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Effective Tools for Projects Delivered by Construction Manager–General Contractor Method

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Construction manager–general contractor (CMGC) is an alternative project delivery method that is fast becoming more prevalently used to accelerate the delivery of highway projects. FHWA's Every Day Counts program is encouraging state departments of transportation (DOTs) to adopt CMGC as a tool to deliver badly needed rapid renewal projects. As part of the program, a CMGC Peer Exchange conference was held in June 2011 in Salt Lake City, Utah. This paper synthesizes the tools used in implementing CMGC project delivery that were reported in those conference presentations by state DOTs with CMGC experience. That information is compared with similar information found in the literature to document the current state-of-the-practice in CMGC highway project delivery. It is concluded that jointly managing risk and developing a collaborative business climate are the two most important aspects of successful CMGC project delivery.

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Effective Tools for Projects Delivered Using the Construction Manager/General Contractor

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Effective Tools for Projects Delivered Using the Construction Manager/General Contractor

Abstract: Construction Manager/General Contractor (CM/GC) is an alternative project delivery method that is fast becoming more prevalent to accelerate the delivery of highway projects. The FHWA's *Every Day Count*s program is encouraging state departments of transportation (DOT) to adopt CM/GC as a tool to deliver badly needed rapid renewal projects. As part of the program, a CM/GC Peer Exchange conference was held in June 2011 in Salt Lake City. This paper synthesizes the tools used in implementing CM/GC project delivery that were reported in those conference presentations by DOTs with CM/GC experience. It compares that information with similar information found in the literature to document the current state-of-the-practice in CM/GC highway project delivery. The paper concludes that jointly managing risk and developing a collaborative business climate are the two most important aspects of successful CM/GC project delivery.

INTRODUCTION

Construction Manager/General Contractor (CM/GC) is an alternative delivery method for transportation projects in which the owner engages a design professional and a CM/GC under separate contracts. The CM/GC contract is awarded during the design phase and provides preconstruction services such as estimating, scheduling and constructability reviews. Once the design has been advanced to a point where a guaranteed maximum price (GMP) can be established, the CM/GC assumes the role of the general contractor and completes the construction *(1)*. Typically this method requires the CM/GC to self-perform a predetermined percent of the project *(2)* and the CM/GC is at-risk for costs per the GMP. The CM/GC method is typically implemented via two separate contracts, one for preconstruction services and the other for construction *(1)*.

The Federal Highway Administration (FHWA) sponsored a CM/GC Peer Exchange in Salt Lake City, Utah in June of 2011 as part of its *Every Day Counts* (EDC) program *(3)*. The event was attended by members of state Departments of Transportation (DOTs), FHWA and the construction industry. Throughout the Peer Exchange agencies with CM/GC experience gave presentations on CM/GC projects that are currently underway. Other speakers discussed their experiences with implementing the method. As a result, the research team was able to capture the state-of-the-practice and lists of key points for achieving successful CM/GC project delivery. Furthermore, many agencies described project delivery tools and practices that have proven to be effective on CM/GC projects. Therefore, the objective of this paper is to compare tools described in the Peer Exchange with the effective CM/GC tools found in National Cooperative Highway Program (NCHRP) Synthesis 402: *Construction Manager-at-Risk Project Delivery for Highway Programs*, *(1)*. and other literature to document the current-state-of-the practice in this emerging technique for accelerating the delivery of critical infrastructure projects.

MOTIVATION

The FHWA EDC program is actively encouraging state DOTs to implement CM/GC *(3)*. For those that decide to adopt CM/GC, it will be the first attempt at alternative delivery method for transportation projects. For this reason, it is critical to document past efforts and transfer lessons learned regarding keys to success and effective CM/GC tools from agencies with CM/GC experience. Sharing this type of knowledge as quickly as possible within the industry allows for greater consistency across the nation and more efficient progression up the learning curve for DOTs.

EFFECTIVE TOOLS IN LITERATURE

The following list of effective practices for is taken directly from NCHRP Synthesis 402 *(1)*.

1. "The case study interviews reported that agencies can develop a documented procedure for selecting [CM/GC] as the project delivery method based on project characteristics. Additionally, a similar policy can be developed for selecting the [CM/GC] contractor based on the same project characteristics.
2. A [CM/GC] selection process is transparent, logical and defensible appears to be less likely to be susceptible to protest.
3. Eight of ten case study agencies utilized the same Quality Assurance (QA) program for CMR as they do for Design Bid Build (DBB). Therefore, it appears that no modification is necessary to a DOT's QA program to implement [CM/GC] project delivery.
4. The two most often cited preconstruction services in transportation projects were design reviews and constructability reviews. Both of these are essential components of the design Quality Control (QC) program. Thus, detailing the roles and responsibilities for design QC for both the designer and the [CM/GC] in the procurement phase facilitates collaboration.

