

# *The Construction Manager-General Contractor method for construction of transportation projects in Puerto Rico*

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**Abstract** — *The Transportation infrastructure always needs investment. Fiscal problems at government [require the use of](#) innovative solutions to optimize the use of public funds. The traditional contract method, currently used, increases risks and loss of money. The CM/GC contract method reduces the risks during construction, which enhances project designs. This innovative contracting method, have good result in other states. The CM/GC was promoted, their implementation was discussed and future projects were identified. If PRHTA makes changes in their code of regulation and obtains the local industry support with a transparent selection method, the CM/GC can be implemented in Puerto Rico with success.*

**Key Terms** — *CM/GC; risks reduce; construction industry; contract innovation.*

## **INTRODUCTION**

Puerto Rico's economy has been going through an economical recession over the past eight years, creating a big deficit that has affected the entire government system and its agencies. One of those agencies is the Puerto Rico Highway and Transportation Authority (PRHTA), with around \$277 million in deficit. The PRHTA is in charge of a great part of the transportation infrastructure. Components of this infrastructure, many of which are over 50 years old, are in the need of updates and maintenance. However, this entity is receiving over \$125 million annually from the Federal Highway Administration (FHWA) in order to invest in transportation infrastructure. The FHWA, through the "Every Day Counts (EDC)" program, promotes innovations with new constructions and contract methods. Therefore, PRHTA could optimize the uses of these federal funds with innovative

initiatives. These actions will promote the economic development and the improvement of the roads and the highway system around the island.

One new construction contract method promoted by EDC is the **Construction Manager General Contractor (CM/GC)**. The CMGC "is a project delivery method in which the agency contracts separately with a designer and a construction manager. The agency can perform a design or will contract with an engineering firm to provide a facility design. The agency selects a construction manager to perform the construction management services and construction works. The significant characteristic of this delivery method is the contract between an agency and a construction manager who will be in charge of the final cost and the construction deadline. The Construction Industry/Contractor input into the design development and constructability of complex and innovative projects are the major reasons an agency would select the CMGC method" [1].

The General objectives of this project were:

- To promote the necessary changes in PRHTA to perform new alternatives of contracting.
- To optimize the use of federal funds allocating for roads, while reducing risks.
- To present reliable information in order to identify projects where PRHTA can apply this construction management method.
- To set the bases to develop a Standard Operations Procedures (SOP).

## **LITERATURE REVIEW**

### **What is CM/GC?**

In the CM/GC method peer review, celebrated in Utah on June 2011, the CM/GC was defined as

“an alternative project delivery method in which the owner places the responsibility for design review, design modifications, system integration, and construction with a single contractor. Typically, a CM/GC contract stipulates that the construction manager (CM) is responsible for the costs over the guaranteed maximum price. It may consist of two separate contracts: pre-construction services and construction. In a typical CM/GC scenario, the owners of a project hire either a general contractor or a design firm to serve as the CM. CM/GC allows State DOTs to remain active in the design process while assigning risks to the parties most able to mitigate them. CM/GC occupies the middle ground between design-bid-build and design-build” [2].

The NCHRP-Synthesis 402 defines the CM/GC as “Construction Manager-at-Risk (CMR) project delivery (also called Construction Manager/General Contractor or CM/GC), which is an integrated team that approach to the planning, design, and construction of a highway project, to control schedule and budget, and to ensure quality for the project owner. The team consists of the owner; the designer, who might be an in-house engineer, and the at-risk construction manager” [3].

#### What are the results in others States?

Currently 13 States have enabling legislation for CM/GC. Other states are working to enabling legislation to implement construction projects with CM/GC. The states with enabling legislation for CM/GC are:

- California
- Nevada\*
- Oregon\*
- Washington
- Idaho
- Utah \*
- Colorado\*
- Arizona\*
- Texas
- Florida\*
- Minnesota\*
- Michigan

- Connecticut

[On the previous list, states with \\* indicate that they](#) have experience with CM/GC on several projects. Other state with experience in CM/GC is Maine. However, the CM/GC in this state was used only for emergency bridge replacement after Irene tropical storm.

