Best Practices from WisDOT Mega and ARRA Projects

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Construction and Materials Support Center

Final Report No. 0092-10-20
March 2012

Research & Library Unit

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Technical Report Documentation Page

1. Report No.	2. Government Accession No	3. Recipient's Catalog No
WisDOT 0092-10-20		

4. Title and Subtitle	5. Report Date
Best Practices From WisDOT Mega and ARRA Projects	March 2012
	6. Performing Organization Code

7. Authors	8. Performing Organization Report No.
Gary Whited Awad Hanna Justin Kavanaugh Eric Tadt	

9. Performing Organization Name and Address	10. Work Unit No. (TRAIS)
University of Wisconsin-Madison Construction and Materials Support Center College of Engineering 1415 Engineering Drive Madison, WI 53706	11. Contract or Grant No. 0092-10-20

12. Sponsoring Agency Name and Address	13. Type of Report and Period Covered
Research and Library Unit Wisconsin Department of Transportation 4802 Sheboygan Avenue	Research Report March 2010 – March 2012

15. Supplementary Notes

16. Abstract

Since 2004 WisDOT has developed a number of new techniques, methods, processes and procedures for management of two new types of transportation projects: "Mega projects" and projects funded through the American Recovery and Reinvestment Act of 2009 (ARRA). However, there has not been a comprehensive evaluation of the processes used to determine their effectiveness and whether they have provided sufficient benefit to be more widely implemented as a department best practice.

This research project identifies procedures, standards, and programs used in these projects and evaluated their effectiveness to determine if they have benefits for future use and how they could be adopted by the department.

The results will help WisDOT best decide where and when to apply the new techniques and processes developed so as to optimize available resources on future projects.

17. Key Words	18. Distribution Statement
Megaprojects, ARRA Projects, Project Management, Management Practices, Best Practices	No restriction. This document is available to the public through the Wisconsin Department of Transportation 4802 Sheboygan Avenue Madison, WI 53707

18. Security Classif.(of this report)	19. Security Classif. (of this page)	20. No. of Pages:	21. Price
Unclassified	Unclassified	60	

Form DOT F 1700.7 (8-72) Reproduction of completed page authorized

Best Practices
From
WisDOT Mega and ARRA Projects

WisDOT Policy Research Program Project
Project ID: 0092-10-20

Final Report

March, 2012

Submitted to the Wisconsin Department of Transportation

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Executive Summary

Since 2004, the Wisconsin Department of Transportation (WisDOT) has developed a number of new techniques, methods, processes and procedures for management of two types of transportation projects: megaprojects and projects funded through the American Recovery and Reinvestment Act of 2009 (ARRA). WisDOT completed a highly successful megaproject, the Marquette Interchange, in 2008 and delivered an equally successful ARRA construction program in 2009 and 2010. Many of the new processes and procedures developed and implemented for these projects were being referred to as "best practices". WisDOT's senior management felt that the department would greatly benefit from a review of these new practices to evaluate their effectiveness, determine if they had benefits for future use and, if so, investigate how they could be adopted by the department. Through WisDOT's Policy Research Program, the University of Wisconsin – Madison College of Engineering's Construction and Materials Support Center (CMSC) was enlisted to conduct a study of the best practices used in delivery of WisDOT's mega and ARRA projects. The study was to identify and evaluate the best practices used on these projects and develop an implementation methodology for the most effective best practices. In addition, available metrics were to be analyzed to determine if they could provide useful benchmarks for project level performance tied to a specific best practice. The best practices research effort was limited to the construction phase of project delivery.

Based upon a review of the new WisDOT practices developed and employed for delivery of their megaprojects and ARRA program, a number of potential best practices were identified for use in management of future highway construction projects. Analysis of these practices resulted in recommending the continuation of 49 of these best practices. The selected best practices are detailed in a separate document titled *Practices from WisDOT Mega and ARRA Projects – Best Practice Catalog.* Each best practice is identified by the project management emphasis area (Project Management, Financial Reporting, Document Control, and Change Management) so that WisDOT can select a specific best practice based upon the project need or goals. Each best practice is also categorized as meeting primary and secondary objectives so that WisDOT staff can quickly identify a specific best practice to meet a particular project management need. Each listed best practice identifies the relative cost to implement and the types of projects it is most applicable to.

A number of project metrics were explored and identified for potential use by WisDOT. Specifically were metrics dealing with categorizing Request for Information (RFIs) and project % Cost vs. % Time analysis. Applicable benchmarks and metrics were incorporated into the best practice catalog listing for the best practices. A new set of reason codes were developed for RFI submittals for use by project staff. A project control chart was also developed for judging project performance based upon % Cost and % Time calculations.

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Background

Delivery of highway design and construction projects can be extremely complex requiring coordination and management of a multitude of organizational, technical and resource issues. The delivery can be further complicated when a project is of such magnitude that it involves significant financial commitments, public involvement and political scrutiny.

The Federal Highway Administration (FHWA) has coined the term "megaproject" for such efforts:

> *The FHWA defines megaprojects as major infrastructure projects that cost more than $500 million, or projects of a significant cost that attract a high level of public attention or political interest because of substantial direct and indirect impacts on the community, environment, and State budgets. "Mega" also connotes the skill level and attention required to manage the project successfully.* http://www.tfhrc.gov/pubrds/04jul/01.htm

The Wisconsin Department of Transportation (WisDOT) completed one highly successful megaproject, the Marquette Interchange, in 2008 and is in the process of delivering two additional megaprojects, I-94 N-S Corridor and USH 41 Expansion, as well as planning for many others. The Marquette Interchange project was completed under budget and ahead of schedule and its success can be directly attributed to the management practices that were established specifically for the project. These new practices focused on careful monitoring and control of scope, cost, schedule, and quality with intense levels of planning, coordination and communication between staff, contractors, consulting engineers and external stakeholders. Some of these management practices have been duplicated and put into practice on the current WisDOT megaprojects, but others have not. Previous attempts have been made to catalog the management practices that contributed to the success of the Marquette Interchange, but there has been no evaluation to determine which ones should be implemented on future megaprojects or which ones might be adopted for statewide delivery of standard highway projects.

The American Recovery and Reinvestment Act of 2009 (ARRA) provided WisDOT many opportunities and challenges with over $350 million in additional investment for Wisconsin's

highway and bridge infrastructure. Oversight of the AARA funded projects largely followed existing WisDOT processes, however, there were modifications made to expand and strengthen these processes to comply with Federal mandates and concerns. Some of the management practices that were developed and implemented for the ARRA projects were based upon the management practices developed for the Marquette Interchange megaproject. These modifications, however, have not as yet been evaluated to determine their effectiveness or if they have sufficient benefits to warrant future use by the department.

Senior management of WisDOT recognized that a number of new techniques, methods, processes and procedures had been developed and implemented in delivery of the mega and ARRA projects and they were often being referred to as "best practices". The Construction Industry Institute (CII) defines best practices as processes or methods that lead to enhanced project performance when effectively executed. Since these new procedures had been used on successful WisDOT mega and ARRA projects, the terminology seemed appropriate. However, senior management felt that the department would greatly benefit from an evaluation of those best practices to evaluate their effectiveness, determine if they had benefits for future use and to determine how they could be adopted by the department. The goal was to fully document the most applicable best practices so that their scope and cost implications were fully understood and that sufficient information was available for effective implementation on future projects.

WisDOT, through its Policy Research Program, enlisted the Construction and Materials Support Center (CMSC) at the University of Wisconsin - Madison to conduct a study of the best practices used in delivery of their mega and ARRA projects. The study was to identify and evaluate the best practices used on the mega and ARRA projects and develop an implementation methodology for the most effective best practices. In addition, available metrics were to be analyzed to determine if they could provide useful benchmarks for project level performance tied to a specific best practice.

This study covers the period from October 2004 through February 2011 and involves project management practices utilized and project performance data from the Marquette Interchange and other WisDOT mega projects and almost all of the WisDOT ARRA program projects. The results are presented in four standalone documents:

- *Best Practices from WisDOT Mega and ARRA Projects – Final Report*
- *Best Practices from WisDOT Mega and ARRA Projects – Best Practice Catalog*
- *Best Practices from WisDOT Mega and ARRA Projects – Request for Information: Benchmarks and Metrics*
- *Best Practices from WisDOT Mega and ARRA Projects – Statistical Analysis and % Time vs. % Cost Metrics Report*

Scope of Work

Prior to starting the study, WisDOT's Research & Communication Services Section conducted a scoping session with departmental staff familiar with delivery of both the Mega and ARRA projects to solicit ideas for topic areas that should be included in the best practices research project. An extensive list was generated that spanned the entire range of project planning, scoping, design and construction phases. This list is provided in Appendix A. While all the areas had merit and had best practices identified and highlighted, doing all of them at once would have been much too broad of a scope for a single effective research project. After reviewing the potential topic list, the Construction & Materials Support Center (CMSC) staff recommended that this best practices research effort be focused in the construction phase of project delivery and specifically in the following four construction areas:

1. Project Management with Benchmarking and Metrics
2. Project Change Management
3. Document Control and Reporting
4. Financial Reporting

These four areas were recommended because the bulk of the new methods, processes and procedures implemented for the Mega and ARRA projects were in the construction phase and in these areas. The Policy and Research Program Manager agreed with this scope and the overall project study was limited to these areas. However, it was felt that many of the best practices identified for the construction phase also had the potential for benefitting and being implemented in design and other phases of project delivery.

Methodology

The research methodology was based upon a systematic identification of the methods, tools, practices and procedures used on WisDOT's Mega and ARRA projects in the four selected topic areas. The initial data collection phase of the study focused on developing lists of things done differently in management of the WisDOT mega and ARRA projects, other WisDOT project improvement initiatives and other successful transportation construction projects done nationally. The activities undertaken included the following:

a) A review of existing documents from the Marquette Interchange and the Project Communication Enhancement Effort (PCEE) highlighting ideas that WisDOT staff felt were best practices;

b) Conducting interviews of those involved with delivery of WisDOT's Mega and ARRA projects to determine approaches and practices used on these projects and why they were implemented;

c) A review of existing WisDOT databases to identify project metrics that could be used to establish project performance benchmarks; and

d) A literature review to examine other state or national-based research into best practices on megaprojects and ARRA projects that have a focus on one of the four emphasis areas.

The identified methods, tools, processes and procedures were then evaluated to identify possible limitations and to determine if their effectiveness warranted being classified as a best practice. This analysis was based largely upon the project management experience and knowledge of the CMSC research team, a review of available literature on mega and ARRA project best practices, and confirmation of usefulness and benefits through verification by multiple sources. Available metrics were also analyzed to determine if they could provide useful benchmarks for project level management and performance tied to a best practice. A key outcome was the identification of which best practices were universal and should be applied on all projects and which ones were applicable only to specific types of projects.

A finalized list of recommended best practices was then prepared to assist WisDOT in delivery of future highway projects. Each best practice was summarized and included:

1. A description of the best practice
2. A listing of all essential elements and tools for each best practice
3. The primary and secondary objective of the best practice
4. When to apply the best practice including limitations and appropriate cautions
5. Conditions that need to exist for successful application
6. Cost implications

Best Practice Inventory Results

The initial data gathering phase of the study resulted in a tabulation of best practice based upon input from one-on-one interviews, a review of existing WisDOT documents, and a literature review. A listing of the resources relied upon follows.

1. Personal Interviews

- Marquette Interchange Project Management Staff and Document Management Team
- I-94 Project Management Team
- USH 41 Project Oversight Consultants
- WisDOT staff involved with ARRA project delivery
- WisDOT ARRA Program Management personnel
- FHWA ARRA Project Management Engineer

2. Document Review

- Marquette Interchange Best Practice Paper
- Marquette Interchange Construction Management Plan
- I-94 Construction Management Plan
- Project Communication Enhancement Effort User Manual
- WisDOT ARRA Program Reports
- Construction Industry Institute, Best Practices Guide: Improving Project Performance
- Best Practices in Project Delivery Management, NCHRP Project 20-68A

The resulting inventory of identified best practices is provided in Appendix B. Each of the inventoried best practices was then carefully evaluated by the CMSC team to consolidate similar best practices, remove duplicates, and eliminate those best practices that had limited applicability. This resulted in a consolidated list of best practices that were felt to be the most viable and warranted further study. The numbers of best practices selected by emphasis area were:

- Project Management (31)
- Change Management (7)
- Document Control (6)
- Financial Reporting (2)

A listing of the best practices selected for additional analysis is provided in Table 1.

