CIP Benchmarking Study

California Multi-Agency CIP Benchmarking Study

Annual Report - Update 2011








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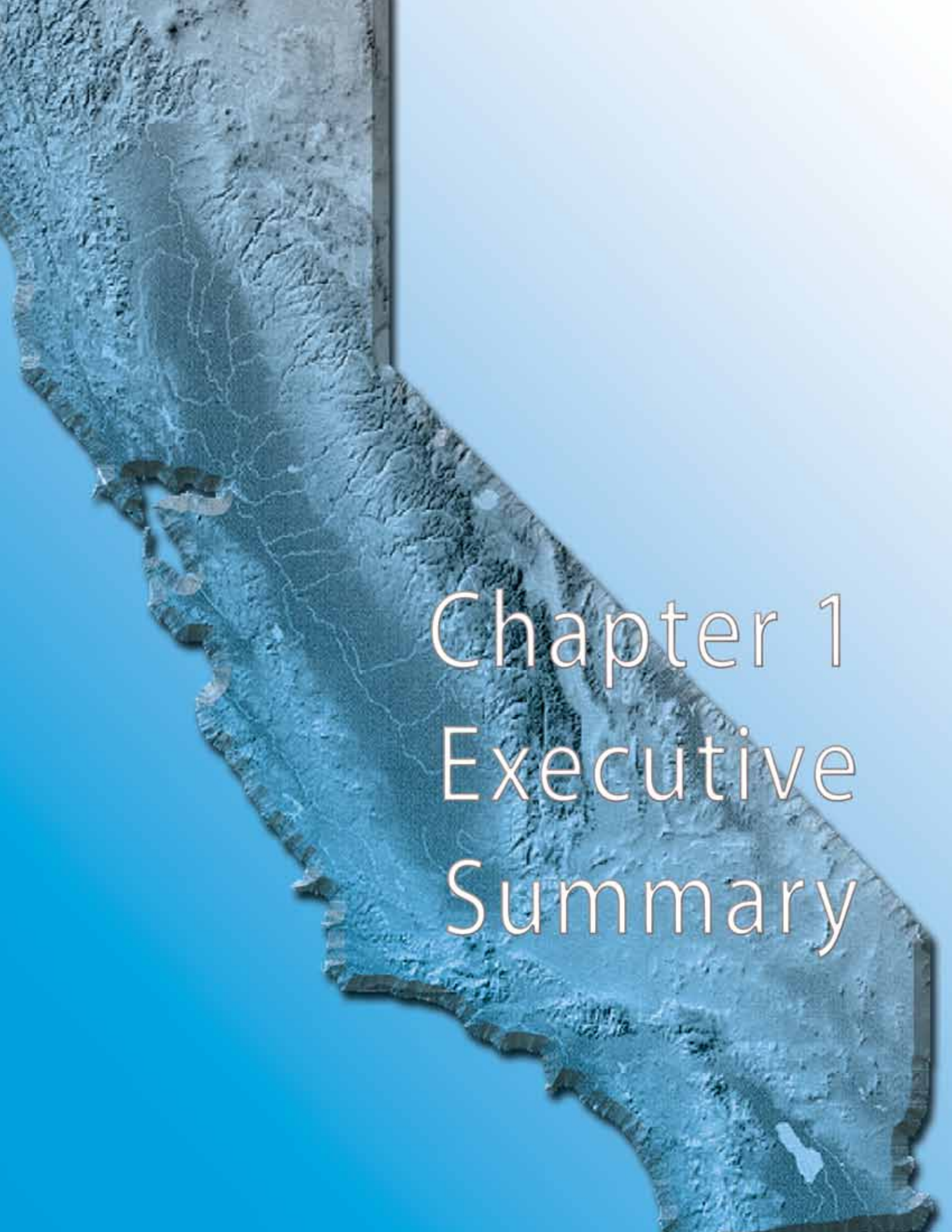

Chapter 1 Executive Summary

CHAPTER 1 Executive Summary

A. INTRODUCTION

As the US economy continues to be impacted by the global economic crisis, governmental agencies throughout the state and nation have endured a third consecutive year of difficult economic times characterized by budget cuts, diminished capital improvement programs (CIPs), and various forms of staff reductions ranging from freezes to furloughs and early retirements to layoffs. Municipal agencies in California are being asked to do more with fewer resources: they are expected to increase their efficiency in delivering services, employ best management practices, implement continuous training programs, and develop best-in-class capabilities.

During these highly challenging economic times, the *California Multi-Agency CIP Benchmarking Study (Study)* has continued its unparalleled effort to share the collective Capital Improvement Project implementation experiences of seven out of the eight largest cities in California for the tenth consecutive year. Since the participating Cities of Long Beach, Los Angeles, Oakland, Sacramento, San Diego, San Jose and the City and County of San Francisco first initiated these efforts, they have developed improved capital project delivery process approaches and an appreciation for the need to maximize efficiencies in the face of shrinking budgets.

This year, the participating agencies spent a substantial amount of effort sharing approaches to continue to provide high value implementation of their capital programs in the most efficient manner possible in the face of unprecedented fiscal hardships. The *Study* provides a forum for the agencies to share information amongst themselves via quarterly meetings with a focus on current issues, an online portal where topics for discussion can be posed and challenges addressed, and a database that serves as both, a repository of the agencies' projects and a tool for data analysis. Through these acts of collaboration, often times an optimum solution is found that can be translated into a Best Management Practice (BMP) for the group.

The purpose of this collaboration is to share the best ideas of the group for the benefit of all and to gather insight on how to address challenges that might appear to be new, but which others have already faced and addressed successfully.

In the tenth year of the *Study*, the Update 2011 participants have continued to pursue on-going endeavors, as well as take on new ones:

- Continuation of the "Special Topic" roundtable discussion forums at Quarterly Meetings to explore areas of potential positive impact in relation to the current fiscal challenges;
- Continued use of the online discussion forum for efficient information sharing;

- Continued project performance data collection and analysis using improved techniques developed during previous *Study* years;
- Collection and preliminary evaluation of project data on alternative project delivery methods such as Design-Build, CM@Risk and Job Order Contracts (JOC);
- Continued monitoring of "below market rate" bid prices on project delivery;
- Delineation and categorization of BMPs amongst six perceived value categories;
- Tracking the adoption of BMPs; and
- Creating new BMPs targeted to common implementation issues.

B. PERFORMANCE BENCHMARKING

Performance benchmarking involves collecting documented project costs and plotting the component costs of project delivery against the total construction cost (TCC). The objective of this exercise is to develop relationships between these variables by performing regression analyses. Since Update 2009, the results of the regression analyses have yielded significantly better correlation compared to prior years of the *Study*. This is primarily due to the adoption of statistical techniques for model selection and significant improvements in the modeling methodology.

The project costs data are collected from the agencies using a Performance Questionnaire created in Microsoft Excel®. Data are then compiled from the questionnaires in Excel® using a Visual Basic for Applications (VBA) code and transferred into the database, where the data is reviewed and vetted. A copy of the current Performance Questionnaire can be found in **Appendix A.**

Performance Database

The projects data submitted by the agencies are complied in a customized Microsoft Access® database. This database not only serves as a repository for the data collected since the inception of the *Study*, but also allows for data analysis using built-in functions. The database also provides customized reports and tables for easy data interpretation. Each year, the projects database is updated with the inclusion of projects data submitted for that *Study* year. The analysis and the reporting features of the database are also updated.

Table 1-1 summarizes the number of projects included in the database and in the analyses. The 5-year database used for the current analysis contains 676 projects. This total excludes project data older than five years or projects identified as outliers. Projects identified as outliers are not included in the performance data analysis but are retained in the performance database. In addition, projects delivered by alternative delivery are excluded from the analysis but included in the database. The 676 projects selected for analysis do not include projects delivered by alternative delivery. As explained under subsection A *Study* Criteria of this chapter, outlier analysis was performed using statistical techniques to ensure consistency in the selection of outlier data points. This

methodology was first implemented during Update 2008 and the agencies recognize the merits of a scientific approach for outlier elimination. Some of the projects classified as outliers in previous *Study* years have been included in the performance data analysis, and vice-versa.

This is an improved practice when compared to prior *Study* years where project data points were classified as outliers based on a combination of statistical parameters and subjective judgments by the Project Team. Previously, projects identified as outliers during one *Study* phase were kept as outliers in subsequent *Study* phases.

Table 1.1 shows that as the rules for project selection were refined, the number of non-representative and projects with TCC less than $100K have decreased. In addition, only five projects have been excluded as outliers in the *Update 2011 Study* as compared to the elimination of several hundred projects prior to the refinement of the statistical model in 2009.

In the *Study 2002* report, it was recommended that at least 10 projects per classification and a minimum data set of 2,000 projects distributed evenly among classifications, ranges of TCC, and agencies are necessary to achieve statistically-significant results. Although the requirement for the minimum number of projects per classification has been met for most project categories, more data needs to be collected to ensure an even distribution of projects amongst all classifications.

Fifteen projects that were funded by the American Recovery and Reinvestment Act (ARRA) of 2009 were included in the data analyses. It is anticipated that the number of projects funded by ARRA will increase in the database in future years when currently on-going projects are completed. The agencies acknowledged that it is vital to the success of the *Study* to continue increasing the size of the data set, thereby increasing the confidence, consistency, and reliability of results. As previously indicated, there are 4 project types (Municipal Facilities, Streets, Pipe Systems, and Parks) and 16 project classifications included in this *Study.*

Characteristics of Data Analyzed

Project performance data were analyzed using the custom database application at both the Project Type level and the Project Classification level.

Project Count and Project Delivery by Completion Year

Table 1-2 summarizes characteristics of the projects included in the analyses by project completion year and shows trends in the average TCC values, median TCC values, design costs, construction management costs, and overall project delivery costs. The median value is the value at which 50 percent of the values are above and 50 percent of the values are below.

Table 1-1
Growth of Database

Study Phase[1]	Submitted			Deleted[2]		Count After Deletions[5]	Excluded		Net
	Traditional Projects Submitted	(a) Alternative Delivery Projects Submitted[4]	(b) Total	c) TCC <$100K	(d) Non-Representative	e)=(b)-(a)-(c)-(d)	e) Project Completion Date < 2006	(f) Outliers[3]	Projects in Analyses (g)= (d)-(e)-(f)
I	239	0	239	27	44	168	168	0	0
II	285	0	285	0	35	250	250	0	0
III	262	0	262	0	29	233	233	0	0
IV	173	0	173	18	24	131	131	0	0
V	182	0	182	0	4	178	178	0	0
VI	191	0	191	0	4	187	61	0	126
VII	158	0	158	1	0	157	27	0	130
VIII	155	0	155	2	4	149	12	2	135
IX	174	10	184	2	1	171	4	3	164
X	122	15	137	1	0	121	0	0	121
Total	**1,941**	**25**	**1966**	**51**	**145**	**1,745**	**1064**	**5**	**676**

[1] Study Phase indicates action taken on the count of projects corresponding to Study Years I = 2002, II = 2003, III = 2004, IV = 2005, V = 2006, VI = 2007, VII = 2008, VIII = 2009, IX = 2010, and X = 2011.

[2]Projects that do not fit Study criteria for project classifications and minimum TCC of $100K were removed from the database.

[3]Outliers are identified based on statistical analysis.

[4]These represent projects delivered by alternative project delivery techniques. These projects are kept in the database, but not analyzed. These projects will be analyzed when a sufficient number of such projects are available to facilitate meaningful analyses.

[5]Projects delivered by alternative techniques are retained in the database but not analyzed. These projects are not included in the 676 projects selected for analysis in the Update 2011 Study.

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Table 1-2
Project Count and Project Delivery by Completion Year

Project Completion Date	Count by Project Type					Project Delivery Data				
	Municipal Facilities	Streets	Pipes	Parks	Total	Average TCC ($M)	Median TCC ($M)	Design Cost (% of TCC)	Construction Management Cost (% of TCC)	Project Delivery Cost (% of TCC)
2006	36	54	67	9	166	$2.76	$0.87	22%	17%	39%
2007	24	52	50	14	140	$2.95	$0.95	24%	17%	40%
2008	15	43	46	15	119	$2.40	$0.86	24%	17%	41%
2009	22	67	44	10	143	$1.71	$0.72	22%	18%	40%
2010	15	41	45	7	108	$2.38	$0.81	24%	18%	42%
Total	**112**	**257**	**252**	**55**	**676**	**$2.45**	**$0.82**	**23%**	**17%**	**40%**

Notes:
[1] Project Delivery percentages represent arithmetic averages of the individual projects and do not represent the results from the regression analyses.
[2] Project Delivery percentages vary from year to year based on the selection and the composition of the projects in the database.
[3] Total excludes projects delivered by alternative delivery mechanisms such a design-build, JOC, and CM@Risk. Projects delivered by alternative techniques are retained in the database but not analyzed. These projects are not included in the 676 projects selected for analysis in the Update 2011 Study.

As indicated in **Table 1-2**, project size (measured as median TCC), increased between 2006 and 2007 with an increase of approximately 10 percent. After spiking in 2007, median project size declined significantly by approximately 25 percent in 2009. After declining in 2009, median project size increased by approximately 13 percent in 2010. The average TCC also declined steadily between 2007 and 2010, with a large decline of 29 percent from 2008 to 2009. However, the average TCC recovered back to 2008 levels in 2010 with an approximately 40 percent increase from 2009 levels.

This could be due to a combination of several factors such as the selection of projects using the five-year window, elimination of projects with high TCC values during the outlier analysis, and the addition of several new projects with low TCC values. Project delivery costs measured as a percentage of the TCC has remained relatively stable; however it increased by 2 percentage points from 2009 to 2010.

Project Delivery Costs by Project Type

Table 1-3 shows project delivery costs by each of the four project types in the *Study* for the full range of TCC. The project delivery percentage for a category is the arithmetic average of the project delivery percentages of the individual projects grouped under that category.

Although it is desirable for project delivery costs to decrease as agency efficiencies increase and BMPs are implemented, this can be confounded by other factors that change annually such as project size and market competition. For example, presently actual bid amounts have been depressed by competitive forces associated with the lagging economic recovery. This will result in the rise of delivery cost as a percentage of TCC as TCC is depressed. The result may be noticed in the coming years as these projects are completed and reported into the database. The agencies acknowledged that the impacts of low-construction bids on project delivery costs needs to be analyzed during future *Study* years as the number of projects completed during the recession increase in the database.

Projects belonging to the Pipes and the

Table 1-3
Average Project Delivery Costs by Project Type (% of TCC)
(Full Range of TCC)

Type	Design	Construction Management	Project Delivery (Total)	Median Total Construction Cost ($M)	Number of Projects (N)
Municipal Facilities	22%	15%	37%	3.32	112
Parks	27%	18%	44%	0.45	55
Pipe Systems	20%	16%	36%	0.86	252
Streets	25%	19%	44%	0.65	257
Average	**23%**	**17%**	**40%**	**0.82**	**676**

Notes:

[1] Project Delivery percentages represent arithmetic averages of the individual projects and do not represent the results from the regression analyses.

[2] Project Delivery percentages vary from year to year based on the selection and the composition of the projects in the database.

[3] Total excludes projects delivered by alternative delivery mechanisms such a design-build, JOC, and CM@Risk. Projects delivered by alternative techniques are retained in the database but not analyzed. These projects are not included in the 676 projects selected for analysis in the Update 2011 Study.

Municipal categories have the lowest average project delivery cost. The Streets category has the maximum number of projects (n = 257) in the Update 2011 database. The Pipes category also has a similar number of projects in the database (n = 252). Along with the Parks category, the Streets category also exhibits the highest average project delivery cost. The influence of low project delivery cost from Pipes projects is balanced by the influence of high project delivery cost from Streets projects. The average project delivery percentage for the overall dataset is approximately 40 percent.

Over the course of the *Study*, the agencies have observed that the relatively high average project delivery cost of Streets projects is probably due to increasing cost influences of right-of-way acquisition, community outreach requirements, environmental mitigation requirements, and the smaller median total construction cost of these projects.

Table 1-4 shows project delivery costs by each of the four project types in the *Study* for the smaller projects subset of TCC (Note: In Update 2009, the concept of looking at a smaller subset of projects was introduced. This smaller subset generally characterizes the smaller projects in the type or classification being examined. This step was taken as it was generally believed that project delivery for smaller projects was different than for larger projects.). The trends in the project delivery costs for the projects in the smaller project subset of TCC follow that of the projects in the full range of TCC. As expected based upon the agencies' practical experience, project delivery costs are higher for projects that fall in the smaller project subset of TCC.

Table 1-4
Average Project Delivery Costs by Project Type (% of TCC)
(Smaller Project Subset of TCC)

Type	Design	Construction Management	Project Delivery (Total)	Median Total Construction Cost ($M)	Number of Projects (N)
Municipal Facilities	24%	15%	38%	3.32	90
Parks	29%	20%	48%	0.45	44
Pipe Systems	22%	17%	38%	0.86	202
Streets	27%	21%	47%	0.65	206
Average	**25%**	**18%**	**43%**	**0.82**	**542**

Notes:
[1] Project Delivery percentages represent arithmetic averages of the individual projects and do not represent the results from the regression analyses.
[2] Project Delivery percentages vary from year to year based on the selection and the composition of the projects in the database.
[3]. Total excludes projects delivered by alternative delivery mechanisms such a design-build, JOC, and CM@Risk. Projects delivered by alternative techniques are retained in the database but not analyzed. These projects are not included in the 676 projects selected for analysis in the Update 2011 Study.

Consultant Usage Analysis

Project delivery performance and consultant usage by agency are presented in **Table 1-5.** The table indicates that approximately 58 percent of the design work and approximately 80 percent of the construction management efforts are completed in-house by the participating agencies. Consultants account for approximately 31 percent of the total project delivery costs while in-house efforts by the participating agencies accounts for the remaining 69 percent of the project delivery costs. For the available data, a clear relationship between the level of in-house effort and project delivery costs cannot be established.

Table 1-5
Project Delivery Performance and Consultant Usage by Agency

AGENCY	DESIGN					CONSTRUCTION MANAGEMENT					PROJECT DELIVERY					TCC	
	In-House		Consultants		Total % of TCC[2]	In-House		Consultants		Total % of TCC	In-House		Consultants		Total % of TCC	Average	Median
	($M)	% of Design	($M)	% of Design		($M)	% of CM	($M)	% of CM		($M)	% of PD	($M)	% of PD			
Agency A	28.3	46%	33.8	54%	22%	36.4	65%	19.4	35%	15%	64.7	55%	53.2	45%	37%	3.9	1.5
Agency B	8.6	51%	8.2	49%	21%	9.6	69%	4.3	31%	15%	18.3	59%	12.5	41%	36%	1.5	0.5
Agency C	32.5	96%	1.2	4%	17%	40.4	99%	0.3	1%	17%	72.9	98%	1.5	2%	34%	2.0	1.3
Agency D	43.3	53%	38.7	47%	25%	55.9	78%	16.2	22%	18%	99.2	64%	54.9	36%	43%	5.3	1.6
Agency E	3.1	51%	3.0	49%	17%	4.2	79%	1.1	21%	15%	7.2	64%	4.1	36%	32%	1.0	0.7
Agency F	26.0	58%	18.6	42%	27%	41.2	87%	6.0	13%	26%	67.1	73%	24.6	27%	52%	1.9	0.5
Agency G	13.5	60%	8.8	40%	26%	8.3	100%	0.0	0%	11%	21.8	71%	8.8	29%	36%	1.0	0.4
OVERALL	155.3	58%	112.3	42%	23%	195.9	81%	47.4	19%	17%	351.2	69%	159.8	31%	40%	2.5	0.8

Notes:

[1] In-House and Consultant costs are expressed as percentages of total agency Design, CM (Construction Management), and PD (Project Delivery) costs.

[2] Total Construction Cost (TCC) is the sum of construction contract award, change orders, utility relocation cost, and city forces construction cost.

[3] Design, CM, and PD costs are expressed as percentages of TCC and are unweighted, arithmetic averages of projects by agency.

C. REGRESSION ANALYSES

During Update 2008, several changes were made to improve the modeling methodology. These included developing a statistically-sound method for outlier analysis, using a linear trendline regression for modeling project costs relationships, and using the upper and lower bounds of a 95 percent confidence interval to estimate the range of the project delivery percentages. As a result of these improvements, the model relationships could be predicted with a high degree of certainty as compared to previous *Study* years. As previously indicated, during Update 2009, the modeling methodology was further refined by analyzing the data in two ranges of TCC. Results from the regression analysis methodology are discussed in Appendix B. Given all these improvements to the analysis of the data, the reader is advised that direct comparison of results between Update 2011 and previous years may be more difficult due to these improvements.

In most cases, the results reflect the agencies' experience with the delivery of capital projects that on a percentage basis projects with lower TCCs are more expensive to deliver than projects with higher TCCs. Only three out of the 15 categories have lower project delivery percentages for the smaller subset of projects than the full range of projects. It is concluded that the model results are reasonable from a statistical perspective.

D. OTHER CONSIDERATIONS

Effect of Economic Conditions

Due to the lagging recovery in the economy, agencies are receiving bids that are significantly lower than the engineer's estimates. During the *Update 2010 Study,* the participating agencies summarized the trends observed in construction bids. These observations are presented below for some of the agencies:

Due to the lagging recovery in the economy, agencies are receiving bids that are significantly lower than the engineer's estimates. During the *Update 2010 Study,* the participating agencies summarized the trends observed in construction bids. These observations are presented below for some of the agencies:

- The City of Los Angeles noticed a decline in the rehabilitation cost per linear feet of sewer pipe for their sewer program.

- The City of Sacramento utilizes rubberized asphalt concrete (RAC) for all street overlays. The City noticed that RAC costs have declined from $120 per ton in 2008 to $87 per ton in 2010. Similarly, the City also noticed that costs for concrete sidewalks (4-inches thick) have declined from $9 per square feet to $5 per square feet over the past few years.

- The City of Long Beach has noticed an approximately 12 percent drop in current bid prices over those received two years ago. This would include

street work, park construction as well as small facilities such as restrooms, teen centers, fire stations, etc.

- The City of San Jose has been experiencing "below-market-rate" bids since late 2007 and early 2008. In studying the trend, the City found that during the period from July 2008 to June 2009, the City received an average of about 8 bids per project and on an average the low bid was approximately 21 percent lower than the engineer's estimate. From July 2009 to June 2010, the City received an average of about 10 bids per project and on an average the low bid was approximately 27 percent lower than the engineer's estimate. In addition to these data, the City has also noticed an increase in bid protests.

- The City and County of San Francisco has noticed that bids have dropped from being 109 percent of the engineer's estimate in 2005 to approximately 79 percent of the engineer's estimate in 2010 for their joint sewer and paving projects. The City of Oakland also noticed a decline in construction costs over the past few years.

The impacts of these low construction bids on project delivery percentages need to be evaluated. It is very likely that project delivery percentages might increase due to the reduced construction bids. However, using such delivery percentages for budgeting a program of projects in the future may be misleading as construction costs are likely to increase improvement in the economy.

In addition, increasing the size of the project database is a major challenge posed to the *Study* participants. This is primarily because of the 5-year rolling window criterion for project completion dates; even as new projects are added, old projects are excluded from analyses by the window of time. The participating agencies are also challenged to identify as many completed projects as possible that meet the rest of the *Study* criteria. The benefits of projects delivered via alternative delivery techniques need to be quantified by including them for analysis in the project database. However, due to the significant difference in delivery mechanisms, those projects will have to be analyzed separately from the rest of the projects in the database.

E. BEST MANAGEMENT PRACTICES

When this *Study* was initiated, the agencies examined over 100 practices used in project delivery. Included in this *Study* were a number of practices that the participants did not commonly use at the time, but believed could have value if ultimately implemented as Best Management Practices (BMPs). Each year the agencies look at changes in the industry in order to identify new BMPs. In some cases existing BMPs are reworked by the agencies to address specific challenges encountered during implementation. BMPs are also added or modified to reflect relevant experiences by the participants. Agency implementation of these selected practices has been, and will continue to be, tracked during the *Study*. Three new BMPs were added this to the list of existing BMPs.

While a BMP may be developed to address a specific issue, its implementation may also impact other elements of project delivery. For example, a BMP that reduces project schedule may also favorably impact project costs. While it is not possible to discreetly quantify all the benefits of the BMPs, the participating agencies developed an approach to identify the major benefits associated with each BMP. This was accomplished by assigning a *Perceived Value* to each BMP in the *Update 2010 Study*. The participating agencies judged that each of the BMP favorably impact one of the following categories:

- Cost
- Schedule
- Quality
- Communication
- Environment
- Customer Service

In *Update 2011*, the Project Team added three new BMPs to the BMP implementation tracking list. The new BMPs were developed by discussions either during quarterly meetings or on-line discussions held throughout the year. The new BMPs are:

- **2.r.2011 –** Use of electronic signatures to do direct conversion from CAD to PDF.
- **2.s.2011 –** Have awarding authority to approve plans, advertisement, and award of contract in one board action.
- **2.t.2011 –** Expedite project duration from design completion to notice to proceed. Examples include items such as: Pre-qualification of contractors, good faith effort submittal on-line, submittal incentives, contract liaison within department, electronic proposal documents provided 48 hours after bid opening, contractor's self certification.

These BMPs are believed to directly influence cost, schedule, quality, communication, environment or customer service aspects of either design or construction management, and, ultimately, project delivery efficiency.

F. ONLINE DISCUSSION FORUM

The following discussion topics are summarized in the Chapter 5 Online Discussion Forum.

- Time to Advertise, Award and Issue Notice to Proceed
- Traffic Engineering Services
- Deferred Capital/ Maintenance Backlog
- Consultant Selection Policies/Procedures

An archive of the full discussion forum is posted confidentially on the *Study* website for access by the participants.

G. CONCLUSIONS

Performance Benchmarking

Performance Benchmarking for the *Update 2011 Study* involved analysis of 676 projects in the projects database. In prior *Study* years, project costs data were only collected and analyzed for projects delivered using the traditional design-bid-build method. For the *Update 2010 Study*, the agencies decided to collect costs data for projects delivered via alternative delivery methods for potential analysis at a later date when sufficient numbers of projects are collected to facilitate meaningful analyses. Collection of projects delivered via alternative methods continued in 2011. Fifteen projects funded by the American Recovery and Reinvestment Act (ARRA) of 2009 are also included in the Update 2011 database.

The results of the performance benchmarking evaluation show that in almost all cases project delivery costs expressed as a percentage of TCC are higher for projects with lower TCCs. This clearly indicates that an economy of scale exists in the delivery of capital projects. Project delivery percentages (arithmetic averages) for the *Update 2011 Study* varied between the following values for the full range and the smaller project subset of TCC respectively:

Table 1-6
Update 2011 Project Delivery Percentages

Type	Project Delivery Percentages
Municipal Projects:	37% - 38%
Parks Projects:	44% - 48%
Pipes Projects:	36% - 38%
Streets Projects:	44% - 47%

Although the results of the performance analyses are based on historical data provided by the participating agencies, there are several factors that could affect project delivery and are not captured in the performance model. These external factors include personnel turnover in the agencies, competitive bids etc. which impact project delivery. Since such factors are not captured in the performance model, the reader is cautioned that the improved results of the regression analyses only be used as a reference and not for prediction of performance. In addition, in light of the current bid environment, it is recommended that the reader use best judgment in the context of the current economic downturn when using the *Study* results for planning and budgeting.

Increasing the size of the project database is a major challenge posed to the *Study*. This is primarily because of the 5-year rolling window criterion for project completion dates; even as new projects are added, old projects are excluded from analyses by the window of time.

The agencies also acknowledge that the benefits of projects delivered via alternative delivery techniques need to be quantified by including them for analysis in the project database. However, due to the significant difference in delivery mechanisms, those projects will have to be analyzed separately from the rest of the projects in the database. Projects delivered by alternative techniques will continue to be compiled in the database until sufficient data are available to perform meaningful analyses.

The agencies recognize the need to evaluate the impacts of low construction bids on project delivery percentages. It is very likely that project delivery percentages might increase due to the reduced construction bids prevalent in the current economy. However, using such delivery percentages to budget a program of projects in the future may be misleading as construction costs are bound to increase with a reversal in the economy.

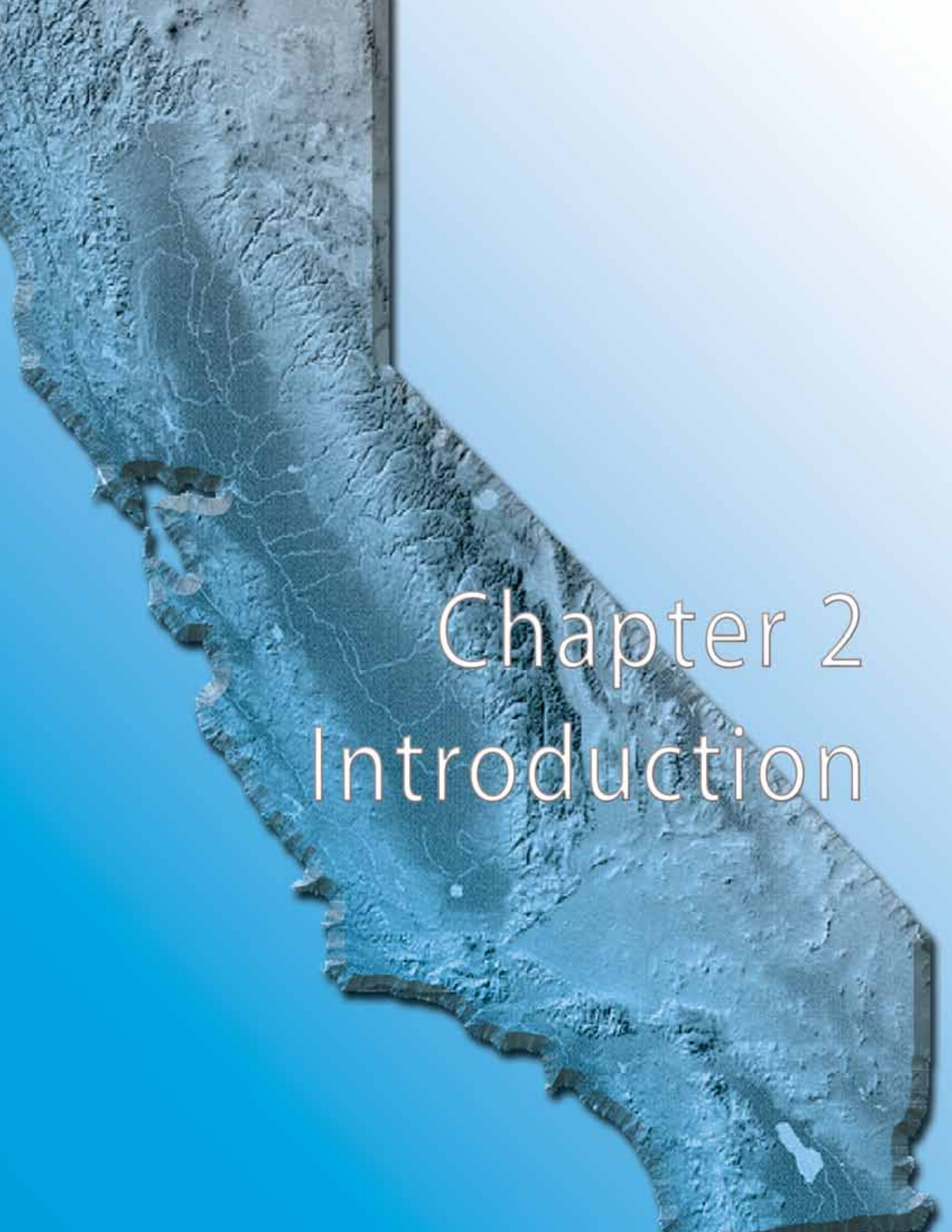
Online Discussion Forum

In Update 2011, the Online Discussion Forum continues to be an important feature for *Study* participants, with active, meaningful exchanges occurring along with important issues being addressed resulting in changes to policy, approach, or BMP implementation. Participants continue sharing information through the Online Discussion Forum and during the face-to-face meetings. The interesting outcomes of these discussions are presented to the public through the *Study* reports. The continued sharing of challenges and solutions through the Online Discussion Forum remains a remarkable benefit to all participants.

Planning for Update 2012

Over the course of Update 2011, the Project Team identified a number of activities to consider including next year in Update 2012. These activities include:

- Continue collecting data on projects delivered via alternative delivery techniques. It is expected that in 2012, a sufficient number of projects will be available to facilitate meaningful analyses;
- Consider evaluating change orders as a percentage of TCC for the 2008-2011 period;
- Exploring the impacts of reduced construction bids on project delivery costs for the 2008-2011 period;
- Adding projects delivered by ARRA funds to the projects database for inclusion in the analysis;
- Developing new BMPs and tracking the implementation of adopted BMPs;
- Continuing discussion on current topics via the round-table discussion forum; and
- Continuing meaningful exchanges on the Online Discussion Forum via a new SharePoint website.



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- Continued use of the online discussion forum for efficient information sharing;
- Continued project performance data collection and analysis using improved techniques developed during previous *Study* years;
- Collection and preliminary evaluation of project data on alternative project delivery methods such as Design-Build, CM@Risk and Job Order Contracts (JOC);
- Continued monitoring of "below market rate" bid prices on project delivery;
- Delineation and categorization of BMPs amongst six perceived value categories;
- Tracking the adoption of BMPs; and
- Creating new BMPs targeted to common implementation issues.

A. BACKGROUND

In October 2001, the City of Los Angeles, Department of Public Works, Bureau of Engineering initiated the *Study* with several of the largest cities in California. These cities joined together to form the Project Team for the *Study*. After working together for ten years, this team agrees that they benefit from collaborating and pooling their project delivery knowledge and experience.

The *Study* initially involved six agencies, with a seventh joining the team in 2003. The participating agencies currently include:

- City of Long Beach, Department of Public Works
- City of Los Angeles, Department of Public Works, Bureau of Engineering
- City of Oakland, Department of Engineering and Construction
- City of Sacramento, Department of General Services, Department of Transportation, and Department of Utilities
- City of San Diego, Engineering and Capital Projects Department
- City and County of San Francisco, Department of Public Works, Bureau of Engineering, Bureau of Architecture, and Bureau of Construction Management
- City of San Jose, Department of Public Works and City Manager's Office

Table 2-1 summarizes some of general characteristics of the participating agencies and/or of specific departments.

Table 2-1
Agencies' Overall Information

Information	Population[2]	Area (sq. mi.)	Website	Government Form
Long Beach	462,257	50	http://www.longbeach.gov	Council-Manager-Charter[1]
Los Angeles	3,792,621	469	http://eng.lacity.org	Mayor-Council
Oakland	3,792,621	66	http://www2.oaklandnet.com/	Mayor-Council-Administrator
Sacramento	466,488	99	http://www.cityofsacramento.org	Council-Manager
Dept. of General Services				
Dept. of Transportation				
Dept. of Utilities				
San Diego	1,307,402	342	http://www.sandiego.gov	Mayor-Council
San Francisco	805,235	49	http://www.sfdpw.org	Mayor-Board of Supervisors (11 members)
San Jose	945,942	178	http://www.sanjoseca.gov	Mayor-Council-Manager

Notes:
[1] Mayor has veto power.
[2] Source: http://2010.census.gov/2010census/popmap/

Upon initiation of the *Study*, it was agreed that published data provided by *Study* participants should remain anonymous in order to create a positive, non-competitive team environment, conducive to meeting the *Study's* goals.

B. BENEFITS OF PARTICIPATION

The participating agencies have been very supportive of the *Study* efforts over the years. The *Study* is possible only because the agencies believe they are benefiting from their continued participation.

The agencies have expressed the benefits they experience in a variety of ways:

- The City of San Jose continues to benefit by having ready access to the performance data and BMPs of the largest cities in California. This has assisted our decision-making process regarding policy and procedural improvements, especially with regard to newer topics that impact capital project delivery such as LEED [Leadership in Energy and Environmental Design] and "green building" initiatives and alternative contracting methods (e.g., design-build). San Jose also offers: "What is great is that we learn new things at every meeting that lead to ways we can challenge ourselves to improve our processes and procedures. The online forum has also proved to be a very valuable tool between meetings and has generated some very informative discussions on a broad range of topics."

- The City and County of San Francisco uses the *Study* in working with other City agencies using our services. Design costs initially quoted by outside consultants may not reflect the final design costs associated with occupied facilities, seismic retrofits, and rehabilitation (especially involving corrosion, dry rot and hazardous material abatement). Presenting 7 cities' data is far more persuasive than presenting our estimates and past data alone. International prices for steel, cement, and petroleum-based products have been volatile over the past 5 years. Since the mortgage lending and auto company economic crisis, the bidding environment has been even more unpredictable. Having the larger sample size of information afforded by the *Study* is essential to forecasting pricing trends with any degree of certainty. The online forum has helped us provide elected officials accurate information quickly regarding other cities' practices on accepting streets and structures for maintenance, and how maintenance work is funded."

- The City of Los Angeles has stated that "in addition to the general benefits that we have described in past years and continue to receive from participation in the Benchmarking group, we find it most interesting to hear how other agencies are

coping in these very challenging economic times. Many of the agencies are experiencing similar challenges, and the actions taken are some of the same the City of Los Angeles is implementing. It is very helpful to hear these comments, and to discover that others are going through similar budget tightening measures."

- The City of Long Beach offers this comment: "Cities in California continue to experience major budget and staffing reductions that are having significant impacts in their ability to deliver capital improvement projects. Understanding the consequences of these resource cuts and learning how to cope with them has become a major challenge for municipal managers. Participation in the statewide benchmarking process has allowed the City of Long Beach to share and acquire the knowledge necessary to tackle these project delivery challenges and to determine if the costs of project delivery are reasonable in today's environment".

- According to the City of Sacramento, "the benefits of our continued participation in the *Study* have increased geometrically each year we have participated. Our data collection and tracking have evolved to mirror the *Study* format, making it much easier for us to directly correlate the results of our work and effort with that of our industry peers. As we continue to implement new BMPs each year, our project management and delivery standards continue to improve. We have also found that the online discussion forum is an invaluable resource when we are researching a new policy or practice, as all of the participating agencies are very generous in sharing their own knowledge, standards, and practices."