The CM/GC produces savings in the construction cost because the risks are reduced. “CMGC produces its greatest savings through innovations that address risks—particularly risks associated with the duration of the construction” [4].

Over 20 projects were constructed with CM/GC through the Nation. Utah is the state with most experience in the use of this innovative contract method. These projects create savings in time and costs. Table 1 includes some of the projects that were constructed with CM/GC, including their estimated cost and it savings.

**Table 1**  
**Projects Savings**

Project	Project Estimated Cost	Cost Savings
VIRGIN RIVER TRAIL	\$1,296,518.74	\$200,000
Replacement of 7 structures along I-80	\$116,425,488.79	\$2,000,000
Sellwood Bridge Replacement	\$136,000,000	\$5,000,000

The CM/GC projects motivate the innovation during the construction. The following information, resume some goals achieved on several projects:

- **The Virgin River Trail**, have cost savings of \$200,000. This project, located in Utah, was constructed in an environmental sensitive area. The construction manager helped determine trail alignment. Also, their consulting reduces the environmental risks because it eliminated the blasting and minimized excavation.

- **The Replacement of 7 structures along I-80.** This project produced over \$2,000,000 in savings in the construction stage. Additionally, improved the constructability with the use of technologies like *Self-propelled modular transporter* (SPTs). The use of new technologies and an enhanced design, where the CM/GC team managed the utilities and prioritize the MOT plan, and achieved the most important goal: the accelerated delivery of this project. “The most dramatic innovation introduced during the I-80 reconstruction project was the mobilization of bridges. By building 7 bridge structures off- site and moving them into place the interruption of traffic per bridge was minimized from months to mere hours” [5]. The project was completed in 2 years.
- **Sellwood Bridge Replacement.** This bridge located at Oregon had a cost of \$136,000,000. The contractor manager enhanced the design and improved the constructability. The total savings in cost was \$6,000,000.
- **State Route 9-Hurricane City,** this route is a Gateway City to Zion Park. The project consisted in addition of 1 lane on each direction. The major risks in the area were third party issues. However, the CM/GC team negotiated the driveway access of residents and businesses and all construction activities that concerned the public. Additionally, the contractor assisted with a 3-D utility map and relocation plan. This relocation plan, developed during the design phase, was included in the construction schedule. These negotiations with the stakeholders during the design reduced the risks and had the result of a better constructability.
- **Bitter Creek Bridge.** This bridge was identified to a full replacement. However, the CM/GC team studied the situation, and repaired the bridge’s girder with a project of \$400,000. The location of this bridge in Colorado was the major risk of this project.

## ANALYSIS

### CM/GC Project Plan

To implement the CM/GC in Puerto Rico, it is necessary to research the current situation of the PRHTA. Currently, PRHTA is constructing projects with the traditional contracting method of Design Bid Build (DBB). The growing need of projects in the urban areas and the lack of personnel on PRHTA increase the risks in many constructions areas.

“In the past, the PRHTA construction projects were across the island. Today, projects are more road reconstruction in high volume traffic sites”, said Eng. Hector Laureno, acting Bridge Program Manager. This problem increases the need of projects with short schedules. “The projects should be faster” [6]. Current delays with the PRHTA projects caused economic losses to its users and businesses.

An additional problem that the PRHTA is facing is the personnel shortage in the design area. “The lack of personnel increase the design phase”, Laureano declared. However, the agency completes the process in order to use federal funds on the design phase. The Request of Proposal (RFP) process is competitive and a design firm is contracted. This process must be in compliance with the FHWA specifications. The use of RFP will help the agency in the project delivery processes with the traditional and CM/GC contract methods.

