 ISBN: 9789052693958

CM-AT-RISK AS A HIGHWAY CONSTRUCTION DELIVERY SYSTEM IN THE SOUTHEASTERN UNITED STATES

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Abstract
The traditional system of design-bid-build has long been the principal delivery system for horizontal construction; it has been employed by all the transportation departments in the United States for almost a century. The shift toward design-build (DB) as a time saving method has been successful in many ways, but use of the system has exposed some disadvantages in the last decade. Construction-manager-at-risk (CMR) is a delivery system often employed in vertical construction, but transportation agencies have recently begun to use it for horizontal construction. The Departments of Transportation (DOT) of eleven states in the southeastern United States were interviewed in this study. The focus was on each DOT's experience and satisfaction with the DB delivery method, as well as their experiences, knowledge, and legal status of the CMR method. Florida was the only state of the eleven that has used CMR on horizontal projects. CMR has also been used as the delivery system on some municipal and county highway projects in Florida.

Keywords: Construction, Manager, Risk, Highway, Delivery

INTRODUCTION

All construction was once performed using a form of the design-build (DB) delivery system. In the 1920's and 1930's, knowledge of construction materials and methods grew at a rapid pace due to significant research, mostly sponsored by the American Association of State Highway Officials (AASHO). With this new knowledge came specialization and with specialization came the design-bid-build (DBB) project delivery system, which dominated horizontal construction in the U.S. for decades. The monopoly of this traditional system lasted until the Transportation Equity Act was enacted. In 1998, it became much easier to procure federal funding for projects utilizing alternative delivery systems, if the use of those delivery systems was in compliance with the state's own statutes. Due to the success numerous projects have experienced with DB, the states have become increasingly receptive to these new concepts of project delivery. Now, many states allow application of alternative delivery methods to public transportation construction projects, but some states differentiate their processes of authorization for DB and other alternative delivery systems such as construction-manager-at-risk (CMR). The differences in these procurement processes show

the skepticism held by many authorities toward CMR as a reliable delivery system for highway construction.

The Construction Industry Institute has pronounced DBB, DB, and CMR as the primary methods of project delivery (CII 2003). While this might be true in vertical construction, in the transportation field, CMR projects are not common. One of the reasons for this inconsistency within the two sectors of the industry is the difference in the characteristics of the project owners. In vertical construction, the identity of the owner can be any entity or individual that is able and willing to fund the project. In horizontal construction, the type of owner is fairly limited, most being a state's DOT, or some other public transportation agency. This can result in the support of a particular system due to the owners' singularity of nature. As the owners become familiar with a specific method, the fear of change inhibits their ability to explore additional options. Another reason for the hesitation, or lack of interest in experimenting with a different method would be the size of projects. Compared to private ventures, the level of funding allocated for a state's transportation projects is substantially higher. Therefore there are more risks involved in the testing of an unfamiliar method.

LITERATURE REVIEW

The National Cooperative Highway Research Program (NCHRP) has funded many comprehensive studies in regards to horizontal construction. In this field the two most commonly employed methods of delivery are DBB and DB. Scott (2006) pointed out the problem associated with low bid in DB; instead of getting the benefits of cost control, most of the time it will result in a decrease in the quality of the final product. Scott focused on the best value approach; it places the emphasis not only on the price but also on other factors. Investigation of the legislative regulation and the nature of this contracting method were analyzed to help develop the best value procurement method in regards to highway construction. Shr (2004) studied the growing popularity of Incentive/ Disincentive bidding for highway construction. This concept is utilized for its ability to shorten the contract time by making it difficult for the contractor to not accelerate the project. Shr developed a quantified model to establish reasonable incentive or disincentive rates based on construction cost and time. But like the low bid method, incentive/disincentive contracting may cause the quality of the final product to decline.

Molenaar, et al (1999) studied the emergence of DB into the public segment of the industry, replacing the traditional DBB. His work analyzes each parties' responsibility in regard to the delivery system, and also explains the procurement process and the structure of this particular method. Marwa, et al (2006) went more in depth than Molenaar by building on his work. Marwa studied a total of 76 DB projects and identified correlations between the procurement processes and the projects' performance overall. Chan (2002) sought specific project conditions that can help increase project success rates when using DB. Chan points out that current measures of success are defined by three factors: time, cost, and quality; but he believes a more comprehensive metric needs to be established.