- The City of San Diego comments that "the *Study* has been used as an invaluable resource in providing delivery benchmarks. Although it is well understood that the data changes from year to year based on factors which affect construction costs, the five year state-wide averages are a gauge to our own delivery costs. The statistical models from the report continue to be refined and provide a good starting point for estimating our program delivery goals. We are excited that the *Study* is now collecting data on alternative delivery processes such as design-build. San Diego is increasingly using this method of delivery in our effort to provide cost efficiencies and we are eager to start seeing results in future years, when more data is available. We continue to take advantage of our quarterly meetings and discussion forum, which provide the means to obtain very useful information on processes and standards from the other participating agencies".

- The City of Oakland offers this comment. "One of the many benefits of the *Study* is the sharing of our challenges in delivering capital projects and ideas on how to address these issues. The Benchmarking group is also an invaluable resource to collect information on common practices of various city policies and standards. We are glad that the Benchmarking group has decided to continue the *Study* and meet semi-annually instead of quarterly during these very difficult economic times. We are proud to be part of this larger Public Works family in California that works together wholeheartedly to improve the delivery of our capital projects".

C. STUDY FOCUS

Since the inception of the *Study*, the agencies have examined over 100 practices used in the delivery of projects. Practices that were not commonly used but whose implementation was believed to benefit overall project delivery have been adopted as BMPs. Each year new BMPs are added, and in some cases existing BMPs are modified by the agencies to address specific challenges they encounter. BMPs are also added or modified to reflect relevant experiences by the participants.

This year's *Study* focused on developing new BMPs to improve project delivery practices. The participating agencies added three new BMPs to the BMP implementation tracking list. The new BMPs were developed by discussions either during quarterly meetings or on-line discussions held throughout the year. The new BMPs are:

- 2.r.2011 – Use of electronic signatures to do direct conversion from CAD to PDF.

- 2.s.2011 – Have awarding authority to approve plans, advertisement, and award of contract in one board action.

- 2.t.2011 – Expedite project duration from design completion to notice to proceed. Examples include items such as: Pre-qualification of contractors, good faith effort submittal on-line, submittal incentives, contract liaison within department, electronic proposal documents provided 48 hours after bid opening, contractor's self certification.

Agency implementation of these selected practices has been and will continue to be tracked during the *Study*. A description of the newly added BMPs along with their "Perceived Value" is presented in **Chapter 4 Best Management Practices**.

D. STUDY GOALS

The *Study* method is described in detail in the first *Study* report (published in 2002) and modifications to it have been documented in subsequent *Study* reports. In *Update 2011* the agencies made progress on several goals:

1. **Collect projects delivered by alternative delivery techniques in the performance database.** In prior *Study* years, project costs data were only col-

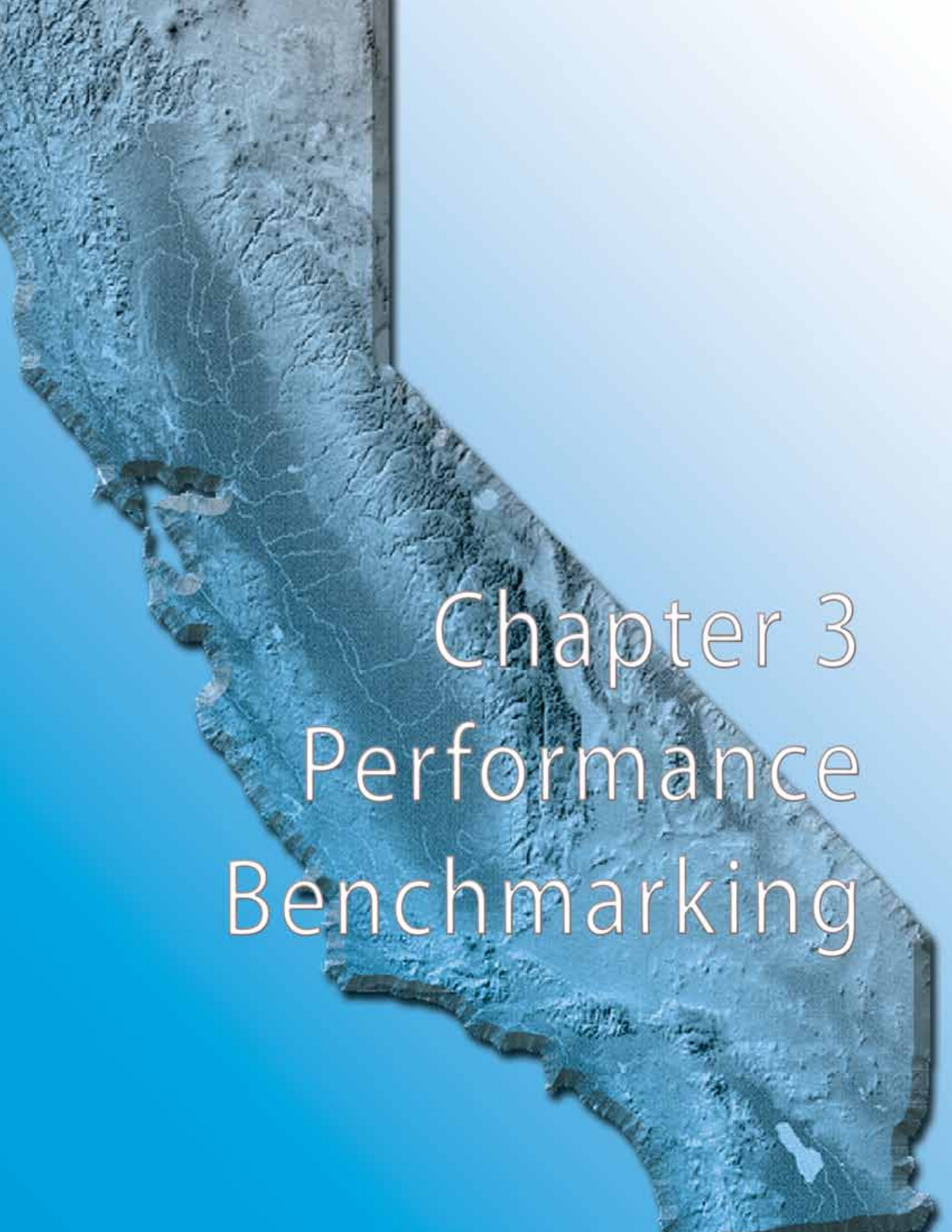
lected and analyzed for projects delivered using the traditional design-bid-build method. Over the years, the participating agencies have executed several projects using alternative delivery methods such as design-build and job-order-contracting yielding benefits in areas such as cost, schedule, and overall project delivery. In order to capture such projects as part of the *Study*, the agencies have decided to collect costs data for projects delivered via alternative methods. However, the agencies decided that these projects will not be analyzed until a sufficient number of projects are collected to facilitate meaningful analyses.

2. **Conduct roundtable discussions on Special Topics.** Continuing the trend from Update 2009, during each quarterly meeting roundtable discussions were held on current events. These sessions included discussions on receiving bids online, balancing staff resources and project workloads during budget cuts, filling of open positions, long term staffing approaches, and the impacts of the demise of the Redevelopment Agencies on cities.

3. **Track the adoption of BMPs.** The Project Team continued to track the implementation of BMPs in order to link these practices to project delivery performance improvement over time in order to encourage their implementation.

4. **Create new BMPs targeted to address commonly held problem areas.** The Project Team continued to discuss common challenges and share ideas for addressing those challenges during the quarterly meetings as well as in the online discussion forum. Three new BMPs were adopted by the Project Team for implementation and added to the BMP implementation list.

5. **Continue efficient information sharing with one another through the online discussion forum.** In *Update 2011*, the Project Team continued to utilize an online portal for discussing issues and challenges. The use of the online portal for exchanging ideas and discussing topics of common interest was first started in 2009. The portal allows for efficient archiving of discussion topics and ease of access. The Project Team uses the discussion forum to share information; survey current processes and policies; and collaborate on implementing new processes and policies.



Chapter 3
Performance Benchmarking

CHAPTER 3 Performance Benchmarking

Performance benchmarking involves collecting documented project costs and plotting the component costs of project delivery against the total construction cost (TCC). The objective of this exercise is to develop relationships between these variables by performing regression analyses. Since Update 2009, the results of the regression analyses have yielded significantly better correlation compared to prior years of the *Study*. This is primarily due to the adoption of statistical techniques for model selection and significant improvements in the modeling methodology.

The project costs data are collected from the agencies using a Performance Questionnaire created in Microsoft Excel®. Data are then compiled from the questionnaires in Excel® using a Visual Basic for Applications (VBA) code and transferred into the database, where the data is reviewed and vetted. A copy of the current Performance Questionnaire can be found in **Appendix A**.

A. STUDY CRITERIA

The following criteria applied to *Update 2011* performance benchmarking analyses:

- **Total Construction Cost** – TCC is the sum of costs associated with the awarded construction contract, net change orders, utility relocation, and construction by agency forces. TCC does not include the cost of land acquisition, environmental monitoring and mitigation, design, or construction management. All projects included in the analyses have a TCC exceeding $100,000. The participating agencies use fully-loaded (direct and indirect) costs for project delivery tasks.

- **Completion Date** – Projects included in the *Study* analyses were completed on or after January 1, 2006. Projects with earlier completion dates were kept in the database, but excluded from the analyses.

- **Outlier Elimination** – Statistical elimination was used to identify outliers in the performance model. The total project delivery percentage of each project in the database was evaluated against all other projects in the same classification. An outlier was identified as a project whose total project delivery percentage was outside the range expressed by the following equation:

  $y=m \pm 3\sigma$, where;

  m represents the mean of the project delivery percentages and σ represents the standard deviation of the project delivery percentages for all projects in the same classification.

It should be noted that this approach, which was first adopted in Update 2008, allows for the inclusion of more data than in previous years. Previously, other methods including visual inspection were used for the elimination of outlier data points. This change was in part allowed by the improved modeling techniques that have been documented in prior *Study* reports.

Projects confirmed as outliers by this statistical technique were kept in the database, but excluded from the analyses.

- **Project Delivery Method** – All projects analyzed in this *Study* were delivered through the traditional design-bid-build method. In prior *Study* years, project costs data were only collected and analyzed for projects delivered using the traditional design-bid-build method. Over the years, the participating agencies have executed several projects using alternative delivery methods such as design-build and job-order-contracting yielding benefits in areas such as cost, schedule, and overall project delivery. In order to capture such projects as part of the *Study*, the agencies have decided to collect costs data for projects delivered via alternative methods. However, the agencies decided that these projects will not be analyzed until a sufficient number of projects are collected to facilitate meaningful analyses.

- **Change Order Classification** – To support meaningful change order analyses, the Project Team reported change orders in accordance with the following classifications:

  1. Changed/Unforeseen Conditions
  2. Changes to Bid Documents
  3. Client-Initiated Changes

- **Project Classifications** – Sixteen project classifications grouped into four project types are used in this *Study*. In Update 2008, two new project classifications, "Other Municipal Facilities" and "Other Pipes" were added to the Municipal and the Pipes projects categories respectively. These two classifications will include projects that do not fall under the existing Municipal and Pipes classifications but are representative of the Municipal and the Pipes categories. The agencies will continue to collect data for these classifications for future analyses. The project types and classifications are shown in **Table 3-1**.

Table 3-1
Project Types and Classifications

Project Types	Classifications
Municipal Facilities	• Libraries • Police and Fire Stations • Community Centers, Recreation Centers, Child Care Facilities, Gymnasiums • Other Municipal Facilities[1]
Streets	• Widening, New, and Grade Separation • Bridges • Reconstruction • Bike Ways, Pedestrian Ways, and Streetscapes • Signals
Pipe Systems	• Gravity Systems • Pressure Systems • Pump Stations • Other Pipes
Parks	• Playgrounds • Sportfields • Restrooms

[1] Projects include design and/or construction activities for parking structures, yards, soil anchors, docks, animal shelters, reservoirs, water treatment plants, piers, and animal services centers.

B. DATA COLLECTION AND CONFIRMATION

To obtain meaningful results from the performance model, it is essential that the data collected from the agencies are accurate and conform to the *Study* criteria. The agencies recognize the importance of quality input data and are commited to providing accurate, complete project delivery cost data to support the development of performance models. Project delivery costs are defined as the sum of all agency and consultant costs associated with project planning, design, bid, award, construction management, and closeout activities. Examples of specific activities included in each phase of project delivery are presented in **Table 3-2**.

For the *Update 2011 Study*, the agencies completed the questionnaires with comparable, complete, and accurate values. The agencies also review and compare their data collection and confirmation techniques on a regular basis. For example, in a quarterly meeting during Update 2008, each agency delivered a presentation describing how it compiles the project delivery data for the Performance Questionnaire. In addition, discussion among the Project Team helps clarify and resolve inconsistencies in the data collection methodologies. It also ensures that input data is vetted before projects are submitted for analysis.

Table 3-2
Project Cost Categories

Category and Phase	Description
1) Design Costs:	The design phase (and associated costs) begins with the initial concept development, includes planning as well as design, and ends with the issuance of a construction Notice to Proceed. Design costs consist of direct labor costs, other direct agency costs such as art fees and permits, and consultant services cost associated with planning and design. Design may include the following:
Planning	• Complete schematic design documents • Review and develop scope • Evaluate schedule and budget • Review alternative approaches to design and construction • Obtain owner approval to proceed • Attend hearings and proceedings in connection with the project • Prepare feasibility studies • Prepare comparative studies of sites, buildings, or locations • Provide submissions for governmental approvals • Provide services related to future facilities, systems, or equipment • Provide services as related to the investigation of existing conditions of site or buildings or to prepare as-built drawings • Develop life cycle costs • Complete environmental documentation and clearances • Manage right-of-way procurement process • Monitor and control project costs
Design	• Complete design development documents including outline specifications • Evaluate budget and schedule against updated construction cost estimate • Complete design and specifications • Develop bid documents and forms including contracts • Complete permit applications • Coordinate agency reviews of documents • Review substitutions of materials and equipment • Prepare additive or deductive alternate documentation • Coordinate geotechnical, hazardous material, acoustic or other specialty design requirements • Provide interior design services • Monitor and control project costs
Bid and Award	• Prepare advertisement for bids • Qualify bidders • Manage the pre-bid conference • Evaluate bids • Prepare the recommendation for award • Obtain approval of contract award from Board/Council • Prepare the Notice to Proceed • Monitor and control project costs

Table 3-2
Project Cost Categories (cont'd)

Category and Phase	Description
2) Construction Management Costs:	All costs associated with construction management, including closeout costs, are included in this category. Construction management costs consist of direct labor, other agency costs, and consultant usage. Construction management may include the following:
Construction	• Hold pre-construction conference • Review and approve schedule and schedule updates • Perform on-site management • Review shop drawings, samples, and submittals • Perform testing and inspection • Process payment requests • Review and negotiate Change Orders • Prepare monthly reports to owner and agencies • Respond to Requests for Information • Develop and implement a project communications plan • Perform document control • Manage claims • Perform final inspections and develop and track punch list
Closeout Phase	• Commission facilities and equipment • Train maintenance and operation personnel • Document and track warranty and guarantee information • Plan move-in • File notices (occupancy, completion, etc.) • Check and file as-built documents • Monitor and control project costs
3) Total Project Delivery Costs:	This is the total cost of delivering a capital improvement project, equal to the sum of the design cost and construction management costs indicated above.
4) Change Order Cost:	Please see the update 2005 Report for descriptions of the following types of change orders: • Changed/unforeseen conditions - This type of change is necessitated by discovery of actual job site conditions that differ from those shown on the contract plans or described in the specifications. These are conditions a designer could not have reasonably been expected to know about during the design of the project. • Changes to Bid Documents - This type of change is necessitated by a mistake or oversight in the original contract documents and is required to correct the plans and specifications. • Client-Initiated Changes - This type of change results from additions, deletions or revisions to the physical work.

Table 3-2
Project Cost Categories (cont'd)

Category and Phase	Description
5)Total Construction Cost (TCC):	This is the direct construction cost, including all change orders during the construction phase (from the issuance of Notice to Proceed to Notice of Completion). The following costs are associated with construction and are included in the TCC: • Direct actual construction • Total amount of positive change orders throughout construction • Fixtures, furnishing, and equipment (FFE) • Utilities relocation • Work performed by the agency's staff and other agencies' staff

C. PERFORMANCE DATABASE

The projects data submitted by the agencies are complied in a customized Microsoft Access® database. This database not only serves as a repository for the data collected since the inception of the *Study*, but also allows for data analysis using built-in functions. The database also provides customized reports and tables for easy data interpretation. Each year, the projects database is updated with the inclusion of projects data submitted for that *Study* year. The analysis and the reporting features of the database are also updated.

Table 3-3 summarizes the number of projects included in the database and in the analyses. The 5-year database used for the current analysis contains 676 projects. This total excludes project data older than five years or projects identified as outliers. Projects identified as outliers are not included in the performance data analysis but are retained in the performance database. In addition, projects delivered by alternative delivery are excluded from the analysis but included in the database. The 676 projects selected for analysis do not include projects delivered by alternative delivery. As explained under subsection A Study Criteria of this chapter, outlier analysis was performed using statistical techniques to ensure consistency in the selection of outlier data points. This methodology was first implemented during Update 2008 and the agencies recognize the merits of a scientific approach for outlier elimination. Some of the projects classified as outliers in previous *Study* years have been included in the performance data analysis, and vice-versa.

This is an improved practice when compared to prior *Study* years where project data points were classified as outliers based on a combination of statistical parameters and subjective judgments by the Project Team. Previously, projects identified as outliers during one *Study* phase were kept as outliers in subsequent *Study* phases.

Table 3-3 shows that as the rules for project selection were refined, the number of non-representative and projects with TCC less than $100K have decreased. In addition, only five projects have been excluded as outliers in the Update 2011 *Study* as compared to the elimination of several hundred projects prior to the refinement of the statistical model in 2009.

In the *Study 2002* report, it was recommended that at least 10 projects per classification and a minimum data set of 2,000 projects distributed evenly among classifications, ranges of TCC, and agencies are necessary to achieve statistically-significant results. Although the requirement for the minimum number of projects per classification has been met for most project categories, more data needs to be collected to ensure an even distribution of projects amongst all classifications.

Fifteen projects that were funded by the American Recovery and Reinvestment Act (ARRA) of 2009 were included in the data analyses. It is anticipated that the number of projects funded by ARRA will increase in the database in future years when currently on-going projects are completed. The agencies acknowledged that it is vital to the success of the *Study* to continue increasing the size of the data set, thereby increasing the confidence, consistency, and reliability of results. As previously indicated, there are 4 project types (Municipal Facilities, Streets, Pipe Systems, and Parks) and 16 project classifications included in this *Study*. **Table 3-4** summarizes the distribution of projects included in the *Update 2011* analyses.

Table 3-3
Growth of Database

Study Phase[1]	Submitted			Deleted[2]		Count After Deletions[5]	Excluded		Net
	Traditional Projects Submitted	(a) Alternative Delivery Projects Submitted[4]	(b) Total	c) TCC <$100K	(d) Non-Repre-sentative	(e)=(b)-(a)-(c)-(d)	(e) Project Completion Date < 2006	(f) Outliers[3]	Projects in Analyses (g)= (d)-(e)-(f)
I	239	0	239	27	44	168	168	0	0
II	285	0	285	0	35	250	250	0	0
III	262	0	262	0	29	233	233	0	0
IV	173	0	173	18	24	131	131	0	0
V	182	0	182	0	4	178	178	0	0
VI	191	0	191	0	4	187	61	0	126
VII	158	0	158	1	0	157	27	0	130
VIII	155	0	155	2	4	149	12	2	135
IX	174	10	184	2	1	171	4	3	164
X	122	15	137	1	0	121	0	0	121
Total	**1,941**	**25**	**1966**	**51**	**145**	**1,745**	**1064**	**5**	**676**

Notes:

[1] *Study* Phase indicates action taken on the count of projects corresponding to Study Years I = 2002, II = 2003, III = 2004, IV = 2005, V = 2006, VI = 2007, VII = 2008, VIII = 2009, IX = 2010, and X = 2011.

[2] Projects that do not fit *Study* criteria for project classifications and minimum TCC of $100K were removed from the database.

[3] Outliers are identified based on statistical analysis.

[4] These represent projects delivered by alternative project delivery techniques. These projects are kept in the database, but not analyzed. These projects will be analyzed when a sufficient number of such projects are available to facilitate meaningful analyses.

[5] Projects delivered by alternative techniques are retained in the database but not analyzed. These projects are not included in the 676 projects selected for analysis in the Update 2011 Study.

Table 3-4
Projects Distribution Matrix

Agency	Long Beach	Los Angeles	Oakland	Sacramento	San Diego	San Francisco	San Jose	Total[3]
Municipal Facilities	**5**	**28**	**14**	**5**	**17**	**13**	**30**	**112**
Comm./Rec. Center/ Child Care/Gyms	1	12	9	1	1	3	10	37
Libraries	1	2	2		4	3	12	24
Other Municipal Facilities	3	4	2	1	9	6	2	27
Police/Fire Stations		10	1	3	3	1	6	24
Streets	**32**	**12**	**35**	**45**	**23**	**52**	**58**	**257**
Bike/Pedestrian/ Streetscapes			15	23	10	4	12	64
Bridges (New/Retrofit)	1	6		3	2		4	16
Reconstructions	30	3	11	3	4	37	10	98
Signals	1		9	5	2	10	25	52
Widening/New/ Grade Separations		3		11	5	1	7	27
Pipe Systems	**5**	**57**	**42**	**24**	**47**	**36**	**41**	**252**
Gravity Systems (Storm Drains/Sewers)	1	54	42	16	22	32	38	205
Other Pipes	1	2		1				4
Pressure Systems				6	18	4	2	30
Pump Stations	3	1		1	7		1	13
Parks	**2**	**3**	**19**	**1**	**5**	**6**	**19**	**55**
Playgrounds	2	2	13	1	3	5	14	40
Restrooms			2				2	4
Sportfields		1	4		2	1	3	11
Total[(1)]	**44**	**100**	**110**	**75**	**92**	**107**	**148**	**676**

Notes:

[1] Total refers to the projects included in the Update 2011 analyses only.

[2] Projects include design and/or construction activities for parking structures, yards, soil anchors, docks, animal shelters, reservoirs, water treatment plants, piers, and animal services centers.

[3] Total excludes projects delivered by alternative delivery mechanisms such a design-build, JOC, and CM@Risk. Projects delivered by alternative techniques are retained in the database but not analyzed. These projects are not included in the 676 projects selected for analysis in the Update 2011 *Study*.

D. CHARACTERISTICS OF DATA ANALYZED

Project performance data were analyzed using the custom database application at both the Project Type level and the Project Classification level (see **Table 3-1**).

Project Count and Project Delivery by Completion Year

Table 3-5 summarizes characteristics of the projects included in the analyses by project completion year and shows trends in the average TCC values, median TCC values, design costs, construction management costs, and overall project delivery costs. The median value is the value at which 50 percent of the values are above and 50 percent of the values are below.

As indicated in **Table 3-5**, project size (measured as median TCC), increased between 2006 and 2007 with an increase of approximately 10 percent. After spiking in 2007, median project size declined significantly by approximately 25 percent in 2009. After declining in 2009, median project size increased by approximately 13 percent in 2010. The average TCC also declined steadily between 2007 and 2010, with a large decline of 29 percent from 2008 to 2009. However, the average TCC recovered back to 2008 levels in 2010 with an approximately 40 percent increase from 2009 levels.

This could be due to a combination of several factors such as the selection of projects using the five-year window, elimination of projects with high TCC values during the outlier analysis, and

Table 3-5
Project Count and Project Delivery by Completion Year

Project Completion Date	Count by Project Type					Project Delivery Data				
	Municipal Facilities	Streets	Pipes	Parks	Total	Average TCC ($M)	Median TCC ($M)	Design Cost (% of TCC)	Construction Management Cost (% of TCC)	Project Delivery Cost (% of TCC)
2006	36	54	67	9	166	$2.76	$0.87	22%	17%	39%
2007	24	52	50	14	140	$2.95	$0.95	24%	17%	40%
2008	15	43	46	15	119	$2.40	$0.86	24%	17%	41%
2009	22	67	44	10	143	$1.71	$0.72	22%	18%	40%
2010	15	41	45	7	108	$2.38	$0.81	24%	18%	42%
Total	**112**	**257**	**252**	**55**	**676**	**$2.45**	**$0.82**	**23%**	**17%**	**40%**

Notes:
[1] Project Delivery percentages represent arithmetic averages of the individual projects and do not represent the results from the regression analyses.
[2] Project Delivery percentages vary from year to year based on the selection and the composition of the projects in the database.
[3] Total excludes projects delivered by alternative delivery mechanisms such a design-build, JOC, and CM@Risk. Projects delivered by alternative techniques are retained in the database but not analyzed. These projects are not included in the 676 projects selected for analysis in the Update 2011 Study.

the addition of several new projects with low TCC values. Project delivery costs measured as a percentage of the TCC has remained relatively stable; however it increased by 2 percentage points from 2009 to 2010.

Project Delivery Costs by Project Type

Table 3-6 shows project delivery costs by each of the four project types in the *Study* for the full range of TCC. The project delivery percentage for a category is the arithmetic average of the project delivery percentages of the individual projects grouped under that category.

Although it is desirable for project delivery costs to decrease as agency efficiencies increase and BMPs are implemented, this can be confounded by other factors that change annually such as project size and market competition. For example, presently actual bid amounts have been depressed by competitive forces associated with the lagging economic recovery. This will result in the rise of delivery cost as a percentage of TCC as TCC is depressed. The result may be noticed in the coming years as these projects are completed and reported into the database. The agencies acknowledged that the impacts of low-construction bids on project delivery costs needs to be analyzed during future *Study* years as the number of projects completed during the recession increase in the database.

Projects belonging to the Pipes and the Municipal categories have the lowest average project delivery cost. The Streets category has the maximum number of projects (n = 257) in the Update 2011 database. The Pipes category also has a similar number of projects in the database

Table 3-6
Project Delivery Costs by Project Type (% of TCC) (Full Range of TCC)

Type	Design	Construction Management	Project Delivery (Total)	Median Total Construction Cost ($M)	Number of Projects (N)
Municipal Facilities	22%	15%	37%	3.32	112
Parks	27%	18%	44%	0.45	55
Pipe Systems	20%	16%	36%	0.86	252
Streets	25%	19%	44%	0.65	257
Average	**23%**	**17%**	**40%**	**0.82**	**676**

Notes:
[1] Project Delivery percentages represent arithmetic averages of the individual projects and do not represent the results from the regression analyses.
[2] Project Delivery percentages vary from year to year based on the selection and the composition of the projects in the database.
[3] Total excludes projects delivered by alternative delivery mechanisms such a design-build, JOC, and CM@Risk. Projects delivered by alternative techniques are retained in the database but not analyzed. These projects are not included in the 676 projects selected for analysis in the Update 2011 Study.

(n = 252). Along with the Parks category, the Streets category also exhibits the highest average project delivery cost. The influence of low project delivery cost from Pipes projects is balanced by the influence of high project delivery cost from Streets projects. The average project delivery percentage for the overall dataset is approximately 40 percent.

Over the course of the *Study*, the agencies have observed that the relatively high average project delivery cost of Streets projects is probably due to increasing cost influences of right-of-way acquisition, community outreach requirements, environmental mitigation requirements, and the smaller median total construction cost of these projects.

Table 3-7 shows project delivery costs by each of the four project types in the *Study* for the smaller projects subset of TCC (Note: In Update 2009, the concept of looking at a smaller subset of projects was introduced. This smaller subset generally characterizes the smaller projects in the type or classification being examined. This step was taken as it was generally believed that project delivery for smaller projects was different than for larger projects.). The trends in the project delivery costs for the projects in the smaller project subset of TCC follow that of the projects in the full range of TCC. As expected based upon the agencies' practical experience, project delivery costs are higher for projects that fall in the smaller project subset of TCC.

Table 3-7
Project Delivery Costs by Project Type (% of TCC)
(Smaller Project Subset of TCC)

Type	Design	Construction Management	Project Delivery (Total)	Median Total Construction Cost ($M)	Number of Projects (N)
Municipal Facilities	24%	15%	38%	3.32	90
Parks	29%	20%	48%	0.45	44
Pipe Systems	22%	17%	38%	0.86	202
Streets	27%	21%	47%	0.65	206
Average	**25%**	**18%**	**43%**	**0.82**	**542**

Notes:
[1] Project Delivery percentages represent arithmetic averages of the individual projects and do not represent the results from the regression analyses.
[2] Project Delivery percentages vary from year to year based on the selection and the composition of the projects in the database.
[3] Total excludes projects delivered by alternative delivery mechanisms such a design-build, JOC, and CM@Risk. Projects delivered by alternative techniques are retained in the database but not analyzed. These projects are not included in the 676 projects selected for analysis in the Update 2011 Study.

Consultant Usage Analysis

Project delivery performance and consultant usage by agency are presented in **Table 3-8**. The table indicates that approximately 58 percent of the design work and approximately 80 percent of the construction management efforts are completed in-house by the participating agencies. Consultants account for approximately 31 percent of the total project delivery costs while in-house efforts by the participating agencies accounts for the remaining 69 percent of the project delivery costs. For the available data, a clear relationship between the level of in-house effort and project delivery costs cannot be established.

Table 3-8
Project Delivery Performance and Consultant Usage by Agency

AGENCY	DESIGN					CONSTRUCTION MANAGEMENT					PROJECT DELIVERY					TCC	
	In-House		Consultants		Total % of TCC[2]	In-House		Consultants		Total % of TCC	In-House		Consultants		Total % of TCC	Average	Median
	($M)	% of Design	($M)	% of Design		($M)	% of CM	($M)	% of CM		($M)	% of PD	($M)	% of PD			
Agency A	28.3	46%	33.8	54%	22%	36.4	65%	19.4	35%	15%	64.7	55%	53.2	45%	37%	3.9	1.5
Agency B	8.6	51%	8.2	49%	21%	9.6	69%	4.3	31%	15%	18.3	59%	12.5	41%	36%	1.5	0.5
Agency C	32.5	96%	1.2	4%	17%	40.4	99%	0.3	1%	17%	72.9	98%	1.5	2%	34%	2.0	1.3
Agency D	43.3	53%	38.7	47%	25%	55.9	78%	16.2	22%	18%	99.2	64%	54.9	36%	43%	5.3	1.6
Agency E	3.1	51%	3.0	49%	17%	4.2	79%	1.1	21%	15%	7.2	64%	4.1	36%	32%	1.0	0.7
Agency F	26.0	58%	18.6	42%	27%	41.2	87%	6.0	13%	26%	67.1	73%	24.6	27%	52%	1.9	0.5
Agency G	13.5	60%	8.8	40%	26%	8.3	100%	0.0	0%	11%	21.8	71%	8.8	29%	36%	1.0	0.4
OVERALL	**155.3**	**58%**	**112.3**	**42%**	**23%**	**195.9**	**81%**	**47.4**	**19%**	**17%**	**351.2**	**69%**	**159.8**	**31%**	**40%**	**2.5**	**0.8**

Notes:
[1] In-House and Consultant costs are expressed as percentages of total agency Design, CM (Construction Management), and PD (Project Delivery) costs.
[2] Total Construction Cost (TCC) is the sum of construction contract award, change orders, utility relocation cost, and city forces construction cost.
[3] Design, CM, and PD costs are expressed as percentages of TCC and are unweighted, arithmetic averages of projects by agency.

E. REGRESSION ANALYSES RESULTS

During Update 2008, several changes were made to improve the modeling methodology. These included developing a statistically-sound method for outlier analysis, using a linear trendline regression for modeling project costs relationships, and using the upper and lower bounds of a 95 percent confidence interval to estimate the range of the project delivery percentages. As a result of these improvements, the model relationships could be predicted with a high degree of certainty as compared to previous *Study* years. As previously indicated, during Update 2009, the modeling methodology was further refined by analyzing the data in two ranges of TCC. Results from the regression analysis methodology are discussed in **Appendix B**. Given all these improvements to the analysis of the data, the reader is advised that direct comparison of results between Update 2011 and previous years may be more difficult due to these improvements.

In most cases, the results reflect the agencies' experience with the delivery of capital projects that on a percentage basis projects with lower TCCs are more expensive to deliver than projects with higher TCCs. Only three out of the 15 categories have lower project delivery percentages for the smaller subset of projects than the full range of projects. It is concluded that the model results are reasonable from a statistical perspective.

F. OTHER CONSIDERATIONS

Effect of Economic Conditions

Due to the lagging recovery in the economy, agencies are receiving bids that are significantly lower than the engineer's estimates. During the Update 2010 *Study*, the participating agencies summarized the trends observed in construction bids. These observations are presented below for some of the agencies:

- The City of Los Angeles noticed a decline in the rehabilitation cost per linear feet of sewer pipe for their sewer program.

- The City of Sacramento utilizes rubberized asphalt concrete (RAC) for all street overlays. The City noticed that RAC costs have declined from $120 per ton in 2008 to $87 per ton in 2010. Similarly, the City also noticed that costs for concrete sidewalks (4-inches thick) have declined from $9 per square feet to $5 per square feet over the past few years.

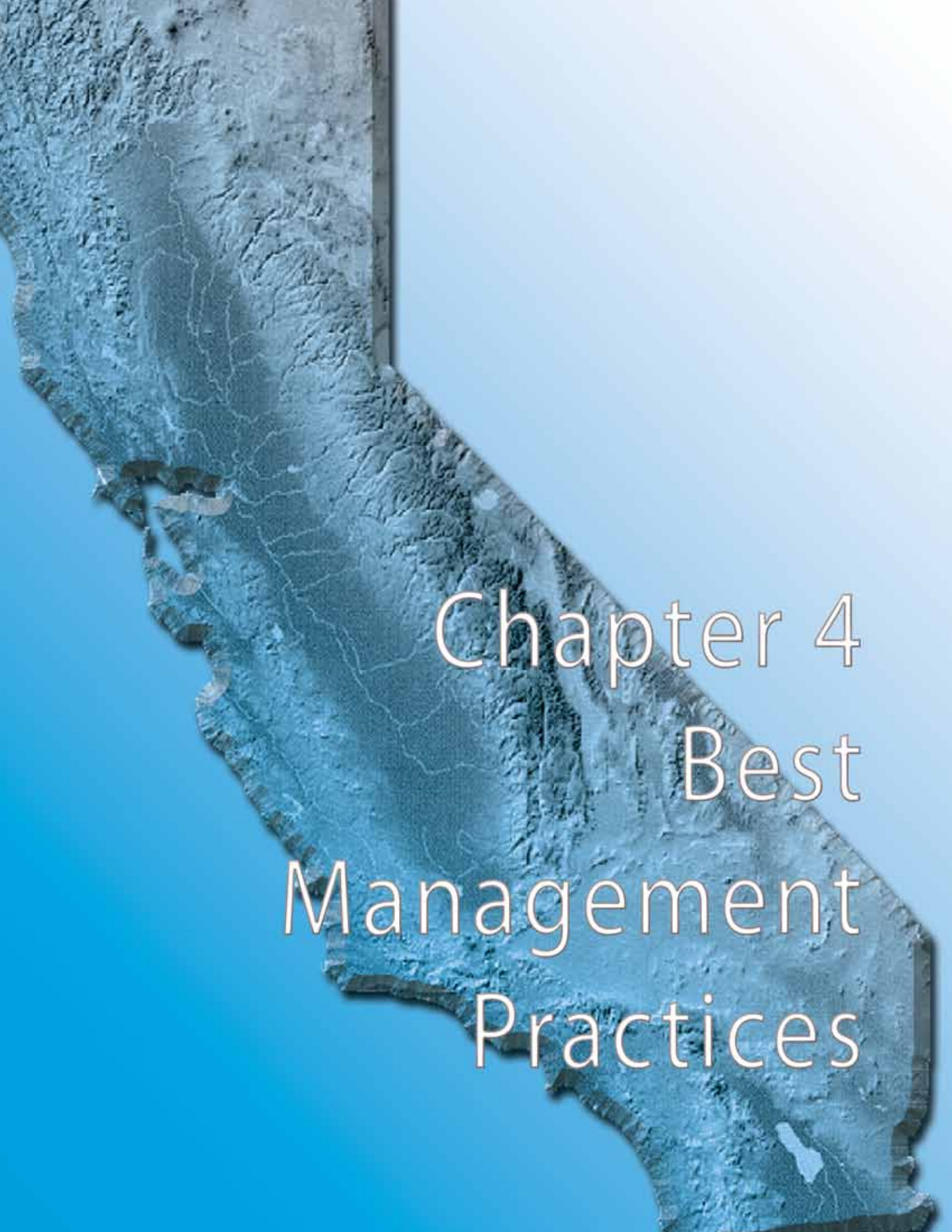
- The City of Long Beach has noticed an approximately 12 percent drop in current bid prices over those received two years ago. This would include street work, park construction as well as small facilities such as restrooms, teen centers, fire stations, etc.

- The City of San Jose has been experiencing "below-market-rate" bids since late 2007 and early 2008. In studying the trend, the City found that during the period from July 2008 to June 2009, the City received an average of about 8 bids per project and on an average the low bid was approximately 21 percent lower than the engineer's estimate. From July 2009 to June 2010, the City received an average of about 10 bids per project and on an average the low bid was approximately 27 percent lower than the engineer's estimate. In addition to these data, the City has also noticed an increase in bid protests.

- The City and County of San Francisco has noticed that bids have dropped from being 109 percent of the engineer's estimate in 2005 to approximately 79 percent of the engineer's estimate in 2010 for their joint sewer and paving projects. The City of Oakland also noticed a decline in construction costs over the past few years.

The impacts of these low construction bids on project delivery percentages need to be evaluated. It is very likely that project delivery percentages might increase due to the reduced construction bids. However, using such delivery percentages for budgeting a program of projects in the future may be misleading as construction costs are likely to increase improvement in the economy.

In addition, increasing the size of the project database is a major challenge posed to the *Study* participants. This is primarily because of the 5-year rolling window criterion for project completion dates; even as new projects are added, old projects are excluded from analyses by the window of time. The participating agencies are also challenged to identify as many completed projects as possible that meet the rest of the *Study* criteria. The benefits of projects delivered via alternative delivery techniques need to be quantified by including them for analysis in the project database. However, due to the significant difference in delivery mechanisms, those projects will have to be analyzed separately from the rest of the projects in the database.