To assist in the evaluation of each best practice for effectiveness, applicability to various project types, limitations in application and barriers to implementation, the CMSC team enlisted input from experienced practitioners familiar with the various tools and processes developed for delivery of the Mega and ARRA projects.

The CMSC team was unable to locate any historical quantitative data from WisDOT, or any other literature source, regarding the cost and savings of individual best practices. The reason

for this lack of data is that WisDOT does not have a formal system of tracking costs for any single activity or management practice. As an alternative to quantitative data, the CMSC organized a face-to-face best practices workshop to obtain qualitative data regarding each best practice. The workshop was attended by upper-level management and project management level staff from the WisDOT along with several consultant industry representatives. The workshop provided the research team with input on items such as usefulness, when to apply, conditions for successful application, constraints that limit deployment, cost implications, lessons learned, and examples of their use. The workshop also had the added benefit of facilitating cross-department education among the participants. Specifically, the open discussion questions during the workshop allowed a productive means of inter-department and owner-representative communication.

Table 1: Selected Best Practices

Best Practice No.	BP Description
PM	**Project Management**
PM-1	Employ a defined hierarchy for decision making
PM-2	Use a Request for Information (RFI) form and process
PM-3	Contract with design firm to be available to the construction team
PM-4	Hold Pre-Construction Planning and Submittal Workshops
PM-5	Require CPM scheduling software and conduct periodic schedule reviews
PM-6	Require Use of Three-Week Look-Ahead Schedules
PM-7	Track productivity of key construction activities
PM-8	Identify a WisDOT project specific Utility Coordinator and require the contractor to provide a Dedicated Utility Coordinator
PM-9	Establish project Close-Out Procedures early in project and track progress
PM-10	Establish project team that is not tied to Region day-to-day activities
PM-11	Project Team prepare Cost-to-Complete budget projections
PM-12	Track Overruns/underruns throughout project
PM-13	Perform project Earned Value Analysis
PM-14	Establish project Reserve Budgets
PM-15	Use a Standing Dispute Review Board
PM-16	Assign a responsible party for resolution of issues at Project Progress Meetings
PM-17	Make “Open Issues” a standing agenda item at Project Progress Meetings
PM-18	Involve DRB Chair in Partnering Meetings
PM-19	Use 3rd Party Work Authorization Form (3rd Party WAF)
PM-20	Hold Specialty Group Meetings
PM-21	Use Work Authorization Form (WAF)
PM-22	Develop and maintain a project Construction Management Plan

PM-23	Develop a Project Responsibility and Accountability Matrix
PM-24	Develop a Project Materials Certification and Submittal Guide
PM-25	Develop and maintain a Project Web Site
PM-26	Develop and maintain a project database of decisions made
PM-27	Monitor and track DBE participation and report on goal achievement progress
PM-28	Encourage 3rd Party representation at Project Progress Meetings
PM-29	Establish project goals for processing of information and documents
PM-30	Designate Pay Plan Quantities for appropriate items of work
PM-31	Utilize a Owner Controlled Insurance Program (OCIP)
FR	**Financial Reporting**
FR-1	Implement a Project Financial Reporting System
FR-2	Utilize a statewide Construction Project Management Dashboard Report
DC	**Document Control**
DC-1	Develop a standardized document control methodology
DC-2	Standardize all forms
DC-3	Document and track all issues using cross linkages
DC-4	Develop Procedural Manual covering WisDOT Region processes
DC-5	Use Civil Rights Compliance System to track DBE usage
DC-6	Escrow bid documents
CM	**Change Management**
CM-1	Establish Change Management Teams
CM-2	Utilize a Senior Management Project Oversight Committee
CM-3	Conduct Risk Assessments to expose, monitor and mitigate risks
CM-4	Conduct Weekly Issues Meeting
CM-5	Utilize partnering with Bi-Weekly meetings between project personnel and contractor
CM-6	Use a Change Management Request Form
CM-7	Establish a Management Reserve Budget

Workshop Input

In February 2011, 24 professionals from WisDOT, FHWA and engineering consultants with WisDOT's mega projects were selected to participate in an all-day workshop geared toward evaluating and ranking the list of 46 best practices that had been selected by the CMSC. The best practice workshop was structured to allow each participant an opportunity to rank each best practice based on a series of cost and value metrics developed by the CMSC. All participants in the workshop were notified that their responses would remain confidential with

the intention of removing as many sources of respondent bias as possible. The majority of the best practices were reviewed at the workshop, but for those that were not covered due to time restraints, the same input was obtained through a web-based survey tool.

Survey participants were asked a series of closed and open-ended questions for each BP. For the closed-ended questions, the participants were offered a choice of responses based on a modified psychometric Likert scale. A traditional Likert scale, often used in social science research, typically has five possible responses that the researcher can choose from. The responses can range from 1, the most negative, to 5, the most positive as shown in Figure 1.

1 =	Strongly Disagree
2 =	Disagree
3 =	Undecided
4 =	Agree
5 =	Strongly Agree

Figure 1: Example of possible responses for a traditional Likert scale

Alternatively, a four-response scale can be used which omits the neutral 'Undecided' option and thus forces the respondent to make a choice in either the negative or positive direction.

While the majority of the participants were WisDOT personnel, their particular areas of expertise were diverse. Therefore, it was unlikely that all members of the survey group had direct or indirect experience with all of the best practices. To overcome this issue, best practice descriptions developed by the CMSC team were provided to each participant to review before then being asked the series of questions shown in Table 2.

Table 2: Full list of survey questions and allowed responses

#	Question	Response Choices
I	To what degree do you feel you understand the application of this BP?	A. Not at all B. Somewhat C. Very Well
II	How experienced are you with using this BP?	A. Not at all B. Slightly C. Somewhat D. Very
III	Which best describes the description provided for the BP?	A. Not adequate and needs to be redone B. OK, but could be improved C. Not perfect, but acceptable D. Perfect, leave it alone
IV	Are there additional details that need to be added to add clarity or provide more information regarding the BP?	Open Ended Question
V	How effective do you think this BP is?	A. Not at all B. Slightly C. Somewhat D. Very E. Extremely
VI	How important do you think it is that this BP be implemented?	A. Not at all B. Slightly C. Somewhat D. Very E. Extremely
VII	When do you think the BP should be implemented on "Mega" type projects?	A. Not at all B. Only on a relatively few select projects C. On most, with a few exceptions D. On all as standard practice E. Don't know

VIII	When do you think the BP should be implemented on "3R" type projects?	A. Not at all B. Only on a relatively few select projects C. On most, with a few exceptions D. On all as standard practice E. Don't know
IX	How difficult will it be to implement this BP?	A. Not difficult at all B. A little difficult C. Somewhat difficult D. Very difficult E. Don't know
X	Are there any additional cautions that should be kept in mind when trying to implement this BP?	Open Ended Question
XI	This BP will result in the following cost impact to the Department/Region if implemented?	A. Have no impact on costs B. Slightly increase costs C. Moderately increase costs D. Significantly increase costs E. Not sure
XII	Implementation of this BP will require the following:	A. Nothing B. Additional manpower C. New or modified software D. Hardware or equipment E. Technical training F. New standard/special provisions
XIII	Are there example projects where this BP has been used?	Open Ended Question

Some of the questions from Table 2, such as III and IV, were included as a means of internal feedback on how the CMSC could improve upon the best practice descriptions. These internal-use questions, along with the open-ended questions X, XII and XIII, were moved into a separate database for later review. The remaining nine questions, Table 3, were analyzed using a series of statistical algorithms to determine which best practice ranked among the top in terms of potential for cost and schedule savings.

Table 3: Nine closed-ended questions asked for each best practice

#	Question
I	To what degree do you feel you understand the application of this BP?
II	How experienced are you with using this BP?
III	Which best describes the description provided for the BP?
V	How effective do you think this BP is?
VI	How important do you think it is that this BP be implemented?
VII	When do you think the BP should be implemented on "Mega" type projects?
VIII	When do you think the BP should be implemented on "3R" type projects?
IX	How difficult will it be to implement this BP?
XI	This BP will result in the following cost impact to the Department/Region if implemented?

The closed-ended responses were collected and stored electronically using iClicker® technology. Each member of the survey group was assigned a specific iClicker® device, allowing the CMSC to track individual responses and to detect any correlations between response and level of seniority or department. In addition to the iClicker® technology, time constraints required that a portion of the survey be completed via the online Qualtrics© survey software program. The online survey mirrored the in-person survey, including the ability to track individual responses and comments.

Electronic polling was chosen for its numerous benefits. First, electronic polling allowed for more rapid and accurate data collection by removing human processing time and error. Furthermore, the software package also allowed for the after-the-fact, anonymous display of survey results for select questions, shown in Figure 2.

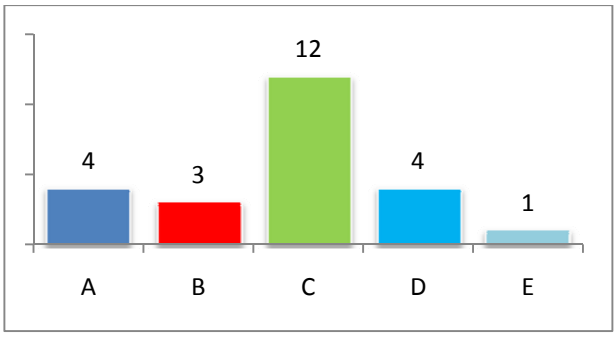

Figure 2: Example survey results bar-chart displayed to workshop participants

Thus polling results could be displayed for those questions that the CMSC thought would be beneficial for the participants to know and to generate discussion. Additionally, requests by the participants to see the question results were generally honored. However, in the interest of time, and also not to induce respondent bias, not all requests were permitted nor were all results displayed.

Workshop Results

Input from the workshop and online survey were used extensively to develop the summaries for each of the best practices. These results are described in more detail in following sections of the report. Responses to the closed-ended questions were analyzed both by evaluating the responses to just questions VI, VII and VIII which focused on importance of the best practice and the types of projects they were most applicable to and by doing an extensive statistical analysis of all the responses. A scoring system was invoked to apply equal weight to each question. The weighting system was intended to be arbitrary, and to only serve as a means of converting the alpha-formatted categorical variable into more manageable numeric format. The scoring system sequentially assigned an integer value starting with “1” for response A, “2” for response B, and so on.

1. Questions VI, VII and VIII Results

Question VI attempted to determine how important it was for the department to implement the best practice while questions VII and VIII focused on the types of projects the best practice should be utilized on. For question VII, 3R (Resurfacing, Restoration, Rehabilitation) projects were taken to represent WisDOT’s standard type of project. Figures 3, 4 and 5 are graphical presentation of the results where the numerical scores for each best practice were added and then ranked based upon the total scores. Figure 3 shows the top 10 best practices ranking based upon those that should be implemented as well as showing how the various best practices rated for being implemented on megaprojects and 3R type projects. Figures 4 and 5

show similar data but with the top 10 best practices ranked by the type of projects they were most applicable too.

An examination of the results indicates that the same best practices show up on all three Top 10 lists, and provides some guidance as to the highest priority best practices for implementation by the department. Also, the highest rated megaproject best practices tended to focus on those dealing with decision making over the life of the project where the higher rated best practices for the 3R projects tend to focus on practices that aided in the completion of the projects.