Gransberg (1999) conducted a survey aimed at all the Departments of Transportation (DOTs) in the United States. With the fifteen DOTs that employ DB, he reviewed the three main methods of DB, which are low-bid DB, adjusted-score DB, and best-value DB. As concluded, each of the different methods can be utilized with different types of highway construction, depending on the nature of the project at hand. Gransberg (2008) also addressed the issue of quality assurance concerning DB as it relates to transportation projects. One of the disadvantages of DB is the lack of control over the detailed components of construction, which requires the agency to form a more comprehensive method to ensure the quality of the

work. A survey from the report demonstrated the different ways in which state transportation agencies have successfully controlled quality by focusing on all the aspects of the construction phases; but this doesn't seem to be the case for all the agencies. In the same year Gransberg (2008) pinpointed the issue of communicating the quality requirements public agencies have on DB projects. The Study found that some owners tend to rely on the qualification evaluation process rather than being proactive on the issue. There are still many improvements that can help enhance the performance of DB. Many agencies still use the traditional DBB method exclusively, or have not utilized DB to its full advantage.

There has been an extensive amount of research done on the comparison of DBB, DB and, to a lesser extent, CMR - most focusing on the performance of each method in regard to the aspects of cost, time, and quality. Ibbs (2003) used sample case studies to present a result that confirmed one of DB's key advantages. Design-build does in fact perform more efficiently with respect to time than traditional DBB. Doren (2005) discovered valuable statistics regarding CMR. In this study, 35 percent of project owners believed that CMR provided them the "best value", followed by 23 percent for DB. And yet the traditional system of delivery (DBB) is employed most frequently. Doren's research combines data from the areas of vertical construction and horizontal construction. According to him, government agencies that have experience with an alternative method consider CMR and DB as the "best-value alternatives". Doren believes that CMR has the potential to become the leading method of delivery, due to positive experiences reported by so many agencies.

Rojas and Kell (2008) used data collected from states to compare the performance of the DB and CMR regarding the public schools. The result of the study conflicted with many researches that have been done before, by concluding that 75% of the circumstances exceeded the guaranteed maximum price when CMR was used. However these statistics are in regards to vertical projects, which are fundamentally different from horizontal projects. Concerning horizontal construction Touran, et Al (2009) published a paper focusing on providing an evaluation process that is able to help agencies identify the suitable delivery system to use for specific projects. The paper points out 24 key concerns that will narrow down the most ideal delivery system. The paper also includes a beneficial example that demonstrates how the evaluation should be conducted. But before the proper system can be chosen, regulations regarding each system are different amount all the states. Ghavamifar (2006) investigated all the regulations that had been set in place by states' legislations regarding public transportation projects. A list of the states' statutes that address DB, CMR, and public/private partnerships was provided.

Gransberg (2010) conducted extensive research on the topic of CMR project delivery for highway programs. According to his report, Utah's DOT (UDOT) has the most experience with this method. At the time the research was conducted, 13 CMR projects had been completed, and 16 projects were in the planning. UDOT confirms the system's ability to fast-track projects, which can result in the decrease of project cost. States like Alaska, Arizona, Florida, Oregon and Utah all have experience with CMR as the method of delivery on transportation projects. The city of Phoenix has had more than 200 projects completed by CMR (including both vertical and horizontal projects). Local transportation projects in Michigan and Rhode Island also use the CMR delivery system. Florida has used CMR on projects of multiple types and scales, from minor local projects to a 1.3 billion dollar intermodal center. Alaska tends to use CMR on projects that have a significant portion of vertical component build-in. Even though Oregan's DOT has limited experience with this system, an interstate bridge that was completed by CMR has been a successful project. They plan to employ the CMR system on future projects. Gransberg gathered a substantial amount of research that had been done on construction delivery methods. Structured interviews were

set up with the agencies to gather statistics, and clear instructions were established to help any organization with the procedure involved in implementing such a delivery system.

CASE STUDY: The Miami Intermodal Center

The Miami Intermodal Center (MIC), the first CMR project ever funded by the U.S. Federal Highway Administration (FHWA) is a $2.5 billion construction project located just east of Miami-Dade International Airport (MIA). The facility is envisioned as a state-of-the-art Grand Central Station — a transfer center for passengers using the airport, intercity and commuter trains, rapid transit, local and intercity buses, and cruise ships in and out of the Port of Miami. The project was developed by FDOT and the Miami-Dade Aviation Department, in cooperation with the Miami-Dade Expressway Authority, Miami-Dade Transit, Amtrak, and various rental car agencies that serve the airport. The MIC project is made up of a series of construction contracts, including one for a consolidated rental car facility (RCF), another for a people-mover connection to the airport, and others for road access improvements around the airport.

