Validating the Outcome of Partnering on Major Capital Projects

Requested by
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The Caltrans Division of Research and Innovation (DRI) receives and evaluates numerous research problem statements for funding every year. DRI conducts Preliminary Investigations on these problem statements to better scope and prioritize the proposed research in light of existing credible work on the topics nationally and internationally. Online and print sources for Preliminary Investigations include the National Cooperative Highway Research Program (NCHRP) and other Transportation Research Board (TRB) programs, the American Association of State Highway and Transportation Officials (AASHTO), the research and practices of other transportation agencies, and related academic and industry research. The views and conclusions in cited works, while generally peer reviewed or published by authoritative sources, may not be accepted without qualification by all experts in the field.

Executive Summary

Background

Collaborative partnering has been used as a framework for communication and problem-solving on highway construction project teams across the United States since the early 1990s. The partnering process aims to foster a team environment where challenges are addressed as a group and disputes are resolved early, ultimately yielding a positive impact on project measures such as costs, schedules, contract change orders, claims, safety and quality. However, it can be difficult to isolate and quantify the effect of partnering on project performance measures.

Caltrans is investigating ways to demonstrate the positive impact that the use of partnering has on its construction projects. This Preliminary Investigation reviews research and data that quantify the effectiveness of partnering on construction projects at other state DOTs, as well as related resources and guidance.

Summary of Findings

Although many state DOTs use partnering on their largest, most high-profile construction projects, Caltrans is among a handful of agencies that have mature partnering programs. Partnering programs at these agencies often have a partnering coordinator and additional staff, provide specifications and manuals that outline partnering procedures, offer partnering training courses for project teams and facilitators, and require that certain construction projects use formal (facilitated) partnering processes. These DOTs commonly use surveys to capture project team members' ratings of the partnering process and related measures, but very few states have undertaken formal research studies to assess the impact of partnering on construction project performance (such as project costs and schedules). A few state DOTs have tracked partnering benefits internally by aggregating performance data for all construction projects completed each year and charting trends over several years (before and after partnering use began).

The studies cited in this Preliminary Investigation use both objective project performance data and subjective project-rating data to assess the effectiveness of partnering. The analysis methodology differs from study to study; for example, while many compare partnered projects with nonpartnered projects, a

2002 Oregon DOT study compares projects that were partnered successfully with those that were unsuccessfully partnered.

Our findings are divided into four sections:

National Resources

- A Partnering Subcommittee that was part of the AASHTO Standing Committee on Quality was active until the committee was sunsetted by AASHTO in 2008. Chaired by Caltrans' Elizabeth Dooher, the subcommittee was addressing the topic of measuring the effectiveness of partnering, and was exploring the possibility of creating a pooled fund research project to fund the development of an AASHTOWare Partnering Measurement Tool. This automated tool would compile the partnering ratings entered by project teams and as well as data on project metrics such as budget and schedule, and would aggregate this data to create performance measures. States could use the tool to evaluate the benefits of using project partnering on a project-by-project basis and at the program level.

- The Contract Administration Section of the AASHTO Standing Committee on Highways, Subcommittee on Construction, recently surveyed states about their use of partnering. Of 40 states responding to the survey, five indicated that they measure the performance of partnered projects.

State DOT Research and Practices

A few states have conducted formal research projects evaluating the effectiveness of partnering at their agencies. Some studies focused on bottom-line performance (effects on project costs and schedule), while others sought to identify the factors that led to a successful partnership. The studies' methodologies varied with these objectives.

Several states have charted trends over time in construction project performance measures, and have generally seen improvement since partnering was implemented. Although these charts tend to indicate the year that partnering began, it is important to note that partnering has been implemented differently at each agency. Most charts show data for all completed projects, which at some agencies includes both partnered and nonpartnered projects within the same year. In addition, agencies differ in their requirements for use of informal partnering vs. formal partnering using a professional facilitator.