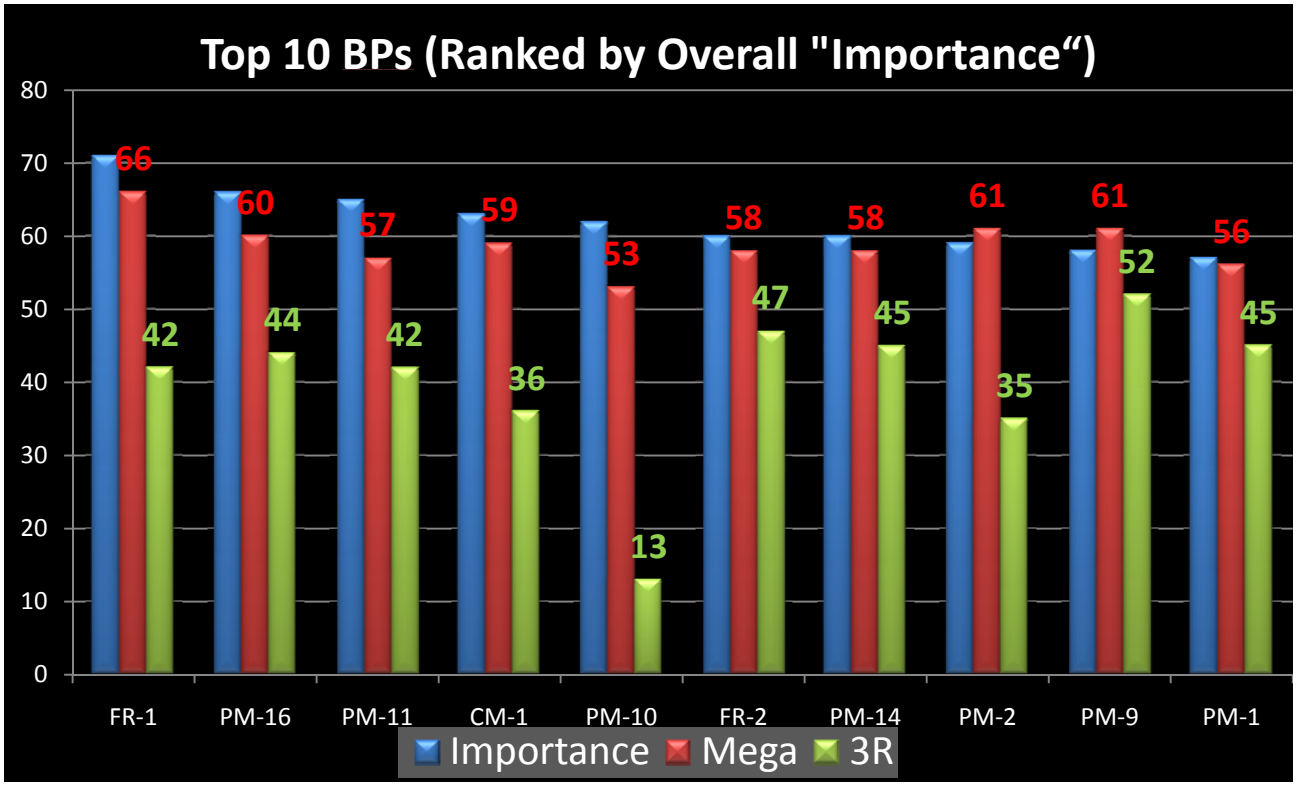

Figure 3: Top 10 Best Practices By Importance

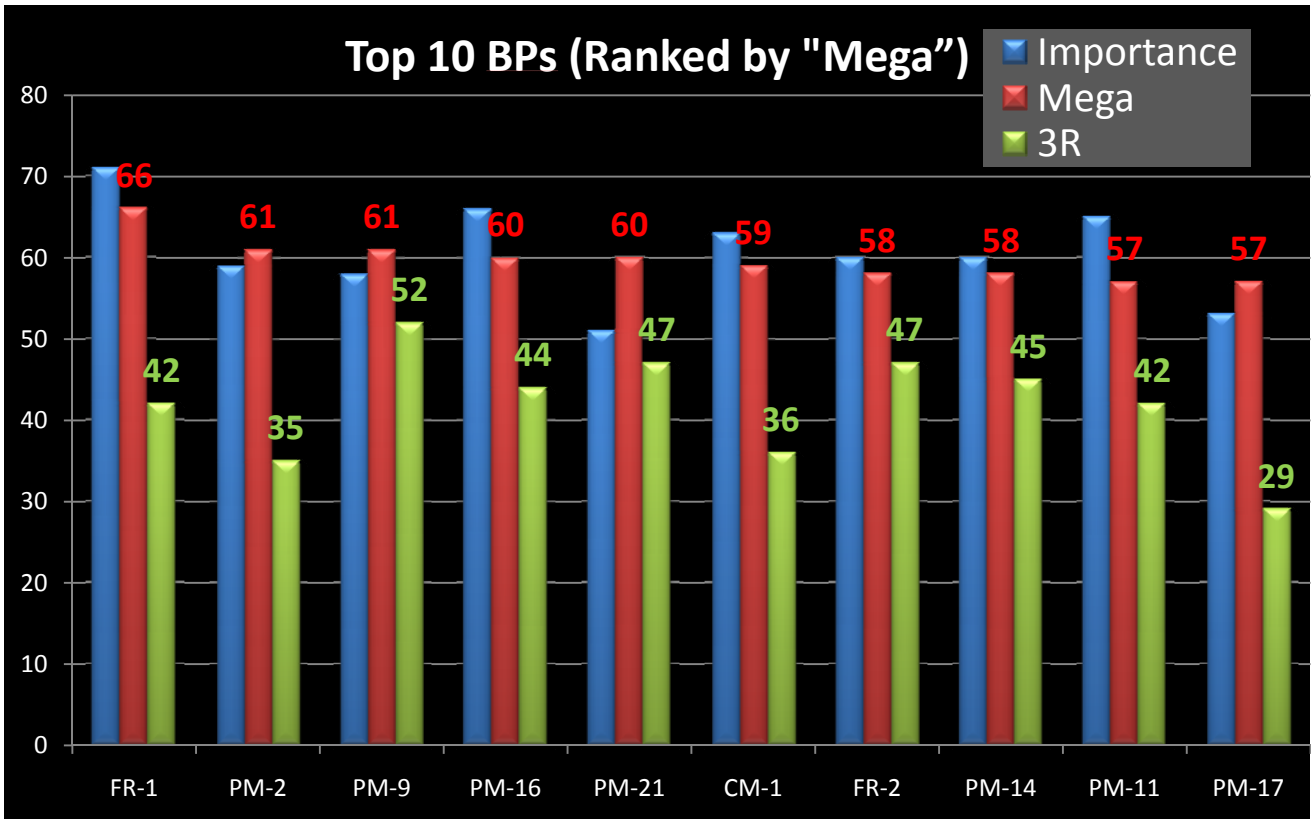

Figure 4: Top 10 Best Practices For Megaprojects

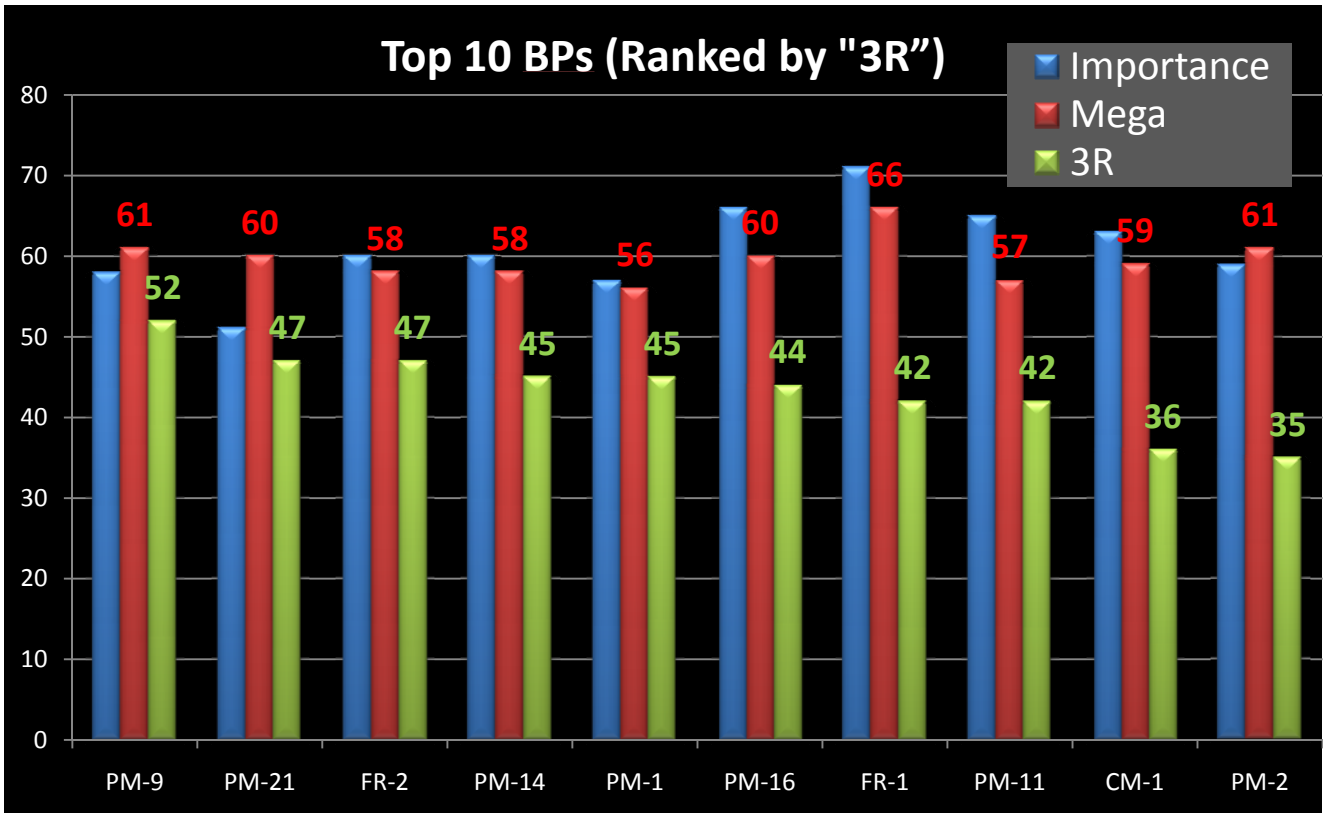

Figure 5: Top 10 Best Practices for 3R Projects

2. Statistical Analysis Results

Results from both the in-person workshop and online survey were collected and consolidated into a single spreadsheet. Next, a scoring system was invoked to apply equal weight to each question. However, not all of the questions had the same number of possible responses. For example, question I related how well the respondent understood the application of the BP and allowed three response options 1) Not at All, 2) Somewhat and 3) Very Well. In contrast, the rest of the questions had four or five response options. Therefore, not all questions would have the same scoring scale length; certain question types would be 1-2-3 while others may be 1-2-3-4. This was not a critical issue, but did impact how the data could be analyzed.

An extensive statistical analysis of the data was done to compensate for that fact that the closed-ended BP survey responses were not on the same scale. The method selected for data comparison was the standard normal deviate, or z-score. Use of the z-score provided a more powerful tool over simple averages because it provided both a means of ranking each best practice against its competitors on a normalized scale as well as displaying the spread of the

data. Furthermore, with a standard normal scale the responses from Questions 1 through 9 could be combined without any ill-effects resulting from the questions having different original response scales.

The complete statistical methodology and results are presented in the *Best Practices from WisDOT Mega and ARRA Projects – Statistical Analysis and % Time vs. % Cost Metrics Report*. For this approach, all construction projects were considered to fall into one of three categories: general projects, megaprojects and 3R projects. The three categories, A, B, and C, were thus created that represented the three logical applications for ranking the list of 46 best practices. Category A represents the case of a general construction project. Additionally, category A was broad reaching and covered those construction projects whose scope did not fit well into either Mega or 3R type projects. Finally, category A is based on survey responses to questions IV, V, VIII and IX. Conversely, categories B and C are more specific than A and represent construction projects categorized as megaprojects and 3R projects respectively. Therefore, category B was based on questions VI, VIII and IX while category C incorporated questions VII, VIII and IX.