Even with all the emphasis on the project, as well as all the planning and funding for the project, it appeared for a while that this project would be remembered as one of the great mistakes in modern U.S. construction history. For the first four years, the project seemed unable to overcome its unfortunate start, which was caused by the terrorist attacks on 9-11-01, and exacerbated by mistakes typical of an owner using a new delivery system. In some respects, it never has recovered, but in others, it has recovered marvelously

Several things contributed to the early problems that plagued the project. For instance, the 9-11 disaster, delayed decisions, and unwise decisions caused the timing of the MIC project to get seriously out of rhythm. By allowing the design, which had just commenced when the terrorism unfolded, to continue unabated while contemplating future moves, and then allowing it to continue even further while the scope shrunk due to the drastic dropoff in airline traffic, put design so far ahead of construction that the project has never enjoyed two of the major of advantages of the CMR system; namely construction involvement in the design and full fast tracking. Other things that contributed to early problems can be seen in the literature. (Minchin 2009)

Relatively recently, the project has started to resemble what was envisioned in the beginning. Progress is being made at a much faster rate; payouts are much higher, visible progress is exponentially greater, and the project is shedding its negative image.

Phase I of the project is broken into sub-phases of work called GMPs. GMP stands for Guaranteed Maximum Price, which is the way the CM bids on each sub-phase. The CM on the project must submit a GMP for each sub-phase GMP. If the GMP for any GMP is higher than the owner can stand, negotiations commence and can be very short, or very lengthy. The owner reserves the right to terminate negotiations and either begin negotiations with another CM, or declare that the GMP for which a cost cannot be agreed upon will be let using another delivery system.

Phase I of the MIC construction project is broken up into seven GMPs. To date, three of the GMPs have been completed. GMPs completed to date were finished within contract time, but all were delayed in their commencement. As for costs, the work in GMP No. 1 was completed for 3.9% under budget and GMP No. 2 was completed for 8.4% under budget; The CM exceeded contract duration on both GMPs — by 40.7% on GMP No. 1 and 72.2% on GMP No. 2. There was a significant scope reduction on GMP No. 3, which renders that data useless for comparative purposes. The project is now progressing well, after a fitful four years that saw an almost total personnel turnover for the owner

and the project management firm retained by the owner to oversee the CM. Construction on the Rental Car Facility and bridge, known as GMP No. 4a, has turned the project around. The project suffered for four years from a lack of respect and credibility in the marketplace. GMP 4a has cured that, but many lessons have been learned. For more details, please see the literature. (Minchin 2009)

METHOD OF RESEARCH

Eleven states from the southeastern part of the United States were chosen to be part of the study. A list of state construction personnel was gathered from the American Association of State Highway and Transportation Officials (AASHTO). These served as potential interviewees. Next, Interview instruments were generated to obtain the main objective of the analysis: each DOT's experiences with DB and CMR. Then the list of interviewees was contacted by telephone. Often some redirection led to the most appropriate authority, but most of those interviewed were the State Construction Engineer for their respective DOT.

Level One Interview

The goals for level one of the interviews was to determine the level of experience that each state has with the DB delivery system. Then the interviewees were asked to identify any dissatisfaction they have experienced with DB in the years that it has been employed. The interviewees were then asked if they, or their agency was aware of the CMR delivery system, and if any dissatisfactions with DB have potentially led the DOTs to seek out or consider CMR as an alternative delivery system.

Level Two Interview

Level two of the interview is designed for states that are using or have completed highway construction using CMR as the delivery system. The objective is to study the process the DOT has established for CMR, and learn about their experiences with CMR in comparison to DBB, or DB. The final goal is to identify any advantages and disadvantages the agency may have already noticed regarding CMR.

DEPARTMENT'S EXPERIENCE WITH DESIGN/BUILD

The data collected during the level one interviews clearly illustrate the widespread nature of DB in the area of highway and transportation programs. It has become the most popular method of alternative delivery system to employ. There are many advantages that proponents of DB claim that it can contribute to a project. The main attractions are: the single point of contact for the project's design and construction and allowing the project to start before construction documents are finished (fast-track). Both of these benefits are designed to compensate for the shortcomings of the traditional DBB delivery system. But data shows only two out of the eleven states that participated in the research have no problem with DB. All the other states either dislike some components of the system or have specific concerns regarding the system.

