OM	
		Pro	Con	Pro	Con	Pro	Con	Pro	Con
<b>Other Issues</b>	<ul style="list-style-type: none"> <li>• Adversarial relationships</li> <li>• Claims</li> <li>• Local talent and expertise</li> <li>• Other:</li> <li>• Other:</li> </ul>								



### V. Achieving Value through Project Delivery Method Selection

This section’s purpose is to collect expert opinions on each project delivery system’s ability to add value to the airport operator’s capital project delivery process. If there are more than one person in the interview, the interviewer should require the group to achieve a consensus opinion for the impact of each project delivery system on the airport’s final constructed product.

1. In your opinion how does each project delivery method impact the quality of the following project aspects for typical projects at your airport?

For each method, assign one of the following ratings based on the airport consensus: Worst= 1; Worse = 2; Neutral= 3; Better = 4; Best = 5				
Project Aspects	Design-Bid-Build	CM-at-Risk	Design-Build	Design-Build w/OM
Completeness of final design deliverables				
Accuracy of design calculations				
Accuracy of quantities				
Acceptance of design deliverables				
Accuracy of specifications				
Accuracy of as-built documents				
Accuracy/applicability of O&M manuals, etc.				
Implementation of approved QA/QC plans				
Accuracy of preconstruction cost estimates				
Ability to achieve post-award budgets				
Accuracy of preconstruction schedules				
Ability to achieve post-award schedules				
Material quality				
Workmanship quality				
Aesthetics				
Sustainability				
Maintainability				
Operability				
Security during construction				
Aircraft operations during construction				
Passenger traffic flow during construction				
Interest to potential bidding community				

2. In your opinion how does each alternative project delivery method impact the value of the following preconstruction services for typical projects at your airport?

For each method, assign one of the following ratings based on the airport consensus: Not valuable = 1; Some value = 2; Valuable = 3; Very valuable= 4; Of highest value = 5				
Preconstruction Service	Design-Bid-Build	CM-at-Risk	Design-Build	Design-Build w/OM
Conceptual estimating				
Value analysis/value engineering				
Design charrettes				
Design reviews				
Regulatory reviews				
Security impact studies				
Environmental studies				
Early contractor involvement				
Cost engineering reviews				
Constructability reviews				
Biddability reviews				
Operability reviews				
Life cycle cost analysis				

## **APPENDIX D – OVERALL ASSESSMENT BLANK FORM**

**Agency:**

**Evaluator:**

**Evaluator's Expertise:**

In the table below, please rate the two-tiered project delivery selection system introduced:

	For each statement, assign one of the following ratings based on <b>1 = <i>poor</i></b> to <b>5 = <i>excellent</i></b> .	1	2	3	4	5
1	Comprehensiveness of the overall selection system and the factors considered	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2	Clarity of presentation and the intent of the selection system	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3	Applicability to real-life projects	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4	Contribution of the system to documenting a transparent and defensible decision regarding project delivery method	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5	Overall satisfaction with the results obtained from applying the selection system to your project (is the outcome realistic?)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

The proposed selection system is based on several pertinent factors as elaborated in Tier 1. Would you add any other factors to the current system?

Would you consider any of the factors redundant or superfluous? Would you consider deleting some of the factors? Which ones?

Any overall comments about the selection system?