Chapter 4 Best Management Practices

CHAPTER 4 Best Management Practices

When this *Study* was initiated, the agencies examined over 100 practices used in project delivery. Included in this *Study* were a number of practices that the participants did not commonly use at the time, but believed could have value if ultimately implemented as Best Management Practices (BMPs). Each year the agencies look at changes in the industry in order to identify new BMPs. In some cases existing BMPs are reworked by the agencies to address specific challenges encountered during implementation. BMPs are also added or modified to reflect relevant experiences by the participants. Agency implementation of these selected practices has been, and will continue to be, tracked during the *Study*. Three new BMPs were added this to the list of existing BMPs.

While a BMP may be developed to address a specific issue, its implementation may also impact other elements of project delivery. For example, a BMP that reduces project schedule may also favorably impact project costs. While it is not possible to discreetly quantify all the benefits of the BMPs, the participating agencies developed an approach to identify the major benefits associated with each BMP. This was accomplished by assigning a *Perceived Value* to each BMP in the Update 2010 *Study*. The participating agencies judged that each of the BMP favorably impact one of the following categories:

- Cost
- Schedule
- Quality
- Communication
- Environment
- Customer Service

To identify the predominant *Perceived Values* associated with each of the new BMPs, the participating agencies voted on which Perceived Value were most applicable and the responses were then tabulated. If a *Perceived Value* received three or more votes relative to a BMP, that *Perceived Value* was considered to be of significance and received a check mark as shown in **Table 4-1**. If a check mark is not shown, it indicates that the Perceived Value received two or less votes relative to a BMP; it does not mean that a BMP has no benefit to that *Perceived Value* category. The check marks only reflect that three or more agencies found that *Perceived Value* to be particularly applicable to the BMP in question. The majority of the BMPs are assigned a *Perceived Value* of either “cost” or “schedule”, followed by “quality”. This indicates that majority of the agencies found these “Perceived Values” as most applicable to the adopted BMPs.

A. NEW BEST MANAGEMENT PRACTICES

In *Update 2011*, the Project Team added three new BMPs to the BMP implementation tracking list. The new BMPs were developed by discussions either during quarterly meetings or on-line discussions held throughout the year. The new BMPs are:

- 2.r.2011 – Use of electronic signatures to do direct conversion from CAD to PDF.
- 2.s.2011 – Have awarding authority to approve plans, advertisement, and award of contract in one board action.
- 2.t.2011 – Expedite project duration from design completion to notice to proceed. Examples include items such as: Pre-qualification of contractors, good faith effort submittal on-line, submittal incentives, contract liaison within department, electronic proposal documents provided 48 hours after bid opening, contractor's self certification.

These BMPs are believed to directly influence cost, schedule, quality, communication, environment or customer service aspects of either design or construction management, and, ultimately, project delivery efficiency.

B. DESCRIPTION OF BEST MANAGEMENT PRACTICES

The *Study 2002* report included descriptions of the BMPs that the Project Team felt were most critical to improving project delivery performance. These descriptions, presented in **Table 4-1,** have been updated to reflect the changes in the interpretation of those BMPs, as well as additions to the BMP list since 2002. **Table 4-1** has also been modified to include *Perceived Values* for each BMP.

Table 4-1
Description of Best Management Practices

Category	Ref:*	BMP	Description	Perceived Value					
				Cost	Schedule	Quality	Communication	Environment	Customer Satisfaction
Planning	1.a	Define capital projects well with respect to scope and budget including community and client approval at the end of the planning phase.	Changes in project scope or budget increase both total construction cost and the cost of project delivery. The later these changes occur in the life of the project, the greater the increase. Reaching and documenting consensus with the community and the client will reduce changes after the project delivery process begins.	✓	✓		✓		✓
	1.b	Complete Feasibility Studies on projects prior to defining budget and scope.	Feasibility studies should be completed early in the process so that issues are identified and either resolved or accommodated within the final definition of scope, budget, and project delivery schedule. This will also reduce overall project delivery costs. Early feasibility studies are particularly important on complex projects and projects with a construction budget greater than $5 million.	✓	✓	✓			
	1.d	Utilize a Board/Council project prioritization system.	Departments responsible for project delivery have limited resources. A system will ensure that resources are directed to meet the community's most critical needs.		✓		✓		
	1.e	Resource load all CIP projects for design and construction.	The resources required to deliver projects according to the master CIP schedule mandated by the Board/ Council should become part of the CIP. This will facilitate defining performance measures and ensure that there is a common understanding of the resources required to deliver the CIP.	✓	✓				

Table 4-1
Description of Best Management Practices (cont'd)

Category	Ref:*	BMP	Description	Perceived Value					
				Cost	Schedule	Quality	Communication	Environment	Customer Satisfaction
Planning	1.f	Include a Master Schedule in the CIP that identifies start and finish dates for projects	A master schedule can be used to define resource needs and performance measures.		✓		✓		
	1.g 2007	Make an early determination on which environmental document is required and incorporate into the schedule.	Completing the environmental assessment and permitting process influences project schedules and costs. Establish a checklist of potential environmental and permit requirements and examine each project scope against the list early in the planning process.	✓	✓			✓	
	1.i	Show projects on a Geographical Information System (GIS).	Entering and tracking planned projects into a GIS which is available to all private and public sector project planners will reduce the potential for conflicts and re-work.		✓		✓		
Design	2.b.	Provide a detailed clear, precise scope, schedule, and budget to designers prior to design start.	Design professionals will work more efficiently if given a clear scope when contracted to provide the design services. Clear scope and budget should be defined in advance and made a part of the design professional's contract if/when a consultant is used.	✓	✓	✓	✓		
	2.f.	Define requirements for reliability, maintenance, and operation prior to design initiation.	Reliability, maintenance, operational requirements, and standard materials and equipment should be clearly defined in advance, approved by the user/ client, and included in the design professional's contract when a consultant is used.	✓		✓			✓
	2.i.	Adapt successful designs to project sites, whenever possible (e.g. fire stations, gymnasiums, etc).	Successful designs of fire stations, police facilities, maintenance facilities, pump stations, and many other projects should be re-used when possible. Site adaptations of successful designs may reduce design costs by half.	✓	✓				

Table 4-1
Description of Best Management Practices (cont'd)

Category	Ref:*	BMP	Description	Perceived Value					
				Cost	Schedule	Quality	Communication	Environment	Customer Satisfaction
Design	2.k. 2003	Train in-house staff to use Green Building Standards.	Communities have a stake in the environment as well as in the cost of operating and maintaining public facilities. Utilizing "Green Building Standards" allows facilities to be built and operated with renewable resources and other environmentally sound practices.					✓	
	2.l. 2004	Limit Scope Changes to early stages of design.	It is well known within the industry that the later a change occurs in the construction process, the more costly the change is.	✓	✓				
	2.m. 2004	Require scope changes during design to be accompanied by budget and schedule approvals.	All scope changes after the initial definition within the design agreement will affect project delivery cost and therefore should be documented. Documentation should include an understanding and acceptance/ approval by all stakeholders of the cost and time implications of any changes.	✓	✓				
	2.n. 2006	Implement a rotating Request for Quote process for contracting small projects to streamline the bidding and award process during construction. (Include criteria for exemptions from formal Council approval.)	Smaller projects cost more (as a percentage of construction cost) to deliver. One way of reducing the cost of project delivery on small projects is to shorten the bid and award process by setting a threshold amount under which the delivery team may solicit and receive quotes from qualified contractors and award contracts without getting Board/Council prior approval.	✓	✓				
	2.o 2007	Establish criteria for obtaining independent cost estimates which take in consideration both project characteristics and volatility of the market.	Having to re-design and re-bid a project on which bids come in over budget can significantly impact project delivery cost. Accurate estimates at the end of each design phase, performed by unbiased, independent, qualified professionals with an understanding of local market conditions will reduce the potential for receiving unexpected bids.	✓	✓				

Table 4-1
Description of Best Management Practices (cont'd)

Category	Ref:*	BMP	Description	Perceived Value					
				Cost	Schedule	Quality	Communication	Environment	Customer Satisfaction
Design	2.p 2008	Establish criteria for responsible charge design approval such that it occurs at the lowest appropriate organizational level in order to expedite design completion.	Many times responsible charge design approval is set at a very high level. This can sometimes result in only one person with limited time who can approve all sheets in a design package. This leads to a bottleneck situation.	✓	✓				
	2.q.2010	Receive bids electronically.	Electronic bidding programs have increased over the last several years. Receiving bids electronically provides a centralized location to store all bid related documents for public access along with ability to increase bidder participation.				✓		✓
	2.r.2011	Use of electronic signatures to do direct conversion from CAD to PDF.	Currently wet signatures on all pages is standard practice. This causes scanned files to be very large electronic files. Use of electronic signatures in all but the cover page will reduce file size and allow for easier distribution.	✓	✓	✓			
	2.s.2011	Have awarding authority to approve plans, advertisement and award of contract in one board action.	Combine approval of plans, advertisement and award of contract by the awarding authority into a single action.		✓				
	2.t.2011	Expedite project duration from design completion to notice to proceed. Examples include items such as: - Pre-qualification of contractors - Good Faith Effort submitted on-line - Submittal incentives (i.e., award and material submittals allowed 30 day period. Every day early is added to construction contract duration) - Contract liaison within department - Electronic proposal documents provided 48 hours after bid opening. Hard copy provided at bid time - Contractor's self certification	Implementation of new practices such as using an electronic process or pre-qualification in an effort to reduce the overall timeframe from design completion to notice to proceed.	✓	✓				✓

Table 4-1
Description of Best Management Practices (cont'd)

Category	Ref:*	BMP	Description	Perceived Value					
				Cost	Schedule	Quality	Communication	Environment	Customer Satisfaction
Quality Assurance / Quality Control	3.I.a.	Develop and use a standardized Project Delivery Manual.	Standardized procedures streamline project design, bidding, and construction processes. Standardized design management procedures will reduce scope creep and delays in construction document preparation. During construction, standard procedures will reduce response times on RFIs, and add overall clarity and efficiency to the construction management process. Having a standard manual will also reduce the time necessary for project documentation training.	✓	✓	✓			
	3.II.b.	Perform a formal Value Engineering *Study* for projects larger than $1 million	Value Engineering identifies life cycle costs of design elements included in a project and certain alternatives. While the cost of the value engineering process may initially add costs to project delivery, overall project costs will be reduced.	✓					
	3.III.a	Use a formal Quality Management System.	Quality management should include all activities from the preparation of design documents through the closeout of construction. (Constructability reviews, independent cost estimates, classification and auditing of change orders, etc.) The implementation and tracking of quality control should be formalized on a checklist to ensure application.	✓		✓			
	3.III.b	Perform and use post-project reviews to identify lessons learned.	Project Managers should develop formal post project reviews and identify lessons learned. These documents should be made available to PM's on projects of a similar scope and nature. This BMP will make future project management and delivery more efficient and cost effective.			✓			

Table 4-1
Description of Best Management Practices (cont'd)

Category	Ref:*	BMP	Description	Perceived Value					
				Cost	Schedule	Quality	Communication	Environment	Customer Satisfaction
Quality Assurance / Quality Control	3.III.k 2007	Establish a Utility Coordinating Committee with members from public and private entities.	Regular meetings of a committee will establish a forum for ideas to improve the utility relocation process and thus improve project progress. Meetings will also be an opportunity for problem projects (relocations) to be discussed.	✓	✓	✓	✓		
	3.III.l 2007	Designate a responsible person or group and establish a process of notifications and milestones for utility relocations.	Identifying a utility relocation specialist within the project delivery team who is familiar with the procedures and contacts within the public and private utility entities will improve communication and problem solving during design and construction	✓	✓		✓		
	3.III.m 2008	Maintain and regularly update electronic standard contract specifications and related documents, as well as technical/special provisions.	Standard contract specifications and technical special provisions need to be regularly maintained and updated in order to reduce the amount of time required to create contract bid documents. If a City implements new requirements, the standards should be modified for every project one time instead of each manager having to modify these documents of every project.	✓	✓	✓			
Construction Management	4.I.a.	Delegate authority to the City Engineer/Public Works Director or other departments to approve change orders to the contingency amount.	Change order work should be authorized as soon as is practically possible in order to avoid potential delays to critical work. Scheduling a significant change order for review and authorization by the Board may delay project progress, even though it may be within the contingency amount allowed in the project budget. Authorization of the City Engineer/Public Works Director to approve changes within the contingency budgeted for changes will ensure that critical changes are acted on promptly and that delays are minimized.	✓	✓				

Table 4-1
Description of Best Management Practices (cont'd)

Category	Ref:*	BMP	Description	Perceived Value					
				Cost	Schedule	Quality	Communication	Environment	Customer Satisfaction
Construction Management	4.I.m.	Classify types of change orders.	Classification of change orders into categories such as changed conditions, unforeseen conditions, owner requests, or design changes for owner use improves understanding of the project and lessons learned from the data may improve project delivery on similar projects.			✓			
	4.II.a.	Include a formal Dispute Resolution Procedure in all contract agreements.	Construction is acknowledged as a dispute prone industry. As such, it makes sense to provide options in the contract documents to avoid litigation and to expedite disputes resolution using alternatives to litigation.	✓	✓		✓		
	4.III.a.	Use a team building process for projects greater than $5 million	Partnering is a team-building process that has a proven record of improving working relationships and production, and reducing claims and disputes on construction projects. It is one of several team-building processes that should be used in the interest of reducing conflict and facilitating project delivery.	✓	✓		✓		✓
	4.IV.a	Involve the Construction Management Team prior to completion of design.	Experienced contractors and construction managers should be included in the design process to make designs more constructible and lower cost. Construction managers and contractors are frequently more experienced about the products and/or equipment as well as construction methods that are readily available. Their contributions to selections and decisions during the design process will facilitate construction procurement, means and methods.	✓		✓	✓		
	4.IV.b 2010	Implement Electronic Contract Payment Process.	Many approvals are required to process contract payments. Using electronic procedures provides an avenue to expedite the necessary approvals.	✓					✓

Table 4-1
Description of Best Management Practices (cont'd)

Category	Ref:*	BMP	Description	Perceived Value					
				Cost	Schedule	Quality	Communication	Environment	Customer Satisfaction
Construction Management	4.IV.c 2010	Agency should file As-built drawings within 6 months of project completion.	One of the last tasks for a project is the updating and filing of As-built drawings. Many times, this task is put off for other pressing matters. This BMP establishes a 6 month deadline.			✓			✓
	4.V.a. 2003	Delegate authority below Council to make contract awards under $1 million.	The time and costs of scheduling and presenting a Council or Board item can be saved and project starts can be expedited if awards on projects with budgets under $1 million can be awarded administratively.	✓	✓				
	4.V.b 2003	Establish a pre-qualification process for contractors on large, complex projects.	Prequalification helps screen contractors for prior performance on similar projects, safety and financial capability thus reducing risk and, ultimately, project delivery cost.		✓	✓			
	4.V.c 2003	Make bid documents available online.	Making bid documents available on line will reduce Agency printing costs. It may also increase bidder participation by making documents easily available to a larger pool of potential bidders and subcontractors.	✓			✓		
Project Management	5.I.f.	Assign a client representative to every project.	Client (end user) representation during the life of the project will expedite decisions on submittals, substitutions, and changes. Their involvement will also help determine intent and streamline the commissioning and occupancy process.		✓		✓		✓
	5.I.j 2003	Create in-house project management team for small projects.	It has been documented that the cost of project delivery of small projects is a higher percentage of the construction cost. Establishing a project management team that specializes in smaller projects may lead to economies such as grouping similar projects during permitting and bidding thus reducing project delivery cost.	✓					

Table 4-1
Description of Best Management Practices (cont'd)

Category	Ref:*	BMP	Description	Perceived Value					
				Cost	Schedule	Quality	Communication	Environment	Customer Satisfaction
Project Management	5.I.k 2004	Institutionalize Project Manager performance and accountability.	Recognize that professional project management requires specific education, training, and experience. Provide for PMI, CCM, or other formal training and certification and establish performance measures for project delivery personnel.			✓			
	5.II.a	Provide formal training for Project Managers on a regular basis.	Project Managers come to projects with varying degrees of skill and familiarity with Agency procedures. Orientation and training will improve their ability to deliver the project on the intended schedule. It is also important that updated training is available at least on an annual basis.			✓			
	5.II.d 2006	Implement verification procedures to ensure that PM training includes Agency policies, procedures, forms, and standards of practice (scheduling, budgeting, claims avoidance, risk analysis, etc).	The success of a project is influenced significantly by the education and skills of the project manager. Agencies should verify that PM's know and use the tools available within an Agency and that they are current with industry practices.		✓	✓			
	5.III.a.	Adopt and use a Project Control System on all projects.	A web-based project control system will improve collaboration and documentation during the design and construction process. Questions, answers, proposals, and decisions can be expedited using a collaborative system.	✓	✓		✓		
	5.III.e 2006	Implement a financial system that tracks expenditures by category to monitor project hard and soft costs during project delivery.	It is recommended that a system that identifies actual expenditures against planned budgets be made available to project managers to be used as a performance measurement tool	✓					
	5.III.f 2006	Implement a Work Breakdown Structure (WBS) to measure progress on project deliverables.	Getting accurate data on the cost of project delivery depends upon being able to capture and classify expenses to the phases of construction on each project. Ideally, costs would be identified by each of five project delivery phases and coded to particular milestones or deliverables.	✓	✓				

Table 4-1
Description of Best Management Practices (cont'd)

Category	Ref:*	BMP	Description	Perceived Value					
				Cost	Schedule	Quality	Communication	Environment	Customer Satisfaction
Project Management	5.III.g 2006	Monitor "earned value" versus budgeted and actual expenditures during project delivery.	Soft costs "burn rate" should be proportionate to percent complete during the design and construction phases. Using a program which measures and relates soft cost expenses to earned values permits better tracking and control during project delivery.	✓					
	5.III.h 2007	Include a fixed ROW acquisition milestone schedule and obtain commitments from participating City departments.	Prolonged ROW acquisition can be avoided if all stakeholders agree on milestones to complete the acquisitions.		✓				
	5.III.i 2008	Implement an electronic progress payment system to improve efficiency	Reduction in the length of time and inefficiencies in processing of progress payments through the use of electronic means.	✓					
	5.IV.a 2006	Bundle small projects whenever possible.	Bundling small projects so that they are designed, bid, and constructed together will reduce project delivery cost proportionately.	✓	✓				
	5.IV.b 2007	Have a coordinator with expertise in the environmental process within the department delivering the engineering/capital project.	Identifying an environmental specialist within the project delivery team who is familiar with procedures and contacts within the approving entities will reduce permit procurement time and costs.	✓	✓			✓	
Consultant Selection and Use	6.c.	Include a standard consultant contract in the RFQ/RFP with an indemnification clause.	The negotiation of the design contract can be expedited if the consultant understands and agrees to the conditions of the contract at the time a proposal is submitted.	✓	✓				
	6.e.	Delegate authority to the Public Works Director/ City Engineer to approve consultant contracts under $250,000 when a formal RFP selection process is used.	Authorization for the Public Works Director/City Engineer to award consulting contracts ensures earlier start of design and construction management activities and will reduce consultant selection process costs.		✓				
	6.g.	Implement and use a consultant rating system that identifies quality of consultant performance.	The performance of consultants should be tracked so that those who deliver quality services at reasonable costs can be adequately considered for future awards.			✓			

Category	Ref:*	BMP	Description	Perceived Value					
				Cost	Schedule	Quality	Communication	Environment	Customer Satisfaction
Consultant Selection and Use	6.m 2006	Implement as-needed, rotating, or on-call contracts for design and construction management work that allow work to be authorized on a task order basis to expedite the delivery of smaller projects.	Establishing an on-call list of qualified consultants with expertise in a variety of design disciplines will expedite the start of the design process	✓	✓				
Sustainable Development	7.a.2009	Identify the environmental benefits of the project at the time of award.	Provide written, environmental benefits to the awarding authority on projects that use sustainable practices or aim to achieve LEED certification.					✓	

C. PROGRESS ON BEST MANAGEMENT PRACTICE IMPLEMENTATION

In *Update 2011*, the agencies continued to exchange ideas regarding strategies for implementing various BMPs using both the networking opportunities at the face-to-face meetings and the online discussion forum. Agencies continue to review and update BMPs that have been fully implemented for several years based on feedback received. Agencies also continue to pursue full implementation of BMPs though many remain only partially implemented. In some cases, constraints limit the full implementation of BMPs. In those instances, a partially implemented BMP is considered complete by that agency and is noted in **Table 4-2**. Full implementation of BMPs continues to be impacted by the continued current state of the economy, staff reductions, furloughs, and the management's increased involvement in resolving budgetary issues. The agencies continue to focus their efforts on monitoring adherence to BMPs that have been implemented and are judged to provide efficiencies in project delivery processes for participating departments. As of *Update 2011,* and including the addition of new BMPs, the agencies have fully implemented about 69 percent of all BMPs. Six (6) percent of the total BMPs have been partially implemented by the agencies. Many of the remaining BMPs require input and involvement from multiple departments and are more complicated to implement than other BMPs.

To support the linking of BMPs to performance improvements, BMP implementation by the agencies is tracked.

BMPs targeted for future implementation and progress on implementation of adopted BMPs since the Update 2010 are summarized below.

I. City of Los Angeles

Implemented from June 2010 to September 2011:	Targeted October 2010 Onward:
• 2.t. 2011 Lessen time period between design completion and issuance of notice to proceed. (partially implemented) • 4.V.c. 2003 Make bid documents available online. • 5.III.h 2007 Include a fixed ROW acquisition milestone schedule and obtain commitments from participating City departments (partially implemented).	• 2.r. 2011 Use of electronic signatures to do direct conversion from CAD to PDF. • 5.III.f 2006 Implement a Work Breakdown Structure (WBS) to measure progress on project deliverables. • 5.III.g 2006 Monitor "earned value" versus budgeted and actual expenditures during project delivery. • 7.a Identify the environmental benefits of the project at the time of award.

II. City of Long Beach

Implemented from June 2010 to September 2011:	Targeted October 2011 Onward:
• 3.III.a. Use a formal Quality Management System (partially implemented). • 2.s. 2011 Have awarding authority to approve plans, advertisement and award of contract in one board action.	• 3.I.a. Develop and use a standardized Project Delivery Manual (partially implemented).

III. City of Oakland

Implemented from June 2010 to September 2011:	Targeted October 2011 Onward:
• 2.n. 2006 Implement a rotating Request for Quote process for contracting small projects to streamline the bidding and award process during construction. (Include criteria for exemptions from formal Council approval). • 2.q. 2010 Receive bids electronically. (Partially implemented) • 2.s. 2011 Have awarding authority to approve plans, advertisement and award of contract in one board action. • 2.t. 2011 Lessen time period between design completion and issuance of notice to proceed. (partially implemented) • 4.IV.c. 2010 Agency should file as-built drawings within 6 months of project completion. (Partially implemented)	• 7.a Identify the environmental benefits of the project at the time of award (Partially implemented)

IV. City of Sacramento

Implemented from June 2010 to September 2011:	Targeted October 2010 Onward:
Department of Transportation • 2.s. 2011 Have awarding authority to approve plans, advertisement and award of contract in one board action. (City Council approval is not required to advertise) • 2.t. 2011 Lessen time period between design completion and issuance of notice to proceed. (partially implemented) • 5.III.f 2006 Implement a Work Breakdown Structure (WBS) to measure progress on project deliverables. • 5.III.i 2008 Implement an electronic progress payment/schedule of value system to improve efficiency. **Department of Utilities**	**Department of Transportation** • 2.o. 2007 Establish criteria for obtaining independent cost estimates which take in consideration both project characteristics and volatility of the market. (partially implemented) • 5.III.g 2006 Monitor "earned value" versus budgeted and actual expenditures during project delivery. **Department of Utilities**

V. City of San Diego

Implemented from June 2010 to September 2011:	Targeted October 2011 Onward:
• 2.r. 2011 Use of electronic signatures to do direct conversion from CAD to PDF. • 2.s. 2011 Have awarding authority to approve plans, advertisement and award of contract in one board/council action. • 2.t. 2011 Lessen time period between design completion and issuance of notice to proceed. • 5.III.h 2007 Include a fixed ROW acquisition milestone schedule and obtain commitments from participating City departments	• 5.III.g 2006 Monitor "earned value" versus budgeted and actual expenditures during project delivery. (partially implemented)

VI. City and County of San Francisco

Implemented from June 2010 to September 2011:	Targeted October 2011 Onward:
• 4.IV.b. 2010 Implement Electronic Contract Payment Process.	• 5.II.d. 2006 Implement verification procedures to ensure that PM training includes agency policies, procedures, forms, and standards of practice (scheduling, budgeting, claims avoidance, risk analysis, etc).

VII. City of San Jose

Implemented from June 2009 to September 2010:	Targeted October 2010 Onward:
• 2.s. 2011 Have awarding authority to approve plans, advertisement and award of contract in one board/council action. • 2.t. 2011 Lessen time period between design completion and issuance of notice to proceed. • 4.IV.c. 2010 Agency should file as-built drawings within 6 months of project completion. (Partially implemented) • 6.e. Delegate authority to the Public Works Director/City Engineer to approve consultant contracts under $250,000 when a formal RFP selection process is used. (Partially implemented – City Manager has such approval authority) • 7.a Identify the environmental benefits of the project at the time of award.	• 2.p.2008 Establish criteria for responsible charge design approval such that it occurs at the lowest appropriate organizational level in order to expedite design completion. • 3.1.a Develop and use a standardized Project Delivery Manual (partially implemented) • 3.III.a Use a formal Quality Management System. (partially implemented) • 3.III.m.2008 Maintain and regularly update electronic standard contract specifications and related documents as well as

Table 4-2 summarizes the BMPs that have been implemented by the participating Agencies, as well as the planned implementation priorities.

Table 4-2
Implementation of BMPs

Category	Ref:*	BMP	LA	LB	OK	SC		SD	SF	SJ	Notes
						DT	DU				
Planning	1.a.	Define capital projects well with respect to scope and budget including community and client approval at the end of the planning phase.	✓	✓	✓	✓	✓	✓	✓	✓	SC DU: Community involved after project is better-defined, typically at 30% design.
	1.b.	Complete Feasibility Studies on projects prior to defining budget and scope.	✓	✓	✓	✓	✓	✓	✓	✓	LB, SD: When applicable SC DU: Only on complex projects that require a Feasibility *Study*
	1.d.	Utilize a Board/Council project prioritization system.	✓	NI	✓	✓	TBD	✓	✓	NI	LA: Council allows Streets, Bridges and Stormwater programs a project priority system. SC DU: Getting closer to approved Asset Mgt system that would facilitate this BMP, but project drivers vary (permit requirements, projects in other departments, etc) SD: Result of CIP Benchmarking SF: Capital plan developed City-wide and priorities set by City-wide committee of major department heads.
	1.e.	Resource load all CIP projects for design and construction.	✓	NI	✓	✓	✓	✓	✓	✓	SC DU: Estimate drafting only.
	1.f.	Include a Master Schedule in the CIP that identifies start and finish dates for projects.	✓	NI	✓	✓	✓	✓	✓	✓	SC DU: Completion date only estimated, not determined by scheduling analysis.

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* See Process Questionnaire in Appendix C of 2002 Report; year noted indicates this BMP was added later.

Table 4-2
Implementation of BMPs (cont'd)

Category	Ref:*	BMP	LA	LB	OK	SC		SD	SF	SJ	Notes
						DT	DU				
Planning	1.g 2007	Make an early determination on which environmental document is required and incorporate into the schedule.	✓	✓	✓	✓	✓	✓	✓	✓	
	1.i.	Show projects on a Geographical Information System.	✓	✓	✓	✓	✓	✓	✓	✓	LB: Infrastructure only
Design	2.b.	Provide a detailed clear, precise scope, schedule, and budget to designers prior to design start.	✓	✓	✓	✓	✓	✓	✓	✓	SC DU: General scope only for simple projects.
	2.f.	Define requirements for reliability, maintenance, and operation prior to design initiation.	✓	✓	✓	✓	NI	✓	✓	✓	SD: Some Divisions only
	2.i.	Adapt successful designs to project sites, whenever possible (e.g. fire stations, gymnasiums, etc).	✓	✓	✓	✓	✓	NI	✓	✓	
	2.k. 2003	Train in-house staff to use Green Building Standards.	✓	✓	✓	NI	NI	✓	✓	✓	This BMP is intended to improve client satisfaction (quality) and may not reduce project delivery cost directly. SF: When applicable

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Table 4-2
Implementation of BMPs (cont'd)

Category	Ref:*	BMP	LA	LB	OK	SC		SD	SF	SJ	Notes
						DT	DU				
Design	2.i.	Adapt successful designs to project sites, whenever possible (e.g. fire stations, gymnasiums, etc).	✓	✓	✓	✓	✓	NI	✓	✓	
	2.k. 2003	Train in-house staff to use Green Building Standards.	✓	✓	✓	NI	NI	✓	✓	✓	This BMP is intended to improve client satisfaction (quality) and may not reduce project delivery cost directly. SF: When applicable
	2.l. 2004	Limit Scope Changes to early stages of design.	✓	✓	✓	✓	NI	✓	✓	✓	SC DU, SD: Control and minimize, but difficult to eliminate, since clients and engineers come up with new/better solutions.
	2.m. 2004	Require scope changes during design to be accompanied by budget and schedule approvals.	✓	✓	✓	✓	NI	✓	✓	✓	
	2.n. 2006	Implement a rotating Request for Quote process for contracting small projects to streamline the bidding and award process during construction. (Include criteria for exemptions from formal Council approval.)	NI	✓	✓	NI	NI	✓	✓	PI	SC DT: Maintains on-call consultant list for various engineering, traffic, landscape, architecture, and geotechnical services. SF: As-needed job order contracting (JOC). SJ: Regularly procures a number of on-call consulting service agreements in various disciplines.
	2.o 2007	Establish criteria for obtaining independent cost estimates which take in consideration both project characteristics and volatility of the market.	TBD	PI, TBD	TBD	2012	NI	TBD	✓	PI	LA will likely implement this in some fashion, but is still working out the details. We are considering only implementing this on projects over $10M. SF: Establishing estimating database SJ: No criteria established – done on a case-by-case basis.

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Table 4-2
Implementation of BMPs (cont'd)

Category	Ref:*	BMP	LA	LB	OK	SC		SD	SF	SJ	Notes
						DT	DU				
Design	2.p 2008	Establish criteria for responsible charge design approval such that it occurs at the lowest appropriate organizational level in order to expedite design completion	✓	TBD	TBD	✓	✓	TBD	✓	PI, 2010	
	2.q 2010	Receive bids electronically.	TBD	PI	PI	NI	TBD	TBD	NI	TBD	LB: Currently receive bids for projects less than $100k
	2.r. 2011	Use of electronic signatures to do direct conversion from CAD to PDF.	2012	TBD	NI	TBD	TBD	✓	TBD	TBD	
	2.s. 2011	Have awarding authority to approve plans, advertisement and award of contract in one board/ council action.	NI	✓	✓	✓	TBD	✓	TBD	✓	SCDT: City Council approval is not required to advertise. SJ: The Director of Public Works approves all plans and advertisements; also generally awards contracts $1M or less

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Table 4-2
Implementation of BMPs (cont'd)

Category	Ref:*	BMP	LA	LB	OK	SC		SD	SF	SJ	Notes
						DT	DU				
Design	2.t. 2011	Lessen time period between design completion and issuance of notice to proceed. Examples include items such as: - Pre-qualification of contractors - Good Faith Effort submitted on-line - Submittal incentives (i.e., award and material submittals allowed 30 day period. Every day early is added to construction contract duration) - Have ability to issue contracts within your department . - Electronic proposal documents provided 48 hours after bid opening. Hard copy provided at bid time - Contractor's self certification	PI	TBD	PI	PI	TBD	✓	TBD	✓	SCDT: Can the last item be clarified? What is meant by "contractor's self-certification"? SD: has an established contractors pre-qualification program
Quality Assurance/ Quality Control	3.I.a.	Develop and use a standardized Project Delivery Manual.	✓	PI, 2011	✓	✓	✓	✓	✓	PI, 2011	SC DU: Badly needs updating. LB: Staffing cuts have delayed completion SD: currently updating it as a result of some organization changes

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Table 4-2
Implementation of BMPs (cont'd)

Category	Ref:*	BMP	LA	LB	OK	SC		SD	SF	SJ	Notes
						DT	DU				
Quality Assurance/ Quality Control	3.II.b.	Perform a formal Value Engineering *Study* for projects larger than $1 million.	✓	✓	NI	✓	NI	✓	✓	NI	LA: For projects > $10M LB: As needed SC: As needed SD: As needed SF: As needed
	3.III.a.	Use a formal Quality Management System.	✓	✓	✓	✓	NI	✓	✓	PI, 2012	SD: Some Divisions only LB: Staffing cuts have delayed completion
	3.III.b	Perform and use post-project reviews to identify lessons learned.	✓	PI	✓	✓	✓	✓	✓	✓	SC DU: For selected projects in one-on-one meetings with design and construction staff. Also includes feedback from client. Intended to promote candid discussion. LB: Is being done only on projects that exceed 10% contingency or go into liquidated damages
	3.III.k 2007	Establish a Utility Coordinating Committee with members from public and private entities.	✓	PI	✓	✓	✓	✓	✓	✓	LB: Committee meets on an ad-hoc basis depending on utility availability
	3.III.l 2007	Designate a responsible person for and establish a process of notifications and milestones for utility relocations.	✓	NI	TBD	✓	✓	✓	✓	TBD	LB: PM remains responsible for all utility work on their projects SJ: Various Divisions/Sections have a utility coordinator and processes as needed
	3.III.m 2008	Maintain and regularly update electronic standard contract specifications and related documents as well as technical/ special provision.	✓	✓	✓	✓	✓	✓	✓	PI, 2012	SD: all standard documents are posted on the Dept. SharePoint for staff use.

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Table 4-2
Implementation of BMPs (cont'd)

Category	Ref:*	BMP	LA	LB	OK	SC		SD	SF	SJ	Notes
						DT	DU				
Construction Management	4.I.a.	Delegate authority to the City Engineer/Public Works Director or other departments to approve change orders to the contingency amount.	✓	✓	✓	NI	✓	✓	✓	✓	SD: Individual CO < $200,000 SF: At Bureau level SJ: Individual CO < $100,000
	4.I.m.	Classify types of change orders.	✓	✓	✓	✓	✓	✓	✓	✓	LA: Draft Special Order prepared.
	4.II.a.	Include a formal Dispute Resolution Procedure in all contract agreements.	✓	NI	✓	✓	✓	✓	✓	✓	SJ: For projects > $10 M LB: City Attorney will not allow this language in project specifications
	4.III.a.	Use a team building process for projects greater than $5 million.	✓	✓	✓	✓	✓	✓	✓	✓	LB: As-needed SD: As-needed SF: As-needed SJ: For projects > $10 M SCDU: As needed
	4.IV.a.	Involve the Construction Management Team prior to completion of design.	✓	✓	✓	✓	✓	✓	✓	✓	SD: always request a constructability review service from the CM team on all projects.

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Table 4-2
Implementation of BMPs (cont'd)

Category	Ref:*	BMP	LA	LB	OK	SC		SD	SF	SJ	Notes
						DT	DU				
Construction Management	4.IV.b 2010	Implement Electronic Contract Payment Process.	TBD	PI	TBD	NI	TBD	TBD	✓	TBD	LB: Currently done for some street related projects. SF: We are doing payments electronically via our first generation system which was demonstrated back in San Diego around 2008. We pay within the Mayor's directive of 10 to 15 days. And direct deposit is already available to the contractors through BofA.
	4.IV.c 2010	Agency should file As-built drawings within 6 months of project completion.	TBD	PI	TBD	✓	TBD	TBD	✓	PI	LB: being done on a go forward basis. Past projects still backlogged. SJ: Generally yes, however, it depends on post-construction circumstances. SD: has been implemented on sewer and water pipeline projects
	4.V.a. 2003	Delegate authority below Council to make contract awards under $1 million.	✓	✓	NI	NI	NI	✓	✓	✓	
	4.V.b 2003	Establish a pre-qualification process for contractors on large, complex projects.	✓	NI	✓	NI	✓	✓	✓	✓	LB: City uses minimum qualification in project specs in lieu of prequalification process
	4.V.c 2003	Make bid documents available online.	✓	✓	✓	✓	NI	✓	✓	✓	LA: Requested this through our ITA Dept for integration with our bid outreach application, but implementation will depend on their resource availability.

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Table 4-2
Implementation of BMPs (cont'd)

Category	Ref:*	BMP	LA	LB	OK	SC		SD	SF	SJ	Notes
						DT	DU				
Project Management	5.I.f.	Assign a client representative to every project.	✓	✓	✓	✓	✓	✓	✓	✓	
	5.I.j 2003	Create in-house project management team for small projects.	NI	✓	✓	NI	NI	NI	✓	✓	SC DU: Not enough PMs to justify this. Don't want to restrict staff to small, less-rewarding projects.
	5.I.k 2004	Institutionalize Project Manager performance and accountability.	✓	✓	✓	✓	PI, 2009	✓	✓	✓	SC DU: There is interest but no definite plan. Implementation, although partially complete, is taken as far as it can go with our Agency.
	5.II.a	Provide formal training for Project Managers on a regular basis.	✓	TBD	✓	✓	NI	✓	✓	TBD	LB, SD: Program implementation put on hold due to budget cuts
	5.II.d 2006	Implement verification procedures to ensure that PM training includes Agency policies, procedures, forms, and standards of practice (scheduling, budgeting, claims avoidance, risk analysis, etc).	✓	TBD	✓	✓	NI	✓	2012	TBD	
	5.III.a.	Adopt and use a Project Control System on all projects.	✓	✓	✓	✓	NI	✓	✓	✓	
	5.III.e 2006	Implement a financial system that tracks expenditures by category to monitor project hard and soft costs during project delivery.	✓	✓	✓	✓	✓	✓	✓	✓	LA: UPRS, Reports, Page 3 SC DT: Will complete automated report system by 2006. SC DU: Intend to utilize SC DT's software if it proves to function well with our PM Database.