Design-build was first introduced to highway construction as a major delivery system option in the mid-1990s; it has been employed for approximately fifteen years. But one of the biggest issues, reported by more than 36 percent of the participants, was the learning curve for this delivery system. Virginia's DOT believes they "don't have enough resources to support it". Georgia's DOT reported several issues with DB. First, the system doesn't always fit the normal process designated for DB. For example, the process of acquiring right-of-way

(ROW) can take more than a year, and during this time, construction documents will be finished, therefore not saving any time. Another is the lack of understanding of the system. Finally it's been hard for the DOT to give up control after so many years of carefully governing the design and construction processes.

Louisiana's DOT currently has five DB projects under construction. One of the criticisms they have regarding this system is somewhat opposite of Georgia's DOT; they believe they have too much control, and thus risk, in regard to the project. They believe that a main contributor to this is their state's legislation, which keeps them from utilizing a true DB delivery system. Florida's DOT points out the dissatisfaction they have with not being able to link a CEI contract to the DB method. Florida officials also expressed dissatisfaction at the lack of control afforded the owner over the design process by DB, due to the lack of direct contractual relationship between the owner and the designer.

Tennessee's and Kentucky's DOTs both are not in favor of the selection process for which projects are designated for DB contracts in their states. For Kentucky, the project must be hand picked by the state's legislature for it to be eligible for DB. Large numbers of personnel are still foreign to the idea of not paying for change orders, which is supposed to be one of the advantages to DB, and the adoption process is fairly slow. Tennessee has only been allowing the use of DB for three years, a relatively short length of time compared to the other states. The legislative limitations on the types of project that can employ the system are relatively restrictive. Any project involving ROW, utilities, and environmental issues are not eligible to be considered. This greatly limits their selection pool of potential candidates. The DOT for Mississippi has a different issue of concern, cost. Many research projects that have studied DB have pointed out cost as one of the disadvantages to this delivery system (Gransberg, 2009). In most cases the increase in cost is due to the lack of concern regarding the constructability aspect of the construction documents, or the inexperienced nature of the DB firm. Another aspect of DB that creates anxiety for some DOTs is the lack of a clear set of plans, and working with only specifications for a large part of the project is sometimes difficult.

There are two states in this study that overwhelmingly support DB and had no concerns with the system. South Carolina stated that their experiences with the system have been "positive", and Maryland, an old client of the system also likes the method of delivery a lot. Table 1 shows each DOT's experiences with DB and CMR.

Table 1. *Each State DOT's Experiences with DB and CMR*:

States	Employment of DB	Number of Years (or projects) DB has been in use	Aware of the CMR delivery system	Employment of CMR	Statutorily free to use CMR
Alabama	No	n/a	Yes	No	No
Florida	Yes	15 years	Yes	Yes	Extra approval required
Georgia	Yes	10 years	Yes	No	No
Kentucky	Yes	10 projects	Yes	No	No
Louisiana	Yes	4 years	Yes	No	No
Maryland	Yes	13 years	Yes	No	Yes
Mississippi	Yes	5 years	Yes	No	Don't know
North Carolina	Yes	Don't know	Yes	No	No
South Carolina	Yes	Don't know	Yes	No	Don't know
Tennessee	Yes	3 years	Yes	No	No
Virginia	Yes	7 years	Yes	No	Don't know

DEPARTMENTS' EXPERIENCES AND LEGAL RESTRICTIONS ON CMR

Even though all the interviewees expressed awareness of the existence of the CMR delivery system, only Florida has hands-on experience with it as a tool for highway construction. In fact, CMR has been authorized in many states to help offer a possibility other than DB as the alternative delivery method. It's designed to help decrease the amount of oversight that normally takes place on construction projects. It reduces the amount of performance risk for the owner and transfers it to the construction manager (CM). A constructability review by the CM becomes part of the design phase of the projects. This, and a direct contractual relationship between the owner and the designer allow the agency to remain in control of the design process. Of course, his method still offers the advantage of fast tracking the project.
Since Florida is the only state in the study to utilize CMR for highway construction, FDOT was the only DOT to participate in a Level Two Interview. Ten FDOT projects have been done using CMR. In addition to the list of projects and the state's statute, the interviewees were able to provide more in-depth assessment of CMR by submitting to the Level Two interview. The Level Two interview is mainly composed of three components, one being the process the DOT has established for CMR; second is the experience with CMR; finally to note any overall advantages and disadvantages the agency may have noticed with the system in comparison to DBB and DB. Table 2 shows how FDOT views the risk/ responsibilities distribution for DB and CMR.