States that have conducted research or compiled data on the impact of partnering include:

- **Arizona:** Data from 1991 to 2006 document a dramatic reduction in claims, as well as time savings and nearly $30 million in construction engineering and construction value engineering savings.
- **Maryland:** Data through 2008 show a decline in claims as the use of partnering increases. A 2006 study identified elements of the program that were working well and made recommendations for improvement.
- **Ohio:** Data through 2009 show fluctuations in claims and change orders over time, with claims falling in recent years after reaching a high of 30 in 2004. A 1994 study of the first two years of ODOT's partnering program did not identify significant cost or time savings.
- **Oregon:** A 2002 study of 12 projects found that unsuccessfully partnered projects experienced greater cost growth (20.2 percent vs. 5.9 percent) and longer schedule delays than successfully partnered projects, and were more costly for ODOT to administer. Case studies outline the differences in project characteristics.
- **Texas:** Two studies in the 1990s both demonstrated benefits; the second, more extensive study analyzed 400 projects and found that partnering had positive impacts on project costs and schedule.

- **Virginia:** Data through 2011 show an improvement in on-time, on-schedule performance and an increase in contract quality rating.

Project-Level Case Studies

- We identified only one large-scale study of the impact of partnering on a specific construction project: a 2011 study of partnering on the Woodrow Wilson Bridge project in Maryland and Virginia. This study of more than eight years of data from 19 individual contracts found that good partnering was strongly associated with the project team's satisfaction with budget and schedule results, and with effective issue resolution.
- Documentation of other successfully partnered projects, such as winners of partnering awards, provide additional examples of cost and time savings.

Additional Research and Guidance

The studies in this section provide examples of different measures used to assess the effectiveness of partnering on highway projects, and guidance documents that address partnering measurement methodologies.

Gaps in Findings

- As noted above, very few formal research projects have been conducted using quantitative project performance data to assess the impact of partnering. No two studies had exactly the same objective and methodology, and most studies that focus on quantitative performance data are several years old, with some dating back to the 1990s.

- The sunsetting of the AASHTO Standing Committee on Quality left the Partnering Subcommittee's considerable work on partnering measurement unfinished. No comparable committee currently exists within the AASHTO or TRB committee structure.

- The 2005 *AASHTO Partnering Handbook* appears to be the only national guidance or research focused on highway construction partnering. No national research on this topic is under way.

Next Steps

Caltrans might consider the following in its continuing evaluation of how to demonstrate the benefits of partnering on its construction projects:

- Contact Virginia DOT to discuss that agency's approach to using multiple types of data to demonstrate the benefits of partnering, including the agency's exploration of the use of risk management principles and its work with consultants who use proprietary measurement software.
- Initiate a research project to gather and analyze data on project performance, building on methodologies used in previous research and tailoring the approach to fit Caltrans' objectives. If appropriate, consider capturing objective and subjective details of successful projects such as partnering award winners.
- Consider building on the work of the Partnering Subcommittee to propose a pooled fund project to fund the development of a Partnering Measurement Tool that would generate project- and program-level performance data validating the impacts of partnering.
- Consider other states' strategies for incorporating performance data into their outreach efforts, such as the Maryland State Highway Administration's joint presentations with a contractor representative.

Contacts

During the course of this Preliminary Investigation, we spoke to or corresponded with the following individuals:

State Transportation Agencies

Arizona DOT
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Federal Highway Administration (FHWA)

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National Resources

There is not much current activity at the national level regarding partnering, either among national committees or in research efforts. This section highlights two AASHTO initiatives.

Partnering Subcommittee, AASHTO Standing Committee on Quality (sunsetted by AASHTO in 2008). For several years until 2008, this subcommittee worked to advance partnering practices at state DOTs, undertaking many related initiatives and producing the *AASHTO Partnering Handbook* in 2005.

The subcommittee was addressing the topic of measuring the effectiveness of partnering, and was exploring the possibility of creating a pooled fund research project to fund the development of an AASHTOWare Partnering Measurement Tool. This automated tool would compile the partnering ratings entered by project teams and as well as data on project metrics such as budget and schedule, and would aggregate this data to create performance measures. The subcommittee anticipated that the measures would focus on areas including:

- Schedule, budget and quality.
- Public impact and relations.
- Innovation.
- Dispute/issue resolution, communication, teamwork and relationships.

States could use the tool to capture and validate the benefits of using partnering on a project-by-project basis and at the program level.