The statistical approach showed that the overall top 10 best practices across the three scenarios were very similar. In fact, nine of ten best practices were common among the general, mega, and 3R categories; only CM-4 and PM-29 fell in and out of the top ten. Furthermore, the nine common best practices were all related to project management; only one change management best practice (CM-4) was ranked among the top 10. These cumulative top 11 best practices were referred to as the '9+2 BPs'. Additionally, the top ten lists for the mega and 3R categories had the same best practices identified, just ranked in a different order. Therefore, the results of the survey suggest that the best practices identified as being most applicable among megaprojects, also apply to the smaller budget and shorter duration 3R type projects. From a general perspective, WisDOT could potentially see improved cost and schedule savings by implementing any of the 9+2 BP's. The resulting top eleven best practices (9+2) are listed in Table 4. (Note, these are listed in best practice numerical order, not a ranked order.)

Table 4: Top Nine best practices plus two

BP #	BP Description
PM-1	Employ a defined hierarchy for decision making
PM-2	Use a Request for Information (RFI) form and process
PM-6	Require Use of Three-Week Look-Ahead Schedules
PM-9	Establish project Close-Out Procedures early in project and track progress
PM-16	Assign a responsible party for resolution of issues at Project Progress Meetings
PM-17	Make "Open Issues" a routine agenda item at Project Progress Meetings
PM-20	Hold Specialty Group Meetings

PM-21	Use Work Authorization Form (WAF)
PM-28	Encourage Third-Party representation at Project Progress Meetings
PM-29	Establish project goals for timely approval of documents
CM-4	Conduct Weekly Issues Meeting

Best Practice Catalog

Based upon results of the document reviews, interviews, literature reviews and the workshop, an inventory of the identified best practices was prepared. Also, input was obtained from the construction industry to incorporate their opinions and thoughts into the process. The inventory includes the 46 best practices identified by the CMSC team for the workshop as well as three additional ones that were developed based upon input at the workshop. The complete list of best practices is provided in Table 5.

Table 5: Best Practice Inventory Listing

Best Practice No.	BP Description
PM	**Project Management**
PM-1	Employ a defined hierarchy for decision making
PM-2	Use a Request for Information (RFI) form and process
PM-3	Contract with design firm to be available to the construction team
PM-4	Hold Pre-Construction Planning and Submittal Workshops
PM-5	Require CPM scheduling software and conduct periodic schedule reviews
PM-6	Require Use of Three-Week Look-Ahead Schedules
PM-7	Track productivity of key construction activities
PM-8	Identify a WisDOT project specific Utility Coordinator and require the contractor to provide a Dedicated Utility Coordinator
PM-9	Establish project Close-Out Procedures early in project and track progress
PM-10	Project management team is not tied to region day-to-day activities
PM-11	Project Team prepare Cost-to-Complete budget projections
PM-12	Track overruns/underruns throughout project
PM-13	Perform project Earned Value Analysis
PM-14	Establish project Reserve (contingency) Budgets
PM-15	Use a Standing Dispute Review Board
PM-16	Assign a responsible party for resolution of issues at Project Progress Meetings
PM-17	Make “Open Issues” a routine agenda item at Project Progress Meetings
PM-18	Involve DRB Chair in Partnering Meetings
PM-19	Use Third- Party Work Authorization Form (Third- Party WAF)

PM-20	Hold Specialty Group Meetings
PM-21	Use Work Authorization Form (WAF)
PM-22	Develop and maintain a project Construction Management Plan
PM-23	Develop a Project Responsibility and Accountability Matrix
PM-24	Develop a Project Materials Certification and Submittal Guide
PM-25	Develop and maintain a Project Website
PM-26	Develop and maintain a project database of decisions made
PM-27	Monitor and track DBE participation and report on goal achievement progress
PM-28	Encourage Third Party representation at Project Progress Meetings
PM-29	Establish project goals for timely approval of documents
PM-30	Designate Pay Plan Quantities for appropriate items of work
PM-31	Utilize a Owner Controlled Insurance Program (OCIP)
PM-32	Prepare Project Benchmark Performance Indicators
PM-33	Execute contract Balancing Modifications to revise line item quantities to account for overrun/underrun quantities
FR	**Financial Reporting**
FR-1	Implement a Project Financial Reporting System
FR-2	Utilize a statewide Construction Project Management Dashboard Report
DC	**Document Control**
DC-1	Develop a standardized document control methodology
DC-2	Standardize all forms
DC-3	Document and track all issues using cross linkages
DC-4	Develop Procedural Manual covering WisDOT Region processes
DC-5	Use Civil Rights Compliance System to track DBE usage
DC-6	Escrow bid documents
CM	**Change Management**
CM-1	Establish Change Management Teams
CM-2	Utilize a Senior Management Project Oversight Committee
CM-3	Conduct Risk Assessments to expose, monitor and mitigate risks
CM-4	Conduct Weekly Issues Meeting
CM-5	Utilize partnering with bi-weekly meetings between project personnel and contractor
CM-6	Use a Change Management Request Form
CM-7	Develop a Change Management Log
CM-8	Identify and track significant project issues

For each of the best practices a detailed description was prepared that included the following items:

- Title
- Brief Description
- Additional Details (provided to aid in implementation)
- Objective
- When to Apply
- Cost Implications
- Conditions for Successful Application
- Cautions

Each of the best practices is identified by study emphasis area (Project Management, Financial Reporting, Document Control, and Change Management) so that WisDOT can identify and select a specific best practice based upon the project need or goals.

Each best practice was also categorized as meeting a primary or secondary objective so that WisDOT staff can quickly identify a specific best practice to meet a particular project management need. The best practices were identified as meeting one or more of the following objectives:

- Cost Control
- Schedule Control
- Quality Control
- Issue Management
- Dispute Resolution
- Document Control
- Communication
- Safety

Each best practice also identified the types of projects it was most applicable to in a "When to Apply" section. Types of projects ranged from megaprojects to 3R type projects and which ones should be put into practice for all projects on a statewide basis.

Relative costs to implement each best practice were also identified. However, these need to be viewed and used with some degree of discretion. Many of the best practice costs were based upon implementing the best practice as described. However, there is definitely a "scalability" component for many of these best practices. In other words, the best practice can be implemented without necessarily using all the bells and whistles described. For example, some of the best practices call for using proprietary software, however the same best practice approach could be applied with a little creativity using commonly available spreadsheet or word processing software. Costs could also be cumulative. It may not be particularly costly or resource intensive to implement one or two of the best practices on a statewide basis, but

implementing several of them at once may prove to be very resource intensive. Also, almost all of these best practices indicate some cost initially, or in the short run, but over time they should produce overall cost and time savings to the department.

The full inventory of best practices and their descriptions is provided in the report *Best Practices from WisDOT Mega and ARRA Projects – Best Practice Catalog.*

Benchmarking and Metrics

Two of the final 49 best practices, PM- 2: Use a Request for Information (RFI) form for Decision Making, and PM-32: Prepare Project Benchmark Performance Indicators, were identified by the CMSC team as having the potential of being highly effective best practices for WisDOT. A review of WisDOT's databases indicated that substantial data was available for each of these best practices, specifically RFI usage on the megaprojects and cost vs. time data for the ARRA projects. Both of these data sources were then examined in more detail for potential metrics and benchmark applications to augment the best practices.

1. Metrics and Benchmarks for the RFI Process

Employing an RFI process provides an orderly, reliable, and documented mechanism to resolve legitimate plan, specification, special provision, or other contract document questions. RFIs then provide a systematic collection of the questions and answers provided throughout construction phase of the project which can then be analyzed to improve the project development process. The CMSC team felt that it would be beneficial to have benchmarks and metrics to measure the performance of the RFI procedure. These performance measures could assist WisDOT in implementing an RFI system on future highway projects and assist in setting staffing levels to handle RFIs. The benchmarks and metrics that could potentially be derived from the WisDOT megaprojects included:

- **RFIs per Million Dollars of Awarded Contract.** Calculate a simple number for WisDOT to use as a starting point for the expected number of RFIs for a major highway project.
- **Percent of RFIs Answered By Request Date.** Determine the quantity of RFIs answered on time (by the requested date on the RFI submittal form).
- **Average Response Time.** Measure the response time of the RFIs for a major highway project by subtracting the RFI submittal date from the respective RFI answer date.

For this analysis a total of 1,350 individual RFI's from the Marquette Interchange and I-94 N-S Corridor projects were read and examined. In addition to the above metrics, each RFI was cataloged by the reason code. The complete analysis of the RFI process can be found in the report *Best Practices from WisDOT Mega and ARRA Projects – Request for Information: Benchmarks and Metrics.*

To assist WisDOT in implementing an RFI process on future megaprojects, one of the considerations is how many and when RFI's are submitted. Figure 6 shows the resulting distribution of RFIs per month based on each contract's Notice To Proceed (NTP) date, which is represented by the number zero on the x-axis. This chart shows the total number of RFIs submitted each month before and after a single, generic NTP. Figure 6 can then be used to estimate the timing of RFI submittals over the course of an entire megaproject.

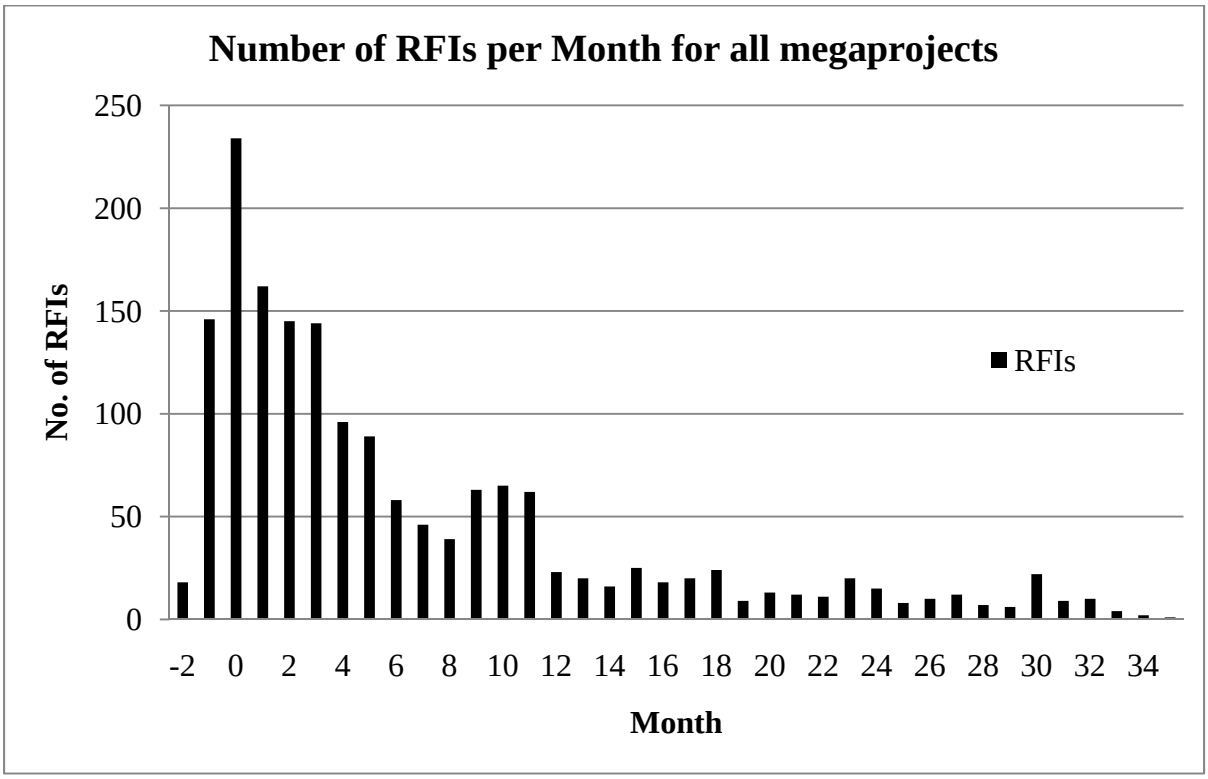

Figure 6: Number of RFIs per Month for all megaprojects

For a highway megaproject, the maximum expected number of RFIs should occur near the NTP date, which again is represented by the number zero on the x-axis. The project team can then expect a decline in the number of RFIs submitted as the project continues. In order to accurately estimate appropriate staffing levels at the NTP, 25 percent, 50 percent, and 75 percent complete, the respective percent of RFIs submitted needs to be known. Table 6 provides the percent of RFI's that can be expected at the various completion stages of a project.