Table 2. *FDOT's Risk/Responsibilities Distribution for DB and CMR:*

Risk/ Responsibility	Design/Build Project		Construction manager at risk project		
	Owner	Design/Builder	Owner	C.M.	Designer
Final Alignment Geometry		✓		✓	
Geotechnical Data		Depends		✓	
Environmental Permits	✓		✓		
Design Criteria	✓		✓		
Design Defects		✓		✓	✓
Constructability of Design	✓			✓	
Obtaining ROW	✓		✓		
Coordinating with utilities/ railroads		Depends		✓	
Quality Control		✓		✓	
Quality Assurance	✓		✓		
Acceptance		✓		✓	

As part of the Level Two Interview, FDOT provided Florida's statute enabling FDOT to use CMR. The statute is shown here in its entirety:

> "337.025 Innovative highway projects; department to establish program.
> (1) The department is authorized to establish a program for highway projects demonstrating innovative techniques of highway construction, maintenance, and finance which have the intended effect of controlling time and cost increases on construction projects. Such techniques may include, but are not limited to, state-of-the-art technology for pavement, safety, and other aspects of highway construction and maintenance; innovative bidding and financing techniques; accelerated construction procedures; and those techniques that have the potential to reduce project life cycle costs. To the maximum extent practical, the department must use the existing process to award and administer construction and maintenance contracts. When specific innovative techniques are to be used, the department is not required to adhere to those provisions of law that would prevent, preclude, or in any way prohibit the department from using the innovative technique. However, prior to using an innovative technique that is inconsistent with another provision of law, the department must document in writing the need for the exception and identify what benefits the traveling public and the affected community are anticipated to receive. The department may enter into no more than $120 million in contracts annually for the purposes authorized by this section.
> (2) The annual cap on contracts provided in subsection (1) shall not apply to:
> (a) Turnpike enterprise projects, and turnpike enterprise projects shall not be counted toward the department's annual cap.
> (b) Transportation projects funded by the American Recovery and Reinvestment Act of 2009."

FDOT'S EXPERIENCE WITH CMR

The main reason FDOT decided to employ CMR was the system's ability to shift risk and fast track, while allowing the department to retain control of the design process, which was not possible with DBB or DB. They plan to continue using CMR on horizontal projects because of this unique characteristic. But not all projects are suitable for CMR. Here are some of the project traits that FDOT believes can help identify the appropriate project for CMR (FDOT 2011):

- Building type projects where construction methods and specifications vary between professional groups (i.e., engineer/architect and construction trades).
- Innovative funding scenarios, where multiple owners may dictate final project criteria.
- Projects where limiting (limited) budgets (budget) threaten (threatens) the delivery of the project and where the CM alternative can help maintain costs.
- Other projects where construction input is required during the early phases of design.

Table 3 shows the projects chosen to date by FDOT for CMR.

Table 3. *FDOT CMR Projects, Project Identity and Type:*

Project Description	Work Description	System Description	Program Description
I-75 Ramp Renovation at AG Station	Miscellaneous Construction	Intrastate Interstate	Roadway
I-75 @ MP 26.861 Welcome Station	Welcome Station	Intrastate Interstate	Roadway
I-10/ Madison Co Rest Areas/Both Sides CMAR	Rest Area	Intrastate Interstate	Roadway
I-95 Agriculture Station Building Modifications	Building Repair/Rehabilitation	Intrastate Interstate	Roadway
ITS /Regional TMC Traffic MGT Center JAX Transportation Center	Traffic Management Centers	Multimodal Facility	Intermodal Access
SR-814/Atlantic Blvd Bridge #860157 Bascule Rehab/CM @ Risk	Bridge-Repair/Rehabilitation	Non-Intrastate State Highway	Bridge Repair
SR-5/US-1 Bridge#930004/Parker BR Bascule Bridge/CM@Risk	Bridge-Repair/Rehabilitation	Non-Intrastate State Highway	Bridge Repair
Miami Intermodal CTR (MIC) MIC Central Station	Intermodal Hub Capacity	Interstate State Highway	Intermodal Access
I-75 Pasco (NB) Rest Area Rehabilitation by CM@Risk Contingent	Rest Area	Intrastate Interstate	Roadway
I-75 Pasco (SB) Rest Area Rehabilitation by CM@RISK Contingent	Rest Area	Intrastate Interstate	Roadway

Once the project has been selected for CMR, FDOT has their own set of contracts and specifications. They have experience with both in-house and outsourced design staff. This process of selection for the design staff or any pre-construction service is sometimes project specific, but overall the more traditional way is to use the qualification method. One of the issues that have most DOTs concerned is the amount of agency administrative time they think this system will require. According to FDOT, CMR consumes less time than the traditional DBB, and about the same time in comparison to DB. In regard to the three delivery systems, small businesses in the state tend to be more involved with DBB than with CMR and DB, with DB being the least preferred of the three. Table 4 shows the performance of the CMR projects build by FDOT to date. Note that some projects are ongoing at the time of publication.