Caltrans' Elizabeth Dooher was the chair of the subcommittee when it was sunsetted. Other subcommittee members included Bridgid Seering of Maryland SHA, George Gardner of Virginia DOT, and Mark Chandler of FHWA-Wisconsin. Consultant Judonne Greham of Isconme Consulting Services was employed to facilitate and coordinate the subcommittee's activities. The subcommittee members we spoke with mentioned that they are continuing efforts to find a new home for the subcommittee within AASHTO's current committee structure.

Most documentation of the subcommittee's work is no longer available online. A few documents are available on the AASHTO website that give a sense of the subcommittee's efforts; including:

- Minutes of many of the subcommittee's monthly meetings through March 2008; three examples include:
  - March 2008:
    http://www.transportation.org/sites/quality/docs/meeting_minutes_March_10th_2008.pdf
  - February 2008:
    http://www.transportation.org/sites/quality/docs/meeting_minutes_February_11th_2008.pdf
  - January 2008:
    http://www.transportation.org/sites/quality/docs/meeting_minutes_January_14th_2008.pdf

- Strategic Plan, February 2007:
  http://www.transportation.org/sites/quality/docs/strategic_plan_february_2007.pdf

Related resource:

AASHTO Partnering Handbook, 2005.
Available for purchase at https://bookstore.transportation.org/item_details.aspx?id=322
This guidebook includes a section on partnering measurement.

Partnering Survey, AASHTO Standing Committee on Highways, Subcommittee on Construction, Contract Administration Section, 2012.
In January and February 2012, the Contract Administration Section conducted a 10-question survey of Subcommittee on Construction members about the use of construction partnering at their agencies. Two survey questions related to measuring the performance of partnered projects. Jerry Yakowenko of FHWA coordinated the survey, and he provided us with the details of survey responses related to partnering measurement.

Forty states responded to the survey, and five states indicated that they measure the performance of partnered projects. The responses to the two relevant survey questions are summarized below, and a summary of survey responses is provided as **Appendix A**.

7. Does your state measure the performance of partnered projects? (36 responses)
Yes – 13.9 percent (5 responses: New Jersey, Ohio, South Carolina, Texas, Virginia)
No – 75.0 percent (27 responses)
Other – 11.4 percent (4 responses)

Five respondents wrote text in response to "Other (please specify)":

- **California:** We currently track which projects have issued a CCO to perform the partnering but do not collect partnering performance measures. We are in the process of developing partnering performance measures and a method to collect the data.
- **Indiana:** We still rate projects at the closeout meeting, but it is subjective and not much is done with the information from the session.
- **Nevada:** Not really. We do have an awards program.
- **New York:** Not formally.
- **West Virginia:** We only have done a couple, but we did review them.

8. If "yes," what do you measure? (5 responses)

Time savings – 80 percent (4 responses – South Carolina, Texas, Virginia, West Virginia)
Cost savings – 80 percent (4 responses – South Carolina, Texas, Virginia, West Virginia)
Claims reduction – 60 percent (3 responses – Ohio, Texas, West Virginia)
Increased safety – 60 percent (3 responses – South Carolina, Texas, Virginia)

One respondent wrote text in response to "Other (please specify)":

- **Ohio:** Claims reduction, service/relationships

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Other Resources

International Partnering Institute
http://www.partneringinstitute.org/
This nonprofit construction organization is focused on research and implementation of partnering concepts and techniques in construction project settings. The institute recently began a research project on the effectiveness of partnering in both vertical and horizontal construction.

Contact: Rob Reaugh, Executive Director, (925) 447-9100, robreaugh@partneringinstitute.org.

Construction Industry Institute
http://www.construction-institute.org/
CII is a consortium of owners, contractors and suppliers that works to improve the cost-effectiveness of the capital facility construction project life cycle. Although CII is focused on vertical construction, the organization has authored several guidance documents that address methodologies for measuring the effectiveness of partnering, which have some applicability to highway construction as well (see the "Additional Research and Guidance" section of this Preliminary Investigation).

State DOT Research and Practices

This section highlights research projects on partnering effectiveness initiated by state DOTs, as well as related data on project and program performance that agencies have compiled.