Table 6: Percent of RFIs Submitted by Project Percent Complete

Percent Complete (Payment Schedule)	Cumulative Percent of RFIs Submitted
NTP	8%
25%	54%
50%	74%
75%	87%
100%	100%

The data from WisDOT's megaprojects also indicated the following metrics that provide helpful insight for future projects. These metrics verify current WisDOT practices and goals, as well as introduce new performance measures.

- **2.4 RFIs per Million Dollars of Awarded Contract:** The expected number of RFIs for a major highway project based on the awarded contract value. The larger the contract, the closer to this expected value. Smaller contracts within the major projects tended to have more variation.

- **66-percent of RFIs Answered Within Requested Period:** Answer a minimum of 66-percent of RFIs by the requested date on the RFI form. A majority of the data shows that there is not a significant variation in the percentage of RFIs answered within the request period.

- **7.1-Day Average Response Time:** The average response time for an RFI was 7.1 calendar days. This number was compared to WisDOT's 7-day stated project goal based upon a philosophy of "responding to an RFI to provide a reasonable amount of time for a sufficient answer as well as minimizing the effect on cost or schedule". The similarity confirms that targeting a seven calendar day time period between the submission of an RFI and the receiving of an answer is an appropriate amount of time. In fact, over 75-percent of the RFIs submitted on WisDOT's megaprojects were answered in fewer than 7.5 days.

The RFIs were classified by WisDOT at the time of responding to the RFI using 10 division codes (also known as "Issues") and seven reason codes. Not all of the submitted RFIs were identified with the appropriate Division code. In fact, 20 percent of the Marquette Interchange's RFIs and

67 percent of the I-94 N-S's RFIs had unlabeled Division codes. The Divisions for the unlabeled RFIs were ultimately classified by the CMSC team based on the descriptions provided in the RFI and through comparing the descriptions with those RFIs with labeled Divisions. The seven reason codes used by WisDOT to classify RFIs were based upon definitions from the WisDOT Construction Management Manual (CMM). Most of the RFIs were found to not be classified with a reason code. The only RFIs that were classified were those that resulted in a Contract Modification, and these RFIs were often grouped into single reason codes. The reason for this lack of information can be speculated as it was not standard practice to classify RFIs, the definitions were thought to be too broad and thus inadequately describe actual construction issues, or using the seven reason codes was not enforced due to a lack of foreseeable advantages.

An analysis of RFIs submitted was completed using the 10 divisions created and currently used by WisDOT to divide among different aspects of construction. It is important to use a wide variety of divisions to accurately describe the type of construction, which can be useful in highlighting areas that may have a significantly higher proportion of RFIs. The analysis indicated that the 10 codes currently used by WisDOT does provide sufficient detail for future use to identify areas of construction that may warrant more attention in design due to a high number of RFI's submitted.

However, the seven reason codes currently used by WisDOT is considered to be too general and creates difficulties in deriving any meaningful conclusions to assist in improving the project delivery process. Thus, fifteen new reason codes were created by the CMS team in order to reclassify the RFIs in a manner that did allow for analysis. Table 7 lists the CMSC reason codes that were generated based on technical and professional experiences of the research team. It is recommended that WisDOT adopt these new reason codes on all future projects that utilize RFI's. Examples of how these reason codes were used and can be used to improve the design process are provided in the report *Practices from WisDOT Mega and ARRA Projects – Request for Information: Benchmarks and Metrics for Major Highway Projects.* To assist in implementing an RFI process that involves classifying the RFI's, a suggested RFI form is provided in Appendix C.

Table 7: CMSC Reason Codes

Reason Code		Description
Added Scope	*AD*	Addition of items to the original project scope
Construction Coordination	*CC*	Organizing and coordinating construction related procedures, schedules, and safety items
Constructability Issues	*CI*	Difficulty in constructing an item as detailed or designed
Change of Staging/Phasing	*CS*	Sequence of construction previously determined deemed inadequate or in need of reorganizing due to resource limitations and manpower organization
Design Change	*DC*	Request to implement an alternative design, modify a design to simplify efforts by construction team, or to correct an error in construction
Design Clarification	*DL*	Additional information requested to further understand and clarify components of the design and its related constituents
Different Method	*DM*	Change in installation technique or construction process
Design Coordination	*DR*	Organizing and coordinating the design and related documents between entities
Deleted Scope	*DS*	Scope or line items to be removed from the project
Incomplete Plans/Specs	*IP*	Error or omission in the plans/specifications
Material Change	*MC*	Different material requested to replace another than what is specified due to having an excess material readily available, or experience demonstrates another material has an improved performance

Differing Site Conditions	*SC*	Impediments discovered at the site that were previously unknown or were not in the condition as described in the contract
Utility Conflict	*UC*	Utility pipes, lines, or boxes prevent the construction strategy from proceeding as planned
Value Engineering	*VE*	Cost-reduction and construction improvement techniques
Other	*OR*	Any justified RFI submitted that does not fit into one of the other 14 categories including but not limited to payment methods, certification requirements, penalties, warranties, and non-design related documents

2. Metrics and Benchmarks for % Cost and % Time

The federal ARRA program mandated tracking of how funds were allocated throughout the duration of each construction project. Adhering to these requirements, the WisDOT had each of its ARRA funded construction projects tracked both in terms of percent complete by cost (% Cost) and percent complete by time (% Time) on a monthly basis.

It is common in non-highway construction to utilize an Earned Value Analysis (EVA) to make predictions on project performance based current data and provides methodology for detecting slippage in both budget and schedule. For this reason, EVA is often referred to as an early-warning system because it allows the project management team to take corrective action early and mitigate risk. The EVA can be represented graphically to provide a quick overview of the project. The cumulative progress curve, or S-curve because of its sigmoid shape, is a common method used to convey progress at the project level. A typical S-curve for a non-highway project is shown in Figure 7.

The shape of the S-curve has a direct correlation to productivity rates. At the beginning of the project, crews are mobilizing to the site and thus productivity, and earned value is low. This is shown by low slope on the EVA graph above. However, as mobilization nears completion and the learning curve is achieved, the crews begin to rapidly increase productivity; this is evident by the exponential increase on the EVA graph. Productivity continues to increase until the work crews reach a point of maximum productivity on the job. Productivity will typically remain at

high until the project nears completion, at which point the productivity wanes as the crews finish up the bulk of their work and are left with rework and punch-list items.

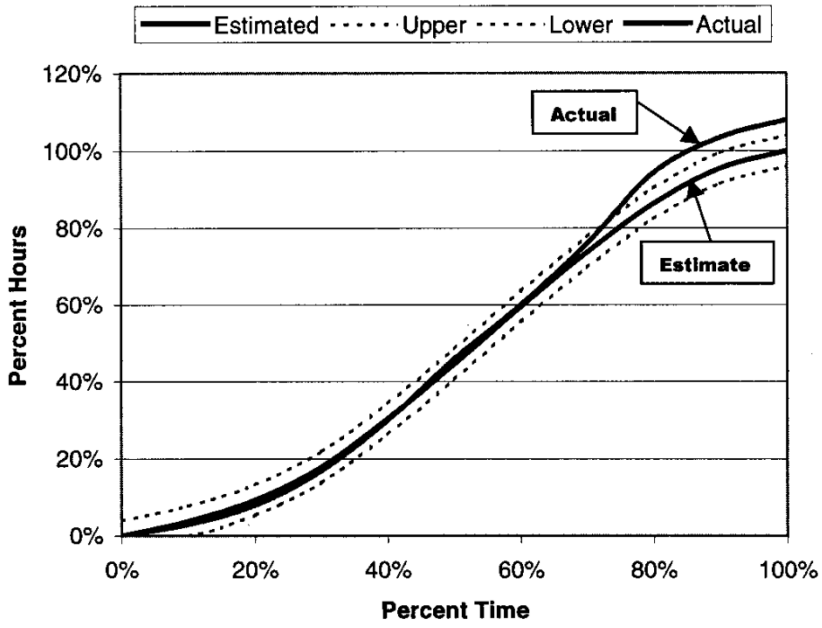

Figure 7: S-Curve example

For the WisDOT highway ARRA projects the two variables of % Time and % Cost are analogous, respectively, to the EVA concepts of percent time and percent hours. Logically it would make sense for highway construction projects to follow a similar sigmoid curve as vertical construction industry. However, while formulas for S-curves have been developed for vertical construction, their application in highway, road and bridge construction has yet to be found in the literature. The focus of this analysis was to see if a predictive model for project performance in regards to budget and schedule could be developed based upon the ARRA data.

CMSC received data on all Wisconsin ARRA projects up through February 2011, by which time nearly all of the ARRA contracts let in 2009 and most of the smaller 2010 construction projects were fully complete. The data collected was then 1) consolidated, 2) optimized for scope of research and 3) analyzed for correlations and trends by the CMSC team. A complete description of the data analysis methodology and results are presented in the *Best Practices from WisDOT Mega and ARRA Projects – Statistical Analysis and % Time vs. % Cost Metrics Report*.

All data provided by WisDOT for the ARRA projects was collected by field personnel through their FieldManager© software. The data was then uploaded into their CAS application, which

served as the WisDOT construction project tracking database. The % Cost and % Time were calculated using the following formulas:

Equation 1: Calculation of % Cost

$$\%\ Cost = \frac{Expenditures\ to\ Date}{Current\ Award\ Amount}$$

Equation 2: Calculation of % Time

$$\%\ Time = \frac{Days\ Charged\ to\ Date}{Current\ Number\ of\ Contract\ Days}$$

It is important to note that it is possible for change orders to affect both the award amount and the date of completion. The denominators in the % Cost and % Time equations above are *not* constant in time. Project change orders during the life of a project are not uncommon in any construction project, nor were they uncommon in the WisDOT data. To avoid having the expenditures exceed the award amount, the current award amount was thus recalculated for each monthly data point to give the current award amount, otherwise expenditures would exceed the award amount and result in a % Cost > 100%. Likewise, change orders could result in additional days being added to the construction project which necessitated that the contract time be adjusted in a similar manner.

A total of 283 contracts had sufficient data to be analyzed and Table 8 provides the breakdown by project type and year while Figure 8 shows a plot of all the data points.