Table 4. *Cost and Duration Variations of CMR Projects Conducted by FDOT.*

Project Description	Cost			Duration	
	Original (Engineers) Cost Estimate ($)	Low Bid or Awarded Bid Amount ($)	Final Cost ($)	Original Contract Duration (days)	Final Contract Duration (days)
I-75 Ramp Renovation at AG Station	3,769,137.94	3,294,096.00	TBD	270	TBD
I-75 @ MP 26.861 Welcome Station	8,170,189.86	13,240,420.00	13,101,578.00	509	519
I-10/ Madison Co Rest Areas/Both Sides CMAR	8,030,191.94	6,966,982.00	6,919,424.00	291	296
I-95 Agriculture Station Building Modifications	2,491,925.00	3,310,500.00	3,318,723.70	215	TBD
ITS /Regional TMC Traffic MGT Center JAX Transportation Center	17,460,000.00	TBD	TBD	TBD	TBD
SR-814/Atlantic Blvd Bridge #860157 Bascule Rehab/CM @ Risk	3,402,669.49	4,164,652.11	TBD	210	302
SR-5/US-1 Bridge#930004/Parker BR Bascule Bridge/CM@Risk	8,153,297.80	10,186,066.98	TBD	330	TBD
Miami Intermodal CTR (MIC) MIC Central Station	None	78,000,000.00	TBD	822	TBD
I-75 Pasco (NB) Rest Area Rehabilitation by CM@Risk Contingent	13,394,134.46	25,137,883.11	TBD	477	TBD
I-75 Pasco (SB) Rest Area Rehabilitation by CM@RISK Contingent	12,102,611.74	25,137,883.11	TBD	477	TBD

FDOT uses the method of reimbursable basis to a guaranteed maximum price (GMP) to compensate the CM for both pre-construction and construction services. In addition, FDOT requires open book accounting for the CM's pay applications during construction for all subcontractors and vendors. The method of negotiation has been employed to help handle

general conditions, contingency and allowances. Normally when it comes to the issue of unused contingency, there are two types of solutions. One approach allows the owner and CM to split the unused funds, while the other lets the owner claim sole ownership. In Florida, the CM is allowed to self-perform part of the work, but it must not exceed 50 percent of the entire workload. And to get the work, it must bid the work against the interested qualified subcontractors, and be the low bidder. FDOT's process of procuring subcontractors and suppliers requires competitive bid; this is the only way to receive federal funding for any project. To this point, FDOT has not identified any specific aspect of the CMR program that has worked best or has fallen short of its intended purpose. Figures 1 and 2 illustrate the performance of two FDOT CMR projects. Note that in each case the engineer's estimate was inaccurate in predicting the low-bid amount. In one case the estimate was high and in the other the estimate was low. Note also that in each case the actual final cost was below the originally submitted GMP.