Arizona

Partnering Office
http://www.azdot.gov/CCPartnerships/Partnering/Index.asp
Since ADOT began using partnering in the early 1990s, the agency has tracked and publicized the effects of partnering on project budgets, schedules, and claims. According to a 2006 ADOT presentation (http://www.ati-sys.com/atisys/ADOT_Partnering_Measurements_060506_Summary.pdf), partnering has led to a dramatic reduction in claims:

- In 1991, ADOT had 60 claims totaling $39.8 million.
- In 1992, ADOT had 20 claims totaling $25.8 million. This year marked the official beginning of partnering at ADOT.
- From 1993 to 2006, ADOT had a *total* of 6 claims totaling $1.3 million.

Between 1991 and 2006, ADOT completed 1,788 construction projects using partnering. During that time, the department attributed the following impacts to the partnering process:

- 24,677 contract days saved
- 12.7 percent average time saved
- $20.3 million in construction engineering savings
- $9.4 million in construction value engineering savings

Similar statistics are presented in a 2002 case study:

> **"Partnering Program Saves ADOT Millions,"** case study, Policy Consensus Initiative, June 2002. http://www.policyconsensus.org/casestudies/docs/AZ_transportation.pdf

We spoke with Michael Carter, coordinator of ADOT's project-level Partnering Evaluation Program. He said that in recent years, ADOT hasn't had the need to compile the type of program-level statistics on the benefits of the partnering program that are displayed in the 2006 presentation, although he noted that the data that would be needed is available. He noted that after 20 years, partnering is simply "the way ADOT does business."

Contact: Michael Carter, Partnering Evaluation Program Coordinator, (602) 653-5434, MCarter@azdot.gov.

Maryland

Partnering Subcommittee, Maryland Quality Initiative
http://mdqi.org/steering-team-a-subcommittees/partnering-subcommittee
Maryland SHA began exploring partnering during the early 1990s and formed a Partnering Subcommittee (part of SHA's Maryland Quality Initiative) in 1997; formal use of partnering at SHA began in 1997-1998.

We spoke with Partnering Coordinator Bridgid Seering, who said SHA has experienced a decline in claims since the agency began using partnering, but noted that it is difficult to say whether partnering was the only factor that influenced this improvement. She provided a 2008 conference presentation on the benefits of partnering that she gave jointly with a contractor representative; slides 7 and 8 chart the decline in the dollar amount of claims and award amounts. (See **Appendix B**.)

SHA commissioned a research study to analyze the effectiveness of the partnering program:

> ***Maryland SHA Partnering: An Analysis of the Maryland Department of Transportation State Highway Administration's Partnering Program and Process,*** Brian Polkinghorn, Robert La Chance and Haleigh La Chance, 2006.
> http://www.conflict-resolution.org/docs/SHA_Partnering_Report.pdf
> This study analyzed the SHA partnering program using data gathered from interviews, surveys and focus groups. Researchers identified aspects that were working well and made recommendations for process improvements. The research team also created a *Best Practices Manual for Partnering* (http://www.conflict-resolution.org/docs/SHA_Best_Practices_Manual.pdf).

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Ohio

Partnering Program
http://www.dot.state.oh.us/Divisions/ConstructionMgt/Pages/Partnering.aspx
Ohio DOT has published two reports evaluating the effectiveness of its partnering program: a formal research study in 1994 and a program status report in 2010. We spoke with Freddie Cruz, an engineer-in-training who has worked with ODOT's partnering program for two years and co-authored the 2010 program status report. His perspective on the 2010 report is provided below.

> ***Evaluation of Partnering on Ohio Department of Transportation Projects,*** L.T. Chapin, Report FHWA/OH-94/022, 1994.
> This research project evaluated the first two years of ODOT's partnering program—29 projects initiated between 1991 and 1993. The research included a review of the projects' final estimates and job completion schedules for cost and time savings, and researchers determined that significant savings had not been achieved in either area.
>
> ***Partnering Program Status Report,*** Robert E. Jessberger and Freddie Cruz, Ohio DOT, May 2010.
> http://www.dot.state.oh.us/Divisions/ConstructionMgt/Admin/Partnering/ODOT_Partnering_Survey_report_2010.PDF
> This report charts the trends in claims over 12 years and change orders over 13 years (see pages 4-5), and analyzes the results of 434 evaluation surveys filled out from 2007-2010 by team members on partnered projects.
>
> The graphs indicate that the amount of claims and change orders has fluctuated over the years, displaying a downward trend in the last few years charted. Cruz explained that the graphs include data for all construction projects (both partnered and nonpartnered), and that although partnering became a requirement of ODOT's construction specifications in 2002, the process has not been embraced consistently on all projects throughout the last decade.
>
> ODOT is in the midst of several initiatives to renew its partnering program, including streamlining specifications, the procedures manual and the project evaluation process, and drafting a proposal note that provides for the inclusion of a facilitator on a construction contract. Cruz noted that in the two years since the status report, claims have continued to fall.