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Implementation of BMPs (cont'd)

Category	Ref:*	BMP	LA	LB	OK	SC		SD	SF	SJ	Notes
						DT	DU				
Project Management	5.III.f 2006	Implement a Work Breakdown Structure (WBS) to measure progress on project deliverables.	2012	✓	✓	✓	NI	✓	✓	TBD	
	5.III.g 2006	Monitor "earned value" versus budgeted and actual expenditures during project delivery.	2012	NI	✓	2012	NI	PI, 2012	✓	NI	
	5.III.h 2007	Include a fixed ROW acquisition milestone schedule and obtain commitments from participating City departments.	PI	PI	TBD	✓	NI	✓	NI	✓	SF: No additional ROW required outside military base closure.
	5.III.i 2008	Implement an electronic progress payment/schedule of values system to improve efficiency.	TBD	NI	TBD	✓	NI	TBD	✓	TBD	LB: Current accounting system cannot accommodate a fully electronic approval process
	5.IV.a 2006	Bundle small projects whenever possible.	✓	✓	✓	✓	✓	✓	✓	✓	
	5.IV.b 2007	Have a coordinator with expertise in the environmental process within the department delivering the engineering/capital project.	✓	NI	NI	NI	NI	✓	✓	✓	SJ: Various Divisions/Sections have an environmental coordinator as needed

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Table 4-2
Implementation of BMPs (cont'd)

Category	Ref:*	BMP	LA	LB	OK	SC		SD	SF	SJ	Notes
						DT	DU				
Consultant Selection and Use	6.c.	Include a standard consultant contract in the RFQ/RFP with an indemnification clause.	✓	✓	✓	✓	✓	✓	✓	✓	SD: Some Divisions only
	6.e.	Delegate authority to the Public Works Director/City Engineer to approve consultant contracts under $250,000 when a formal RFP selection process is used.	NI	NI	NI	NI	NI	✓	✓	TBD	SC DU: Threshold is $100,000. LB: City Manager retains authority up to $100k SJ: City Manager has authority described.
	6.g.	Implement and use a consultant rating system that identifies quality of consultant performance.	✓	PI	✓	NI	NI	✓	✓	TBD	SC DU: Track performance for those selected for "support services." SJ: Need to incorporate more post-project review. LB: Used for on-call consulting services contracts
	6.m 2006	Implement as-needed, rotating, or on-call contracts for design and construction management work that allow work to be authorized on a task order basis to expedite the delivery of smaller projects	✓	✓	✓	✓	PI	✓	✓	✓	
Sustainable Development	7 . a . 2009	Identify the environmental benefits of the project at the time of award	2012	✓	PI, 2010	TBD	TBD	TBD	PI, TBD	✓	

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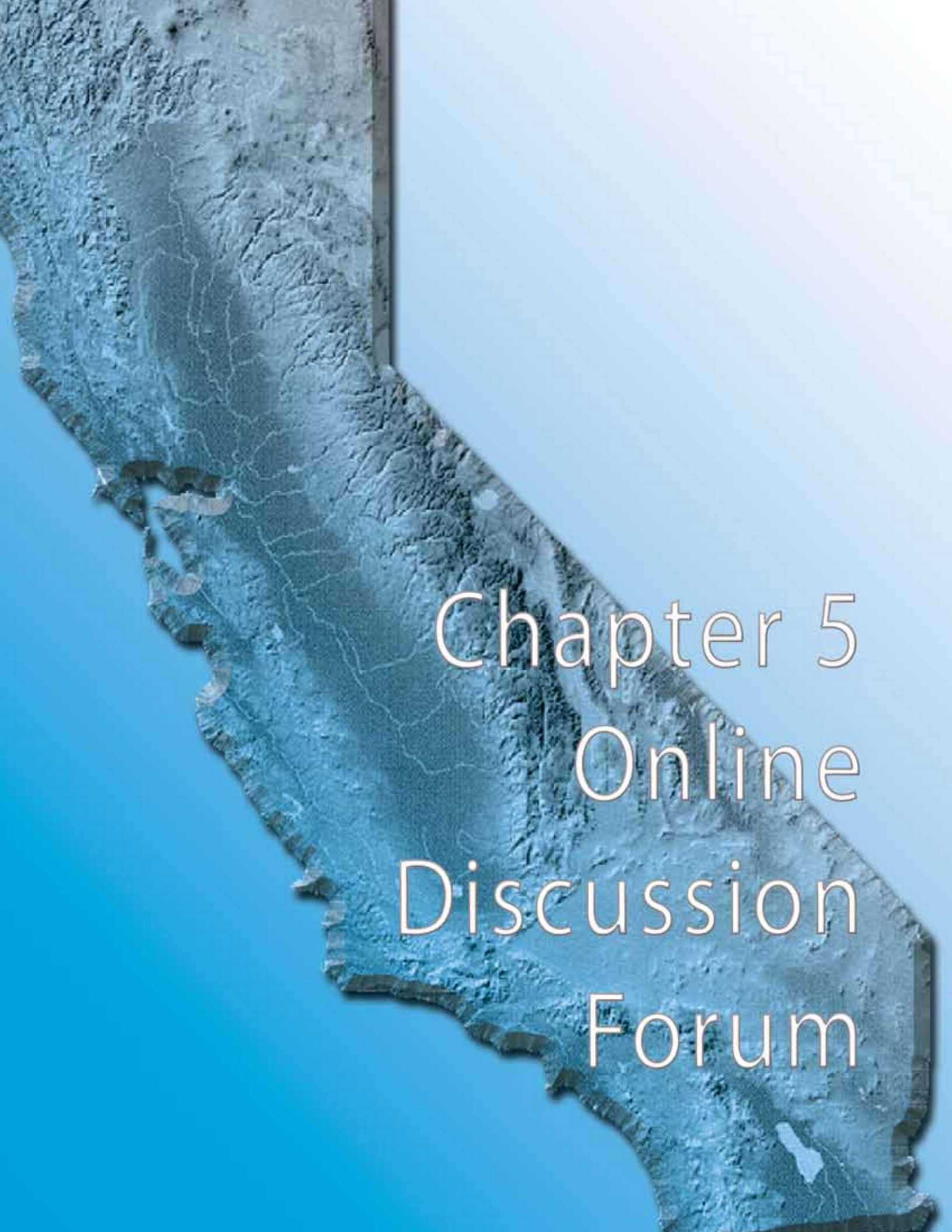


Chapter 5
Online Discussion Forum

CHAPTER 5 Online Discussion Forum

The ability to share issues or concerns continues to be one of the *Study* benefits most appreciated by the participating agencies. Information exchange occurs in a web based forum which provides an avenue to receive input from fellow team members. A total of eight topics were discussed during *Update 2011*. From this set of discussions, the following four topics are presented as an example of the types of informational exchanges that occurred within the *Update 2011* Online Discussion Forum.

- Time to Advertise, Award, and Issue Notice to Proceed
- Traffic Engineering Services
- Deferred Capital/Maintenance Backlog
- Consultant Selection Policies/Procedures

A. TIME TO ADVERTISE, AWARD AND ISSUE NOTICE TO PROCEED

The City of Oakland has experienced a gradual increase in the amount of time it takes to progress a construction project from Final Plans to Notice to Proceed. The City's goal is to progress from Final Plans (design completion) to issuance of the construction Notice to Proceed within a six-month period. However, the City has found that recent projects have been taking substantially longer to complete.

Observing this recent trend, the City of Oakland posed the following questions enquiring about durations for:

Signed Plans to Notice to Proceed?
If additional details are available, please provide the following:

1. Sign plans to Bid Opening?
2. Bid Opening to Council/ Board Approval?
3. Council/Board Approval to Executed Contract?
4. Executed Contract to Notice to Proceed?

Provide additional comments, observations or recommendations that may improve the process.

The City of Oakland also provided the time taken by the City for completing each of the four items listed above. Their durations for the project steps outlined above are as follows:

Activity	Duration
Sign plans to Bid Opening	7.9 weeks
Bid Opening to Council/Board Approval	12.4 weeks
Council/Board Approval to Executed Contract	16 weeks
Executed Contract to Notice to Proceed	4 weeks

The City of Los Angeles award process also takes 6 months on average; however the duration can be longer if there are bid protests. Detailed durations for the project steps outlined above for the City of Los Angeles are as follows:

Activity	Duration
Sign plans to Bid Opening	10.5 weeks
Bid Opening to Council/Board Approval	8 weeks
Council/Board Approval to Executed Contract	2.5 weeks
Executed Contract to Notice to Proceed	1-2 weeks

The City of Los Angeles also provided several internal documents; Bid and Award Flow Chart, Bid and Award Flow Chart – Process Step Description, and List of Contracting Requirements for Personal Services Consultants and Construction Contracts.

The City of Sacramento, Department of Transportation (DOT) award process is about 3 months. The City responded with the following durations for their corresponding project steps:

Activity	Duration
Sign plans to Bid Opening	4.5 weeks
Bid Opening to Council/Board Approval	4 weeks
Council/Board Approval to Executed Contract	1 weeks
Executed Contract to Notice to Proceed	2 weeks

For federally funded projects, one week should be added to the total duration for all City of Sacramento, DOT projects. For projects under $100,000, two weeks can be subtracted from the total duration because the City's Director of Transportation can sign the contract without the approval of the City Council. The City of Sacramento, DOT has shorter durations for corresponding project steps because:

1. Their department has a Contracts Officer that handles bid advertisement, bid analysis and contract processing.

2. They are not required to go to the City Council to request approval for advertising bids

3. On time critical projects, they add a provision in the contract specifications that requires the lowest responsive and responsible contractor to provide a signed agreement, bonds and proof of insurance prior to the City Council award date.

Response from the City of Sacramento, Department of Utilities generally matched that of the City's DOT. However, they have noticed an increase in the durations of steps leading to a Notice to Proceed. Some recent developments, such as a new on-line Council Letter process, will eventually increase the total duration between the Advertise Date to the Notice to Proceed beyond their current planned 3 month duration.

The City of San Diego has experienced timeframes that are substantially longer than other agencies. Factors contributing to the longer timeframes include strict review of insurance documents, Equal Opportunity Contracting Program (EOCP) documentation review, some new internal controls, and current vacancies in some contracting positions. An overall average between the Advertised Date and the Notice to Proceed is approximately 9 months. Detailed durations are as follows:

Activity	Duration
Sign plans to Bid Opening	11.9 weeks
Bid Opening to Council/Board Approval	14.7 weeks
Council/Board Approval to Executed Contract	14.4 weeks
Executed Contract to Notice to Proceed	7.3 weeks

The City of Long Beach takes approximately four months to process and provide the following typical timelines:

Activity	Duration
Sign plans to Bid Opening	6 weeks
Bid Opening to Council/Board Approval	4 weeks
Council/Board Approval to Executed Contract	4 weeks
Executed Contract to Notice to Proceed	3 weeks

The City of San Francisco provided their ideal target durations for the identified milestones. This is labeled "Baseline." The City provided information from three sample projects. Below is the average data from these three projects and how they compare to the City's baseline:

Activity	Duration
Sign plans to Bid Opening	6.0 weeks
Bid Opening to Council/Board Approval	3.8 weeks
Council/Board Approval to Executed Contract	4.0 weeks
Executed Contract to Notice to Proceed	4.1 weeks

The City of San Jose provided an overview of their average data since June 2010:

Activity	Duration
Sign plans to Bid Opening	4.2 weeks*
Bid Opening to Council/Board Approval	4.2 weeks*
Council/Board Approval to Executed Contract	Data not broken down** 8.7 week average for both activities.
Executed Contract to Notice to Proceed	Data not broken down**

Legend

* The City of San Jose adopted BMP 4.V.a 2003 allowing the Director of Public Works to have authority to award construction contracts up to $1 million. This, in many cases, streamlines their process, however, if bid irregularities or protests occur, the time is extended. This average takes both the streamlined process and potential for bid irregularities and protests into consideration.

** Data is tracked from Award to Notice to Proceed. The duration between these milestones is, on average, two months.

B. TRAFFIC ENGINEERING SERVICES

The City of San Jose's Department of Transportation Traffic Operations Section conducted a benchmarking study specifically looking at how agencies deliver traffic engineering services to their customers. Their benchmarking questions were:

1. How many traffic signals does your agency operate and maintain?
2. How many signals are on-line?
3. Please provide an estimate of how many new signals and how many signal modifications are performed in your jurisdiction per year.
4. What is the number of staff persons, or FTEs, that are responsible for traffic signal design services?
5. What is the number of staff persons, or FTEs, that are responsible for operations and timing? Do they work outside normal office hours?
6. In general, how are the following services provided by your jurisdiction? Are they done in-house, contracted out, or provided by some other means? Please note differences, if any, between CIP, Development, and projects by other agencies.

- Traffic signal design
- Traffic signal design review
- Traffic signal material review
- Traffic signal construction cost estimates
- Traffic signal construction engineering support
- Producing work orders for signal work
- Maintenance of traffic signal record drawings
- Oversight of signal operations
- Traffic signal timing plan design
- Field implementation of timing plans
- Review of installed timing plans
- Collection/analysis/archiving of traffic data
- Response to traffic signal related trouble calls/complaints

Additionally they requested that each agency describe any services provided related to traffic signal design, construction, or operations that were not covered above.

All agencies responded to the posted questions. **Table 5-1** provides a summary of each agency's response.

Table 5-1
Traffic Engineering Services

Questions	Long Beach	Los Angeles	Oakland	Sacramento DOT	San Diego	San Francisco	San Jose
How many traffic signals does your agency operate and maintain?	599 plus 34 by contract in adjacent cities	4400	633	707	1500	1184	901
How many signals are on-line?	572	4010	21 and 67 coming on-line this year	300 (80IP base / 220 interfacing in serial mode)	1100	140-150	650
Please provide an estimate of how many new signals and how many signal modifications are performed in your jurisdiction per year?	4 to 5 new and 10 to 15 modification	300+/-	4 new and 10 modification	2 new and 2 modification	2 new and 1-10 modification	5 new and 10 upgrades/ modification	Average 3 new, 7 modifications per year
What is the number of staff persons, or FTEs, that are responsible for traffic signal design services?	4	6 Engineers & 4 Drafting techs	1.5	3 Engineers & 2 Drafters	2 Asst. Engineer & 1 Assoc. Engineer	Typically, our engineering group will design the signal layout and the signal timing and out traffic signals electricians programs the controllers and maintain the signal. 10 FTE engineering / 22 FTE electrician/ maintenance	4 FTE
What is the number of staff persons, or FTEs, that are responsible for operations and timing? Do they work outside normal office hours?	8 and they do work overtime	30. The traffic management center is staffed 6AM – 10PM, seven days a week	One and they do work outside normal office hours	3 engineers & 2 technicians	Budgeted for 6 FTE for signal timing & 2 Sup. These positions do more than just signal timing. They do work overtime if called on emergencies		7 FTE / Yes
In general, how are they following services provided by your jurisdiction? Are they done in-house, contracted out, or provided by some other means? Please note differences, if any, between CIP, Development, and project by other agencies							
Traffic signal design	Both in-house and with consultants	In-house	Both in-house and with consultants	In-house if CIP, otherwise consultant	CIP is done both in-house with consultants	In-house	CIP - in-house, Development – in-house/ consultant

Table 5-1
Traffic Engineering Services (cont'd)

Questions	Long Beach	Los Angeles	Oakland	Sacramento DOT	San Diego	San Francisco	San Jose
Traffic signal design review	In-house	In-house	In-house	In-house	In-house	In-house	In-house
Traffic signal material review	In-house	In-house	In-house	In-house	In-house	In-house	In-house
Traffic signal construction cost estimates	In-house	In-house	In-house	In-house if CIP, otherwise consultant	CIP work is done in-house	In-house	In-house
Traffic signal construction engineering support	In-house	In-house	In-house	In-house if CIP, otherwise consultant	In-house	In-house	In-house
Producing work orders for signal work	In-house	In-house	In-house	In-house	In-house	In-house	In-house
Maintenance of traffic single record drawings	In-house	In-house	In-house	In-house	In-house	In-house	In-house
Oversight of signal operations	In-house	In-house	In-house	In-house	In-house	In-house	In-house
Traffic signal timing plan design	In-house	In-house	In-house	In-house if CIP, otherwise consultant	Typically in-house, sometimes contracted	In-house	In-house / Consultant
Field implementation of timing plans	In-house	In-house	In-house	In-house	In-house	In-house	In-house
Review of installed timing plans	In-house	In-house	In-house	In-house	In-house	In-house	In-house
Collection/analysis/ arching of traffic data	In-house	In-house	In-house	In-house	In-house	In-house	In-house / Consultant
Response to traffic signal related trouble calls/ complaints	In-house	In-house	In-house	In-house	In-house	In-house	In-house

C. DEFERRED CAPITAL/ MAINTENANCE BACKLOG

The City of San Diego was in the process of preparing a report to their City Council on Deferred Capital/Maintenance backlog in mid-March 2011. The City enquired whether the participating agencies had any similar deferred maintenance (capital) backlog estimates for streets, buildings, and storm drains. The City of San Diego provided a definition of how they defined the problem, and categories that would help orient the participating agencies with the information being requested.

"Deferred Capital" is a term that refers to the following types of conditions:

- Items that are broken and can't be economically repaired
- Items that have reached the end of their useful service life
- Items that are presently not in place and should be installed
- Items that don't meet the standard regulatory codes
- Items related to hazardous materials (e.g., asbestos and lead-based paint)

This discussion includes the following assets:

- Streets/alleys
- Buildings/facilities
- Storm drains

Does not include the following assets:

- Sidewalks
- Water and sewer infrastructure
- Right of way features (signs, signals, guardrails, trees)
- Drainage channels
- Bridges
- Convention Center
- Qualcomm Stadium/Petco Park

Information requested is shown below:

1. Streets

- Estimated cost of asphalt streets to maintain acceptable rating or better ($)
- Estimated cost concrete streets ($)

2. Buildings

- Number of public safety buildings (#) and estimated cost for facility renewal or replacement ($)
- Number of civic and public buildings (#) and estimated cost for facility renewal or replacement ($)

3. Storm Drains

- CMP drains estimated mileage (mi) and estimated cost of replacement ($)
- Other drainage backlog mileage (mi) and estimated cost ($)

Responses were received from five agencies. The detailed responses can be found in **Table 5-2** below.

Table 5-2 City of San Diego
Deferred Capital/Maintenance backlog

Questions	1. Streets: Asphalt and Concrete?	2. Buildings: Number of Public Safety Buildings and cost for replacement, Number of Civic Buildings and cost of replacement?	3. Storm Drains: CMP mileage and cost of replacement, other drainage mileage and estimated cost of replacement?
City of Long Beach	Asphalt - $110m Concrete - $40m	Number of public safety buildings – 42 Replacement costs - $44m Number of Civic buildings – 84 Replacement costs - $112m	CMP mileage – 12 miles Replacement costs - $6m Other drainage miles – 43 miles Replacement costs - $105m
City of Los Angeles BOE	Asphalt – 1.92b Concrete - $included in Asphalt amount	Number of public safety buildings – NA Replacement costs - NA Number of Civic buildings – NA Replacement costs - NA	CMP mileage – 30 miles Replacement costs - $100m Other drainage miles – 770 miles Replacement costs - $200m
City of Oakland	Asphalt - $420m Concrete – Included in Asphalt amount	Number of public safety buildings – 34 Replacement costs - $500m (approx) Number of Civic buildings – 266 Replacement costs - $500m (approx)	CMP mileage – Replacement costs – Included below Other drainage miles – Replacement costs - $220m
City of San Francisco	Asphalt - $Included below Concrete - $2.226b	Number of public safety buildings – NA Replacement costs - $Included below Number of Civic buildings – NA Replacement costs - $4.452 b	CMP mileage – Not Available (NA) Replacement costs - NA Other drainage miles – NA Replacement costs - NA
City of San Jose	Asphalt - $277m Concrete – No information available	Number of public safety buildings – 0 Replacement costs - 0 Number of Civic buildings – 0 Replacement costs - 0	CMP mileage – 0 Replacement costs - 0 Other drainage miles – 25 miles Replacement costs - $40m
City of San Diego	Asphalt - $378m Concrete - $included in Asphalt amount 2,574 miles of asphalt and 111 miles of concrete, excluding alleys	Number of public safety buildings – 64 Replacement costs - $included below Number of Civic buildings – 5 (or 379?) Replacement costs - $216m	CMP mileage – 38 miles Replacement costs - $Included below Other drainage miles – 46 miles Replacement costs - $246m

D. CONSULTANT SELECTION POLICIES/PROCEDURES

The City of San Jose was revisiting their Council-approved Qualifications Based Consultant Selection (QBCS) Policy/ Procedures. This procedure applies strictly to architectural/engineering service consultant procurement. They enquired whether the participating agencies had such a strict policy/procedure or if they had a general procurement procedure. The City of San Jose also requested copies of documents if those were readily available. Reponses were received from all agencies.

The City of Long Beach follows Senate Bill 419, known as the Mini Brooks Act for consultant selection. This is a qualification based selection procedure. They made reference to Consulting Engineers & Land Surveyors of California (CELSOC) and American Public Works Association (APWA) for topics related to this subject. They provided a copy of a 1991 legislative legal review which states that even Charter Cities must comply with the Mini Brooks Act.

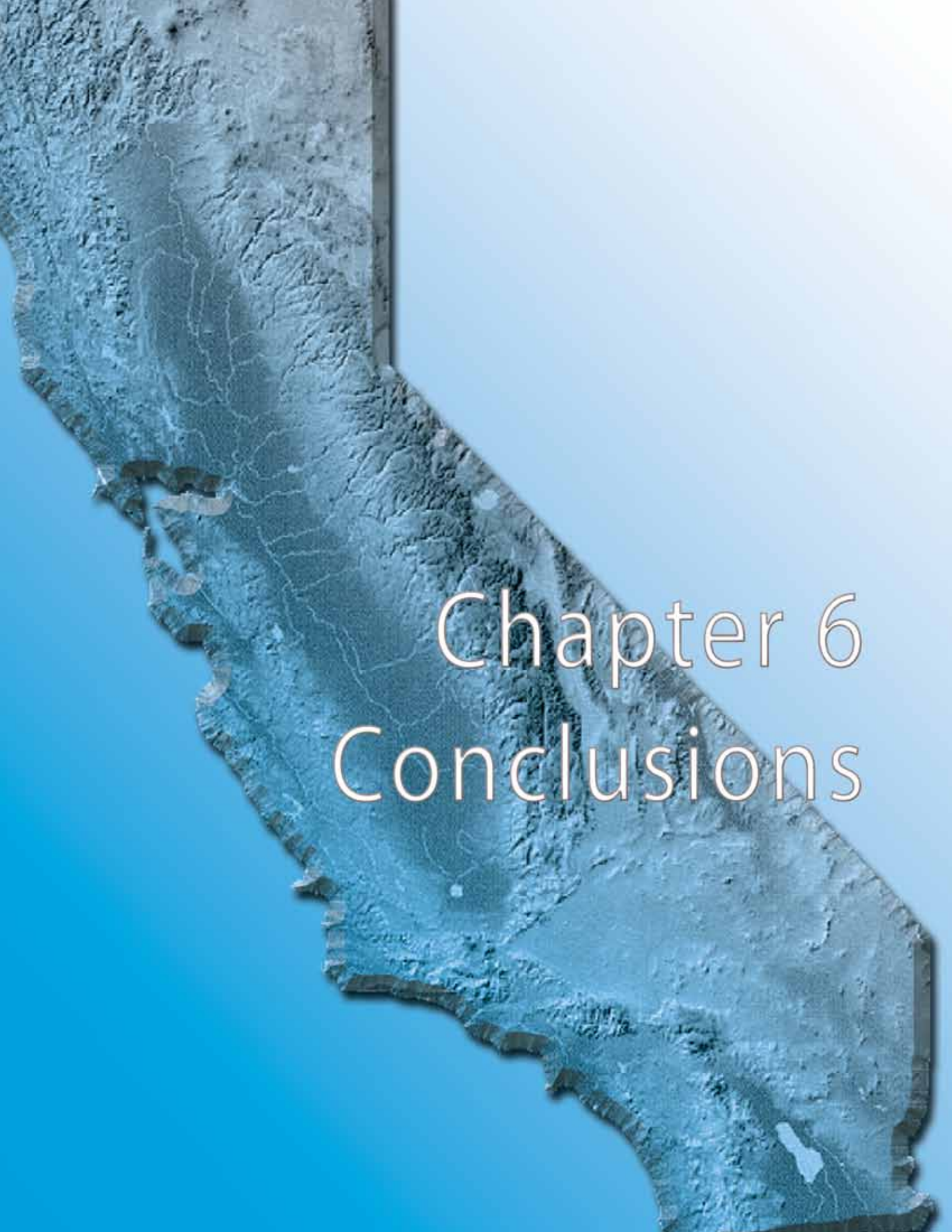
The City of Los Angeles' procedures for personal services contracts can be found in their Project Delivery Manual located online at http://eng.lacity.org/index.cfm. The Manual, located under the Technical Information tab, outlines a qualification based selection process. The procedures are found in Chapter 6. The website also contains the City's current lists of pre-qualified on-call consultants.

The City of Sacramento, Department of Transportation provided Sections 8-1 through 8-6 of Chapter 8: Contracts from their Project Delivery Manual which outlines a qualification based selection process.

The City of San Diego provided a portion of their Administrative Regulation Review Number 25.60, effective June 1, 2004, regarding consultant selection. In addition, they also provided Council Policy Number 300-07, effective August 10, 2004 regarding consultant services selection along with the City's Standard Operating Procedure for procurement of architectural and engineering consultants. Described within the document is a qualification based selection process.

The City of San Francisco, Bureau of Engineering consultant selection process is qualification based. They provided Volume 9, Sections 9.5.1 Request for Qualifications/Proposals, 9.5.2 Consultant Selection Process, and 9.5.3 Administering Consultant Contracts from their Project Delivery Manual which addresses consultant selection process.

The City of Oakland's consultant selection process is also qualification based. The City provided Volume 1, Chapter 6, Section 6.3 – Consultant Selection Process from their Design and Construction Services Department Project Delivery Manual which outlines the various steps taken during the entire selection process.



Chapter 6
Conclusions

CHAPTER 6 Conclusions

A. PERFORMANCE BENCHMARKING

Performance Benchmarking for the *Update 2011 Study* involved analysis of 676 projects in the projects database. In prior *Study* years, project costs data were only collected and analyzed for projects delivered using the traditional design-bid-build method. For the Update 2010 *Study*, the agencies decided to collect costs data for projects delivered via alternative delivery methods for potential analysis at a later date when sufficient numbers of projects are collected to facilitate meaningful analyses. Collection of projects delivered via alternative methods continued in 2011. Fifteen projects funded by the American Recovery and Reinvestment Act (ARRA) of 2009 are also included in the *Update 2011* database.

The results of the performance benchmarking evaluation show that in almost all cases project delivery costs expressed as a percentage of TCC are higher for projects with lower TCCs. This clearly indicates that an economy of scale exists in the delivery of capital projects. Project delivery percentages (arithmetic averages) for the *Update 2011 Study* varied between the following values for the full range and the smaller project subset of TCC respectively:

Table 6-1
Update 2011 Project Delivery Percentages

Type	Project Delivery Percentages
Municipal Projects	37% - 38%
Parks Projects	44% - 48%
Pipes Projects	36% - 38%
Streets Projects	44% - 47%

Although the results of the performance analyses are based on historical data provided by the participating agencies, there are several factors that could affect project delivery and are not captured in the performance model. These external factors include personnel turnover in the agencies, competitive bids etc. which impact project delivery. Since such factors are not captured in the performance model, the reader is cautioned that the improved results of the regression analyses only be used as a reference and not for prediction of performance. In addition, in light of the current bid environment, it is recommended that the reader use best judgment in the context of the current economic downturn when using the *Study* results for planning and budgeting.

Increasing the size of the project database is a major challenge posed to the *Study*. This is primarily because of the 5-year rolling window criterion for project completion dates; even as new projects are added, old projects are excluded from analyses by the window of time.

The agencies also acknowledge that the benefits of projects delivered via alternative delivery techniques need to be quantified by including them for analysis in the project database. However, due to the significant difference in delivery mechanisms, those projects will have to be analyzed separately from the rest of the projects in the database. Projects delivered by alternative techniques will continue to be compiled in the database until sufficient data are available to perform meaningful analyses.

The agencies recognize the need to evaluate the impacts of low construction bids on project delivery percentages. It is very likely that project delivery percentages might increase due to the reduced construction bids prevalent in the current economy. However, using such delivery percentages to budget a program of projects in the future may be misleading as construction costs are bound to increase with a reversal in the economy.

B. BEST MANAGEMENT PRACTICES

In *Update 2011*, the agencies continued to exchange ideas regarding strategies for implementing various BMPs using both the networking opportunities at the face-to-face meetings and the online discussion forum. In *Update 2011*, the Project Team added three new BMPs:

- 2.r.2011 – Use of electronic signatures to do direct conversion from CAD to PDF.
- 2.s.2011 – Have awarding authority to approve plans, advertisement, and award of contract in one board action.
- 2.t.2011 – Expedite project duration from design completion to notice to proceed. Examples include items such as: Pre-qualification of contractors, good faith effort submittal on-line, submittal incentives, contract liaison within department, electronic proposal documents provided 48 hours after bid opening, contractor's self certification.

These new BMPs along with the existing BMPs are believed to directly influence cost, schedule, quality, communication, environment or customer service aspects of design or construction management and, ultimately, project delivery efficiency.

Agencies continue to review and update BMPs that have been fully implemented for several years based on feedback received. Agencies also continue to pursue full implementation of BMPs though many remain only partially implemented. In some cases, constraints limit the full implementation of BMPs. Full implementation of BMPs continues to be impacted by the continued current state of the economy, staff reductions, furloughs, and the management's increased involvement in resolving budgetary issues. The agencies continue to focus their efforts on monitoring adherence to BMPs that have been implemented and are judged

to provide efficiencies in project delivery processes for participating departments.

To support the linking of BMPs to performance improvements, BMP implementation by the agencies is tracked. As of *Update 2011*, and including the addition of new BMPs, the agencies have fully implemented about 69 percent of all BMPs. Six (6) percent of the total BMPs have been partially implemented by the agencies. Many of the remaining BMPs require input and involvement from multiple departments and are more complicated to implement than other BMPs.

C. ONLINE DISCUSSION FORUM

In *Update 2011*, the Online Discussion Forum continues to be an important feature for *Study* participants, with active, meaningful exchanges occurring along with important issues being addressed resulting in changes to policy, approach, or BMP implementation. Participants continue sharing information through the Online Discussion Forum and during the face-to-face meetings. The interesting outcomes of these discussions are presented to the public through the *Study* reports. The continued sharing of challenges and solutions through the Online Discussion Forum remains a remarkable benefit to all participants.

D. PLANNING FOR UPDATE 2012

Over the course of *Update 2011*, the Project Team identified a number of activities to consider including next year in *Update 2012*. These activities include:

- Continue collecting data on projects delivered via alternative delivery techniques. It is expected that in 2012, a sufficient number of projects will be available to facilitate meaningful analyses;
- Consider evaluating change orders as a percentage of TCC for the 2008-2011 period;
- Exploring the impacts of reduced construction bids on project delivery costs for the 2008-2011 period;
- Adding projects delivered by ARRA funds to the projects database for inclusion in the analysis;
- Developing new BMPs and tracking the implementation of adopted BMPs;
- Continuing discussion on current topics via the round-table discussion forum; and
- Continuing meaningful exchanges on the Online Discussion Forum via a new SharePoint website.

E. ACKNOWLEDGEMENTS

The participation and contribution of the following individuals to the *Study* is gratefully acknowledged. This work would not have been possible without their contributions.

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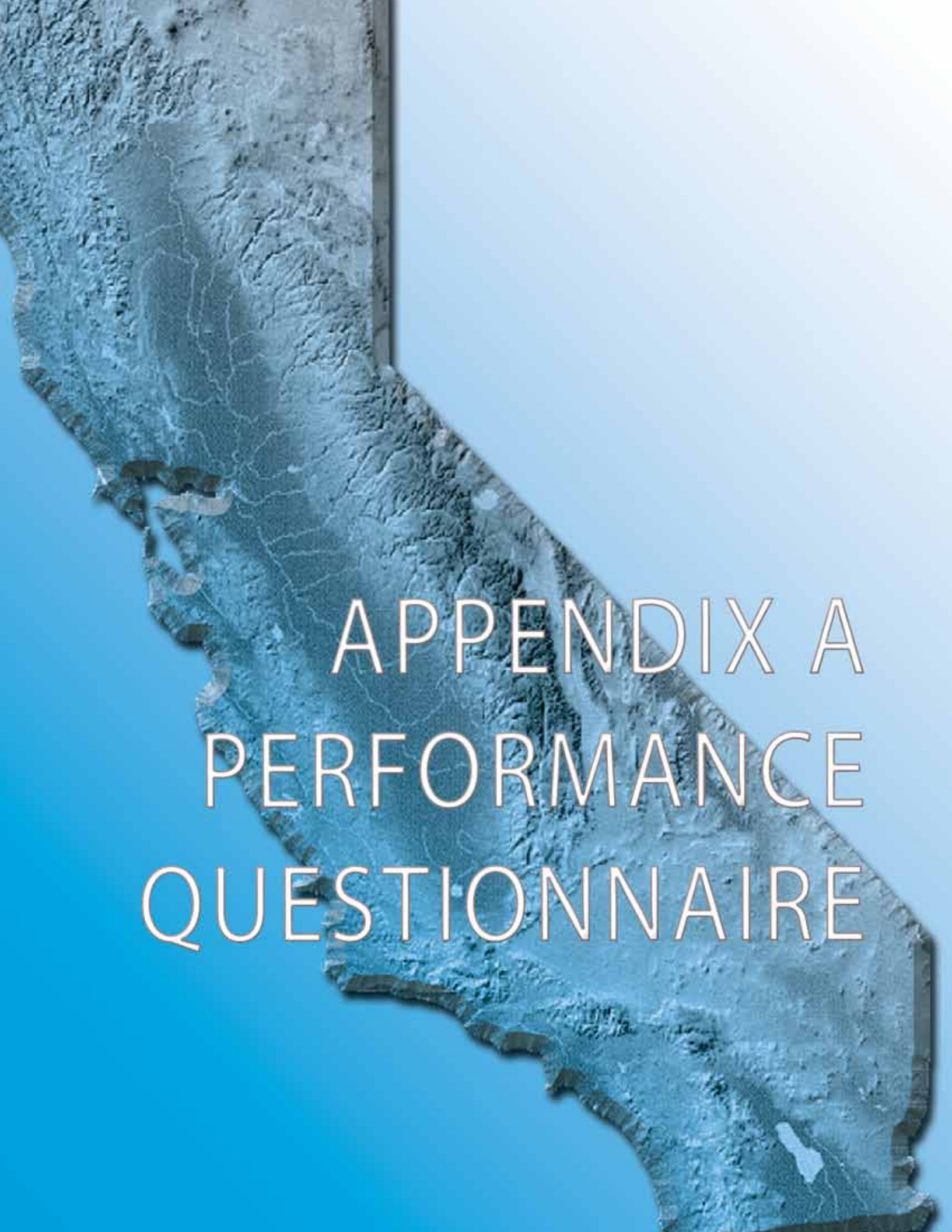
APPENDICES



APPENDIX A PERFORMANCE QUESTIONNAIRE

APPENDIX A Performance Questionnaire

California Multi-Agency Benchmarking Study Update 2011 Performance Questionnaire

Agency: | Project Name:

Project type:

New/Rehab Index:

Alternative Project Delivery:

☐ LEED Green Building

☐ Project Financial Elements Closed and Complete

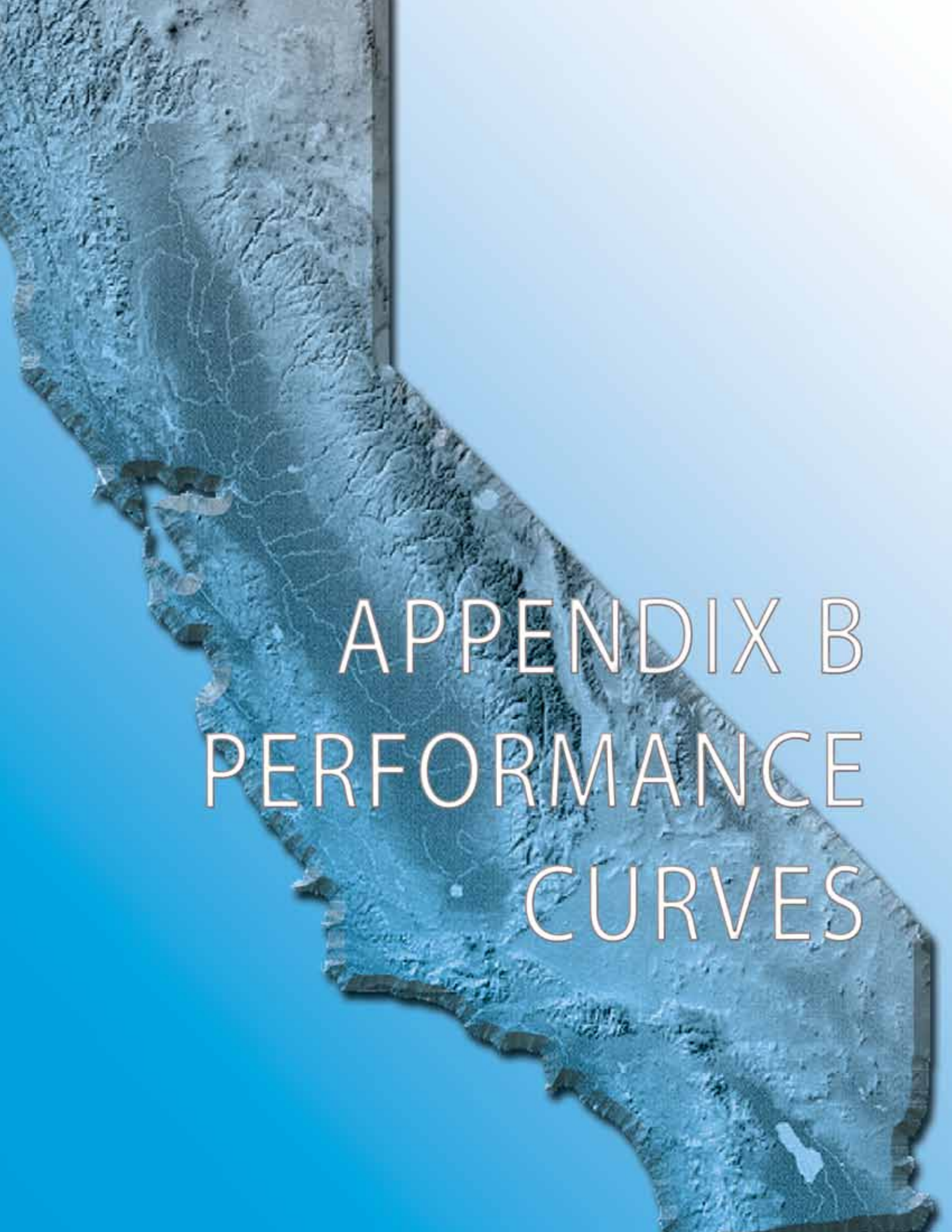
Description:

Comments:

	Planning		Design		Construction		Total	
	DOLLAR	% of TCC*	DOLLAR	% of TCC*	DOLLAR	% of TCC*	DOLLAR	% of TCC*
AGENCY LABOR								
AGENCY COSTS(1)								
Art Fees								
SUB-TOTAL AGENCY								
CONSULTANT								
TOTALS								
PHASE DURATION		Months		Months		Months		

AMOUNT OF CONSTRUCTION CONTRACT ENGINEER'S ESTIMATE							
COST OF CHANGE ORDERS	Changed Conditions		Changed Bid Documents		Client-Initiated Changes:		Total Change Orders $-
UTILITY RELOCATION COST							
CITY FORCES CONSTRUCTION							
TOTAL CONSTRUCTION COST (TCC)							
LAND ACQUISITION							
PROJECT COMPLETION DATE							
TOTAL PROJECT COST							$-
NUMBER OF BIDS RECEIVED							

(1) Agency costs include other direct costs and can be listed underneath.
This value is locked and it is calculated from its items (Rows 15 - 19)



APPENDIX B PERFORMANCE CURVES

APPENDIX B Performance Curves

REGRESSION ANALYSIS RESULTS

The results of the regression analysis performed using the performance model are presented in the following paragraphs.