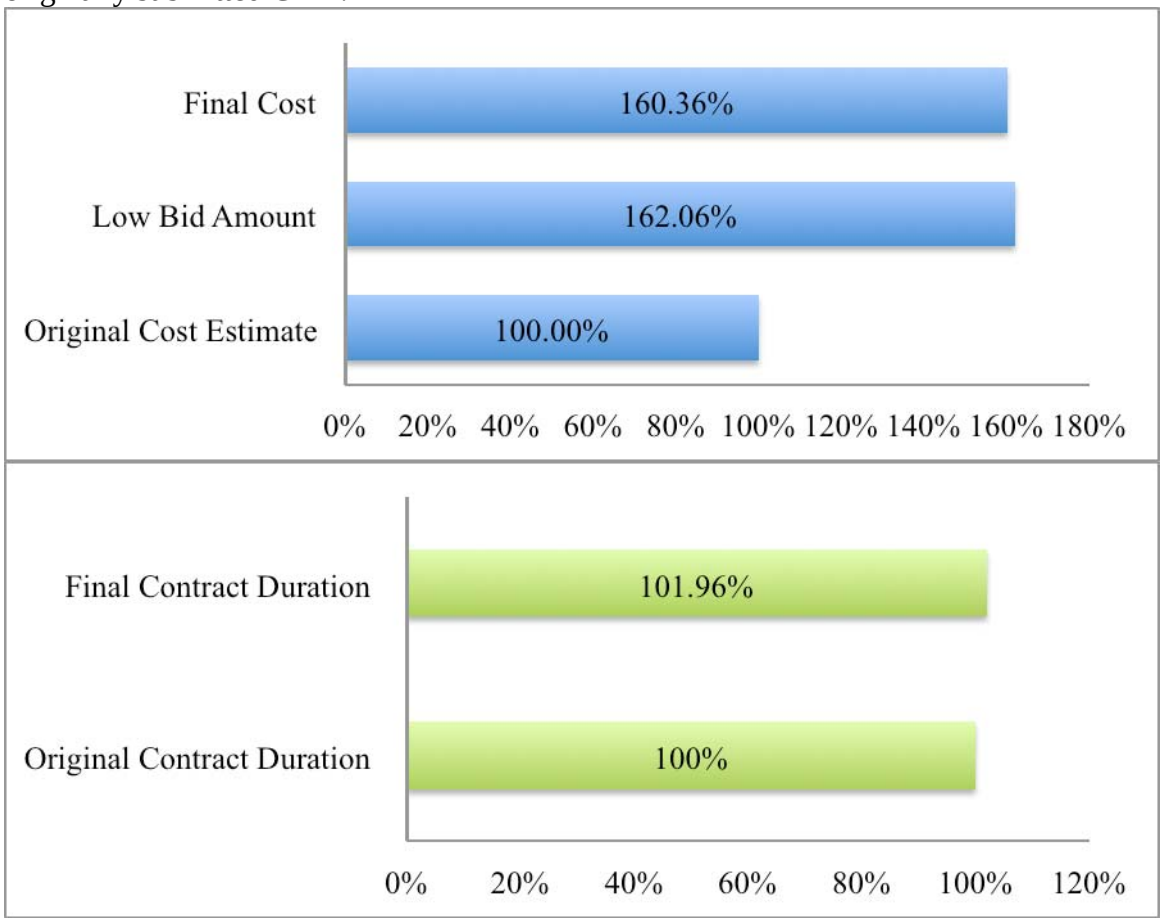

Figure 1. *Cost and Duration Analysis: I-75 Welcome Station*

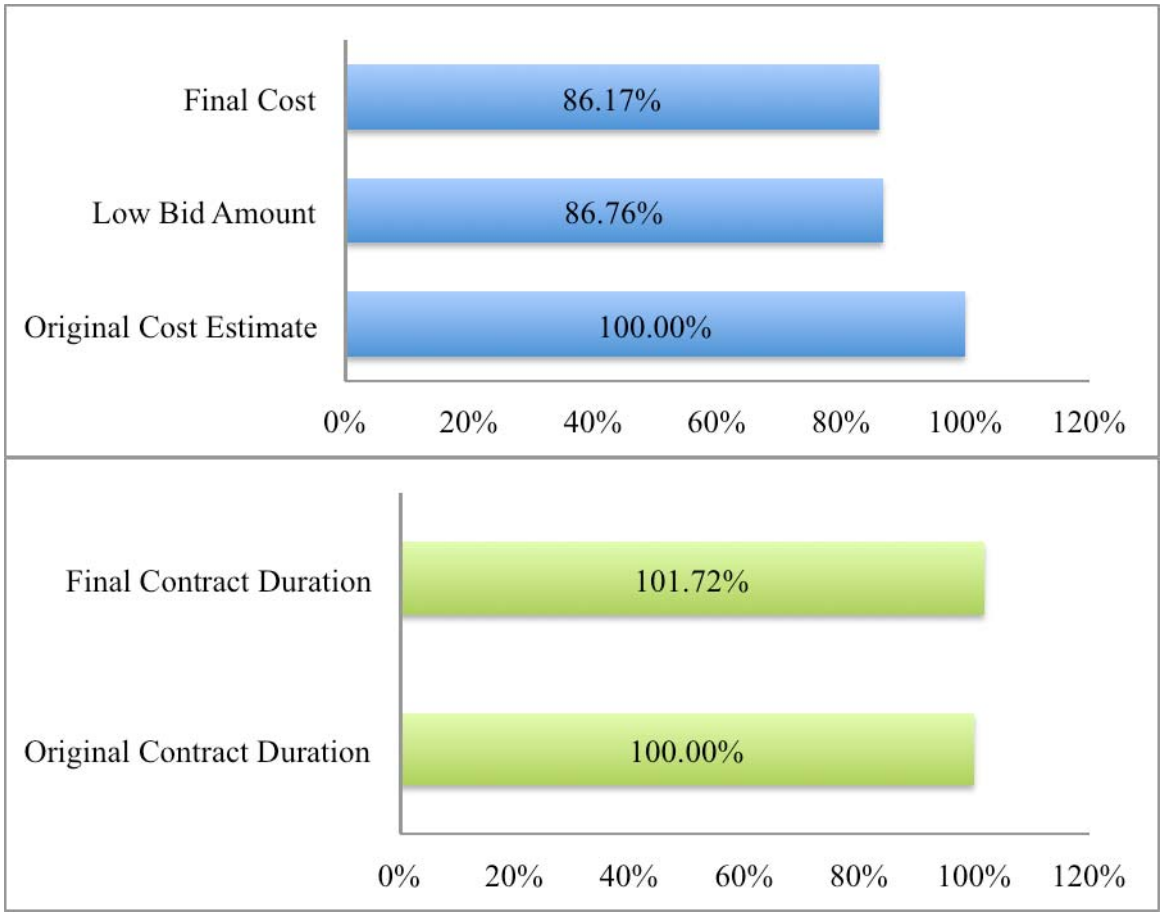

Figure 2. *Cost and Duration Analysis: I-10/ Madison Co Rest Areas/Both Sides CMAR*

CONCLUSIONS

Construction manager-at-risk is a construction delivery system that has been tried and found effective for years in the vertical construction industry. Its relatively recent introduction into the world of highway and bridge construction has been a slow process. Though the first CMR projects were let just after the turn of the 21st century, year 12 of that century yields a scenario that shows only two states have really used the system as a regular course of business. Some others have dabbled in it, but only Florida and Utah have used it extensively. To gain information on CMR, the team thought it important to compare the performance of CMR to DB, as well as to DBB. It is well known that all DOTs use DBB more than any other delivery system, so no questions were asked regarding DBB except how it compared to CMR in some way. The questions to the DOTs began with inquiries regarding DB. All the DOTs have used DB. Florida, Maryland, and Georgia have used it for 10 years or more (Florida 15, Maryland 13), while Tennessee, Louisiana and Mississippi have used it for five years or less (Louisiana 4, Tennessee 3). Since FDOT is the only DOT to use both DB and CMR contracts on horizontal transportation projects, their opinions regarding the two systems are of interest. The Interview Instrument broke the construction project into 11 categories; Final Alignment Geometry, Geotechnical Data, etc. When it comes to responsibility and risk in a DB contract, FDOT believes that majority of the responsibility and risk resides with themselves for five of the 11 categories. They believe that the majority of the responsibility/risk lies with the DB firm for four categories, and for two of the categories, they believe that it depends upon the circumstances of the individual project.