During the conversation, one project identified as a good prospectus to use CM/GC contract method was: **The PR-18 Reconstruction.** The project consists in “the rehabilitation or replacement of 5 bridges and the pavement. The major risk of this reconstruction is the traffic volume. Over 289,000 vehicles use this route and it provides access to important stakeholders such as Centro Medico Hospital, Plaza Las Americas Mall, and many others” [6]. Other risks include the MOT, and the drainage system. Additional potential projects are:

- **PR-3 Pavement Reconstruction:** The PR-3 or “65 de Infanteria Avenue” is good candidate

for CM/GC. The major risks are the businesses in the area, plus the utilities management and the MOT.

- **Bridge Emergency Replacement:** Currently PRHTA has many small bridges that could represent the opportunity to practice the CM/GC projects.

## RESULTS

### CM/GC Implementation Analysis

All changes in any organization need the feedback and approval from top managers. Also, a lawyer from PRHTA is necessary, especially with the changes in the contract procedures. A team composed by Eng. Noel Rosario, PRHTA Construction Director, Eng. Hector Laureano, Acting Bridge Program Manager, Eng. Ana Torres, Project Control Director, Angel Rivera, FHWA Assistant Area Engineer, and Gretchen Burgos, PRHTA Attorney, met to share ideas on how to implement the CM/GC in Puerto Rico. During the meeting, the most important issues explained by Attorney Burgos were:

- **The Corporation Law:** “The Corporations Act is restricting, for example, a corporation of professional engineering services, can only provide these services” [7]. This law could restrain a contractor to work as a consultant during the design phase. This law regulates the PRHTA Code of Regulations. This code prohibits “Engineering” consulting services “If the corporation is organized and is not authorized to provide professional services” [7].
- **RFP Contracts:** To be contracted with a RFP process, the engineer firm or company should be a corporation of professional services. “Those who participate in this RFP are organized as professional service corporations (PSC or CSP, LLC or LLP and are in compliance with provisions Act 273 of 1988” [7].

The PRHTA Code of Regulations allows the hiring of a consultant if the proposal:

- Specialize in Counseling
- Engineering Services
- Highly Technical Counseling

The PRHTA could recruit a contractor during the design phase if the constructability consulting services are not interpreted as engineering services, but as highly technical services. Also, the company should be organized, as the Act 273 of 1988 requires. The PRHTA Code of Regulation should be amended to include the CM/GC contract method.

## DISCUSSION

Puerto Rico Law prohibits the participation of the contractor whom participated in the design process during the auction process since “There would be a conflict of interest and in turn would be to the advantage of the contractor who participated in the project design. It would limit competition” [7]. To solve this problem, an auction should be performed when a 30% of the project has been designed. During this auction, the contractors will have the same information, and prepare good proposals with their methods to make the project. Figure 1 shows the basic flowchart with PRHTA as owner.

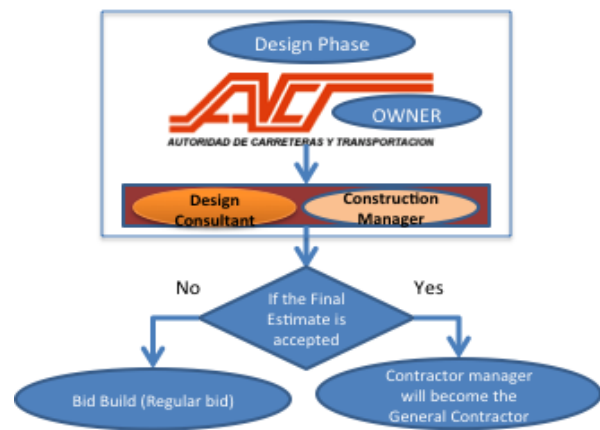


Figure 1  
CM/GC Flowchart with PRHTA as owner

The auction can be performed under the article VIII of the PRHTA Code of Regulations. This auction can be completed with a public formal bid and the contractor selected can be the lower bidder

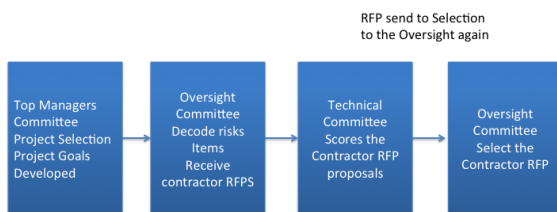
“Or in the best interest of the Authority (Articles VII and VIII of PRHTA Code of Regulations)” [7].