5. Joint development of the preconstruction service cost model prior to commencing design allows the designer and the [CM/GC] to be able to leverage it to make design decisions and to benchmark value engineering savings.
6. Splitting the contingency between the owner and the CM/GC appears to make accounting for contingency allocation less ponderous.
7. An open books approach to contingency calculation and allocation enhances the spirit of trust between the owner and the [CM/GC].
8. Detailing the specific preconstruction services the agency wants to be provided in the preconstruction services contract in the solicitation document leads to responsive proposals. This is critical to a getting reasonable proposal if costs are included in the selection process.
9. Including the submittal of an outline of the proposed [CM/GC] project quality management plan with the Statement of Qualifications or proposal allows the agency to evaluate each competitor's understanding of the quality assurance challenges in the project
10. Assigning the [CM/GC] the duties of scheduling for both design and construction during the preconstruction phase enhances collaboration between the parties. This service was rated as the second most valuable preconstruction service by both the case study agencies and contractors and ability to fast-track was cited by ten of the fifteen papers [reviewed in the synthesis.]
11. The agency can furnish a list of the cost categories to be used in preconstruction and where it wants various costs, like fees and contingencies, to be accounted for in the [CM/GC] contract. Doing so eliminates confusion as to where each cost is to be allocated and facilitates the Guaranteed Maximum Price negotiations" *(1)*.

This list of effective practices was compiled based on information gained through case studies, surveys, a content analysis of CM/GC solicitation documents and structured interviews with suitable agencies. These effective practices are next compared to the effective tools described in the CM/GC Peer Exchange later in this report.

KEYS TO SUCCESS FOR THE CM/GC PROJECT DELIVERY METHOD

A content analysis of the presentation transcripts from the CM/GC Peer Exchange was conducted in order to find keys to success for implementing the CM/GC method. This type of analysis can be used to develop "valid inferences from a message, written or visual, using a set of procedures" *(4)*. The primary approach is to develop a set of standard categories into which words that appear in the text of a written document, in this case a DB RFP, can be placed and then the method utilizes the frequency of their appearance as a means to infer the content of the document*(5)*. Thus, in this study, the content analysis consisted of two stages. First, all instances of each word were found in each presentation and the context was recorded. Secondly, that context was used to determine, if possible, the relative success of each practice. This allowed an inference to be made regarding the effectiveness of each tool/practice on the presenter's CM/GC projects. When the results are accumulated for the entire population, trends can be identified and reported.

Eight agencies were represented in the presentations. Of these, three state DOTs and one Construction Company were found to include CM/GC keys to success. These keys were suggested based on past CM/GC experience and highlight aspects to focus on during a CM/GC project. Table 1 displays the keys to success suggested by Utah DOT, Sundt Construction, Colorado DOT and Oregon DOT.

TABLE 1: CM/GC Keys to Success suggested by entities with CM/GC experience

Keys to Success	Utah DOT *(6)*	Sundt Construction *(7)*	Colorado DOT *(8)*	Oregon DOT *(9)*	Total Count
Partnering/Teamwork; Co-location and Collaboration	X	X	X	X	4
Manage Risk	X	X	X		3
Cultivate Good Relationships; Commitment	X	X	X		3
Active Project Management; Measure Success	X		X	X	3
Proactive Leadership; Objectivity to each Team Member		X	X	X	3
Timely Issue Resolution; Proactively solve challenges and prevent disputes without blame; Competition ends at Selection	X	X	X		3

Trust		X	X		2
Stimulate Innovation; Flexibility and Adaptability	X		X		2
Communication; Regular Meetings	X	X			2
Common Goals and Objectives		X			1
Good Intentions and Mutual Purpose			X		1
Cooperation in Design Effort	X				1
Understand the Scope and Delivery Method			X		1

Table 1 shows that partnering is cited by all four entities as an important key to success for CM/GC projects. This makes it the most commonly given key to success, followed by risk management, relationship cultivation, active project management, proactive leadership and timely issue resolution.