After discussing DB, the interviews discussed CMR. As for the responsibility/risk in a CMR contract, FDOT believes that they bear the majority in three of the 11 categories, the CM bears the majority in seven categories, and the designer bears the majority in one category.
FDOT has used CMR on a variety of projects. The majority of projects could be categorized as "combination" projects due to the fact that they contain substantial work in both the vertical and horizontal construction areas. In fact, six of the projects are of this variety. These six combination projects include an interstate highway Agricultural Station, three interstate Rest Areas, an interstate Welcome Center, and the massive MIC. There are two vertical construction projects - an FDOT office building and a building at an interstate highway Agricultural Station on a different interstate highway than the one mentioned above. Finally, there are two wholly horizontal construction projects, both bascule bridges.
The FDOT CMR projects ranged from $3.2 million to $78 million, based on accepted GMP. The $78 million is the MIC rental car facility, which may grow based on decisions for further GMPs. The entire MIC will not be built using CMR. Of the eight projects that have had an engineer's (preliminary) estimate and an awarded GMP, six have been awarded for GMPs above the engineer's estimate; two for GMPs below the engineer's estimate. Of the three FDOT projects that have reached the Final Estimate stage, two were completed at slightly under the GMP and one at slightly over the GMP. Both underruns and the overrun were less than one percent. All three completed projects went over the original duration, two slightly (less than two percent) and one substantially (almost 44 percent).

ACKNOWLEDGMENT

The research team gratefully acknowledges a grant from Balfour- Beatty Construction, which funded the research reported upon herein.

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