REGRESSION DEFINITIONS

A brief overview of the relevant statistical terminology and their definitions is provided in the following paragraphs:

Performance curves produced for this Study are regressions of data, demonstrating how close of a relationship exists between the dependent variable (on the y-axis) and the independent variable (on the x-axis). For instance, a regression curve of design cost versus total construction cost (TCC) would be prepared to evaluate how much of the variability in design cost is due to the TCC value.

The regression trendline can be used as a starting point for evaluating the budget for a suite of projects. Caution and use of professional judgment is required if using the regression trendline to budget an individual project.

Confidence Interval

The upper and lower bounds of the confidence interval indicates the level of certainty in a data set and how likely it is that a random sample from the data set will fall within the interval. The wider the distance between the upper and lower bounds of a confidence interval, the less certainty in the model and greater the need to collect more data before drawing conclusions from the data set.

Coefficient of Determination

A best-fit logarithmic curve is calculated using the least-squares method in Excel®, and a R^2 value is displayed. The R^2 value, also called the coefficient of determination, is a value between 1 and 0, with a value approaching 0 indicating a poor model and a value approaching 1 indicating a high dependence of the y-value statistic on the x-value statistic.

Statistical Significance

To evaluate the statistical significance of the result obtained, the regression analyses included a calculation of p-values. Whereas the R^2 value is a descriptive statistic (i.e., describes the current set of data), the p-value is a predictive statistic. It indicates whether there are enough data points to arrive at statistically-significant results and whether the data set could be used to forecast new values. The selection of a desirable p-value is subjective, though 0.10 or 0.05 is typically used as the maximum desirable value.

For the purposes of this *Study*, a critical p-value of 0.10 was selected. Thus, any result where $p \leq 0.10$ is considered statistically significant. There is no difference between a p-value slightly below 0.10 as one that is far below 0.10. Both results are considered to have equal statistical significance.

For regressions resulting in a p-value above 0.10, additional projects should be added to the database to improve the result. Please see the *Study 2002* report for additional detail on the connection between the number of projects and p-values.

For each of the regressions, the R^2 value and p-value should be considered separately. A high R^2 value does not mean the result is statistically-significant, and vice-versa.

The results of the regression analyses are discussed in the remainder of this section. The results of the regression analyses are summarized in **Table B-1** and **Table B-2**. **Table B-1** summarizes the performance model results for the full range of TCC while **Table B-2** summarizes the results for the smaller project subset of TCC. These tables also summarize the design, construction management, and project delivery costs expressed as a percentage of the TCC and the R^2 and the p-values for the different project types.

It is important to note that while the slopes of the linear regression models are an expression of the project delivery cost as a percentage of construction, the slopes are not equal to the average and median project delivery percentages shown in **Table 3-5**, **Table 3-6** and **Table 3-7**. This is due to the fact that the linear trendline is fit by the least squares method.

This is better explained by the following example. Consider 5 projects in the municipal category having the a1, a2, a3, a4, and a5 as their individual project delivery costs and b1, b2, b3, b4, and b5 as their individual TCC. The arithmetic average of the project delivery percentages would be represented as:

Project Delivery Percentage =

$$\left(\frac{a1}{b1} + \frac{a2}{b2} + \frac{a3}{b3} + \frac{a4}{b4} + \frac{a5}{b5} \right) \Big/ 5$$

The project delivery percentages presented in **Table 3-5**, **Table 3-6**, and **Table 3-7** are computed using the above formula which is the average of the individual project delivery percentages

In the regression analysis, the project delivery percentage is computed in fashion that is more similar to the following formula which represents the average slope of the least squares fit.

Project Delivery Percentage =

$$\left(\frac{a1 + a2 + a3 + a4 + a5}{b1 + b2 + b3 + b4 + b5} \right)$$

The project delivery percentages presented in **Table B-1** and **Table B-2** are computed using the above formula.

The plots depicting the regression relationships are shown in this section. It should also be noted that while majority of projects are clustered near the origin of the graph, the slope of the trendline is predominantly governed by the data points scattered at relatively high TCC values. Since the slope of the trendline provides the design, construction management, or the project delivery costs as a percentage of the TCC for a group of projects, the results better reflect the properties of a program of projects rather than that of an individual project. Therefore, the reader must avoid budgeting individual projects based solely on these analyses.

In most cases, the results reflect the agencies' experience with the delivery of capital projects that on a percentage basis projects with lower TCCs are more expensive to deliver than projects with higher TCCs. Only four out of the 16 categories have lower project delivery percentages for the smaller subset of projects than the full range of projects. It is concluded that the model results are reasonable from a statistical perspective.

For projects belonging to the Pipes category, there is an increase of approximately eight percent in the project delivery percentages for projects evaluated in the smaller project subset of TCC. Similarly, project delivery percentages for projects belonging to the Streets category exhibit a six percent increase. Projects under the Municipal category exhibit a minor increase while projects under the Parks category show a ten percent change in their project delivery percentages for projects evaluated in the smaller project subset of TCC. Comparing the results summarized in **Table B-1** and **Table B-2** shows that an economy of scale exists in delivering projects with a higher TCC versus those with a lower TCC.

In addition, it should be noted that although the R^2 and p-values are higher than in previous *Study* phases, the reader is cautioned that this table only be used as a reference and not for prediction of performance. Readers are urged to review the curves in this section in conjunction with using this table.

Table B-1
Summary of Performance Models (Full Range of TCC)

Project Type or Classification	Number of Projects (N)	Design Cost				Construction Management Cost				Project Delivery Cost			
		(% of TCC)	95% CI (% of TCC)	R^2	p-value	(% of TCC)	95% CI (% of TCC)	R^2	p-value	(% of TCC)	95% CI (% of TCC)	R^2	p-value
Municipal Projects	**112**	**14%**	**13%-16%**	**0.74**	**3.99E-41**	**16%**	**14%-18%**	**0.65**	**2.36E-31**	**30%**	**27%-33%**	**0.73**	**4.13E-39**
Libraries	24	15%	13%-16%	0.80	3.64E-17	14%	12%-16%	0.70	1.51E-12	28%	26%-30%	0.89	1.59E-19
Police/Fire Stations	24	12%	10%-14%	0.73	1.36E-12	13%	10%-16%	0.59	4.57E-9	25%	21%-29%	0.68	5.73E-11
Comm./Rec.Center/ Child Care/Gyms	37	15%	13%-16%	0.84	2.44E-21	11%	10%-12%	0.81	1E-18	26%	24%-28%	0.90	1.86E-24
Other Municipal	27	14%	11%-17%	0.73	6.77E-10	17%	13%-22%	0.65	2.56E-8	32%	25%-39%	0.72	1E-9
Streets Projects	**257**	**13%**	**12%-14%**	**0.76**	**7.15E-94**	**18%**	**18%-19%**	**0.94**	**9E-163**	**31%**	**30%-32%**	**0.94**	**8.7E-169**
Widening/New/ Grade Separations	27	12%	10%-14%	0.83	4.44E-13	19%	19%-20%	0.99	1.34E-26	31%	30%-33%	0.98	1.57E-25
Bridges	16	19%	13%-22%	0.60	7.56E-7	16%	12%-19%	0.77	1.28E-7	33%	27%-39%	0.81	6E-9
Reconstructions	98	13%	12%-15%	0.42	1.7E-31	14%	12%-16%	0.48	1.58E-29	27%	24%-29%	0.59	1.1E-38
Bike/Pedestrian/ Streetscapes	64	18%	15%-22%	0.51	6.35E-17	12%	10%-14%	0.61	3.24E-21	31%	26%-35%	0.59	6.42E-20
Signals	52	12%	10%-14%	0.01	1.27E-14	19%	17%-22%	0.68	8.08E-23	31%	28%-35%	0.57	4.63E-22
Pipes Projects	**252**	**15%**	**14%-15%**	**0.99**	**1.4E-235**	**10%**	**10%-11%**	**0.95**	**9.5E-164**	**25%**	**25%-25%**	**0.98**	**2.3E-227**
Gravity Mains	205	15%	14%-15%	0.99	3.5E-208	10%	10%-11%	0.95	8E-139	25%	24%-25%	0.99	4.6E-195
Pressure Systems	30	18%	16%-20%	0.87	1.56E-16	15%	13%-17%	0.84	5.17E-15	33%	29%-37%	0.87	1.03E-16
Pump Stations	13	10%	8%-13%	0.77	1.18E-6	13%	10%-15%	0.87	1.07E-7	23%	18%-25%	0.92	2.27E-8
Parks Projects	**55**	**25%**	**22%-29%**	**0.72**	**2.9E-20**	**10%**	**7%-12%**	**0.20**	**2.74E-10**	**35%**	**32%-38%**	**0.86**	**9.38E-31**
Playgrounds	40	23%	21%-26%	0.69	3.69E-20	14%	11%-16%	0.39	6.47E-14	37%	33%-41%	0.67	1.38E-20
Sportfields	11	26%	16%-36%	0.71	2.59E-4	8%	2%-15%	0.14	1.71E-2	34%	28%-40%	0.90	5.61E-7
Restrooms	4	54%	25%-83%	0.83	9.80E-3	18%	0%-43%	0.00	1.13E-1	71%	30%-113%	0.75	1.22E-2

Notes:

[1] TCC = Total Construction Cost; Des. = Design Cost; CM = Construction Management Cost, and PD = Project Delivery Cost. CI = Confidence Interval. The project delivery percentages indicated are the ranges corresponding to the 95 percent confidence intervals on the slope of the linear regression trendline. Caution and review of the report text are urged in using this information. Refer to **Appendix B** for the corresponding regression curves, R^2 values, and N values for more details. Highlighted values indicate those for which R^2 values were low (below 0.50).

[2] Other Pipes Projects are not included in this table due to a small number of projects (less than 5).

[3] Total excludes projects delivered by alternative delivery mechanisms such a design-build, JOC, and CM@Risk. Projects delivered by alternative techniques are retained in the database but not analyzed. These projects are not included in the 676 projects selected for analysis in the Update 2011 Study.

Table B-2
Summary of Performance Models (Smaller Project Subset of TCC)

Project Type or Classification	TCC Upper Bound ($ Millions)	Number of Projects (N)	Design Cost				Construction Management Cost				Project Delivery Cost			
			(% of TCC)	95% CI (% of TCC)	R^2	p-value	(% of TCC)	95% CI (% of TCC)	R^2	p-value	(% of TCC)	95% CI (% of TCC)	R^2	p-value
Municipal Projects	**9.00**	**95**	**16%**	**15%-17%**	**0.78**	**5.35E-48**	**12%**	**11%-13%**	**0.63**	**4.81E-39**	**28%**	**26%-30%**	**0.82**	**7.34E-55**
Libraries	9.25	20	16%	15%-18%	0.83	1.25E-14	13%	11%-15%	0.61	1.18E-10	29%	26%-32%	0.82	1.25E-14
Police/Fire Stations	7.30	19	15%	12%-18%	0.39	6.02E-9	15%	12%-17%	0.65	5.6E-10	30%	25%-34%	0.68	8.01E-11
Comm./Rec.Center/ Child Care/Gyms	7.25	30	17%	14%-20%	0.63	2.08E-12	12%	10%-14%	0.65	6.71E-15	29%	25%-33%	0.72	6.96E-16
Other Municipal	12.70	23	17%	15%-18%	0.94	1.01E-16	7%	6%-9%	0.78	3.58E-12	24%	22%-26%	0.95	1.37E-18
Streets Projects	**1.84**	**204**	**20%**	**18%-21%**	**0.29**	**2.18E-58**	**18%**	**18%-19%**	**0.34**	**5.29E-50**	**37%**	**35%-40%**	**0.43**	**7.41E-70**
Widening/New/ Grade Separations	5.00	22	31%	25%-37%	0.72	1.22E-9	11%	8%-14%	0.27	1.31E-7	42%	35%-48%	0.77	2.67E-11
Bridges	5.50	13	29%	22%-36%	0.73	6.09E-7	24%	16%-32%	0.68	2.95E-5	53%	40%-65%	0.77	1.03E-6
Reconstructions	2.10	78	17%	15%-20%	0.42	7.35E-27	16%	13%-19%	0.28	1.55E-17	34%	30%-38%	0.45	1.06E-27
Bike/Pedestrian/ Streetscapes	1.52	50	24%	20%-27%	0.38	2.53E-18	18%	15%-20%	0.40	3.82E-17	41%	36%-47%	0.49	6.54E-21
Signals	**0.62**	41	24%	20%-27%	0.26	2.63E-16	28%	23%-32%	0.40	2.47E-16	51%	46%-57%	0.50	2.53E-21
Pipes Projects	2.15	**202**	**17%**	**16%-19%**	**0.35**	**2.51E-61**	**16%**	**15%-17%**	**0.58**	**9.76E-82**	**33%**	**31%-35%**	**0.57**	**3.04E-85**
Gravity Mains	1.95	163	17%	15%-18%	0.31	6.08E-49	17%	16%-18%	0.60	2.03E-67	33%	31%-36%	0.55	2.99E-68
Pressure Systems	2.80	25	12%	9%-15%	0.26	2.2E-8	11%	9%-13%	0.58	1.42E-12	23%	19%-27%	0.44	6.14E-11
Pump Stations	**32.5**	10	23%	15%-32%	0.56	1.85E-4	22%	19%-26%	0.92	4.18E-7	46%	38%-54%	0.89	5.63E-7
Parks Projects	1.00	**46**	**28%**	**25%-32%**	**0.51**	**1.28E-18**	**17%**	**13%-20%**	**0.10**	**9.11E-13**	**45%**	**40%-50%**	**0.47**	**2.52E-20**
Playgrounds	0.918	33	26%	22%-30%	0.39	2.89E-14	19%	15%-23%	0.21	4.73E-10	45%	38%-52%	0.39	1.46E-14
Sportfields	2.50	10	15%	8%-22%	0.34	1.38E-3	8%	3%-12%	0.23	3.42E-3	22%	14%-30%	0.23	1.89E-4
Restrooms	0.40	3	39%	0%-120%	0.25	1.68E-1	34%	0%-91%	0.42	1.20E-1	74%	0%-209%	0.33	1.44E-1

Notes:

[1] TCC = Total Construction Cost; Des. = Design Cost; CM = Construction Management Cost, and PD = Project Delivery Cost. CI = Confidence Interval. The project delivery percentages indicated are the ranges corresponding to the 95 percent confidence intervals on the slope of the linear regression trendline. Caution and review of the report text are urged in using this information. Refer to **Appendix B** for the corresponding regression curves, R^2 values, and N values for more details. Highlighted values indicate those for which R^2 values were low (below 0.50).

[2] Other Pipes Projects are not included in this table due to a small number of projects (less than 5).

[3] Total excludes projects delivered by alternative delivery mechanisms such a design-build, JOC, and CM@Risk. Projects delivered by alternative techniques are retained in the database but not analyzed. These projects are not included in the 676 projects selected for analysis in the Update 2011 Study.

The elimination of auto-correlation in Update 2008 and the use of the linear trendline to describe the relationship between project delivery costs and the TCC have significantly improved the R^2 values in the past three years as compared to the Study years prior to 2008.

For projects evaluated under the full range of TCC, Pipes and Municipal Facilities projects exhibit higher R^2 values as compared to Streets and Parks projects for the project delivery versus TCC regressions. This may be attributed to better definition of Pipes and Municipal Facilities projects at the beginning of a project and thus allow for the design effort to be more focused. This would lead to more consistent performance and therefore higher R^2 values.

It is observed that the R^2 values are lower for projects falling in the smaller project subset of TCC than for projects falling under the full range of TCC. This is explained due to the fact that there is greater scatter amongst the project data points evaluated under a smaller range of TCC than the full range of TCC. Project classifications with very few data points typically exhibit low R^2 values (less than 0.5).

Table B-3 Summary of Regression Equations

Project Type or Classification	Design Cost ($) vs. TCC($) Full Range of TCC	Design Cost ($) vs. TCC($) Smaller Project Subset of TCC	CM Cost ($) vs. TCC($) Full Range of TCC	CM Cost ($) vs. TCC($) Smaller Project Subset of TCC	Project Delivery Cost ($) vs. TCC($) Full Range of TCC	Project Delivery Cost ($) vs. TCC($) Smaller Project Subset of TCC
Municipal Projects	**y=0.142x**	**y=0.1609x**	**y=0.1604x**	**y=0.1187x**	**y=0.3024x**	**y=0.2791x**
Libraries	y=0.1465x	y=0.1639x	y=0.138x	y=0.1263x	y=0.2845x	y=0.2902x
Police/Fire Stations	y=0.1224x	y=0.1491x	y=0.1271x	y=0.148x	y=0.2493x	y=0.2956x
Comm./Rec. Center/	7.25	30	17%	14%-20%	0.63	2.08E-12
Other Municipal	y=0.1433x	y=0.1681x	y=0.1734x	y=0.0738x	y=0.3167x	y=0.2418x
Streets Projects	**y=0.1289x**	**y=0.1968x**	**y=0.184x**	**y=0.175x**	**y=0.3129x**	**y=0.3721x**
Widening/New/ Grade Separations	y=0.1199x	y=0.3076x	y=0.1945x	y=0.1076x	y=0.3144x	y=0.4152x
Bridges	y=0.1762x	y=0.2891x	y=0.1564x	y=0.2378x	y=0.3326x	y=0.5269x
Reconstructions	y=0.1305x	y=0.1743x	y=0.1391x	y=0.1619x	y=0.2696x	y=0.3361x
Bike/Pedestrian/ Streetscapes	y=0.1848x	y=0.2387x	y=0.1207x	y=0.175x	y=0.3054x	y=0.4138x
Signals	**y=0.1166x**	y=0.238x	y=0.1937x	y=0.276x	y=0.3124x	y=0.5139x
Pipes Projects	y=0.1454x	**y=0.1723x**	**y=0.1036x**	**y=0.1565x**	**y=0.249x**	**y=0.3288x**
Gravity Mains	y=0.1456x	y=0.1686x	y=0.1027x	y=0.1662x	y=0.2483x	y=0.3349x
Pressure Systems	y=0.1801x	y=0.1217x	y=0.1524x	y=0.1094x	y=0.3324x	y=0.2311x
Pump Stations	**y=0.103x**	y=0.2336x	y=0.129x	y=0.2248x	y=0.232x	y=0.4584x
Parks	y=0.2534x	**y=0.284x**	**y=0.0972x**	**y=0.1653x**	**y=0.3506x**	**y=0.4494x**
Playgrounds	y=0.2333x	y=0.2593x	y=0.1381x	y=0.1898x	y=0.3715x	y=0.4491x
Sportfields	y=0.2566x	y=0.1456x	y=0.0833x	y=0.0755x	y=0.34x	y=0.2211x
Restrooms	y=0.5387x	y=0.3946x	y=0.1753x	y=0.343x	y=0.714x	y=0.7375x

Note:
[1]m = slope of the regression trendline which is the project delivery percentage.

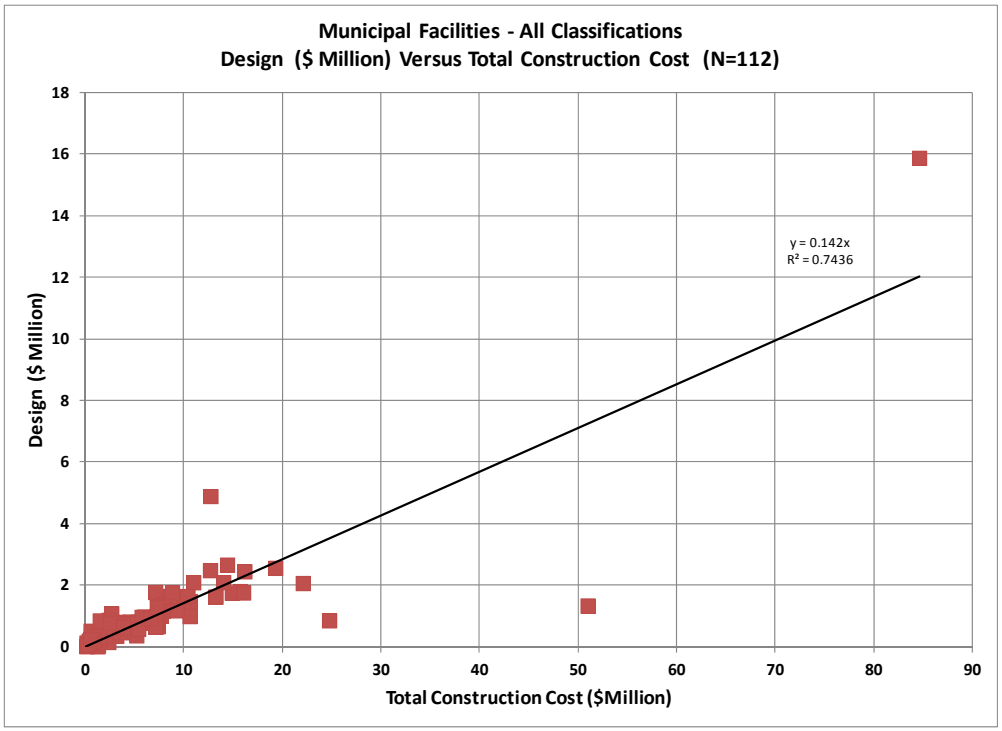
APPENDIX B

Performance Curves

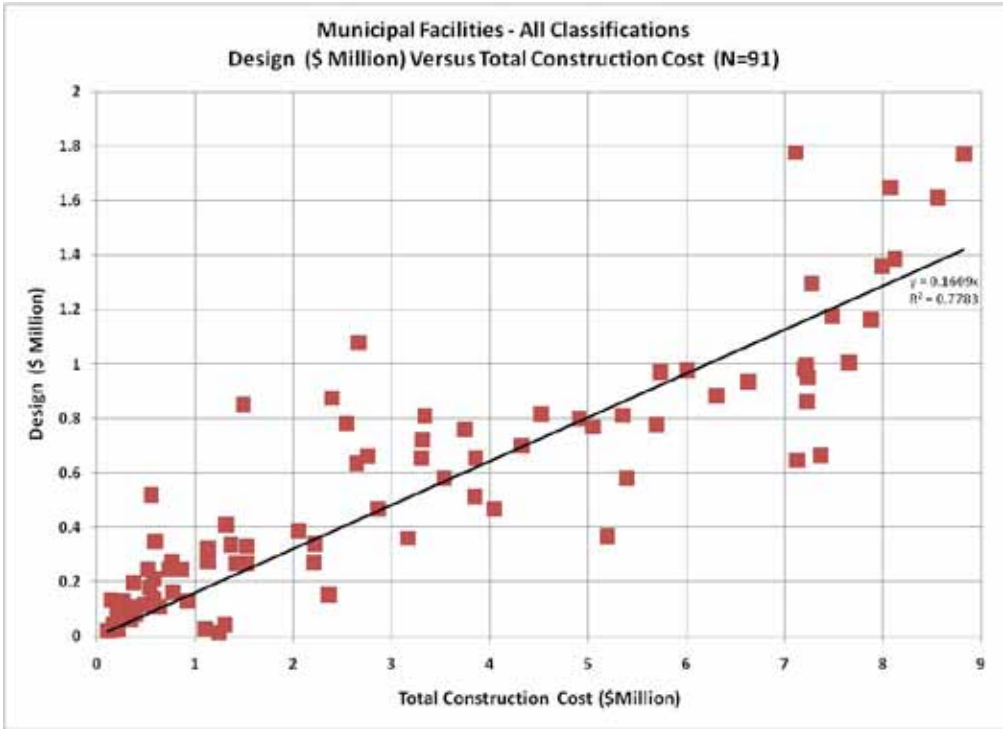
CURVES GROUP 1

Design Cost
vs
Total Construction Cost

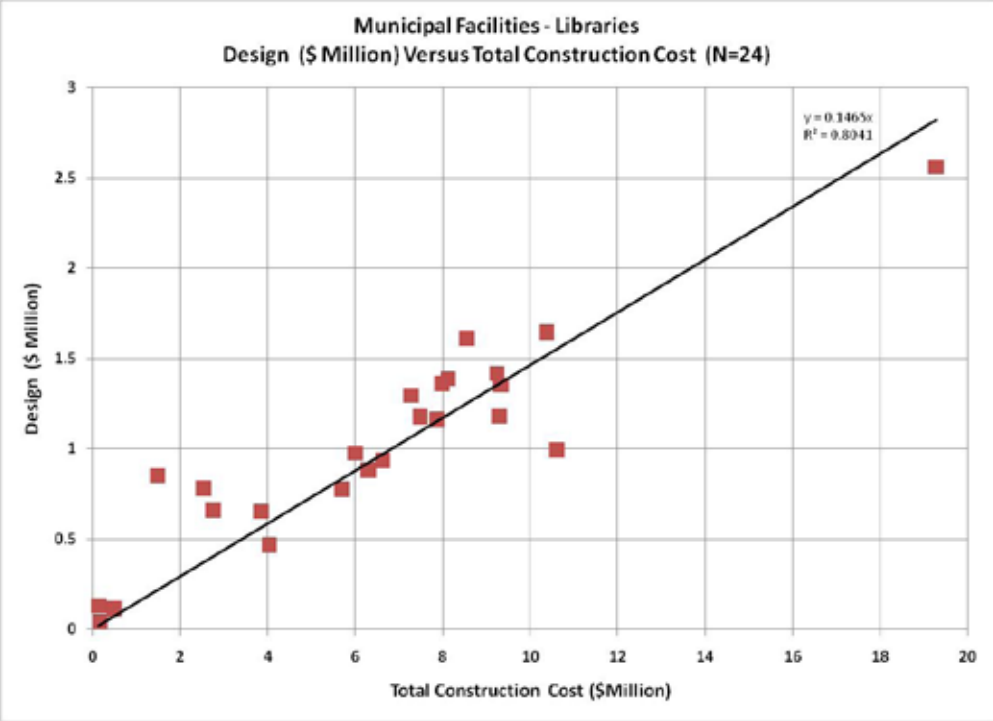
All Projects



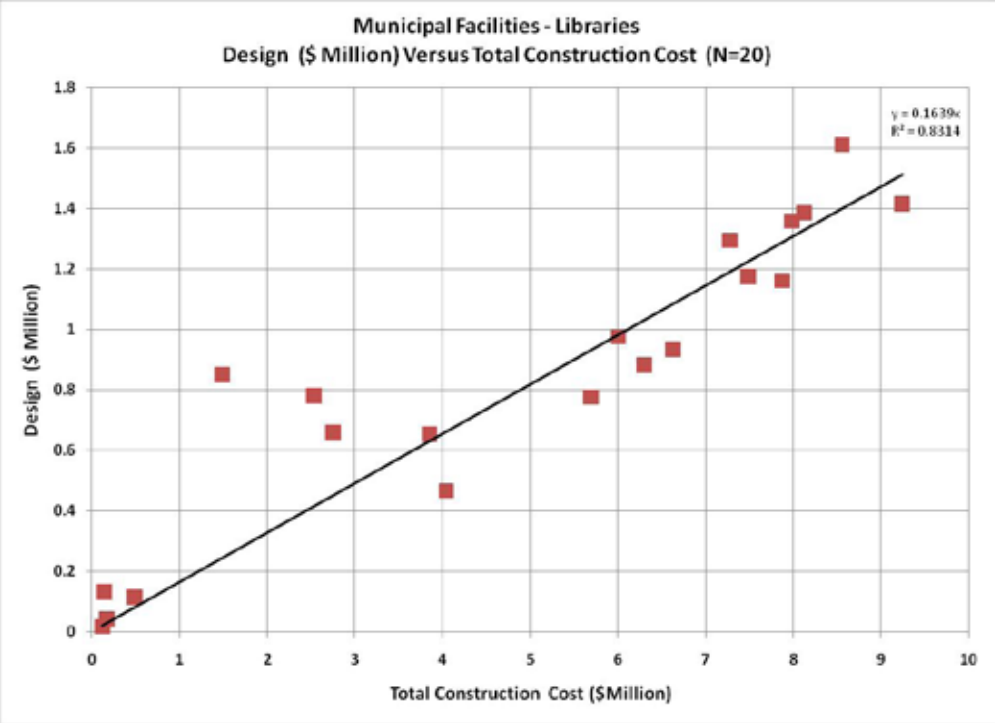
Smaller Projects



All Projects



Smaller Projects



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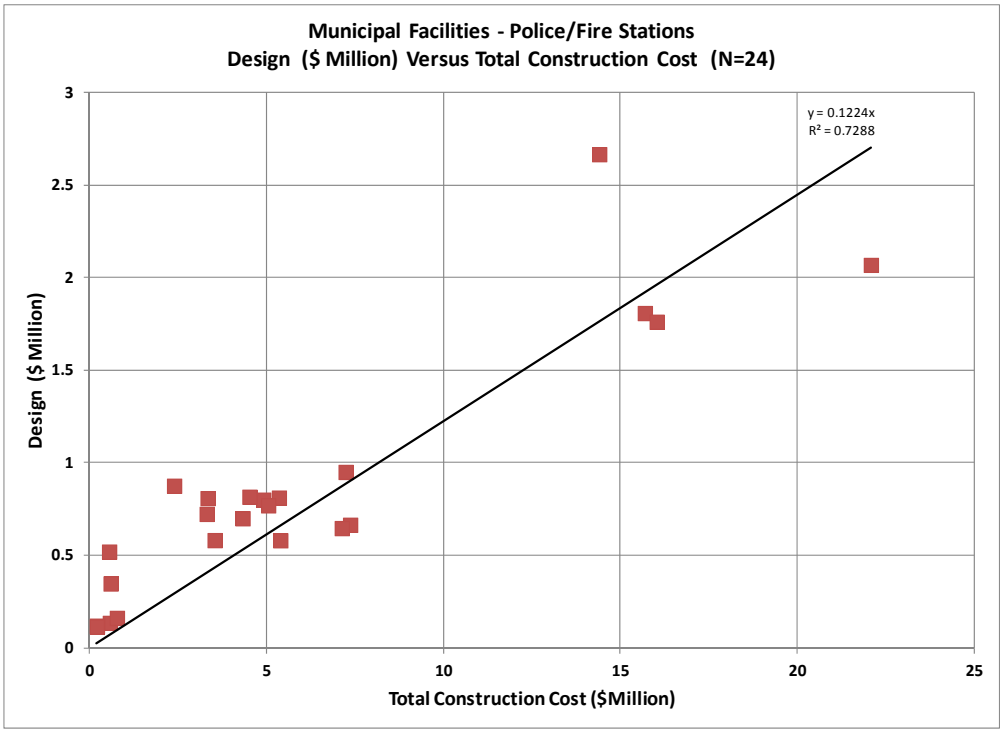

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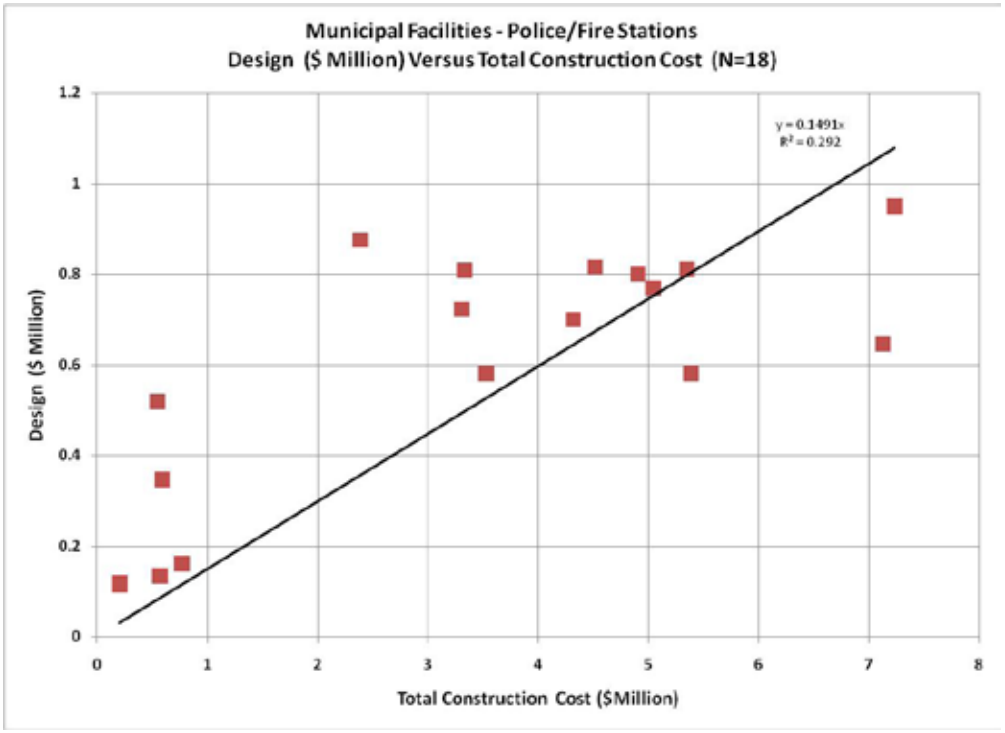

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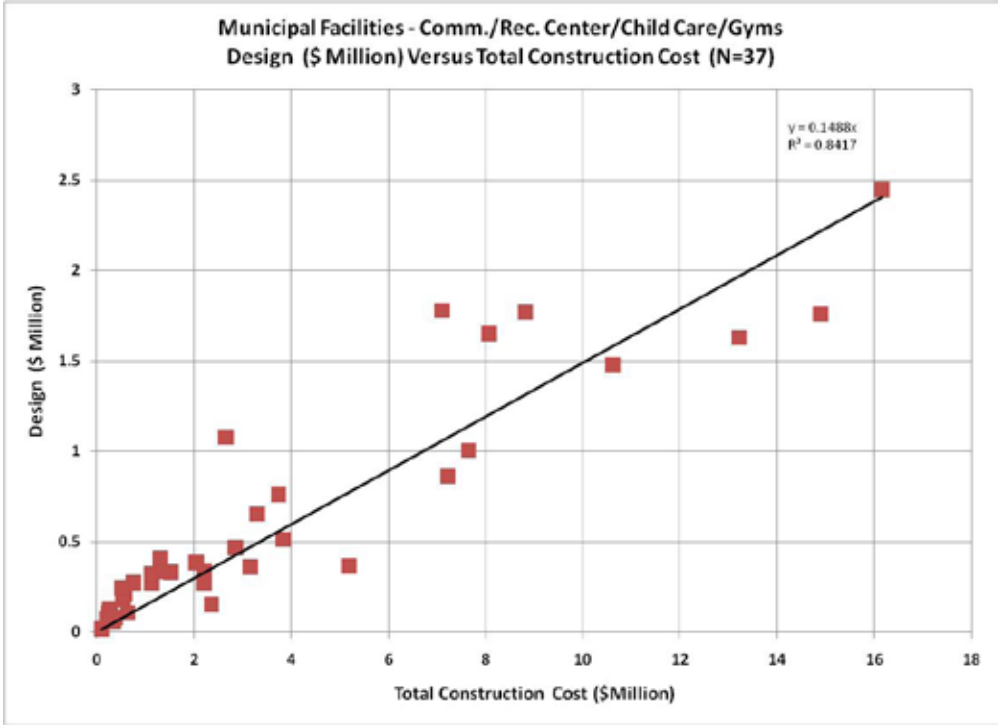

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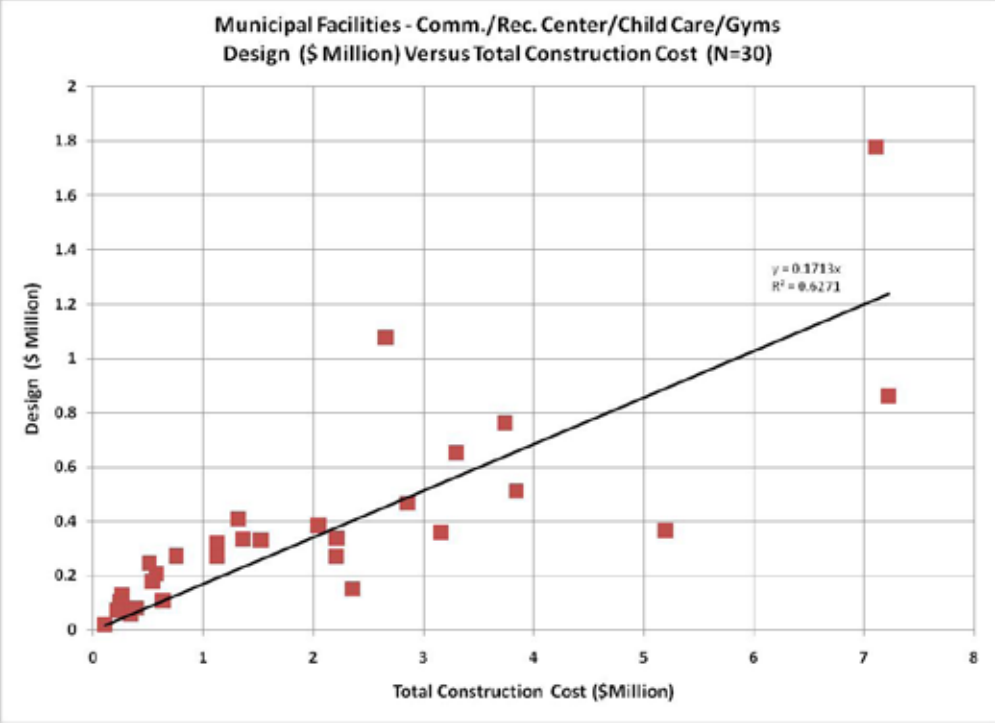