Table 8: Summary of initial ARRA data

Category	# of Contracts
2009 State	43
2010 State	16
2009 Local	73
2010 Local	151

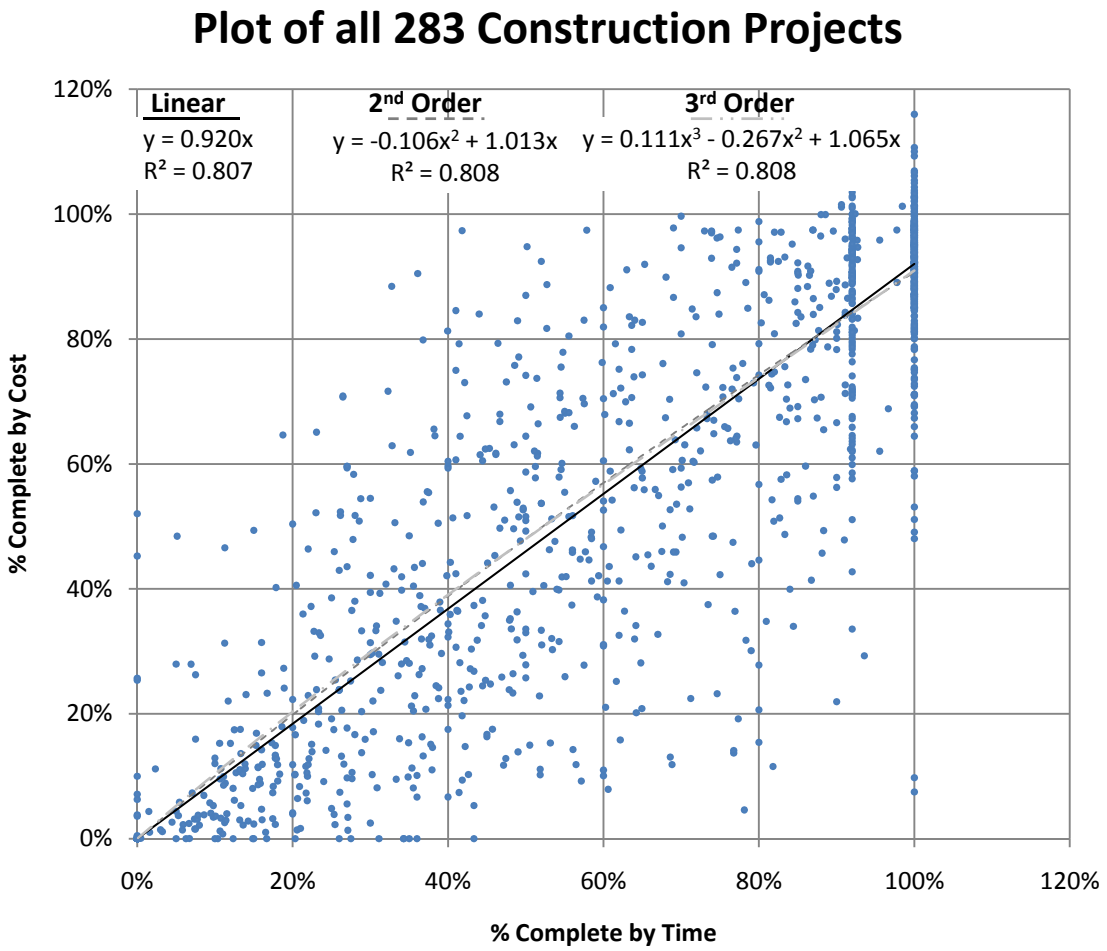

Figure 8: Regression Analysis of all 283 WisDOT ARRA Projects

The plot of all 283 construction projects shows the data in its original form with three different types of regression models also shown for comparison. Based on this comparison, higher order models appear only to increase the R^2 by a trivial amount and a linear line provides a good statistical representation of the ARRA projects but not the typical S-Curve expected.

Further examination of Figure 8 and the overall data set revealed numerous concerns:

- A large number of data points were observed near 92% Time and for many of these projects it was the final reporting point. Further examination found that a majority of the 92% Time data points did not represent the terminus of construction projects, but rather was a common point in time among many projects that could be considered as representing substantial completion. Based on this observation, it was decided that

construction projects not having reached at least 92% Time would be excluded from further study on the basis of being incomplete.

- In addition to % Time, construction projects not achieving at least 94% Cost were also eliminated. The rationale for placing minimum thresholds on both % Time and % Cost was that the CMSC team was interested in tracking *individual* construction projects from the start of construction through substantial completion. Having incomplete projects would not allow for this individual tracking methodology.
- Many of the construction projects from the ARRA study had very few data points. It would be unreasonable to expect anything more refined than a linear model for those construction projects with so few data points. Subsequently, the CMSC team determined that at least 10 data points would provide both the resolution and accuracy need for modeling a realistic regression function and potential S-Curve.

Of the original 283 contracts, only 20 were selected based on having enough data points to allow accurate regression analysis. The % Time was graphically plotted against % Cost for each of the 20 construction projects. Then a series of regression functions were fitted to the model using the method of least squares. The regression models ranged from linear to fourth-order polynomial functions. In all cases the models were required to have a y-intercept of zero to account for the known starting point. The selected 20 construction projects were combined and plotted as a whole and are shown in Figure 9.

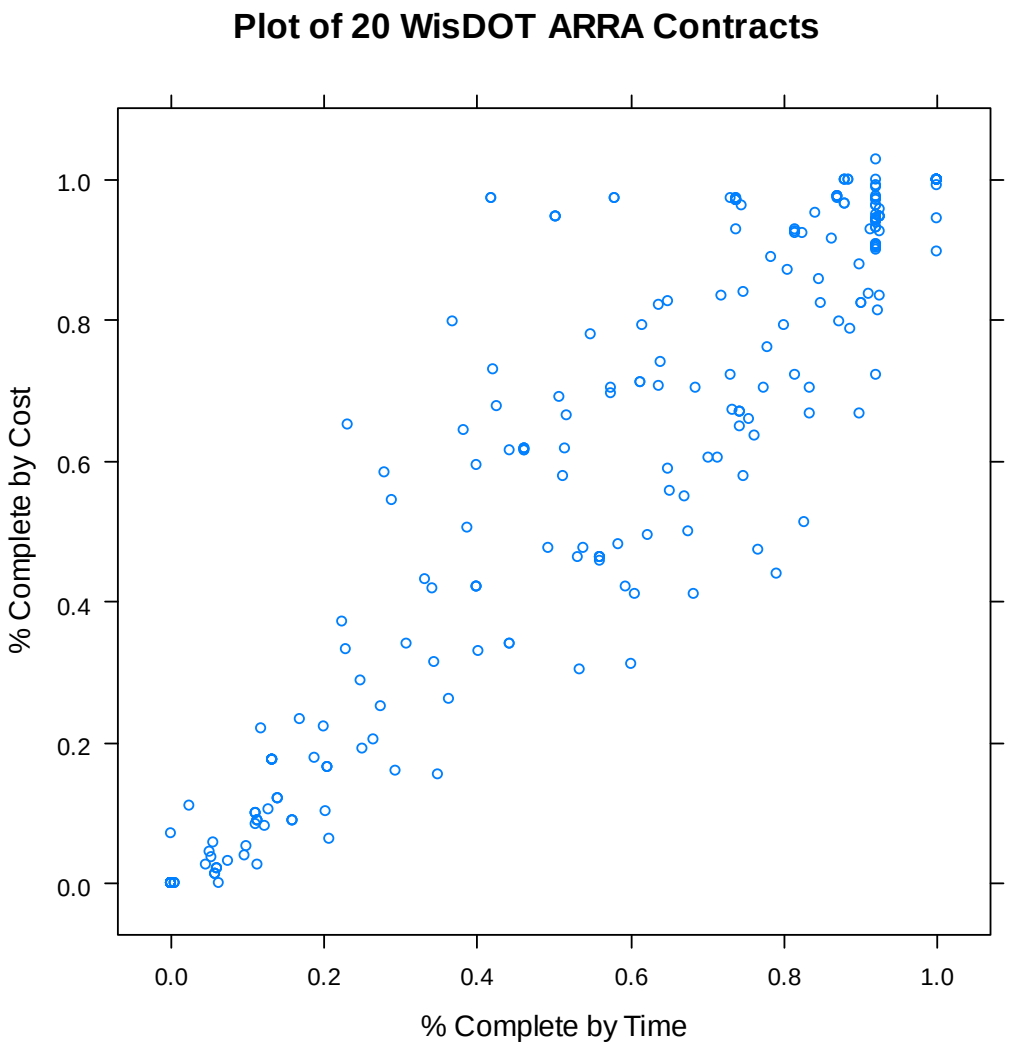

Figure 9: Combined plot of the selected 20 construction projects

Regression models were fitted to the combined data with the optimum model being a quadratic, second-order function. An alternative to plotting all the data points for all 20 contracts was to develop a series of control points at defined values of % Time. The % Time axis was divided into 10% blocks. The % Cost and % Time values associated with those distinct blocks were then averaged and the standard deviations calculated for % Cost are shown in Table 9.

Table 9: Control point data for the 20 selected construction projects

% Time Range	# of Data Points	Average % Time	Average % Cost	SD (%Cost)
0%	--	0.0%	0.0%	--
0% - 9.9%	18	5.1%	2.9%	2.7%
10% - 19.9%	26	13.5%	13.2%	5.1%
20% - 29.9 %	17	24.0%	28.3%	17.6%
30% - 39.9 %	18	36.7%	44.1%	17.9%
40% - 49.9%	25	44.4%	61.0%	20.4%
50% - 59.9%	24	54.9%	60.7%	20.7%
60% - 69.9%	17	64.4%	63.0%	16.3%
70% - 79.9%	30	74.7%	79.0%	17.2%
80% - 89.9%	29	85.8%	88.5%	12.0%
90% - 99.9%	37	92.0%	92.4%	7.4%
100%	--	100.0%	100.0%	--

The data in Table 9 was plotted along with upper and lower bound curves created by respectively adding and subtracting the standard deviation to the control point at each block of time and is shown in Figure 10.

Based upon the results shown in Figure 10, potential control points could be established for future WisDOT projects to judge performance. However, while the data obtained through the WisDOT project tracking database was extensive, it still relied on the users of FieldManager to correctly interpret and enter the data. Also, data entered into the FieldManager did not go through a quality control or quality assurance process which may explain many of the problems observed including incomplete and erratic data. Even with a small sub-sample of the 20 'best' construction projects, there still were anomalies that could not be explained. For example, plots of the control points showed periods of maximum productivity occurring at the start and end of the contract, when logic suggests they should be at their lowest. Use of these control points is suggested, but these should be augmented with future longer term projects where there is much more oversight of the data. In addition, short duration construction projects of only several months simply do not have a sufficient number of observations to be explained by anything other than a linear model. For the overall data set, a simple linear regression function also provided a reasonable fit without the complexity of the higher order functions.

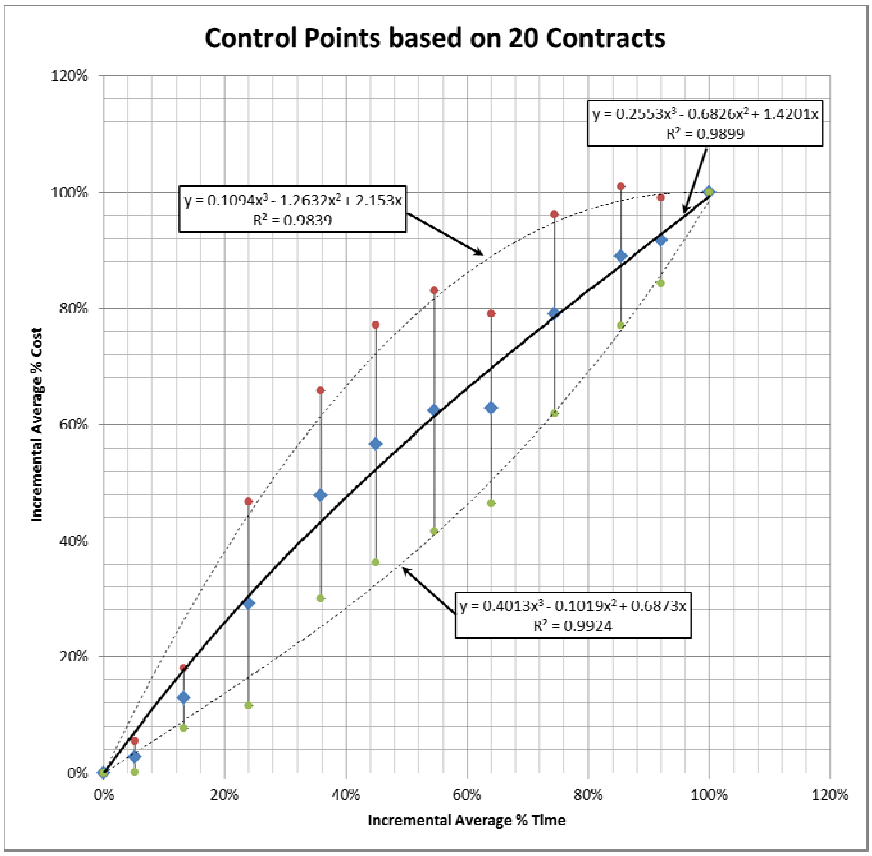

Figure 10: Plot of control points for the 20 selected construction projects

Based upon the results of this analysis, it is suggested that projects of duration less than nine months the % Cost should be calculated at the 33% and 66% time complete and compared to Figure 10 to evaluate overall performance. Multi-year projects should have this calculation and comparison done monthly. Projects falling outside of the dashed lines should be given extra scrutiny. Those projects that fall below the identified range should particularly be focused on to see if corrections can be made to bring the projects back on schedule.