EFFECTIVE CM/GC TOOLS

Throughout the course of the CM/GC Peer Exchange a number of effective techniques for CM/GC projects were described. Those that were described most frequently by multiple presenters include Blind Bid Comparison, Selection Process Interviews, Selection Criteria Weighting, Iterative Pricing, Open Books Accounting and Measuring and Recording Success. These tools have each been used by an agency for a CM/GC project in the past and have proven to be effective practices for the delivery method. Table 2 shows the project phase to which each tool relates.

TABLE 2: Effective CM/GC Tools described at the CM/GC Peer Exchange

Tool	Project Phase
Blind Bid Comparison	Procurement
Selection Process Interviews	Procurement
Selection Criteria Weighting	Procurement
Iterative Pricing	Preconstruction/Construction
Open Books Accounting	Preconstruction/Construction
Measuring and Recording Success	Entire Project

Blind Bid Comparison

Blind Bid Comparison is an effective tool that has been adopted by Utah DOT for all CM/GC projects *(6, 10)*. The Blind Bid Comparison process involves three estimates:

1. The CM/GC's estimate,
2. The Engineer's estimate
3. The Independent Cost Estimator's (ICE) estimate.

When the CM/GC is ready to establish the GMP, the three estimates are compared. The CM/GC is then told whether or not their estimate is within 10% of the average of the three estimates. If the CM/GC's estimate is within the 10% range, the project may be awarded. However, if the CM/GC's estimate does not fall within the 10% range, the CM/GC, the Designer and ICE meet to discuss the reasons for the differences in estimates. This discussion is not to negotiate price, but rather to compare the assumptions affecting the price and to establish a common understanding of the bid items *(2)*. Often the price differences are found to be due to differences applied or perceived risk. At this point the Owner can choose to accept the risk, do more design work, or adopt a method to mitigate the risk. The CM/GC is then given the opportunity to reevaluate and estimate a new GMP. A new Engineer's estimate and ICE are developed for the next GMP submittal. This process is iterative and continues until an acceptable GMP is reached. If an acceptable price cannot be reached the Owner may choose to have the design completed and proceed with construction using Design-Bid-Build delivery *(6)*. However, in Utah DOT's experience, prices usually converge after two or three iterations. Throughout the entire GMP negotiation process the ICE is kept confidential, hence the tool name of Blind Bid Comparison.

Selection Process Interviews

Conducting interviews during the selection process is highly recommended by more than one agency at the CM/GC Peer Exchange as being a valuable practice *(6,7,8,9)*. Interviews allow the owner to judge the chemistry and dynamics of a group of people before selecting a project team. This is important for a delivery method such as CM/GC because partnership, teamwork and trust have been identified as keys to success. In addition, this interview process gave the interview team a way to clarify and understand the contractor's proposal. Interviews are typically conducted as part of the selection process for a CM/GC project. For example, Colorado DOT forms a selection panel and decides on a short list of contractors for each CM/GC project *(8)*. Interviews are then performed in which each contractor is asked the same questions. Each interview is scored and the winning contractor is subsequently chosen.

Selection Criteria Weighting

Four of the presentations at the CM/GC Peer Exchange contained information regarding selection criteria used for selecting a contractor. Selection criteria are chosen and weighted by an agency in order to determine which CM/GC firm offers the best value. Table 3 displays the maximum possible score for the selection criteria used by three of the four agencies when selecting a CM/GC firm for a project.

TABLE 3: Sample Selection Criteria

	Maximum Score		
Selection Criteria	**Arizona DOT** *(10)*	**City of Phoenix Street Transportation Department** *(11)*	**Utah DOT** *(6)*
General Information		5	
Qualifications of Firm	20	20	
Experience of Key Personnel	15	20	20
Project Understanding	30	25	15
Safety	10		
Miscellaneous	15		
Interview	20		
Quality Control and Safety Program		10	
Subcontractor Selection Plan		10	
Overall Evaluation of the Firm		10	
Innovations			10
CM/GC Design Process			25
Price			10
Approach to Price			20
Maximum Total Score	110	100	100

It can be seen that both Arizona DOT and the City of Phoenix Street Transportation Department exclude criteria related to pricing when evaluating CM/GC firms. Historically, in early projects Utah DOT also excluded pricing criteria from the selection process. However, pricing criteria was added at the request of the construction industry in order to prevent the process from becoming a 'beauty contest' *(2)*. In their experience with CM/GC projects, Utah DOT has found that pricing criteria is becoming more important as contractors are becoming more skilled at writing proposals *(6)*.