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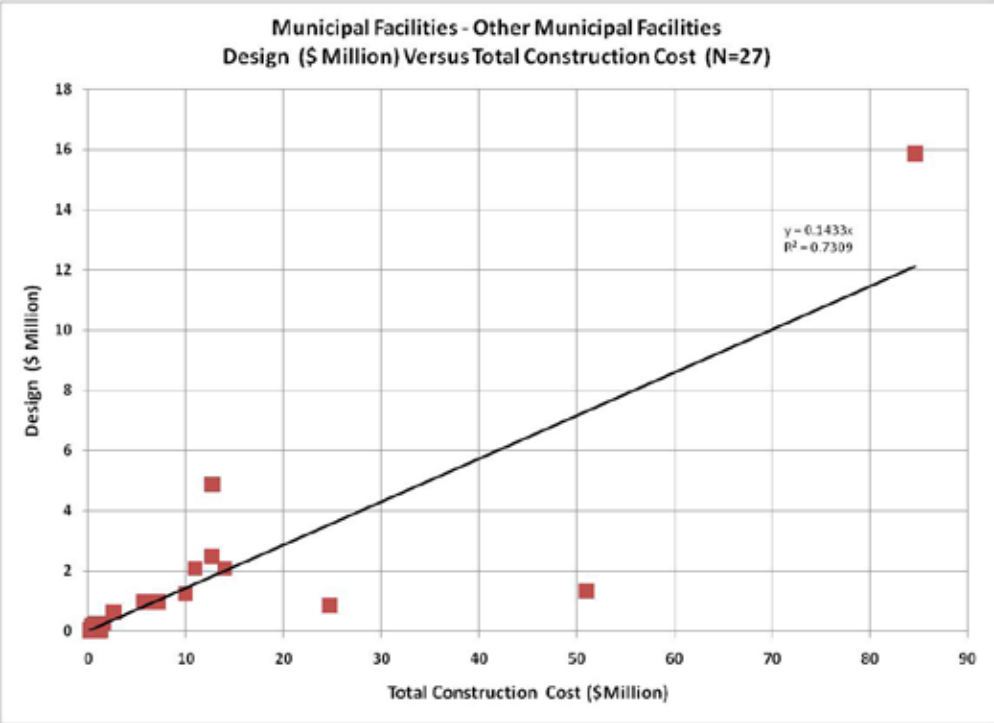

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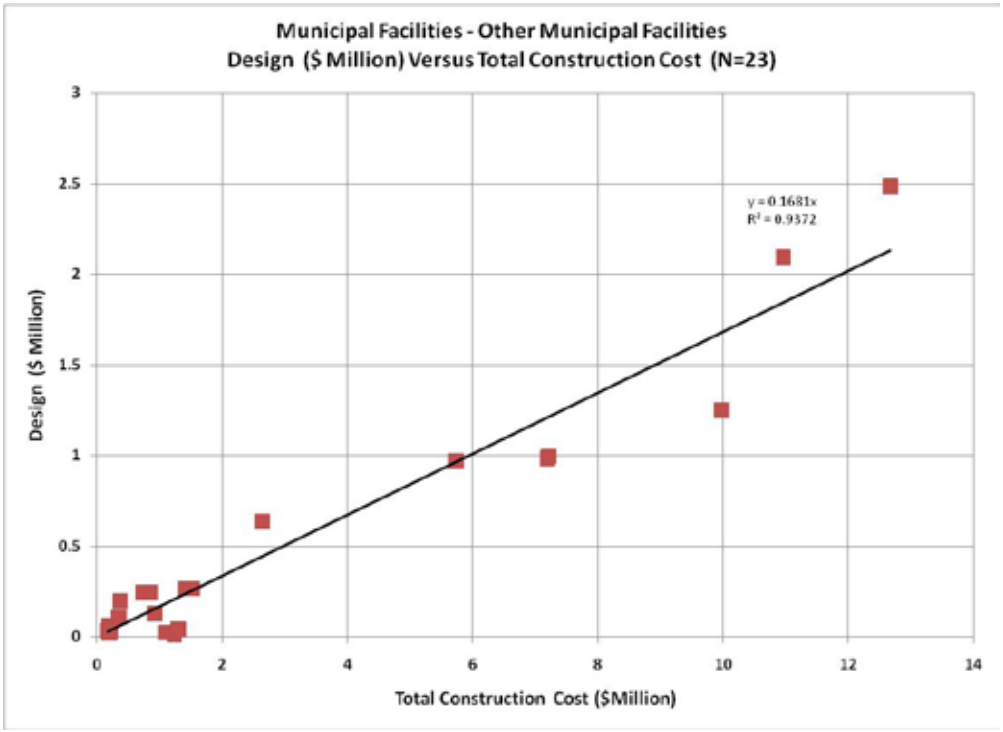

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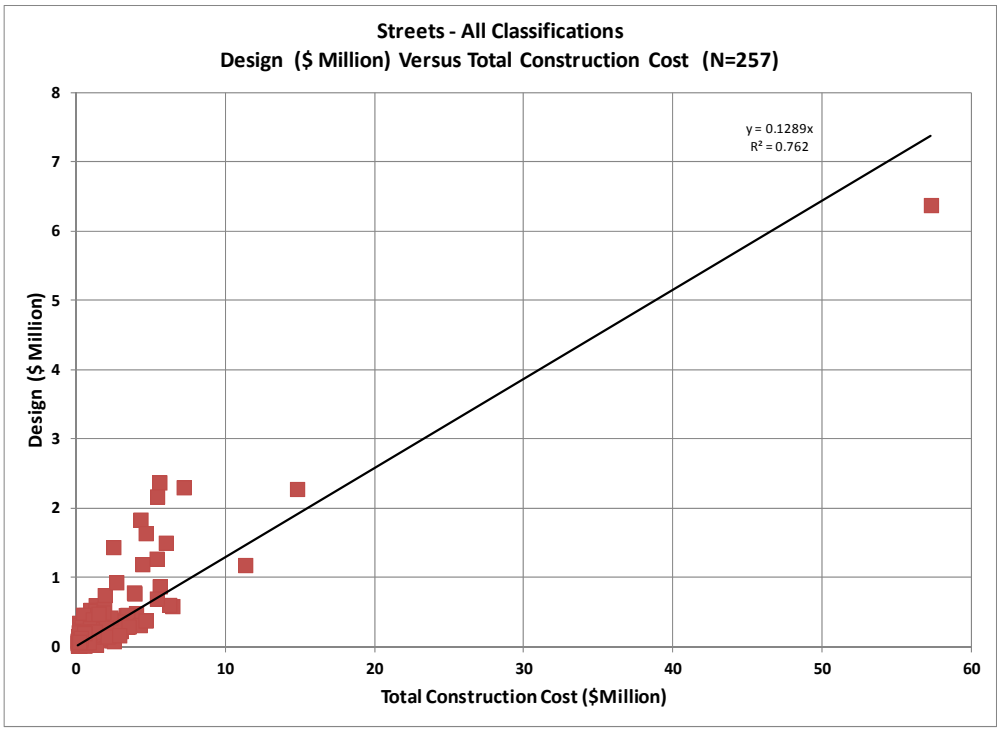

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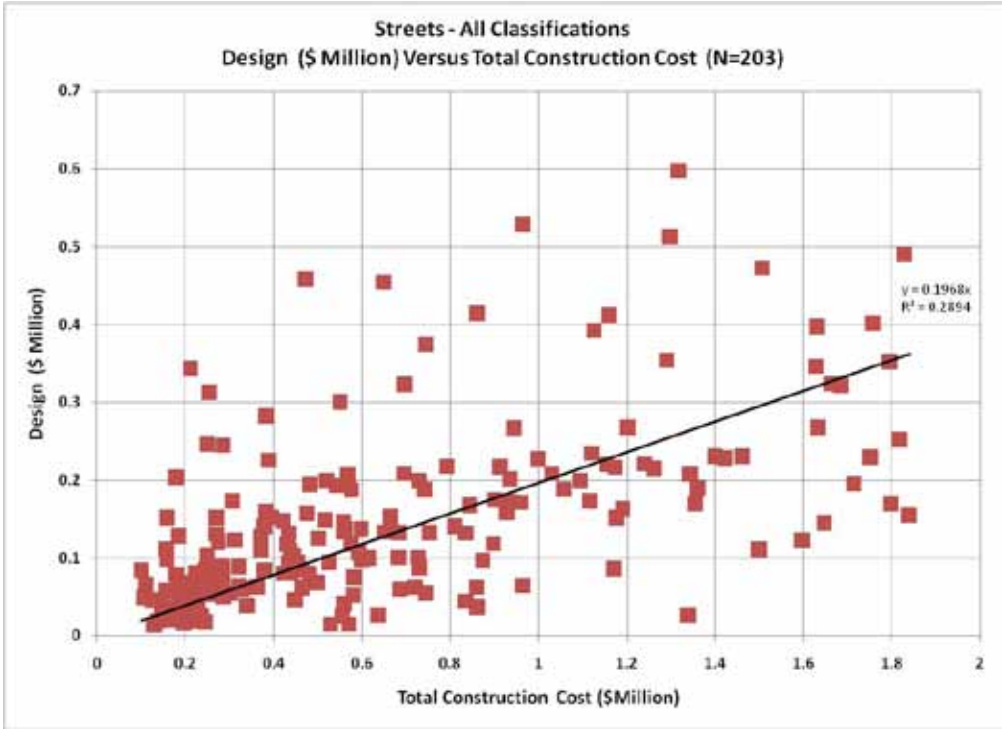

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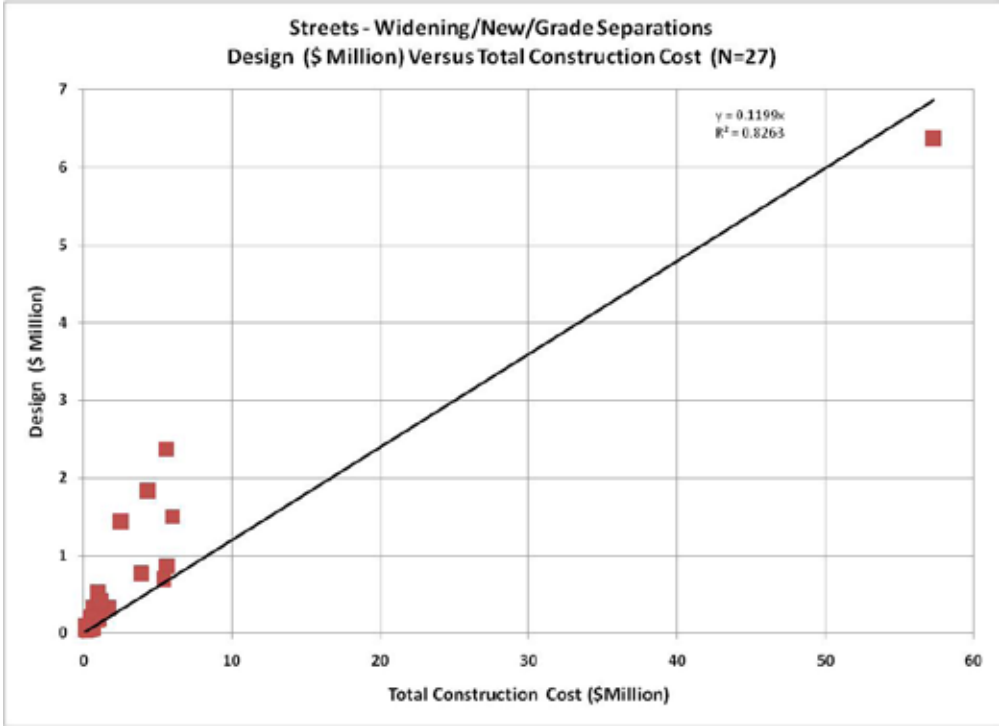

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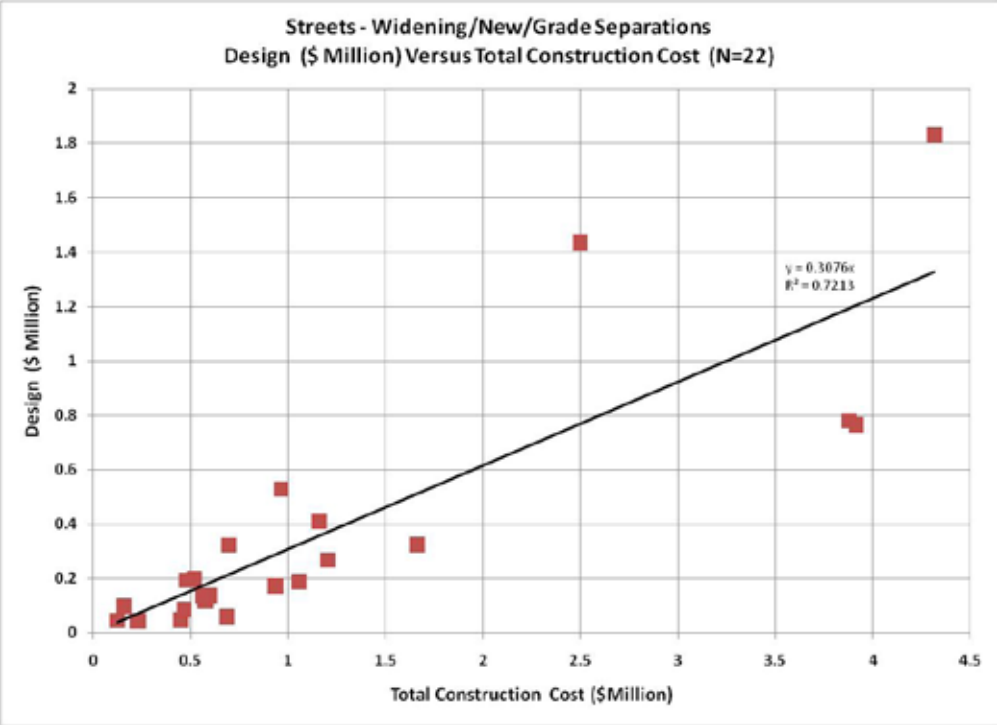

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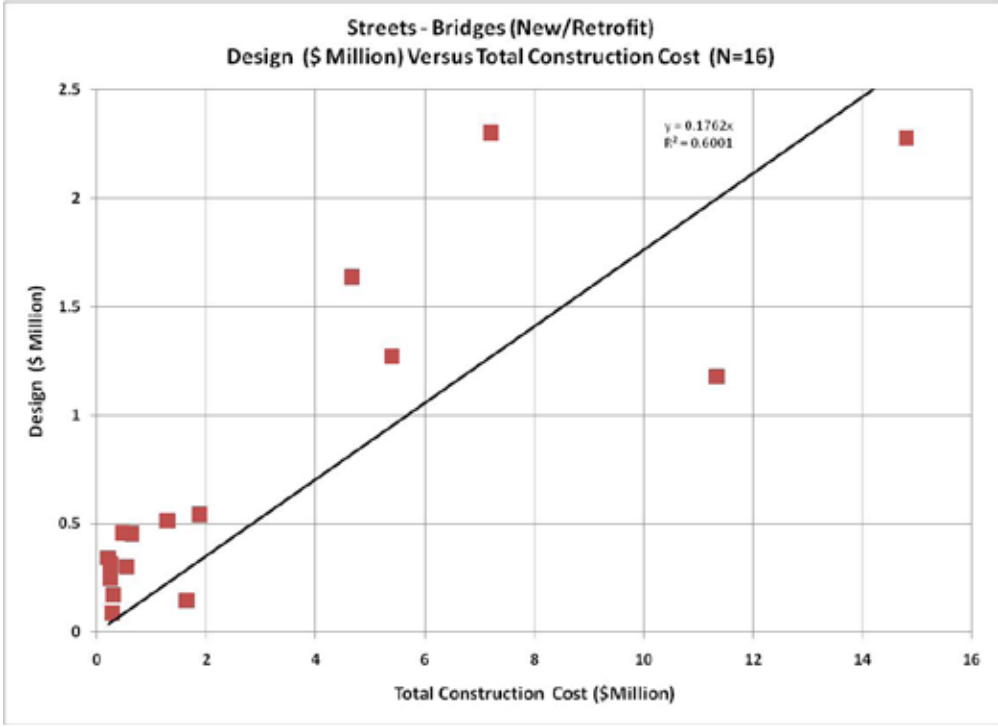

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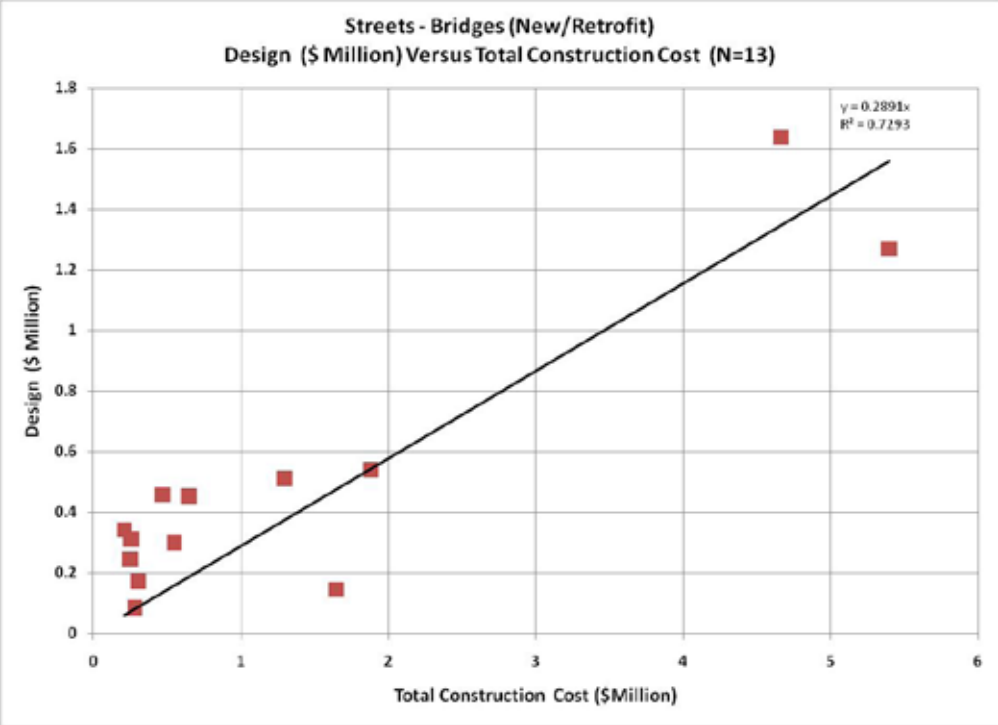

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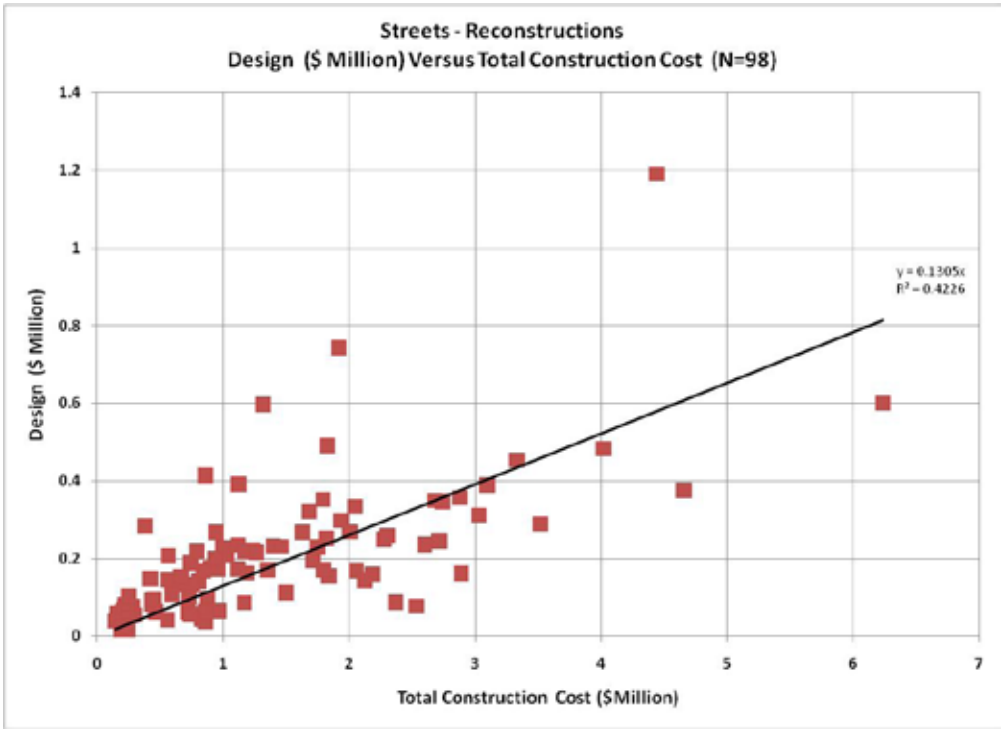

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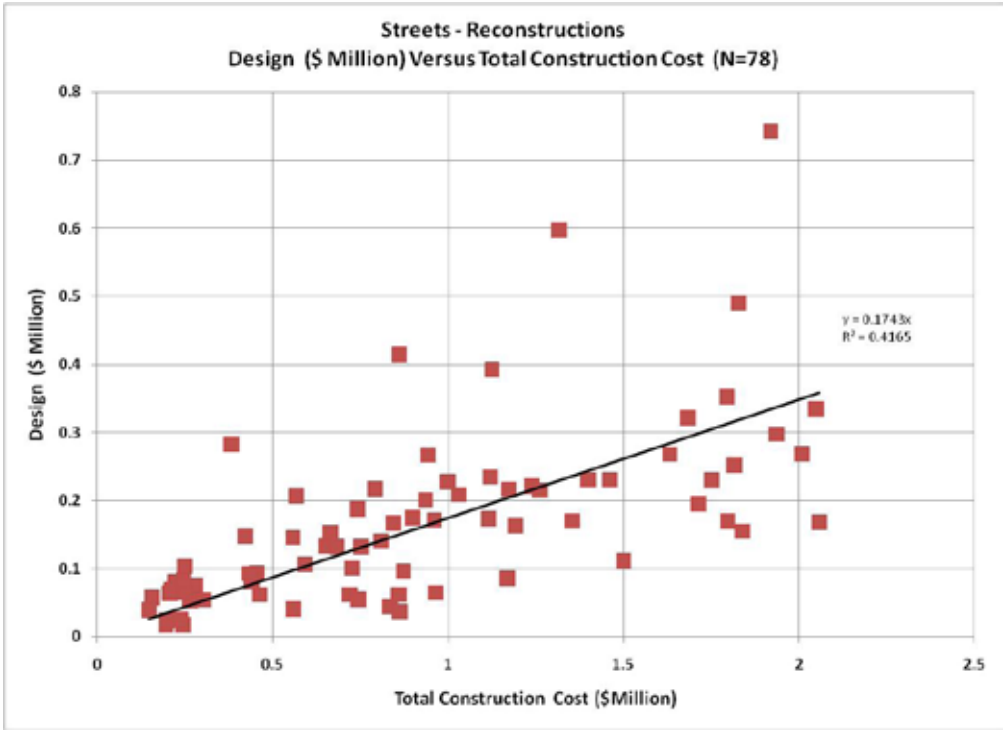

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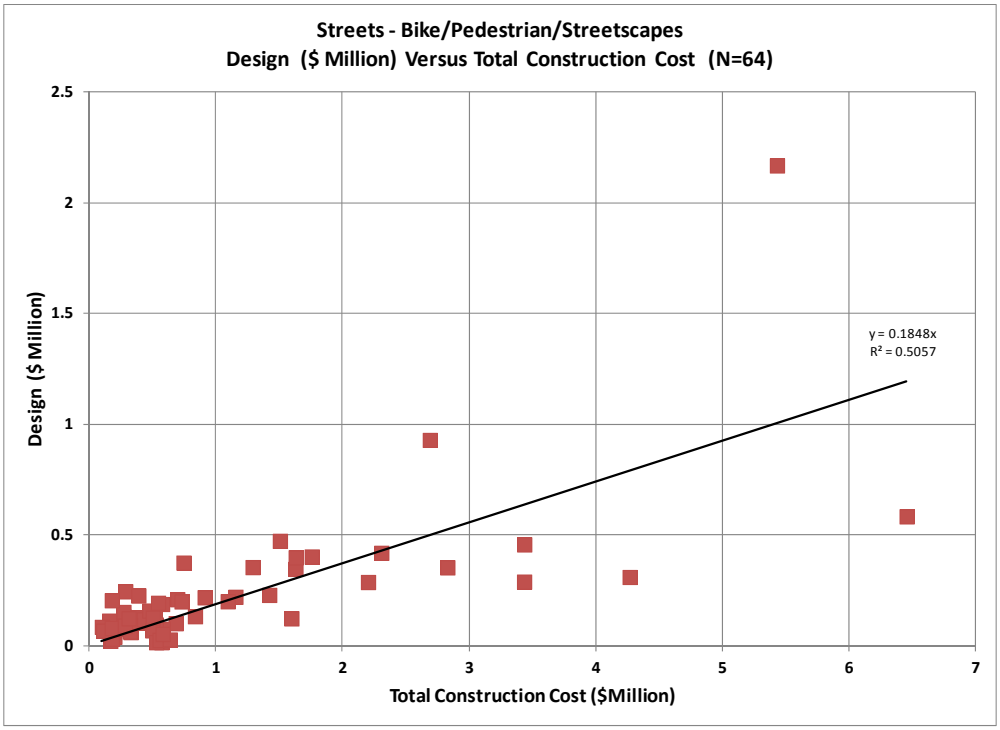

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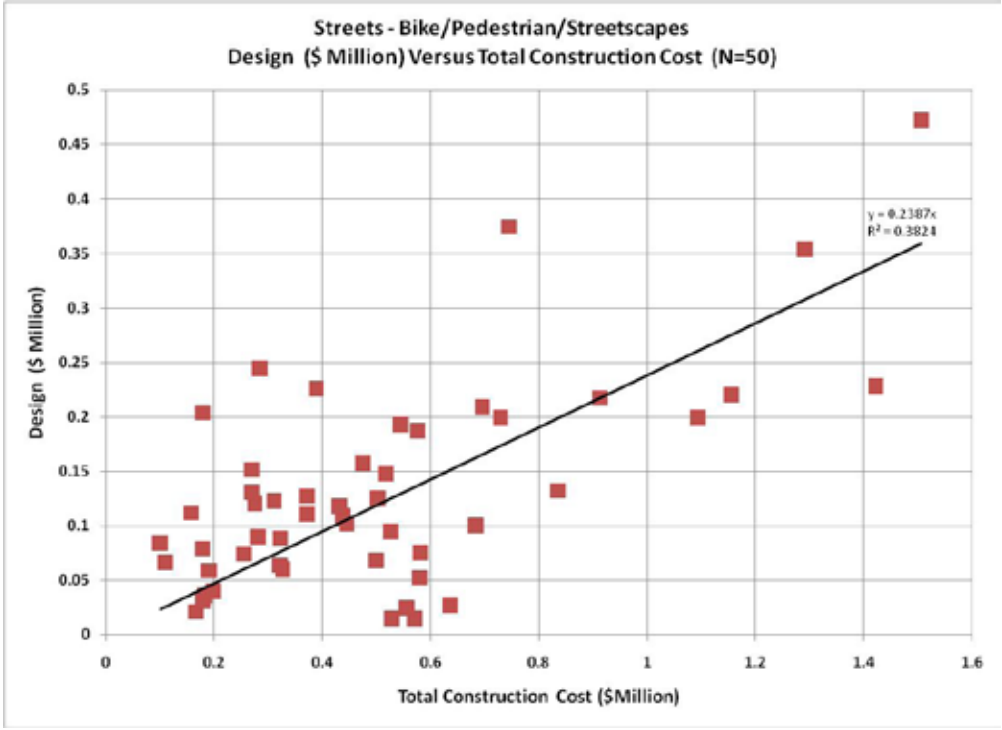

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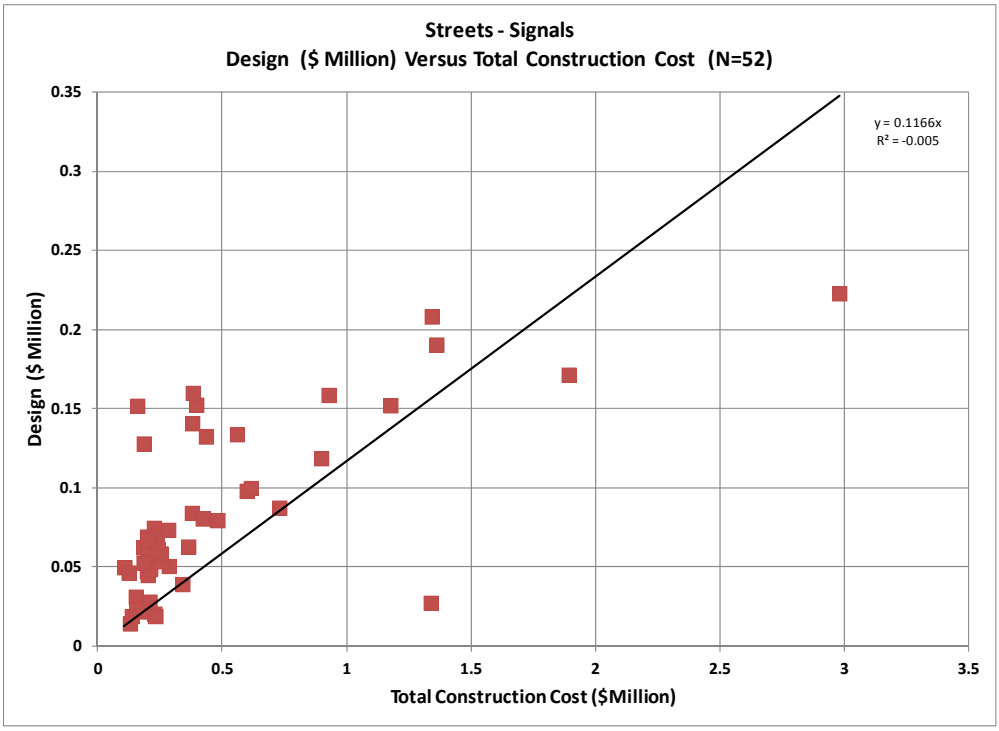

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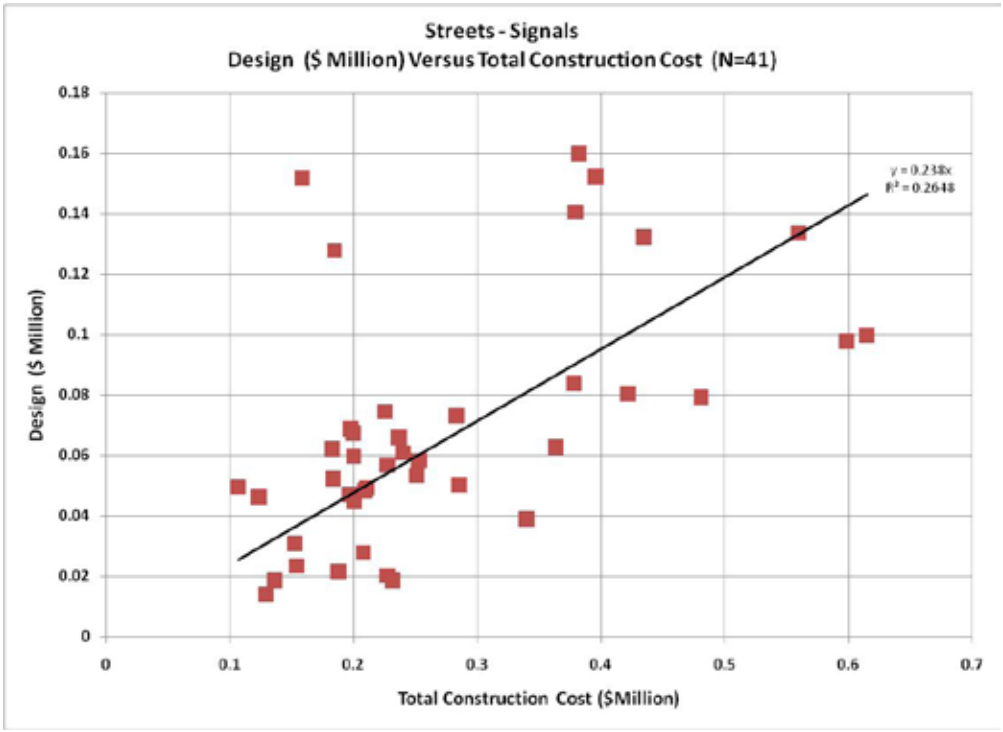

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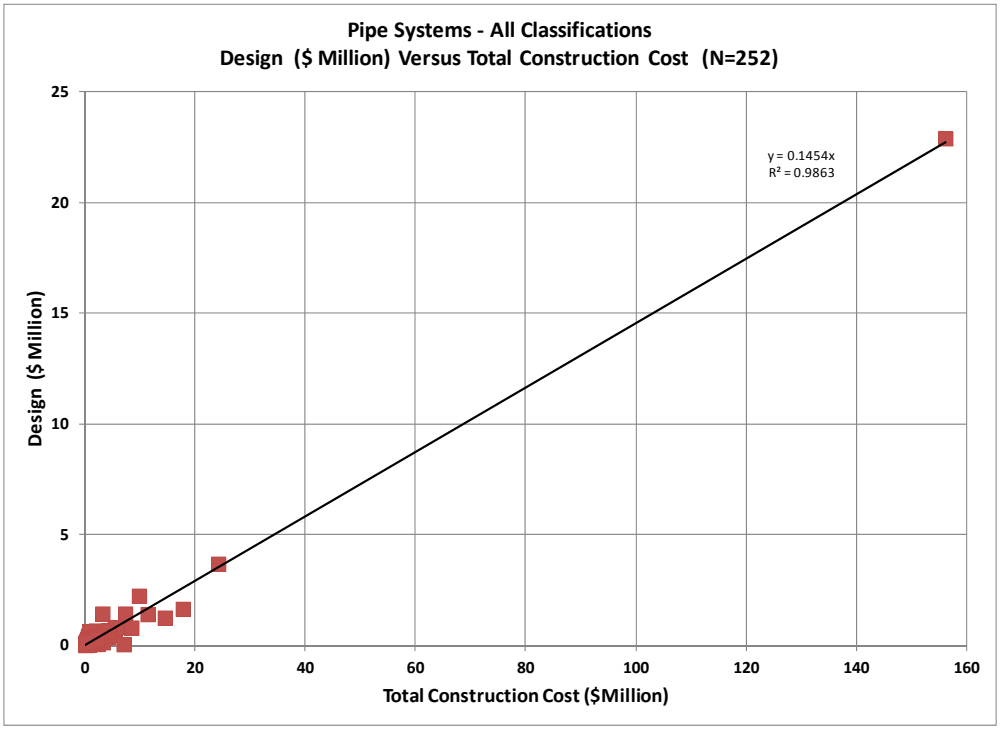

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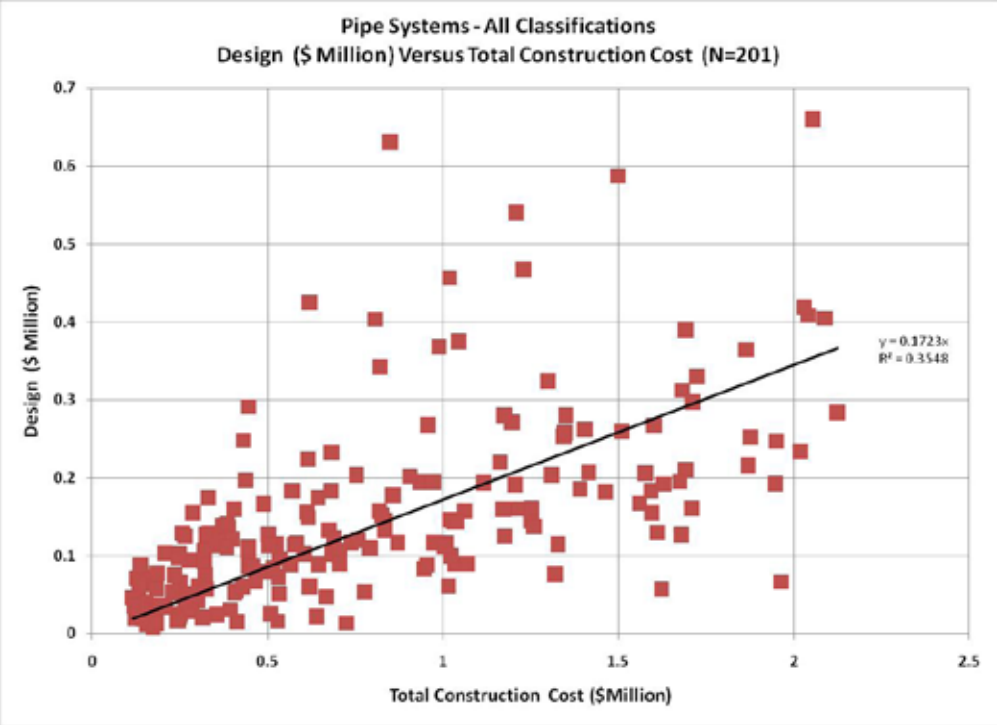