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Oregon

Oregon DOT began using partnering on high-profile projects in the early 1990s, and sponsored a 2002 research study to analyze the program's effectiveness. We contacted Lori Butler, ODOT construction program analyst, who said the agency has not formally made an effort to determine whether partnering has had an effect on construction project performance measures.

> ***Improving the Effectiveness of Partnering,*** David Rogge, Andrew Griffith and Wesley Hutchins, State Planning and Research Report No. 344, November 2002.
> http://www.oregon.gov/ODOT/TD/TP_RES/docs/Reports/ImprovEffectPartnering.pdf?ga=t
> This study evaluated the effectiveness of Oregon DOT's partnering program and recommended process improvements. The study used a unique methodology, comparing the results of successfully and unsuccessfully partnered projects. The report includes:

- A comparison of project metrics (budget, schedule and claims) for seven successfully partnered projects and five unsuccessfully partnered projects (see pages 45-46). Researchers found that the unsuccessfully partnered projects experienced greater cost growth (20.2 percent vs. 5.9 percent) and longer schedule delays than the successfully partnered projects, and were more costly for ODOT to administer.
- Case studies outlining the differences in successfully and unsuccessfully partnered projects (see page 43).
- A survey of 174 ODOT project managers and contractors on their perceptions of the impact of partnering on change orders and claims costs (pages 25-26), and on quality, safety, schedules and claims (pages 28-31). Perceived overall benefits to ODOT and to contractors were also examined (pages 36-37).
- A discussion of nine measures that could be used to quantify partnering's effectiveness (pages 33-35).

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Texas

Partnering Program
http://www.txdot.gov/business/contractors_consultants/partnering_program.htm
Texas DOT has used partnering since the early 1990s, and two years ago began requiring that all projects use partnering, including maintenance projects. TxDOT has both an informal and a formal partnering program.

In 1995, researchers from the University of Texas at Austin conducted a study benchmarking the performance of the first four years of TxDOT's partnering program, which is summarized in the 2000 paper below. TxDOT sponsored a follow-up study that was published in 1999.

> **"Partnered Project Performance in Texas Department of Transportation,"** Kenneth M. Grajek, G. Edward Gibson Jr., and Richard L. Tucker, *Journal of Infrastructure Systems,* June 2000.
> http://adr.navy.mil/docs/Tx_DOTpartnering.pdf
> This paper presents the results of the 1995 benchmarking study, which compared data on costs, schedule, change orders and claims for 54 partnered projects and 107 nonpartnered projects. Researchers found that partnering had a positive effect on project completion times, and that it appeared to reduce the number of claims. The researchers also analyzed subjective data gathered through a survey of nearly 900 TxDOT staff and contractors who had participated in partnered projects.
>
> **"Quantitative Analysis of Partnered Project Performance,"** Douglas D. Gransberg, William D. Dillon, Lee Reynolds, and Jack Boyd, *Journal of Construction Engineering and Management,* Vol. 125, Issue 3, 1999.
> The follow-up study described in this paper analyzed more than 400 TxDOT construction projects totaling nearly $2.1 billion, half of which used partnering. A statistical analysis found that partnering had positive impacts on project costs and schedule.

According to Interim Construction Section Director Roxana García-Zinsmeyer, TxDOT does not currently use measures to evaluate the performance of its partnering program as a whole. García-Zinsmeyer said there was no immediate need for this type of evaluation; she was among several interviewees who noted that with its long history at the agency, "partnering is the way we do business."

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Virginia

Virginia DOT initiated its partnering program in 2004. We spoke with George Gardner, State Partnering Coordinator, who provided a 2012 presentation, "Successful Partnering Methodology Deployment," that charts the improvement in on-time, on-budget performance of VDOT construction projects since partnering was implemented (see **Appendix C**, slides 25 and 26). Contract quality rating has increased as well.