Conclusions

Based upon a review of new WisDOT practices developed and employed for delivery of their megaprojects and ARRA program, a number of potential best practices were identified for use in management of future highway construction projects. Analysis of these practices resulted in recommending the continuation of 49 of these best practices. The original thoughts of the CMSC team were to reduce the number of best practices down to a select few, but all of the final 49 have benefits and applications depending on a project's unique circumstances. For that reason, all of the selected best practices were expanded upon and provided in a separate document titled *Practices from WisDOT Mega and ARRA Projects – Best Practice Catalog.* Each of the best practices is identified by construction project management emphasis area (Project

Management, Financial Reporting, Document Control, and Change Management) so that WisDOT staff can select specific best practices based upon the project need or goals. Each best practice is also categorized as meeting primary and secondary objectives so that WisDOT staff can quickly identify a specific best practice to meet a particular management need. Each listed best practice identifies the relative cost to implement and the types of projects it is most applicable to. This was done so that WisDOT can begin statewide application of those best practices found to be appropriate for all project sizes.

While we thought it important to provide a summary of all the best practices, there were several that seemed to be particularly important that WisDOT focus on based upon the input obtained from experienced project managers and the thoughts of the CMSC team. Those are:

PM-1	Employ a defined hierarchy for decision making
PM-2	Use a Request for Information (RFI) form and process
PM-6	Require Use of Three-Week Look-Ahead Schedules
PM-9	Establish project Close-Out Procedures early in project and track progress
PM-11	Project Team prepare Cost-to-Complete budget projections
PM-14	Establish project Reserve (contingency) Budgets
PM-16	Assign a responsible party for resolution of issues at Project Progress Meetings
PM-17	Make “Open Issues” a routine agenda item at Project Progress Meetings
PM-21	Use Work Authorization Form (WAF)
PM-29	Establish project goals for timely approval of documents
PM-32	Prepare Project Benchmark Performance Indicators (% Cost & % Time)
FR-1	Implement a Project Financial Reporting System
FR-2	Utilize a statewide Construction Project Management Dashboard Report
CM-1	Establish Change Management Teams
CM-4	Conduct Weekly Issues Meetings

A number of project metrics were explored and identified for potential use by WisDOT. Specifically were metrics dealing with RFI’s (PM-2) and project % Cost vs. % Time analysis (PM-32). In addition to benchmarks and metrics that were incorporated into the best practice catalog listing for PM-2, a new set of reason codes were developed and should be adopted by WisDOT to allow a more thorough analysis of design problem areas. A project control chart was also developed for judging project performance based upon % Cost and % Time calculations. These were incorporated in the best practice write-up for PM-32 in the catalog.

Recommendations

Since the start of this research project, WisDOT has undertaken other best practice initiatives within the Division of Transportation System Development. Those efforts are broader in scope and include all aspects of project delivery, but seem to be more general and in less depth than

this study. It is recommended that the results of this study, which focused on just the construction phase, be combined with those other efforts and a department web-based best practice site be established for broader distribution of all best practices.

Even with the creation of a web-based best practice site, we recommend that several hard copies of the Best Practice Catalog be made available to the Regions so that their project management staffs are aware of the best practices and can select ones that fit their particular project needs. The catalog should also be made available on the WisDOT extranet web site for use by WisDOT staff and consultants.

We also recommend that WisDOT review the best practices that have applicability for use on all projects and thus, statewide implementation. These should be incorporated into the Construction and Materials Manual.

Several metrics and benchmarks were developed as part of this study. Data should continue to be collected for “successful” projects and the identified benchmarks updated based upon the experience of these newer projects.

APPENDIX A

Research & Communication Services Section
“Best practices on mega-projects and ARRA projects”

Division of Business Management
Research & Communication Services Section

Policy research project scoping meeting
"Best practices on mega-projects and ARRA projects"

Background
WisDOT's Board of Directors and the Research & Library Advisory Committee have given top priority for a policy research project or projects to identify best practices for the department from mega-projects (e.g. Marquette Interchange) and projects funded through the American Recover & Reinvestment Act (ARRA). The research would identify procedures, standards and programs used in these projects, evaluate their effectiveness, determine if they have benefits for future use and determine how they could be adopted by the department.

Discussion for scoping meeting

1. Is this research best handled as one project or as two separate projects? Items for consideration:
    a. Business areas impacted / personnel involved
    b. Management of research projects
    c. Similarities or differences in best practices
    d. Capability / capacity of researchers

2. What topic areas should be included in the project(s)?
    a. Planning
    b. Public involvement
    c. Design
    d. Context sensitive design
    e. Real estate
    f. Utilities
    g. Construction
    h. OCIP
    i. Traffic mitigation
    j. Budgeting & programming
    k. Financial reporting
    l. Management / oversight
    m. Consultant use
    n. Document control
    o. Local coordination
    p. Civil rights compliance
    q. DBE contracting
    r. Executive level project management
    s. Scoping
    t. Training materials
    u. Change management
    v. Project scheduling
    w. Contract development
    x. Value engineering
    y. Environmental barriers
    z. Others?

Best Practices on Mega Projects Already Identified
From David Nguyen presentation

Project Management: Decision Making
Goal: Implement a decision making process to resolve issues timely and effectively
Best Practices

- Define clear decision making process
- Track and monitor decisions for timeliness
- Set-up organizational tree with dollar value thresholds
- Stream line approval process with FHWA
- Use Dispute Resolution Board
- Use project control software to record & manage issues
- Resolve Issues at lowest possible level

Project Management: Document Management
Goal: Provide collection, storage and distribution of information
Best Practices

- Standardize the procedure for managing documentation and information
- Distribute the information effectively and timely amongst project personnel
- Transfer knowledge between current individual projects to future projects

Project Management: Program Management
Goal: Develop, implement & maintain project management plan required by FHWA
Best Practices

- Develop a comprehensive project management plan
- Complete management plan early to avoid confusion
- Review plan annually
- Plan needs to have roles & responsibilities
- Review program performance regularly
- Hold partnering meeting with WisDOT staff, consultants, designers, FHWA, Contractors
- Provide opportunities for staff input

Project Controls: Cost Management
Goal: Provide systematic way to project and track the cost to complete
Best Practices

- Develop complete initial scope
- Condense various accounting systems into one database
- Maintain real-time budget expenditures

Project Controls: Risk Management
Goal: Identify, monitor, and mitigate risks
Best Practices

- Outline processes to identify risks
- Monitor risk status throughout the execution of the program
- Review the complete risk log at regular intervals
- Prepare mitigation plans in the event the risk occurs
- Hold meetings to discuss the risk threat and potential solutions
- Analysis of alternative risk scenarios

Project Controls: Issue Management
Goal: Identify, track, and resolve all issues timely and effectively
Best Practices

- Use of Expedition software
- Assign lead (B.I.C.) & have regular meetings to track resolution
- Assign cost for projection purposes
- Set realistic and aggressive completion dates
- Track Issues to ensure the flow of accurate, timely, and useful information between parties

Project Controls: Schedule Management
Goal: Complete project by committed deadline
Best Practices

- Use of Primavera P3
- 3-week look-ahead schedule
- Require regular progress reports
- Hold project workshop with contractors before bidding
- Require explanation of schedule slippage
- Compare progress to baseline at 25%, 50%, 75%, & 100%
- Provide feedback to contractor on schedule report
- Be receptive to contractor initiatives

Public Information: Public Outreach
Goal: Share timely and accurate information with stakeholders
Best Practices

- 100% Dedicated P.I. Officer
- Interactive Project Web-site
- Weekly TV and radio updates
- 3-D Scale model of interchange
- "get-around" guide for new traffic setup and ramp closures
- Provide avenue for feedback.

Public Information: Community Sensitive Design
Goal: Develop a project that is reflective of the community
Best Practices

- Workshop meetings with stakeholders
- Involved Local artists and National experts

Public Information: Traffic Mitigation
Goal: Develop and implement a plan to mitigate project impact on traffic
Best Practices

- Focus on freeway operation
- Lane rental in contract
- Transit & demand management
- Promote carpooling
- Work closely with Sheriffs on freeway incident management
- Coordinate & Facilitate product deliveries
- Work with DPW local streets & alternate route operation

Public Information: Local Business Interaction
Goal: Develop, implement and communicate a plan to mitigate project impacts on local business
Best Practices
- Work with Downtown Business Association
- Coordinate with Marquette University
- Meet anytime, anywhere with any group
- Meeting with Neighborhood groups

Third-Party Involvement: Utility Coordination
Goal: Mitigate impact of utility coordination on construction schedule, cost and local community
Best Practices
- Outline responsibilities
- Work and cost share agreements
- Schedule cooperation
- Early 3-D locates during design

Third-Party Involvement: Real Estate
Goal: Identify, manage, and resolve real estate acquisitions
Best Practices
- Use of early acquisition process
- Construction staging area
- Disposal site for onsite disposal of excavation
- Future development after project

Third-Party Involvement: Environmental Impact
Goal: Minimize noise impact on community and monitor vibration effects on local structures
Best Practices
- Incorporate local ordinances into specifications for clarity
- Night-time noise specs
- Real time vibration monitoring

Project Initiatives: Owner Controlled Insurance Program (OCIP)
Goal: Implement a safety insurance program to protect schedule and costs, promote a safe work environment and provide liability protection to WisDOT and Contractor.

Safety Awareness
- OCIP – Initial Awareness Training
  - 100% contractor/worker registration
  - Safety indoctrination training
  - Drug free workplace
  - Jobsite access control stickers
- Safety Training
  - Weekly safety training topics
  - Daily “Toolbox Talks”
- Worker /Public Protection
  - PPE requirements for workers
  - Monetary fines in place
  - Signage and barriers
- Culture of Safety
  - “We are our brothers keeper”
  - Safety is everyone's job

Safety Work plan

- Activity specific work plans
  - ❑ Work planning
  - ❑ Hazard identification
  - ❑ Risk mitigation
  - ❑ Task execution
  - ❑ Supervision and control
- Pre-activity safety briefing
- Critical activity checklists
  - ❑ Crane lifts
  - ❑ Steel erection
  - ❑ Demolition
  - ❑ Excavations

Project Initiatives: Disadvantaged Business Enterprises

Goal: Increase DBE participation in the Marquette Interchange Program

Best Practices

- Set up Community based advisory groups for labor & business development
- The use of TRANS Program to provide minority labor to the projects
- Pre-bid Workshops for networking between prime & sub
- Set high DBE goal for large Projects
- "Bulls-eye Targeting"

Project Initiatives: Disadvantaged Business Enterprises

Best Practices

- Provide an environment to build DBE capacity in community.
- Provide an environment to enhance workers skills and education in community.
- Monitor and report DBE participation.
- DBE Goal as Condition of Award
- Good Faith Waiver Process
- No bonding required of subs by WisDOT
- "Civil Rights Compliance System" - payroll payment tracking system
- Project newsletters to update community on DBE achievement

Project Initiatives: Partnering

Goal: Improve communications; resolve conflicts and maintain focus on project mission

Best Practices

- Establish a Commitment for conflict resolution
- Process and resolve issues quickly, minimize response time and appropriate level of documentation
- Create Group charter
- Bring issues to Partnering meeting only when both parties agree they have failed to come to solution.
- Develop consistency and uniformity across program

Processes and Procedures: Changing Culture
Goal: Select a superior team, improve the project management culture, and expand knowledge to future projects.
Best Practices

- Co-locate the Team – WisDOT & Consultants
- Prevent 'Sticker-shock' mentality
- Reinforce & promote successful project measurements
- Unify project team around new culture
- Cross boundaries

Processes and Procedures: Specifications
Goal: Incorporate national standards of Mega-project Management to the Marquette Program
Best Practices

- Identify National standards for innovative processes
- Enhance critical processes by improve procedures

Processes and Procedures: Expediting Close-Out
Goal: Establish, maintain and execute a timely comprehensive Project and Program closeout process
Best Practices

- Establish Close-out procedures early in program and transfer methods to the individual project processes
- Review and Maintain records throughout project
- Provide clear and searchable records for future reference.