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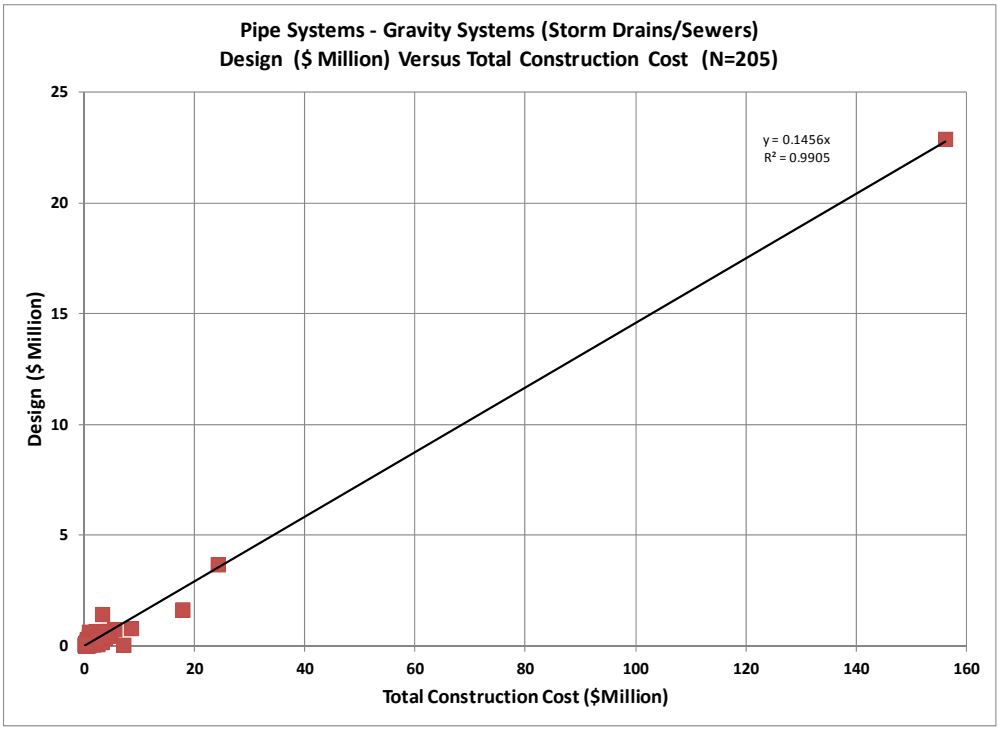

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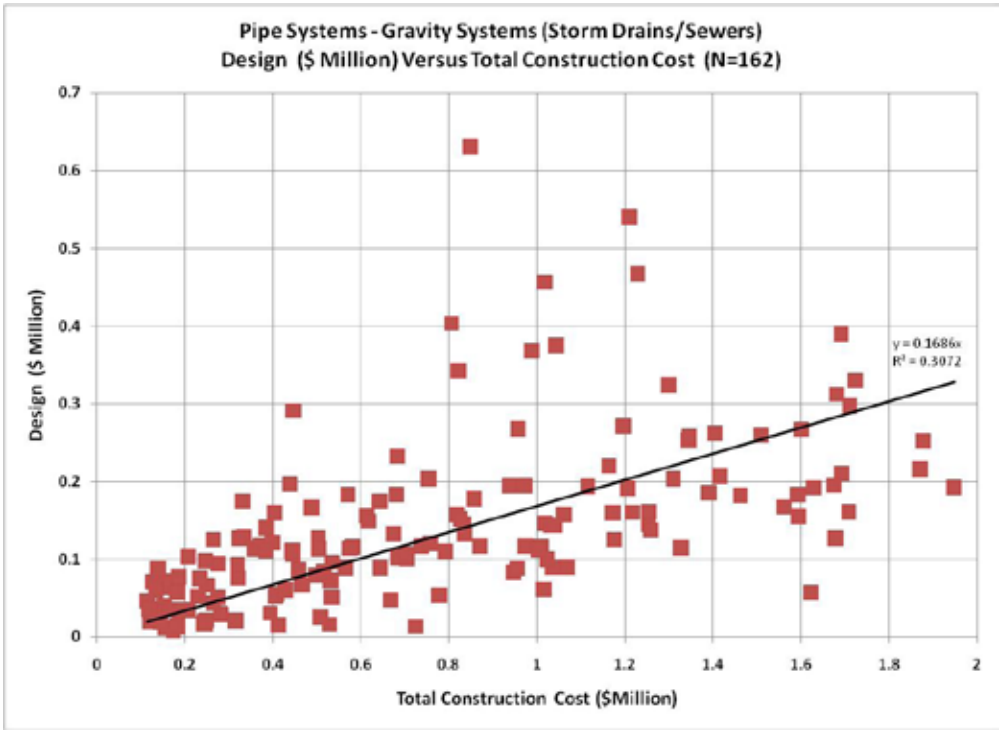

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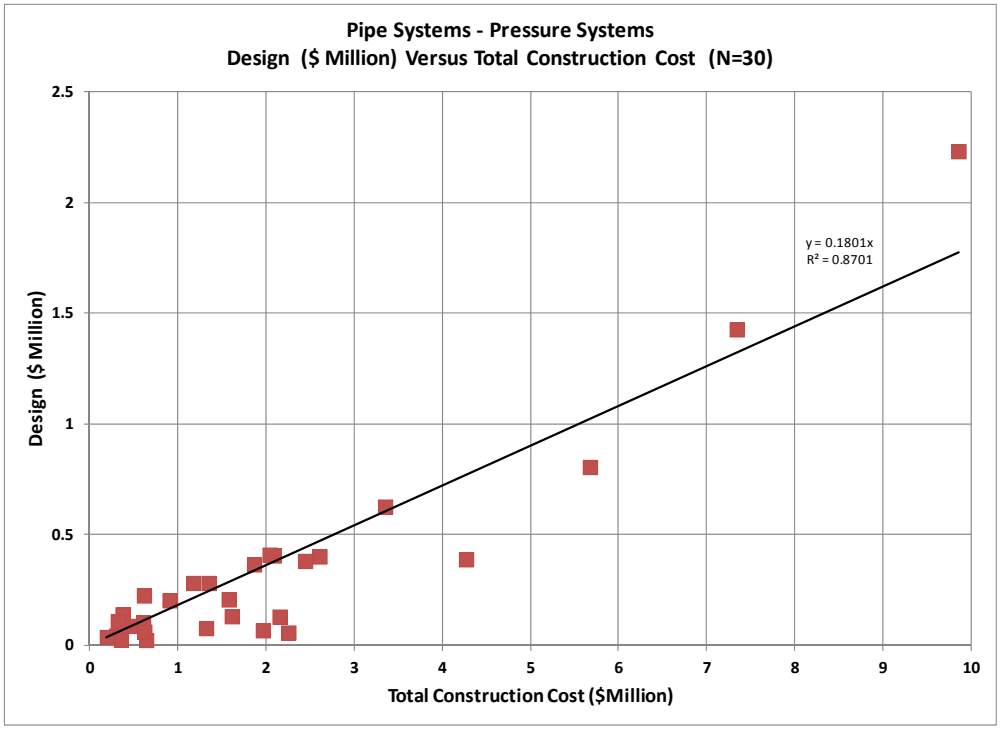

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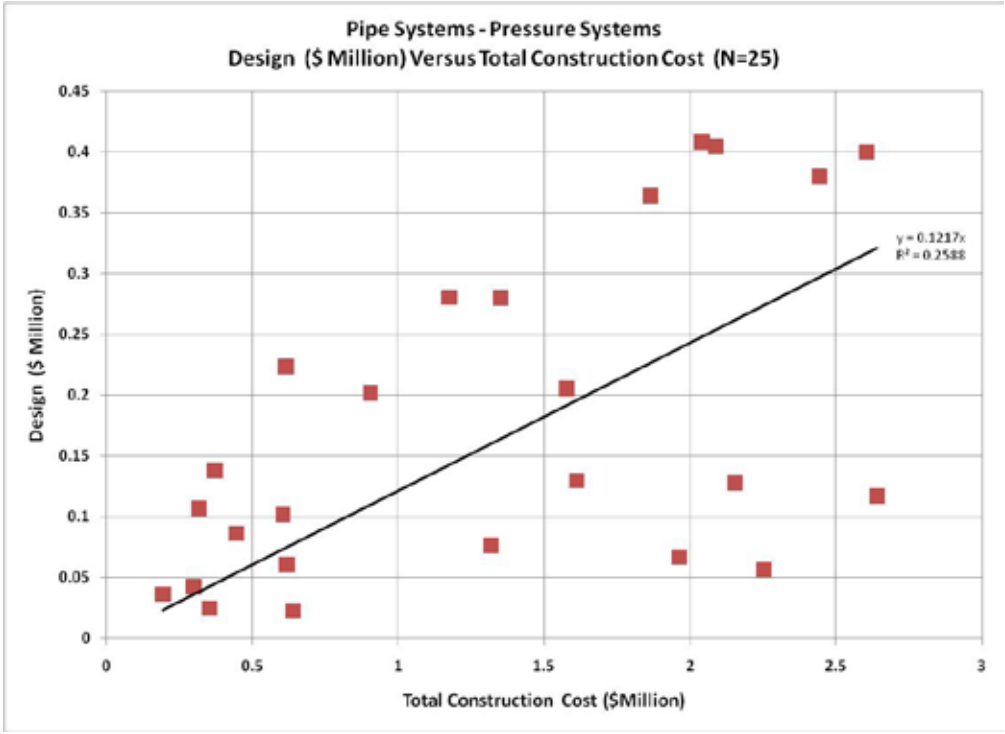

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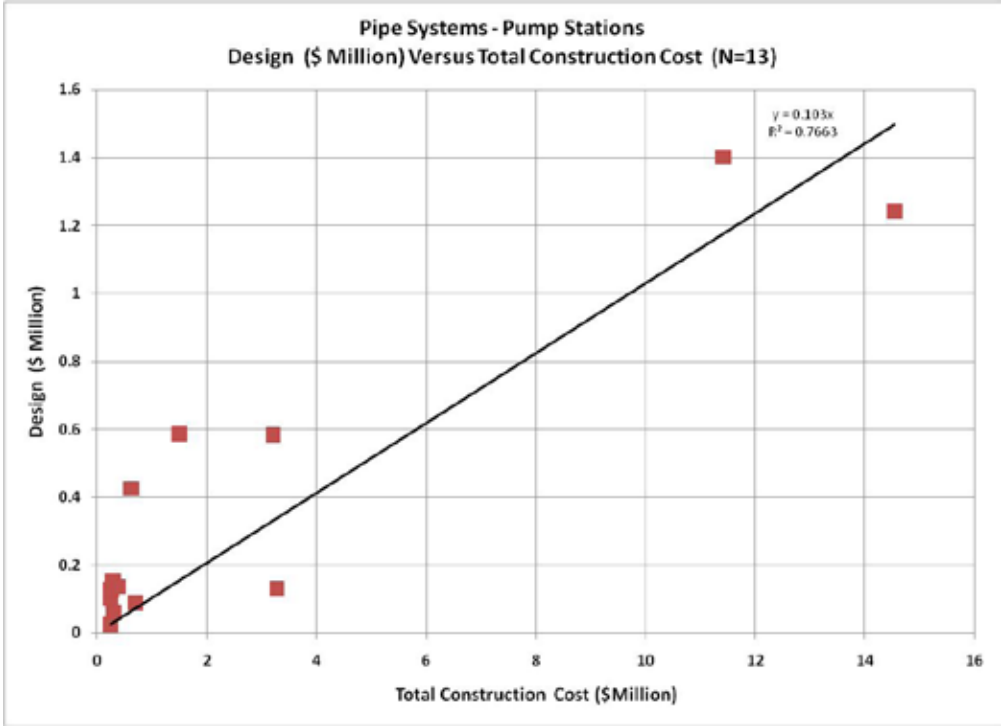

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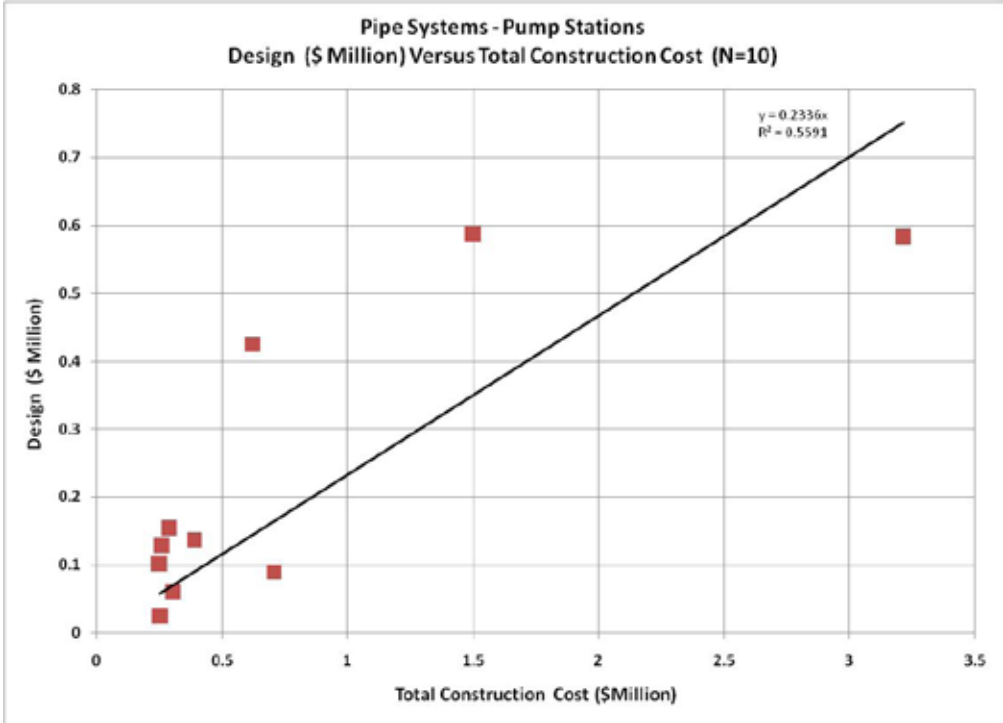

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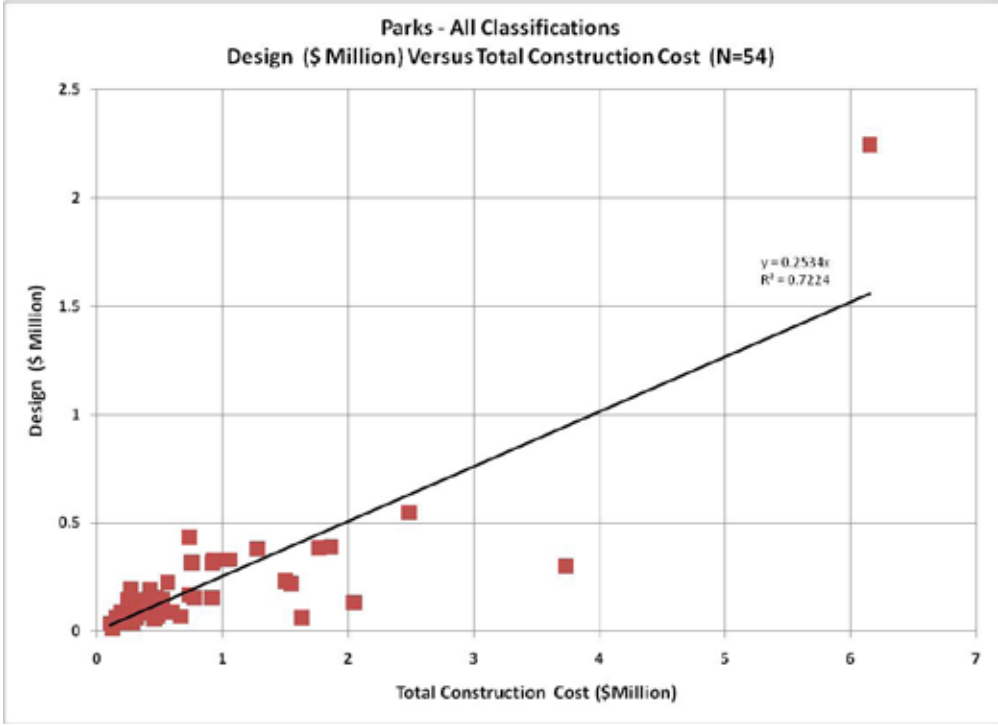

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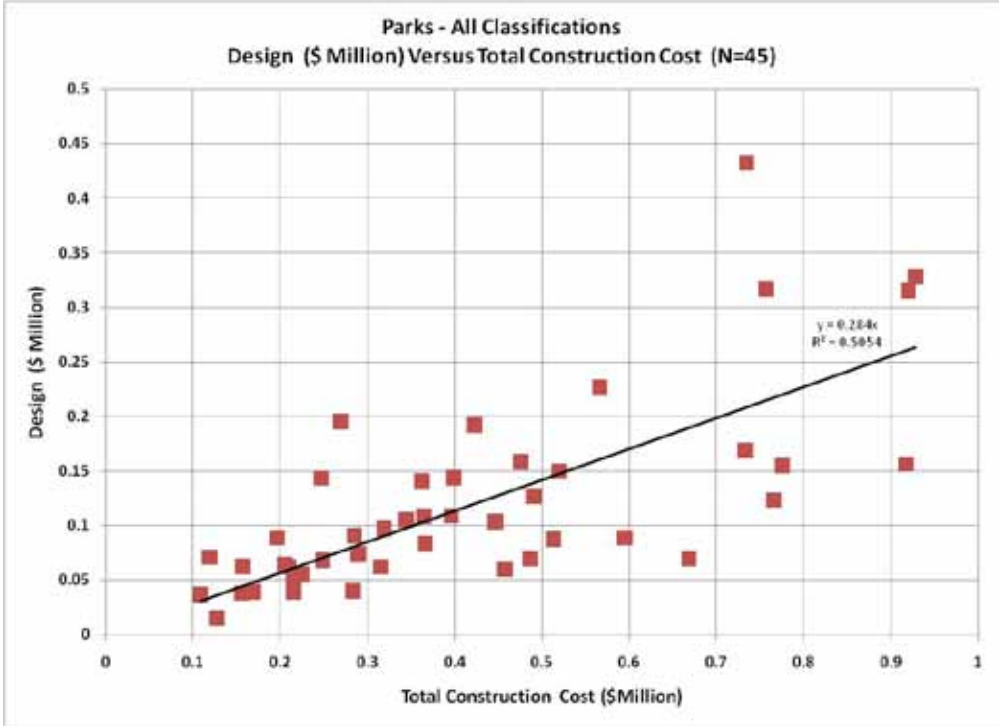

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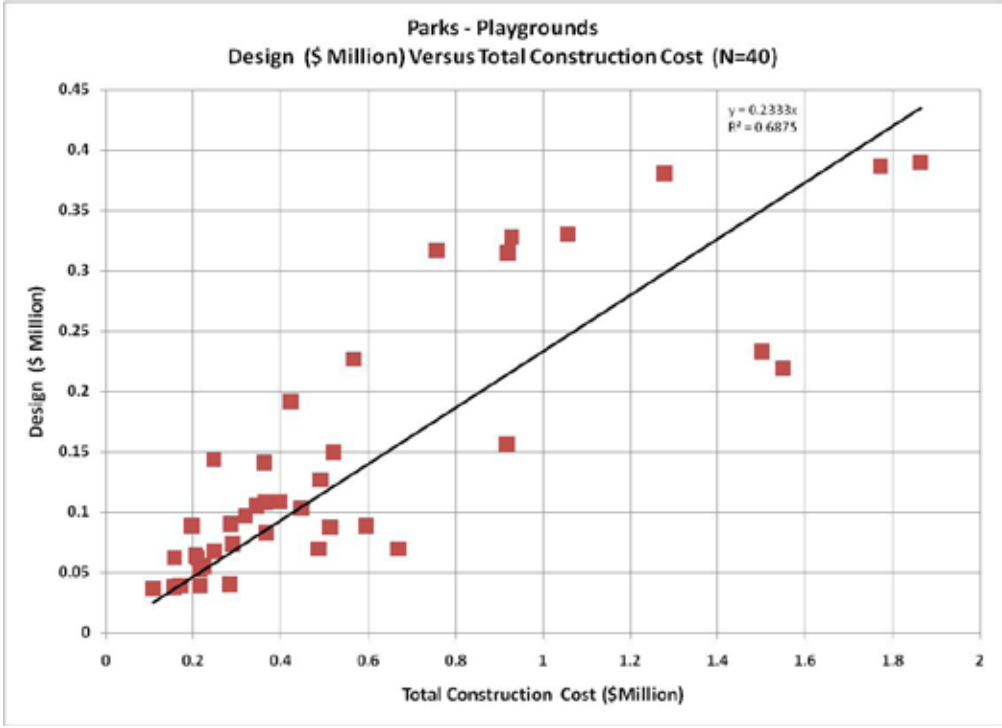

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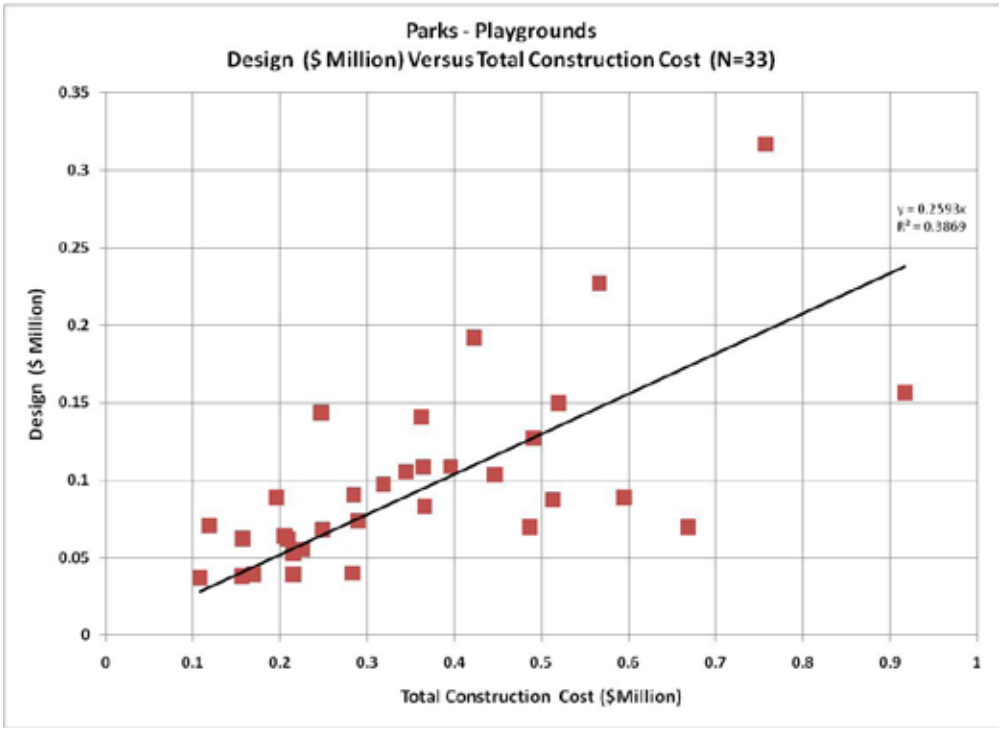

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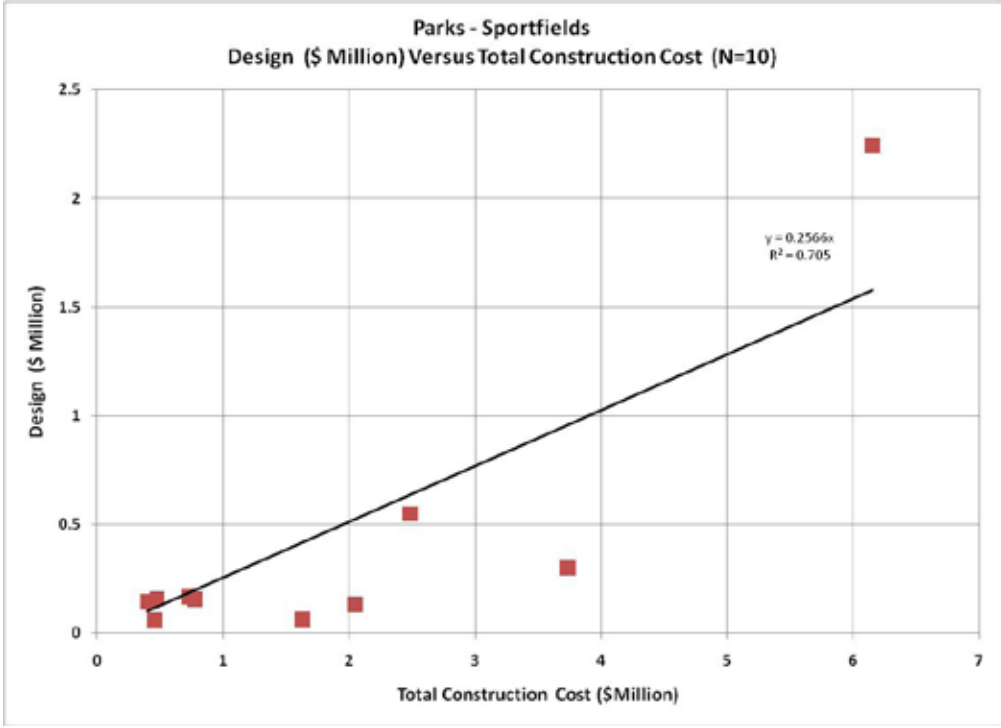

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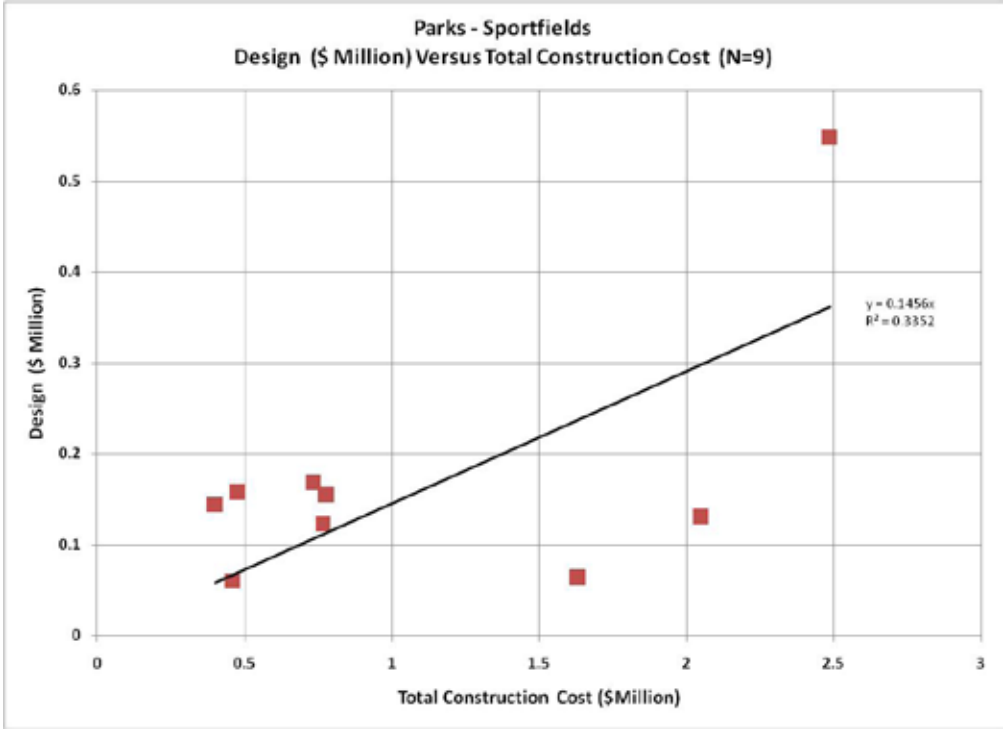

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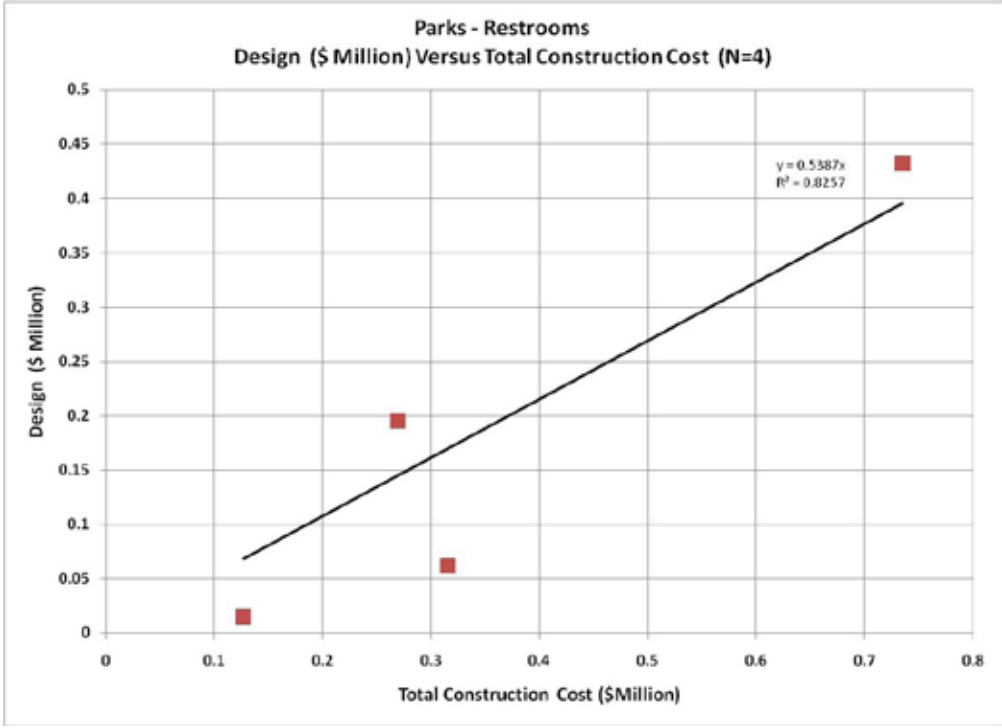

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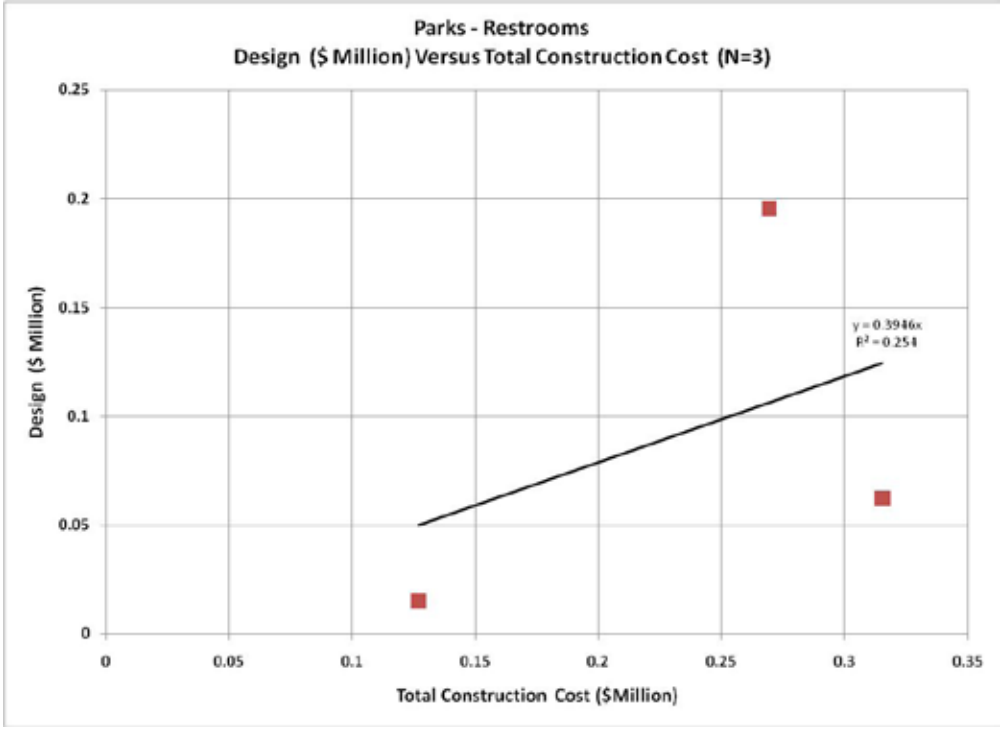
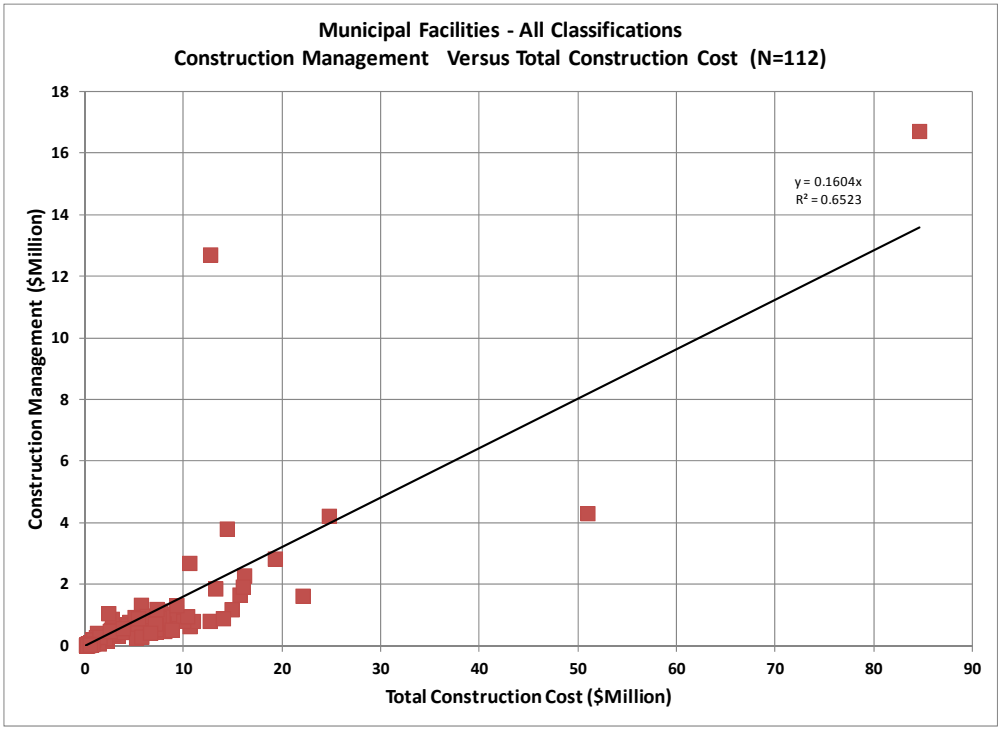


CURVES GROUP 2

Construction Management Cost
vs
Total Construction Cost

All Projects



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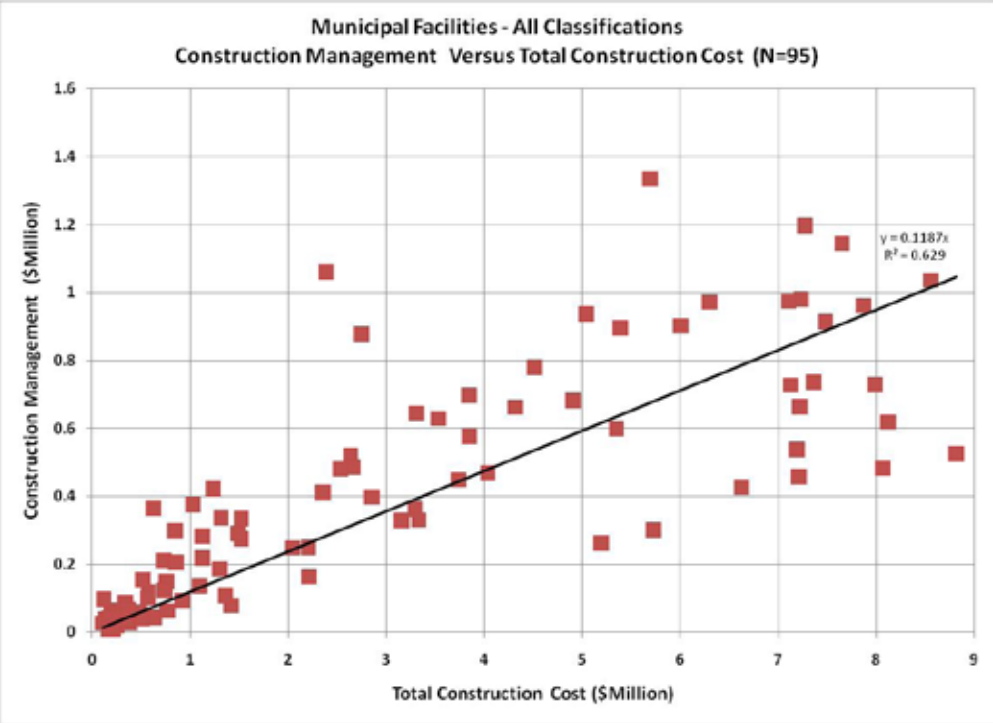

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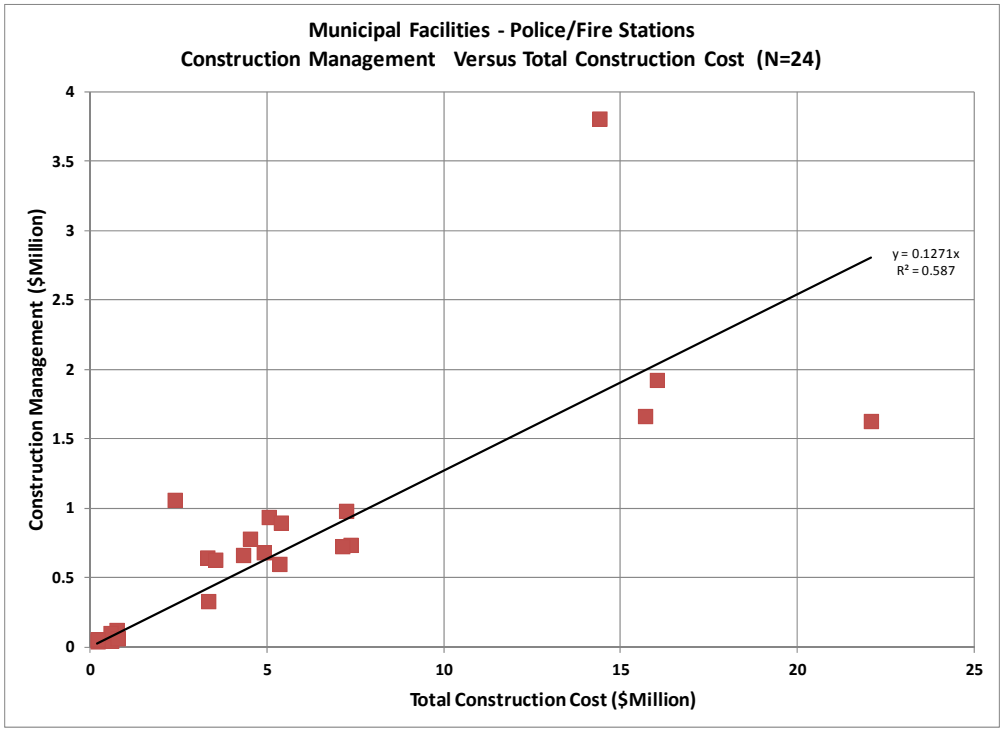