Furthermore, Utah DOT recommends that evaluation of Request for Proposals includes a 30% experience portion and a 70% portion for price and approach to price. The experience portion comprises a 25% technical element including consideration of the team capability and project approach, and a 5% interview element. Similarly, the price portion consists of a 30% price element and a 40% approach to price element including open book price details and risk consideration *(6)*. In performing such evaluations, the Utah DOT are applying a "1/3 Rule" for both price and technical factors. This rule says that in order to avoid awarding the contract to a contractor whose bid is more than 10% over the low bidder then the qualification component of the evaluation should not be more than 30%. This method is the result of some evolution in which a variety of scoring criteria and weightings were tried. Utah DOT would now admit that there is not one best portion combination, but rather each project should be considered individually to arrive at the best method specific to the project.

The fourth system is used by Oregon DOT and involves calculating the best value proposal based on equations for both Project Proposal Factor (PF1) and Price Proposal Factor (PF2) *(9)*. This system assigns a weight

of 85% to the Project Proposal and 15% to the Price Proposal. The Total Score of a proposal is calculated using Equation 1.

$$\text{Total Score} = (\text{Project Proposal Weight} \times PF1) + (\text{Price Proposal Weight} \times PF2) \quad (1)$$

Similarly, the values for PF1 and PF2 for each proposal are calculated using equations (2) and (3) respectively.

$$PF1 = \frac{\text{Proposer's Project Proposal Score}}{\text{Highest Project Proposal Score}} \quad (2)$$

$$PF2 = \frac{\text{Lowest CM/GC Fee Percentage}}{\text{Proposer's CM/GC Fee Percentage}} \quad (3)$$

Iterative Pricing

Iterative pricing is an effective tool used by Utah DOT in order to obtain cost estimate comparisons at regular intervals *(2,6)*. An Opinion of Probable Cost of Construction (OPCC) is determined through analysis of the project cost and risks. As each estimate is determined, project risks are both realized and resolved. Table 4 displays the Base Cost Drivers that were used to produce each OPCC for Utah DOT's Mountain View Corridor Project in Salt Lake City, Utah.

TABLE 4: UDOT Mountain View Corridor Project Base Cost Drivers for each Opinion of Probable Construction Cost

	OPCC1	OPCC2	OPCC3	OPCC4
% of Roadway and Structure Design Complete	30%	45%	60%	60% - 75%
% of Drainage Design Complete	0%	30%	60%	80%
Base Cost Uncertainty Range	+11% to +20%	-18% to +15%	-9% to +9%	-7% to +7%

The initial OPCC typically involves only the owner and the designer in the risk analysis. Subsequent estimates include the CM/GC. As a result, the second OPCC is usually higher due to risks identified from the contractor's perspective. Subsequent OPCCs are lower as the project team works through cost versus technical issues during design. Furthermore, with each OPCC Utah DOT found that the required contingencies are reduced releasing additional funding for construction. Iterative pricing using OPCCs creates an opportunity for an owner to reduce project cost as a result of employing contractor knowledge and experience.

Open Books Accounting

Open Books Accounting is a tool that was recommended at the CM/GC Peer Exchange by three speakers. It is said that the GMP, used in CM/GC projects allows open book accounting and design to progress, leading to minimized risk and reduced hidden contingencies *(12)*. Open Books Accounting is effective because it provides transparency and develops trust among project team members

Measuring and Record Recording Success

Keeping track of the records that document success, such as cost and time savings, throughout an entire CM/GC project is an effective tool that was recommended by representatives from two different agencies at the CM/GC Peer Exchange. Utah DOT recognizes the value of collecting and documenting data from a project in order to maintain ongoing, verifiable statistics to promote CM/GC as a delivery method. For example, Utah DOT is currently involved in a large highway project in Salt Lake City called the Mountain View Corridor Project. An approach to documenting savings in constructability and innovation has been implemented on this project and has allowed the project team to gain otherwise unknown information relating to project savings. Utah DOT also utilizes project documentation by viewing Change Orders and Overruns in order to gain insight into overall project savings.

The City of Phoenix Street Transportation Department has also found value in measuring and recording project successes *(11)*. They implement the tracking of cost estimates during the pre-bid phase of the project in order to identify increases or decreases in cost. This is done to eliminate the possibility of surprises on bid day.

COMPARISON OF EFFECTIVE TOOLS

A comparison of the effective tools described in the CM/GC Peer Exchange and those listed in the NCHRP Synthesis 402 *(1)* revealed three obvious similarities. First, the literature states that developing a policy "for selecting the [CM/GC] contractor based on [specific] project characteristics" is an effective means to maximize the CM/GC's experience with the project's requirements. This aligns with the Selection Criteria Weighting tool reported in the CM/GC Peer Exchange. Implementing the Selection Criteria Weighting tool requires an agency to establish selection criteria that includes important project characteristics and the resulting criteria form the policy CM/GC selection based on project characteristics. This also implies that the weighting of the scoring criteria consider the project.