Gardner noted the difficulty of determining whether partnering was the only contributor to these improvements. He suggested that the effectiveness of partnering may be best demonstrated through a combination of measures, including both objective measures of a project's performance (such as on-time, on-budget performance) and subjective measures of the project team's experiences (such as project evaluation ratings).

In addition, Gardner said VDOT is exploring a new methodology for quantifying the value of partnering, which involves applying risk management principles to the issue resolution process, assigning a rank and weight to specific issues.

Gardner also noted that some consultants who work as partnering facilitators have proprietary measurement software that facilitates the collection and analysis of project data. VDOT has worked with Tom Warne (http://www.tomwarne.com/services/partnering/), Larry Anderson (http://partneringcenter.com), and Larry Bonine (http://www.larrybonine.com/), among others.

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Project-Level Case Studies

We identified only one large-scale study of the impact of partnering on a specific construction project: a 2011 study of partnering on the Woodrow Wilson Bridge project in Maryland and Virginia. Documentation of other successfully partnered projects, such as winners of partnering awards, provide additional examples of cost and time savings.

"Efficacy of Partnering on the Woodrow Wilson Bridge Project: Empirical Evidence of Collaborative Problem-Solving Benefits," Lee L. Anderson, Jr., and Brian D. Polkinghorn, *Journal of Legal Affairs and Dispute Resolution in Engineering and Construction,* pages 17-27, February 2011. This paper describes the results of a study of the use of partnering on 19 construction contracts that were part of the Woodrow Wilson Bridge project. More than 6,000 project rating forms were collected during the project, which lasted more than eight years. Researchers compared this data with budget and schedule results from the individual contracts. They also analyzed whether factors such as bid results and whether the construction firm was regional or national had an effect on the project team's ability to form a successful partnership. The study found that good partnering was strongly associated with team satisfaction with budget and schedule results, and with effective issue resolution.

The researchers have authored other articles about the successful aspects of the Woodrow Wilson Bridge project, including:

"Managing Conflict in Construction Megaprojects: Leadership and Third-Party Principles," Lee L. Anderson Jr. and Brian Polkinghorn, *Conflict Resolution Quarterly,* Vol. 26, No. 2, pages 167-198, Winter 2008.
http://pt3.uaf.edu/files/justice/T8-Woodrow-Wilson-Bridge-Anderson-Polkinghorn-2009.pdf

"Anatomy of a Successful Partnering Program on a Megaproject," Lee L. Anderson, Jr., Robert D. Douglass and Brian C. Kaub, *Leadership and Management in Engineering*, Vol. 6, No. 3, pages 110-116, July 2006.
http://media.wilsonbridge.com/lessonsLearned/PDFs/ConstructionIssues/CON14A%20Partnering%20Overview%20Article%20July%202006.pdf

Award-Winning Projects

Projects that have won state or national partnering awards provide another source of data documenting how partnering led to cost or time savings. This section provides a few examples of this type of data from national awards; many DOTs have their own award programs as well.

I-238 Widening and Rehabilitation, Caltrans, Diamond Award winner, 2011 International Partnering Institute awards
http://www.partneringinstitute.org/ipi_2011_award_winners.html
Excerpts from the project description:

- "Partnering provided a methodology for all of the parties on the project to observe problems as challenges to be faced as a team and allowed them to take a project that was 6 months behind schedule by 2007 and complete it four months early in 2010."
- "In spite of the significant acceleration in timeframes, Flatiron maintained a zero safety or time-loss claim record throughout 2009."

I-15 North Corridor, Las Vegas, Nevada DOT, 2010 Marvin M. Black Excellence in Partnering award winner
http://news.agc.org/2011/03/22/las-vegas'-i-15-north-corridor-and-phoenix's-red-mountain-freeway-widening-projects-named-2010's-most-successful-construction-partnerships/
Excerpt from the project description:

- "Through close collaboration with state officials, the project team put in place a number of innovations that resulted in the completion of the project 228 days ahead of schedule, improved the quality of the work, increased safety and reduced costs."