### **Set the Bases to create a Standard Operation Procedures for implement CM/GC in Puerto Rico**

The process of selection should begin with a committee composed with the Top Managers of PRHTA, and offices directives like construction and design. They should select a design in house or a design RFP project. The project selected should have many risks during the construction phase. This committee should establish the goal of the project selected. “The goals should be generally based on the following:

- Quality
- Scope
- Budget
- Schedule
- Impacts to the public”[8]

Another committee in Utah known as the Oversight Committee should decide the Items that have more risks, and public the RFPs to auction. A third committee will score the proposals by cost and construction methods presented by the contractors. The scores rules should be decided by PRHTA. Then with the score completed by the technical committee, the proposal should go back to



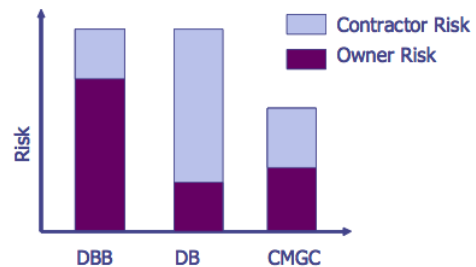
**Figure 2**  
**PRHTA CM/GC proposals implementation**

oversight committee. In this stage, the RFP will be selected only by scoring without the contractor’s name. This type of auction can be performed on PRHTA under the Article VIII of PRHTA Code of Regulations. Shown in Figure 2 is the proposed implementation flowchart.

The CM/GC can be a good alternative; especially with the projects with more risks. “Is a good option on certain transportation projects, where unique challenges call for special qualifications and extraordinary contractor cooperation for the project success of the project” [9].

The CM/GC has many benefits for PRHTA. The following list of benefits is the result of projects in the state with more experience with CM/GC, Utah.

- **Reduces risks:** The use of CM/GC reduces the risks to the owner and the contractor, because the integration of designer and the contractor, make the design more accurate and realistic. “Involving the contractor in design reduces risk and improves constructability. Contractors are encouraged to identify, track, and eliminate risk. If there is something unknown the project manager will task the contractor to investigate and resolve the risk or at least be better prepared to meet a risk that has become an event.” [10]. Other additional reduce in risks comes the teamwork and collaboration, the leadership and communication is crucial for the success of this type of project. “Randy Park concludes by saying that the benefits of the CM/GC method outweigh the challenges. It provides maximum opportunity for risk reduction through teamwork and collaboration”[2]. In Figure 3 the risks sharing are showed.



**Figure 3**  
**Risk sharing by contract construction methods [10]**

- **Reduction in time of project delivery:** The traditional contract method produces many delays with the federally financed projects in

Puerto Rico. The bureaucracy of the state, the lack of personal in PRHTA causes this problem.

- The CM/GC reduces the delivery project timing in over 25%. “CMGC has shown a consistent ability to shorten overall project schedules. Some of the timesaving is the result of CMGC’s ability to get the project into construction more quickly than traditional projects. The majority of timesaving occur in construction. The design team places additional effort into identifying, investigating, and developing time saving innovations” [10]. Other reports of Utah said that the reduction in schedule achieve the 40% during the process of design contracts: “CMR services furnished during the preconstruction phase reduce design costs by diminishing the amount of design detail that is required and by focusing the early design effort on constructible solutions. In other words, the CMR can tell the designer when it has sufficient design detail to properly construct a given feature of work. The Utah DOT has experienced a 40% savings on its design contracts, whereas the U.S. Army Corps of Engineers reported a savings of 2% of on its design costs for medical facilities. Achieving these savings requires a high level of collaboration and strong spirit of partnering” [3].
- The requests for proposal for CM/GC are shorter and easier that the requests for proposal for Design build. “A typical RFP for a Design Build process is over 500 pages and averages 250 days. A typical RFP for CMGC is 30 pages and can be shorted to less than 90 days. It is possible to start the RFP development during the environmental process and reduces the selection time to about 70 days. Using this process we are also able to purchase select items early. Items like steal girders have a

long lead-time and the cost frequently increases over time” [10].