Processes and Procedures: Software Integration
Goal: Implement Program Management software across program, provide continuity between projects, and provide the tools needed to make intelligent and wise decisions.
Best Practices

- Choose a software management tool proven to add value to existing project management practices
- Integrate issues, costs and schedule
- Enhance the Project teams ability to manage and make decisions

APPENDIX B

Tabulation of Inventoried Best Practices

Best Practices From ARRA Projects

Study Emphasis Area	WisDOT Function	Best Practice Description
Program Management*	Program Management	Use of Senior Management Oversight Committee
Program Management	Cost Management	Use of Executive Change Management Team
Program Management	Cost Management	Use of Division Change Management Team
Program Management	Cost Management	Use of Region Change Management Team
Financial Reporting	Cost Management	Project Expenditure Reporting Monthly (Construction and Delivery) Appendix B Report
Financial Reporting	Cost Management	*Tracked Actual Expenditures vs. Budget
Financial Reporting	Cost Management	*Tracked % Of Current Budget Expended
Financial Reporting	Cost Management	* Tracked Anticipated Cost-to-Complete
Financial Reporting	Cost Management	*Tracked Pending Contract Mods
Financial Reporting	Cost Management	*Tracked Reserve Balances
Program Management	Cost Management	Tracked Project Baseline Budget vs. Current Project Budget (Construction/Delivery/Reserve) - Appendix A Report
Program Management	Schedule Management	Tracked Project Construction Start Date
Program Management	Managing Project Closeout	Tracked Project Finals Progress
Program Management	Cost Management	Tracked Consultant Finals Invoice
Project Management	Cost Management	Established Project Reserve Budget
Project Management	Decision Making	Predetermined decision level authority
Project Management	Issue Management	Monthly Project Data Collection
Project Management	Schedule Management	*Identified recent project accomplishments
Project Management	Schedule Management	*Identified key work scheduled
Project Management	Issue Management	*Identified top project issues
Project Management	Issue Management	*Projected project Overruns/Underruns
Project Management	Cost Management	*Reasons why project was over/under budget
Project Management	Cost Management	Projected Contract Over/Underrun Form
Project Change Management	Cost Management	Change Management Request Form
Project Management	Quality Management	FHWA Quality Assurance Checklist
Project Management	Issue Management	FHWA Pre-Construction Meeting Checklist
Project Management	Safety Management	FHWA Traffic Control Focus Review Form

Project Management	Schedule Management	Cooperation and commitments from external agencies (DNR & SHPO) for quick project reviews, approvals and permits.
Document Control	Contract Administration	Use of Civil Rights Compliance System (CRCS) for tracking DBE utilization

Best Practices from Mega Projects (Marquette Interchange & I-94 N-S Corridor)

Study Emphasis Area	WisDOT Function	MI	I-94	Description
Project Management	Decision Making	Yes	Yes	Employ a defined decision making escalation process
Project Management	Decision Making	Yes	Yes	Establish a dollar value threshold for decision making authority
Project Management	Decision Making	Yes	Yes	Engage FHWA at the initiation of a large or significant issue to streamline approvals
Project Management	Decision Making	Yes	No	Incorporating Topic Experts "On-Call-1st Priority" for project questions.
Project Management	Decision Making	Yes	Yes	Use of Request for Information Form
Project Management	Decision Making	Yes	Yes	Contract with design firm to be available to the construction team
Project Management	Decision Making	Yes	Yes	Establish time goals for processing information (i.e. 5 or 7 days for responding to an RFI)
Project Management	Schedule Management	Yes	Yes	Hold scheduling workshop between contractor and WisDOT prior to starting work
Project Management	Schedule Management	Yes	Yes	Require use of specified CPM schedule
Project Management	Schedule Management	Yes	Yes	Require three-week look-ahead schedules from contractor
Project Management	Schedule Management	Yes	Yes	Compare progress to baseline schedule at 25%,50%,75% and 100% completion
Project Management	Schedule Management	Yes	Yes	Mandatory use of contract specified CPM scheduling tool
Project Management	Schedule Management	Yes	Yes	Identification of key construction activities and track productivity
Project Management	Schedule Management	Yes	Yes	Preconstruction workshops between contractor and WisDOT to clarify schedule and get consensus on scheduling tools
Project Management	Schedule Management	Yes	Yes	Require monthly updates by contractor showing actual start dates, completion percentages, remaining durations, and actual finish dates

Project Management	Schedule Management	Yes	Yes	Hold monthly schedule review meetings with contractor to identify scheduling issues
Project Management	Schedule Management	Yes	No	Utilize Owner procured preliminary shop drawings
Project Management	Utility Coordination	Yes	Yes	Identify a WisDOT Project Specific Utility Coordinator
Project Management	Utility Coordination	Yes	No	Require contractor to provide a dedicated utility coordinator
Project Management	Managing Project Closeout	Yes	Not Yet	Establish Close-out procedures early in the project.
Project Management	Managing Project Closeout	Yes	Not Yet	Track closeout progress and assign action items
Project Management	Managing Project Closeout	Yes	Not Yet	Develop process for partial acceptance leading to final acceptance
Project Management	Managing Project Closeout	Yes	Not Yet	Consolidate Closeout documents as each phase is completed
Project Management	Managing Project Closeout	Yes	Not Yet	Identify close out items that can be worked on simultaneously or in parallel
Project Management	Managing Project Closeout	Yes	Not Yet	Maintain running Punch lists for management of closeout items
Project Management	Managing Project Closeout	Yes	Not Yet	Conduct periodic review of preliminary finals to expedite final closeout
Project Management	Schedule Management	No	Yes	Have separate contracts to procure steel for bridge construction
Project Management	Issue Management	Yes	No	Establish a "Project Team" that is not tied to the Region on a day-to-day basis
Project Management	Schedule Management	Yes	Yes	Hold Submittal Workshops for Contractor prior to NTP (Utilities, Potential CRI's, Specialty Items to be constructed, etc.)
Financial Reporting	Cost Management	Yes	Yes	Implement single financial reporting system
Program Management	Cost Management	Yes	No	Establish financial monitoring team that liaison with Central Office
Project Management	Cost Management	Yes	Yes	Require cost-to-complete budget projections on a monthly basis
Project Change Management	Cost Management	Yes	Yes	Form a Change Management Team

Project Change Management	Cost Management	Yes	No	Development of project budgets by department, section, and unit.
Project Change Management	Cost Management	Yes	Yes	Execute periodic contract mods (Balancing Mods) to revise authorized line item quantities to account for overrun/underrun quantities
Financial Reporting	Utility Coordination	Yes	Yes	Coordinate billing and reimbursement procedures with utilities so costs are tracked and compared to budgets
Project Management	Cost Management	Yes	No	Conduct Earned Value Analysis Monthly
Project Management	Cost Management	No	Yes	Conduct Earned Value Analysis at 25%, 50%, 75% and 100% completion milestones
Project Management	Cost Management	Yes	Yes	Establish a Project Managers Reserve and a Oversight Committee Reserve for each project
Project Management	Cost Management	Yes	Yes	Track Over Runs/Underruns throughout the project
Project Management	Decision Making	Yes	Yes	Centrally locate the project team in one on-site location
Project Management	Decision Making	Yes	Yes	Track, monitor and report decisions made
Project Management	Decision Making	Yes	Yes	Establish contacts, chain of command and lines of communication
Project Management	Decision Making	Yes	Yes	Utilize project database of decisions to provide guidance on new issues
Project Management	Decision Making	Yes	Yes	Use of Work Authorization (WAF) Form
Project Management	Decision Making	Yes	Yes	Develop a Construction Management Plan
Project Management	Decision Making	Yes	No	Use of Trend Charts (Cost at Complete and various Project Metrics & Data)
Program Management	Program Management	Yes	Yes	Create an accountability Matrix to clarify roles and responsibilities
Program Management	Program Management	Yes	Yes	Preparation of Monthly Project Reports that detail progress, issues, current costs and projected cost to complete
Project Management	Utility Coordination	Yes	Yes	Establish chain of command for coordination and communication between WisDOT, Utility & Contractor
Project Management	Quality Management	Yes	Yes	Develop Materials Certification and Submittal Requirements Listing

Project Management	Issue Management	Yes	Yes	Develop project web site for communication with public
Project Management	Decision Making	Yes	No	Use of Contract Change Notice Form
Document Control	Document Management.	Yes	Yes	Standardized method for managing documentation
Document Control	Document Management	Yes	Yes	Standardize all forms (RFI, Design Issue Notices, Meeting Notes, Issue Logs, Change Management Logs, etc.)
Document Control	Document Management.	No	Yes	Require contractors and designers to submit material electronically
Document Control	Issue Management	Yes	Yes	Document and track all issues with cross linkage to RFI's, Contract Mods, Progress Meeting Notes
Project Management	Issue Management	No	Yes	Develop Procedural Manual for consultant engineers on how to do business using WisDOT processes
Document Control	Contract Administration	Yes	Yes	Use of Civil Rights Compliance System (CRSC) for tracking DBE usage
Progject Management	Decision Making	Yes	Yes	Utilize a standardized project control software system
Project Management	Decision Making	Yes	Yes	Utilize a Standing Dispute Review Board
Program Management	Program Management	Yes	Yes	Utilize a Senior Management Oversight Committee
Project Change Management	Risk Management	Yes	Yes	Develop a risk log identifying potential project risks, impact, likelihood, and responsible person
Project Change Management	Risk Management	Yes	Yes	Assign a team member responsibility for tracking identified risks and status
Project Change Management	Risk Management	Yes	No	Prepare risk mitigation plans to deal with the risk should it occur
Project Change Management	Risk Management	Yes	Yes	Conduct risk assessments to identify likelihood and impact.
Project Management	Issue Management	Yes	Yes	Assign lead on resolving issues aggressively at Project Progress Meetings (Ball-In-Court")
Project Management	Issue Management	Yes	Yes	Conduct weekly Issues Meeting involving project leaders and project managers
Project Management	Issue Management	Yes	Yes	Make "open issues" a routine agenda item at Weekly Project Progress Meetings

Project Management	Issue Management	Yes	Yes	Delegate document control managers to follow-up on unresolved issues.
Project Management	Issue Management	Yes	Yes	Utilize Partnering with bi-weekly meetings
Project Management	Issue Management	Yes	Yes	Involve DRB Chair in Partnering Meetings
Project Management	Schedule Management	Yes	Yes	Preconstruction workshops between contractor and WisDOT to clarify schedule and get consensus on scheduling tools
Project Management	Schedule Management	Yes	Yes	Hold Specialty Group weekly meetings (Utilities, Traffic)
Project Management	Safety Management	Yes	Yes	Implement Owner Controlled Insurance Program
Project Management	Safety Management	Yes	Yes	Designate a Project Safety Engineer

Best Practices from PCCE Initiative

Study Emphasis Category	WisDOT Function	Description
Project Management	Project Management	Line of Communication Form
Project Management	Decision Making	Decision Time Form
Project Management	Issue Management	Pre-Construction Issue Identification Form
Project Management	Issue Management	Standardized Pre-Construction Meeting Agenda
Project Management	Project Management	Subcontractors Contact Information Form
Project Management	Project Management	Responsibility Matrix
Project Management	Decision Making	Use of RFI submittal form
Project Management	Decision Making	Use of RFI Log
Project Management	Decision Making	Standardized Project Progress Meeting Agenda
Document Control	Document Management	Standardized Progress Meeting Notes

APPENDIX C

Request for Information (RFI) FORM

Company Name:

REQUEST FOR INFORMATION

Company Initials - Number

Address:

Phone:
Fax:
Email:

DATE:
TITLE:
PROJECT: Contract #/s:
TO: Project Leader
WisDOT
Address

STARTED:
COMPLETED:
REQUIRED:

REQUEST:

References:

Possible Solution:

Cost Estimate ($): _____
Additional Time (MH): _____

Requested By: _____ Date: _____
Signed: _____

ANSWER:

Division

☐ BR ☐ DM ☐ EW ☐ GN ☐ RD ☐ SS ☐ TR ☐ DU ☐ WU ☐ WL

Tracking Number: _____

Reason Code

☐ AD ☐ CC ☐ CI ☐ CS ☐ DC ☐ DL ☐ DM ☐ DR ☐ DS ☐ IP ☐ MC ☐ SC ☐ UC ☐ VE ☐ OR

Justified

☐ Yes ☐ No

Answered By: _____ Date: _____
Signed: _____