Red Mountain Freeway Widening, Phoenix, Arizona DOT, 2010 Marvin M. Black Excellence in Partnering award winner
http://news.agc.org/2011/03/22/las-vegas'-i-15-north-corridor-and-phoenix's-red-mountain-freeway-widening-projects-named-2010's-most-successful-construction-partnerships/
Excerpt from the project description:

- "The team completed the design and construction eight months ahead of schedule and $9 million below budget. The team held two separate workshops to discuss project goals and potential issues, and everyone involved with the project attended weekly design and construction status meetings to provide input for the project. The team logged approximately 700,000 man hours with zero lost time incidents."

Additional Research and Guidance

The studies in this section provide examples of different measures used to assess the effectiveness of partnering on highway projects, and guidance documents that address partnering measurement methodologies.

Highway Construction

"Measuring the Benefits of Construction Partnering," K.R. Baker, *TR News,* No. 183, pages 40-44, March 1996.
This article describes the results of a 1994 survey of 46 state DOTs about their experiences with partnering, covering more than 700 completed construction projects. The survey found evidence of tangible benefits to all members of the project team. The article describes measurement techniques used by the agencies surveyed, and provides guidance on implementing partnering measurement programs.

"Longitudinal Study of Innovative Contracting Practices in State Departments of Transportation," Steven W. McCrary and Richard J. Gebken, *Journal of Legal Affairs and Dispute Resolution in Engineering and Construction,* Vol. 2, No. 2, pages 113-119, May 2010.
This paper describes a 10-year longitudinal study that surveyed 43 state DOTs about their use of 16 innovative contracting practices on highway construction projects, including partnering. States were surveyed in 1996 and again in 2007. The study found that use of 10 of the 16 practices had increased significantly, but that perceived benefits had increased very little, and in one case perceived benefits had significantly decreased.

"Collaborative Working in Highways Major Maintenance Projects," M. Ansell, R. Evans, M. Holmes, A. Price and C. Pasquire, *Management, Procurement and Law (Proceedings of the ICE),* Vol. 162, No. 2, May 2009.
This paper describes the use of a partnering approach called the construction management framework (CMF) in the United Kingdom, comparing the benefits realized by two projects that used this strategy: an early project and one that occurred two years later, after the CMF process became more established. The research considered key performance indicators, including cost and time predictability measures, respect for people surveys, innovations and lessons learned, and instructions for changes to works information. Data from both projects demonstrated improvements in measurement and culture fostered by the CMF.

Guidance on Partnering Measurement Methodologies

This section highlights a few foundational publications that discuss methodologies for measuring the effectiveness of construction partnering at the project and program levels. The methodologies are applicable to both horizontal and vertical construction.

"Partnering Measures," T.G. Crane, J.P. Felder, P.J. Thompson, M.G. Thompson, S.R. Sanders, *Journal of Management in Engineering,* Vol. 15, No. 2, pages 37-42, March 1999.
http://www.civ.utoronto.ca/sect/coneng/tamer/Courses/CIV1278/REF/partenring%20measures.pdf
Written by the authors of one of the Construction Industry Institute publications listed below, this article discusses the effective use of partnering measures. The article discusses the use of measures at three levels of the partnering relationship: the alliance, project and discipline levels, and outlines three types of measures: results, process and relationship. The authors discuss using the appropriate measures in combination to evaluate a partnering relationship.

The Construction Industry Institute has published several guidance documents relating to partnering that address the topic of measurement, including:

Partnering Toolkit, CII Implementation Resource 102-2, 1996.
https://www.construction-institute.org/scriptcontent/more/ir102_2_more.cfm
This toolkit provides guidance on implementing a partnering program, including a section on partnering measurement.

Model for Partnering Excellence, CII publication RS102-1, 1996.
https://www.construction-institute.org/scriptcontent/more/102_1_more.cfm
The authors identified "benchmarks that verify the benefits achievable through partnering in the areas of cost, schedule, safety, and quality."

The Partnering Process—Its Benefits, Implementation and Measurement, S.R. Sanders, P.J. Thompson and T.G. Crane, CII publication RR102-11, 1996.
http://www.construction-institute.org/scriptcontent/more/rr102_11_more.cfm
This publication includes a chapter on measures, outlining three types: result measures, process measures and relationship measures.

In Search of Partnering Excellence, CII publication 17-1, 1991.
https://www.construction-institute.org/scriptcontent/more/sp17_1_more.cfm
This foundational publication was among the earliest to explore the benefits of partnering.