- **Application of innovations:** The construction projects especially in these times need to be innovative. The use of new technologies could be more risk and many states and construction companies do not invest in these innovations. The CM/GC method helps in the use of innovating alternatives. “CMGC is the ideal delivery method to use when a project contains opportunities and risks that are best addressed through innovations. This is because it assembles a design team that is able to better identifying those opportunities and risks” [8]. The traditional method regularly gives the risk to one party (the state or the contractor). “It is also superior to traditional delivery methods, which do not provide support for unproven solutions to the challenges a project faces. In traditional methods innovations are only implemented if one party is willing to accept all risk” [8]. However, on CM/GC the owner distribute the risk, this give more confidence to the industry to invest time and money in innovation alternatives. “CMGC allows the owner to distribute risk for innovations in a more balanced approach. CMGC also reduces the risk of innovation by enabling all parties to gain a greater level of confidence that an innovation can be successfully applied. This true partnering process allows the industry to introduce new innovations safely and normalize their use across all delivery methods” [8].
- **Cost Reduction:** Puerto Rico needs a reduction in the cost of construction projects. Some projects in Utah experiment a cost reduction of 40%.
  - “Some projects report a cost savings of 40% in design cost for a 25% or more reduction in time. This savings is attributed to the improved communication that occurs between the contractor and the designer in the design process. The contractor helps to select constructible

solutions that save the designer time in analyzing alternatives. This communication also reduces the level of detail required for traditional design packages. In addition design flaws or deficiencies are discovered through a continuous peer review process that reduces total design effort” [10].

- This communication that the Utah report mentions is the key that Puerto Rico needs to optimize the use of federal funds. Additionally with the use of alternatives contract methods, the sharing between the state and federal government changes. In the example of Utah they had a sharing of 80% federal funds and 20% state funds. The CM/GC projects the sharing cost are 85% federal funds and 15% of state funds. This generates confidence in the state citizens and in the same time, the state has more money to invest in other infrastructure projects. “Prior to innovative funding the Utah Department of Transportation (UDOT) was 80% federally funded and 20% State funding. Following the implementation of innovative contracting UDOT projects have been 85% state funded and 15% federally funded. Innovative contracting helps to limit user costs through reduced construction times, reduced construction delays and support for economic development. Support of economic development is not often considered, but is important as it builds public trust and political support, which increases funding” [2].

## CONCLUSION

During this research process the objectives proposed at this paper were achieved. The new contracting method of CM/GC was promoted and a committee was created to analyze the implementation the future implementation of this

contract method. Also the projects that can be performed with CM/GC were identified. The meetings and discussion performed set the bases to develop a Standard of Procedures (SOP). This SOP began with the discussion and will continue in future meetings. If PRHTA completes this process, the agency will optimize the use of federal funds. The optimization of funds mean, more money to improve and reconstruct the transportation infrastructure. Finally, the presentation of reliable information and successful examples, like the CM/GC projects in other states, creates more confidence on PRHTA and the some projects were identified to use CM/GC. Also the CM/GC expert Eng. John Haynes will provide more reliable information about CM/GC contract method through a workshop. This workshop is the first step to continue the research and meetings to implement CM/GC.

According with John Haynes the keys to success with the CM/GC implementation are:

- “Give DOT a solid business case for implementing a CM/GC program.
- “Contractor selection process must be transparent to local industry.
- “DOT’s and contractor industry must have a mature partnering environment.
- “Dedicated staff and champion dedicated to CM/GC deployment.
- “Initiative CM/GC deployment on smaller less complex projects” [9].

In conclusion, the CM/GC construction method can be useful for Puerto Rico infrastructure investment with the federal funds allocated for highways. The PRHTA should continue the research of this innovated contract method. The FHWA will support with this and other initiative initiatives.

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