Secondly, the literature lists "an open books approach to contingency calculation… [and] allocation enhances the spirit of trust between the owner and the CMR" *(1)*. This practice is consistent with Open Book Accounting described in the CM/GC Peer Exchange due to the trust and transparency described by both the literature and the tools discussed in the presentations.

Last, there is a linkage between the literature and the effective Peer Exchange tools as each relates to cost categories. The literature states that "the agency can furnish a list of the cost categories to be used in preconstruction" to "eliminate confusion as to where each cost is to be allocated" *(1)*. This practice is consistent with the Blind Bid Comparison process in which price discussions take place to establish assumptions and bid item understanding. Therefore, both practices call for some form of price clarification, eliminating confusion and potential misunderstanding by mandating information-rich communications.

RELATIONSHIP BETWEEN EFFECTIVE TOOLS AND KEYS TO SUCCESS

Each of the effective tools identified at the CM/GC Peer Exchange supports one or more of the keys to success given in the presentations. Table 5 is a matrix that shows the interrelationships between the two. It is clear from Table 5 that managing risk is a common key to success that is achieved by the implementation of most of the effective tools. This is desirable because risk discussions are critical to the success of the CM/GC delivery method and to project pricing *(2)*. One of the primary goals of the CM/GC delivery method is to minimize risk wherever possible and to determine where it should be allocated. The elimination and mitigation of risk is critical to ensuring that a good project price is achieved. The remainder of the tools generally relate to the quality of the business relationships established inside the CM/GC contract between the various stakeholders. Having common goals and objectives that are set and maintained via information-rich communications that take place in a routine manner in regular meetings appears to be critical to the successful delivery of a CM/GC project.

Table 5: Keys to Success Achieved by Implementing the Effective Tools

Tool	#	Keys to Success					
		Blind Bid Comparison	**Selection Process Interview**	**Iterative Pricing**	**Selection Criteria Weights**	**Measuring and Recording Success**	**Open Books Accounting**
Manage Risk	5	X	X	X	X		X
Communication; Regular Meetings	5	X		X	X	X	X
Common Goals and Objectives	5	X	X	X	X	X	
Cultivate Good Relationships; Commitment	4		X	X		X	X
Timely Issue Resolution; Proactively solve challenges and prevent disputes without blame; Competition ends at Selection	4	X	X	X			X
Cooperation in Design Effort	4	X	X			X	X
Partnering/Teamwork; Co-location and Collaboration	3		X			X	X
Active Project Management; Measure Success	3			X		X	X
Proactive Leadership; Objectivity to each Team Member	3		X	X	X		

Develop an Environment of Trust	3		X	X			X
Stimulate Innovation; Flexibility and Adaptability	3		X	X	X		
Good Intentions and Mutual Purpose	2		X				X
Understand the Scope and Delivery Method	2		X				X

CONCLUSIONS

The review of the CM/GC Peer Exchange and its comparison with the literature has identified a number of effective CM/GC implementation tools. Each of the tools lines up with at least one of the keys to CM/GC success that were detailed during the presentations. The fact that the keys to the success came from both DOT and contractor entities validates their selection. The following conclusions are drawn from the above analysis:

- Managing risk is the most important aspect of CM/GC project delivery success. Risk can be managed by a number of mechanisms such as open books accounting, partnering, iterative pricing, and blind bid comparison.
- Creating an environment of trust is also important to CM/GC success. Through selection process interviews and the weighting of selection criteria, the DOT is able to pick its CM/GC on a basis of qualifications and past performance and is no longer "stuck" with the low bidder. Therefore, the ability to work in an open and honest manner is possible. Mechanisms like open books accounting furnish a means for the owner to understand the CM/GC's perception of risk and the use of iterative pricing provides a format where both sides can adjust and revise their numbers during GMP negotiations.
- The first two conclusions are essential to maximizing the benefit possible from cooperation during the design effort. When the designer has access to the construction contractor's real-time pricing and the ability to review the constructability of the design before it is completed, there is no longer an excuse to exceed the publish budget for the project. Using tools like co-location and collaboration creates instant access for the designer to the builder and the owner, which permits timely questions and design decisions being made in an information-rich environment.

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