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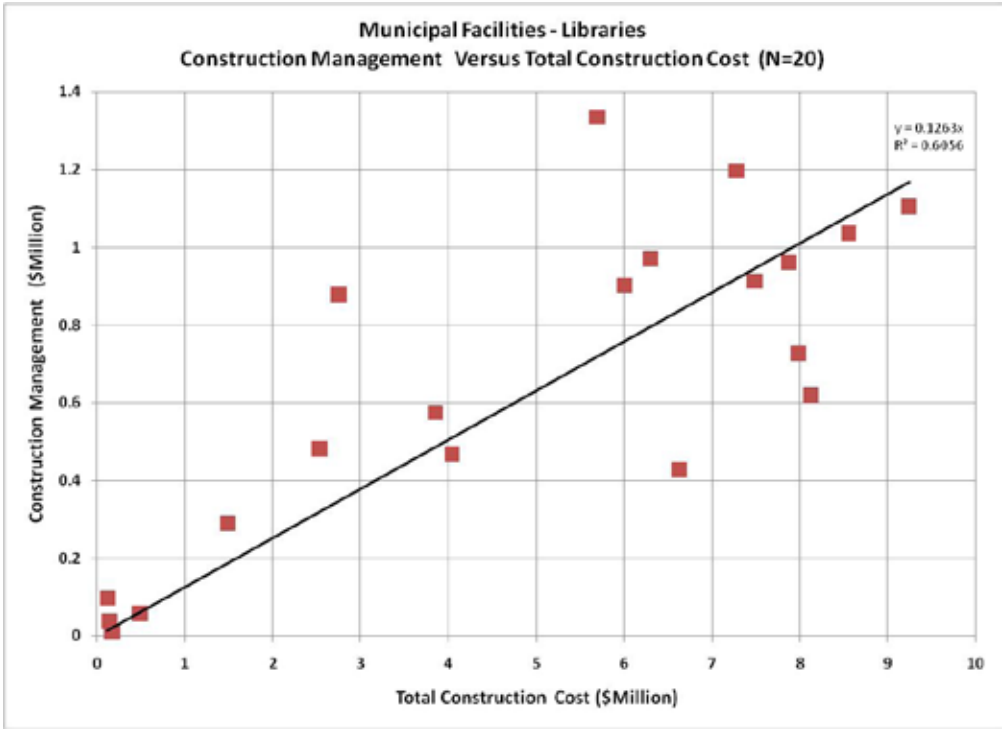

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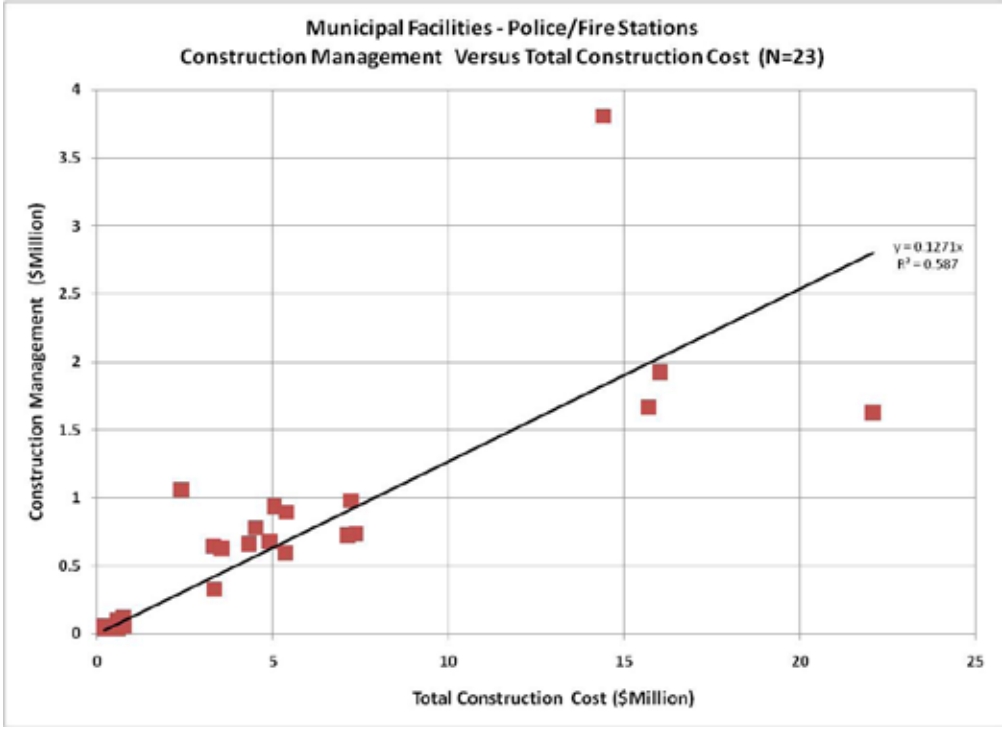

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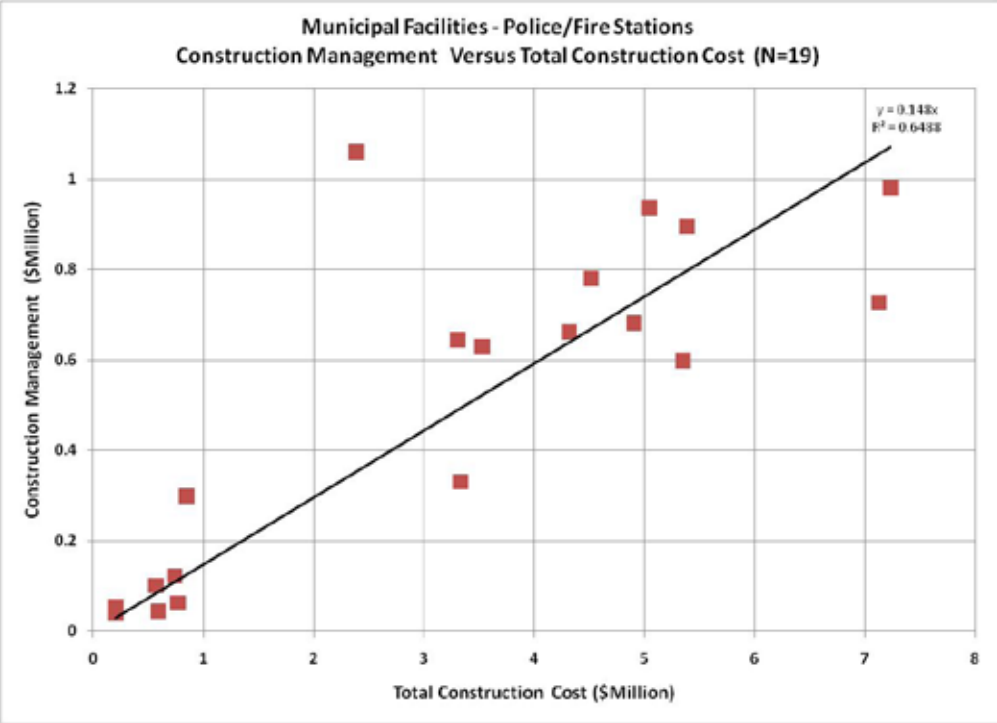

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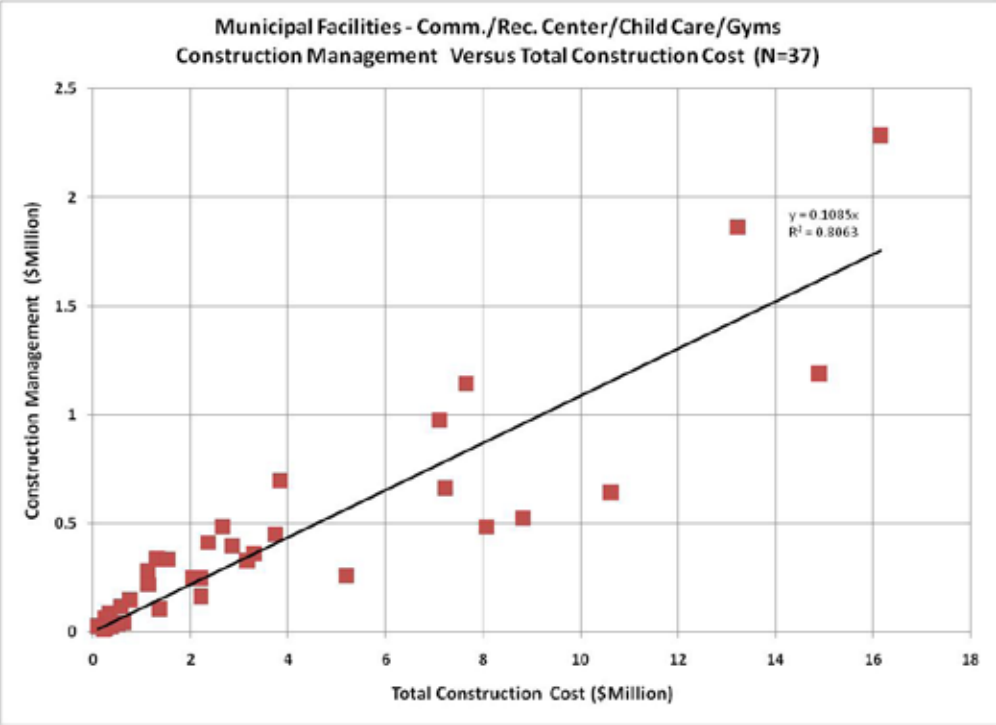

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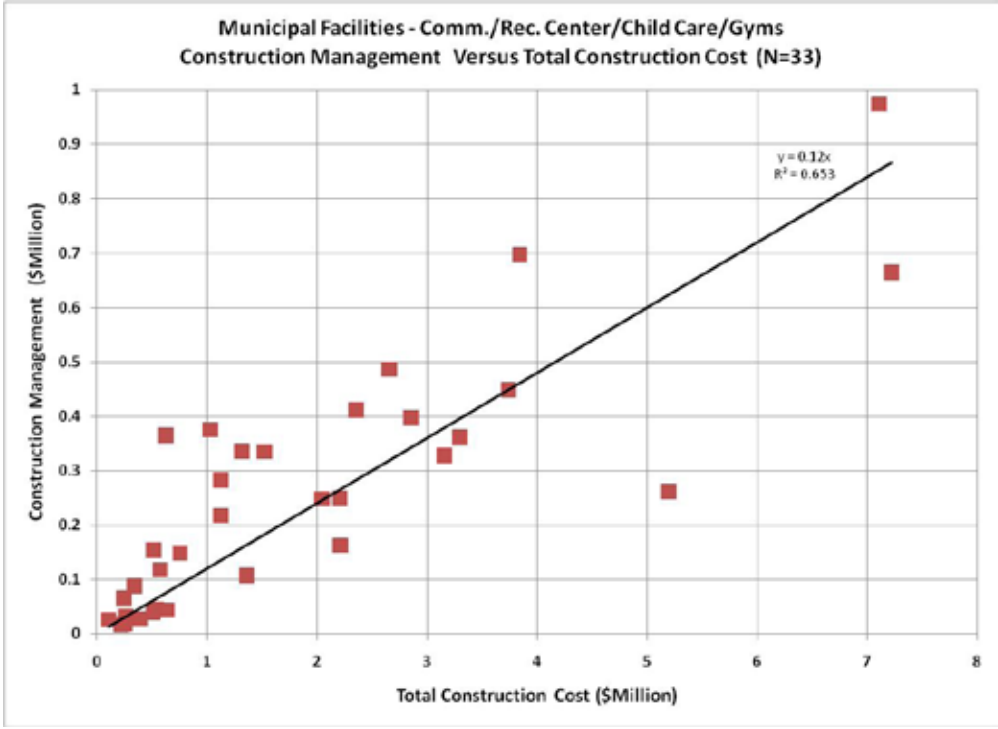

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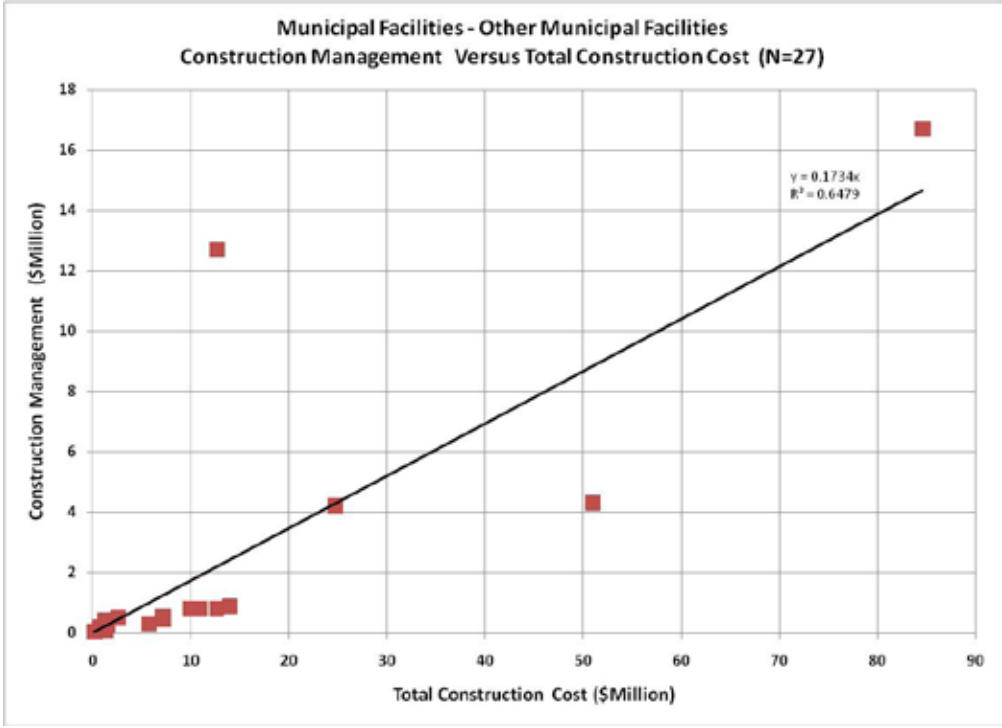

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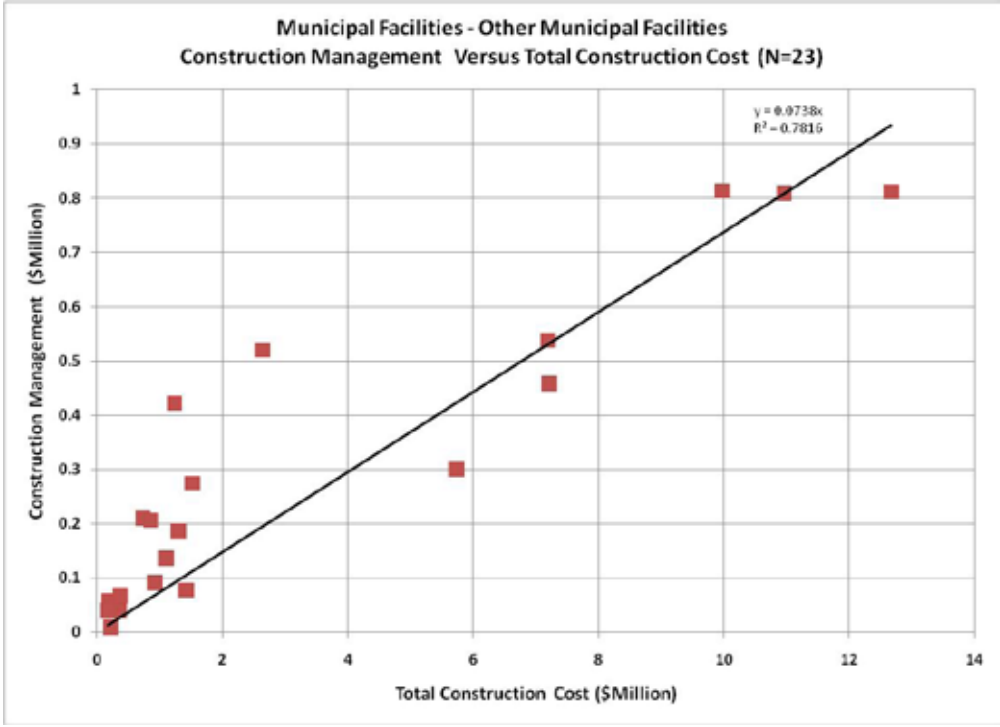

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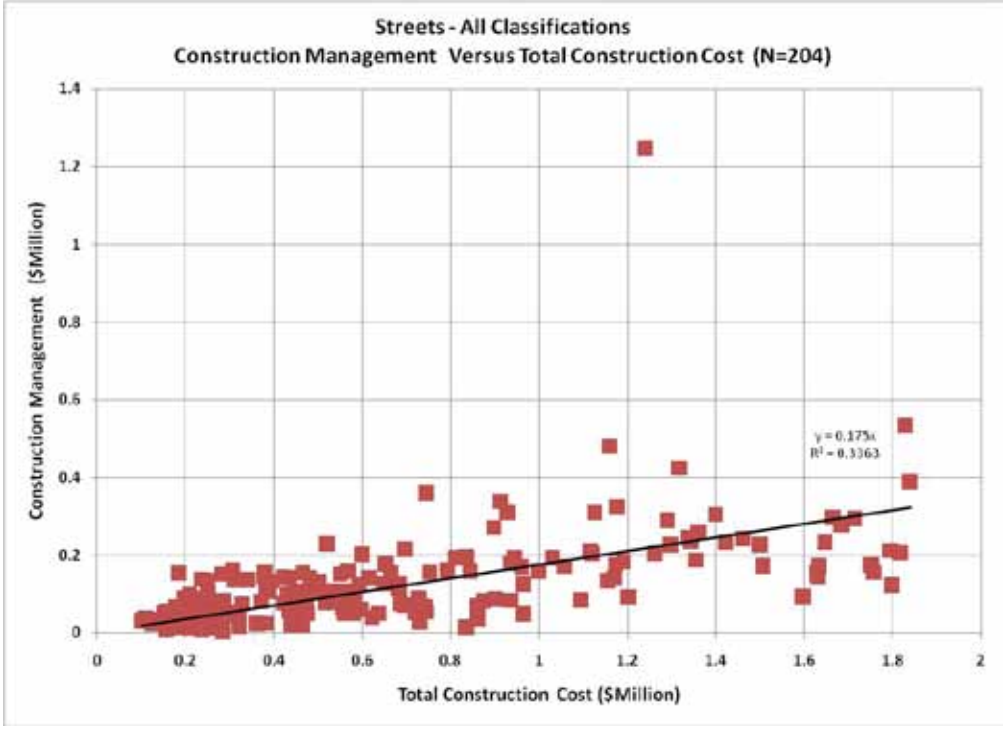

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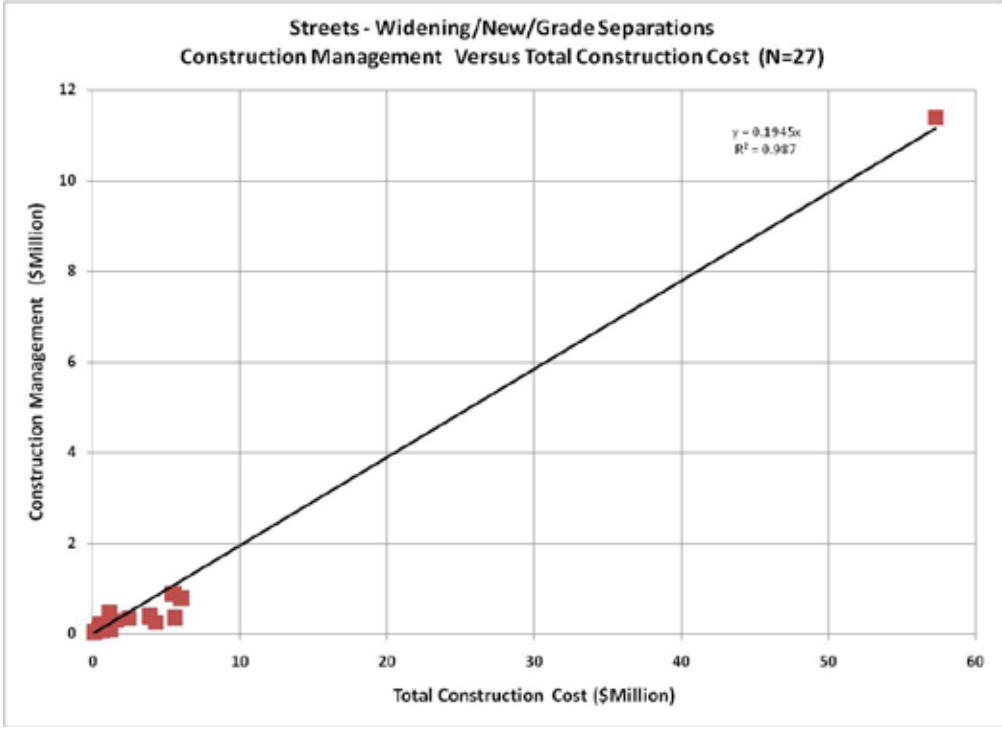

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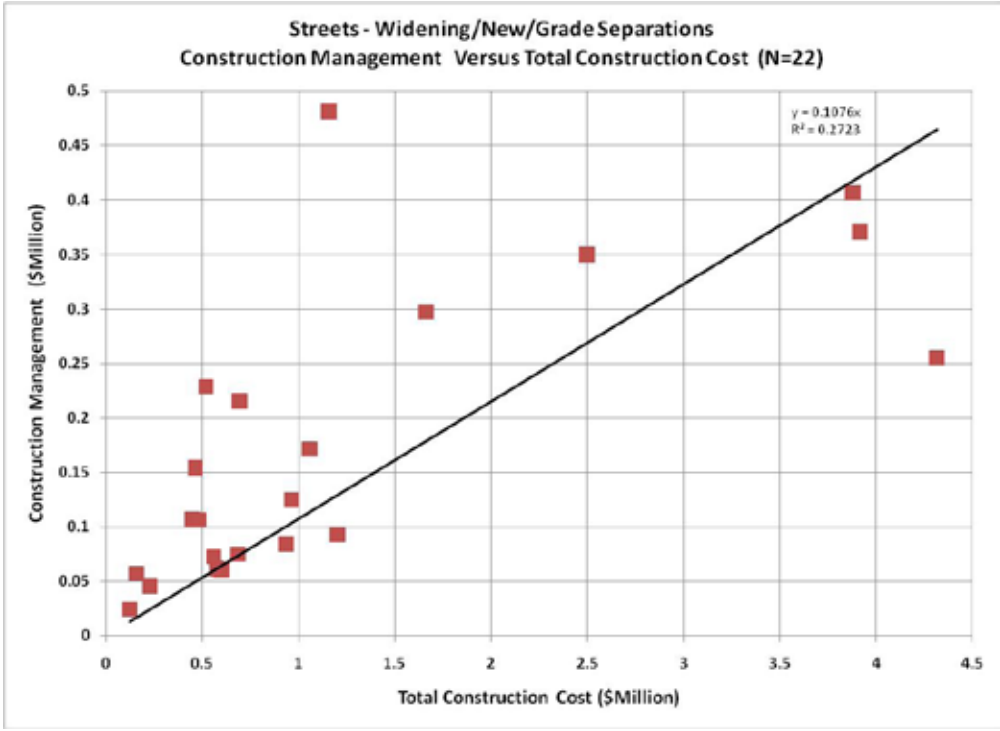

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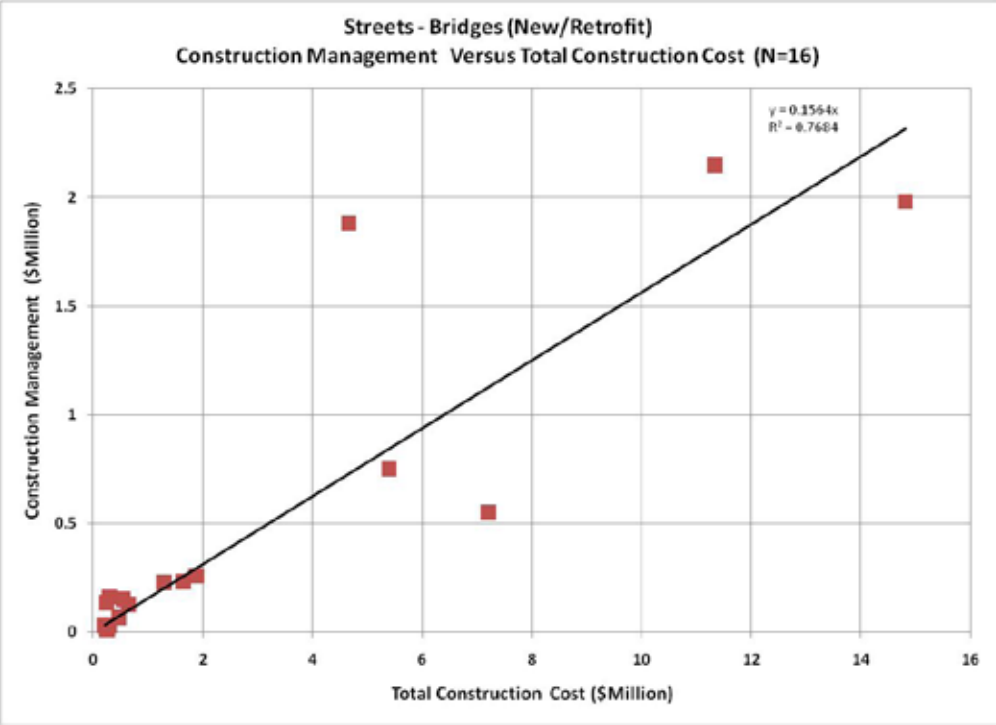

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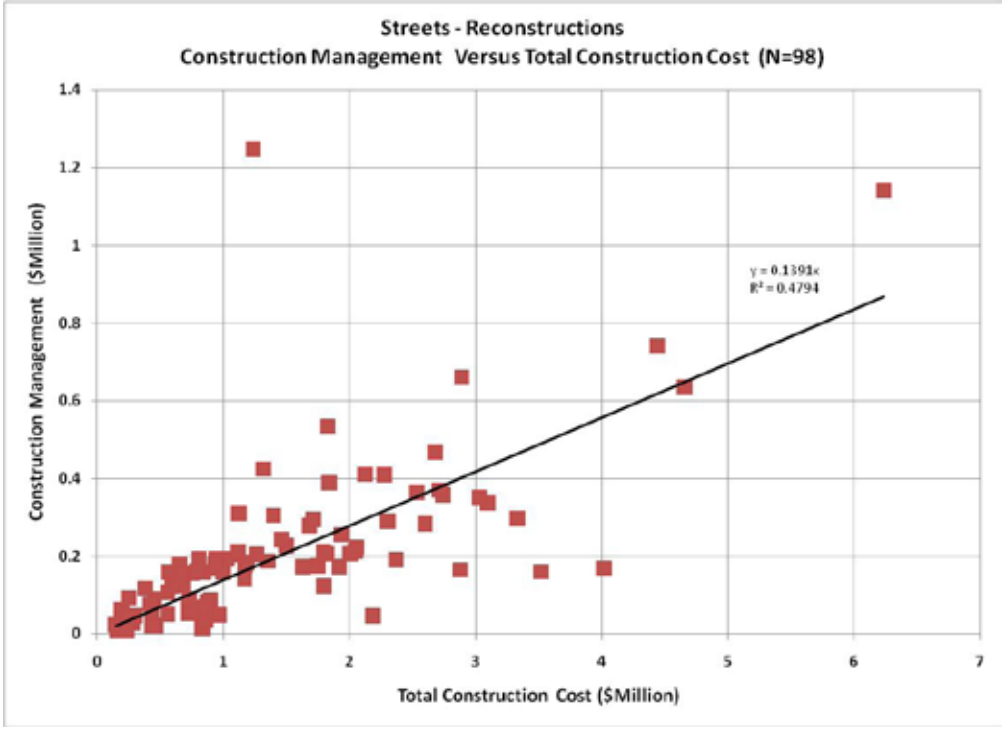

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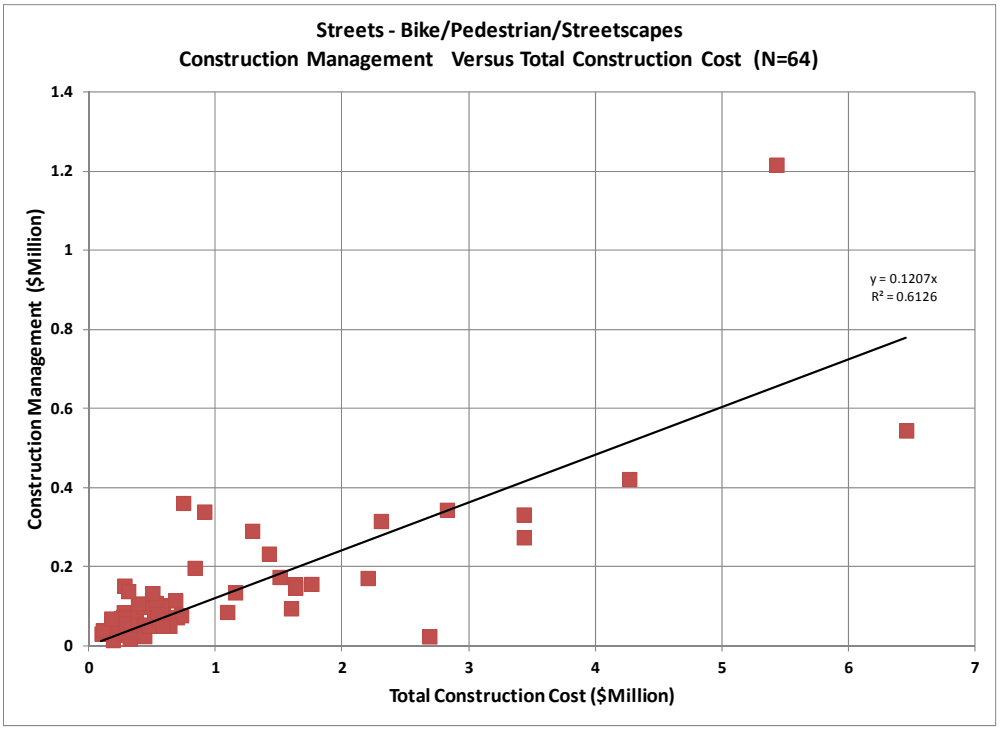

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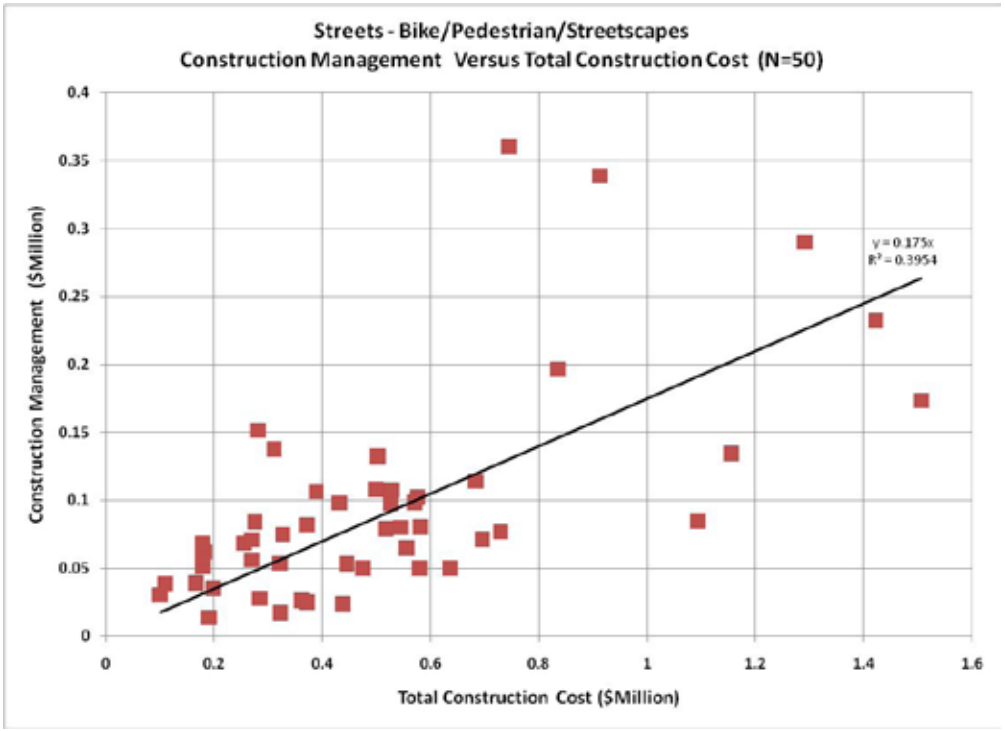

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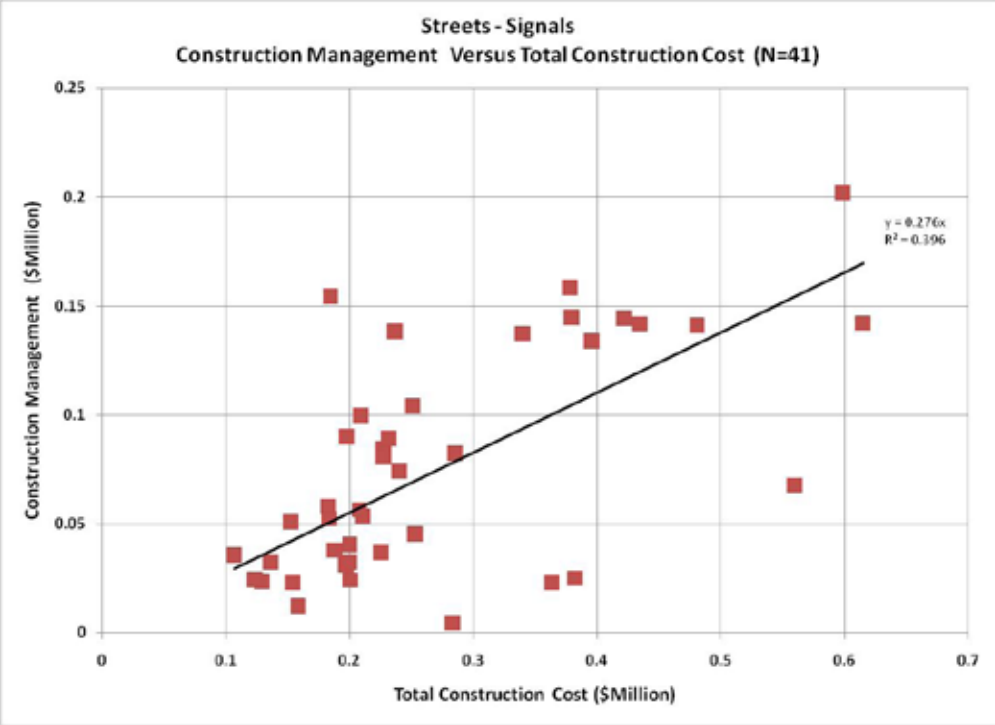

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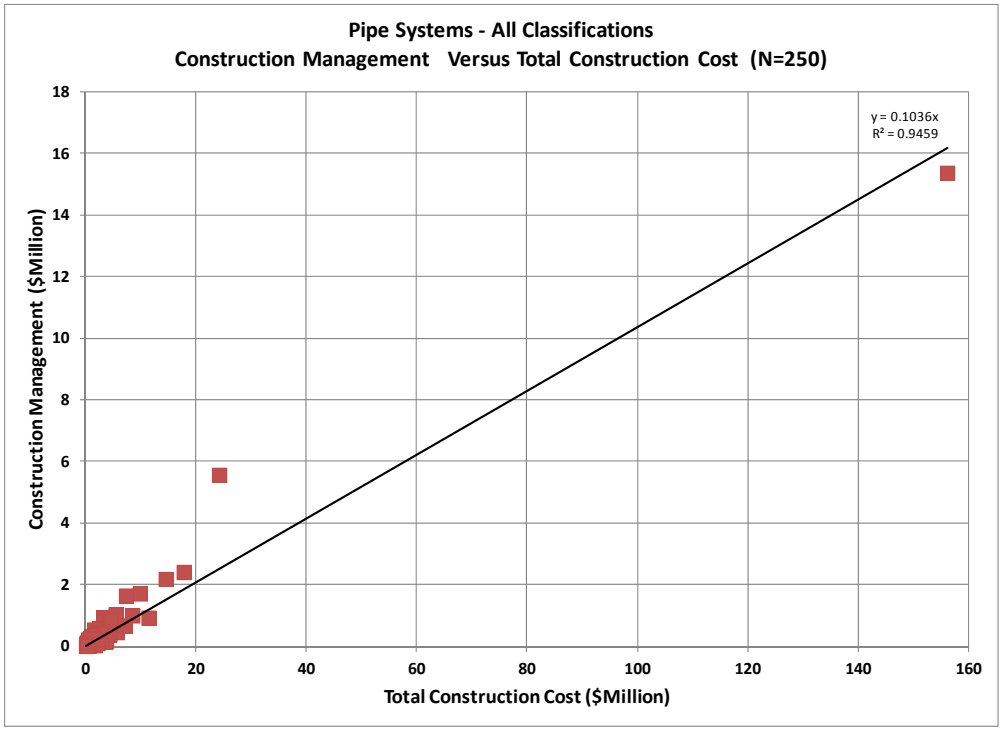

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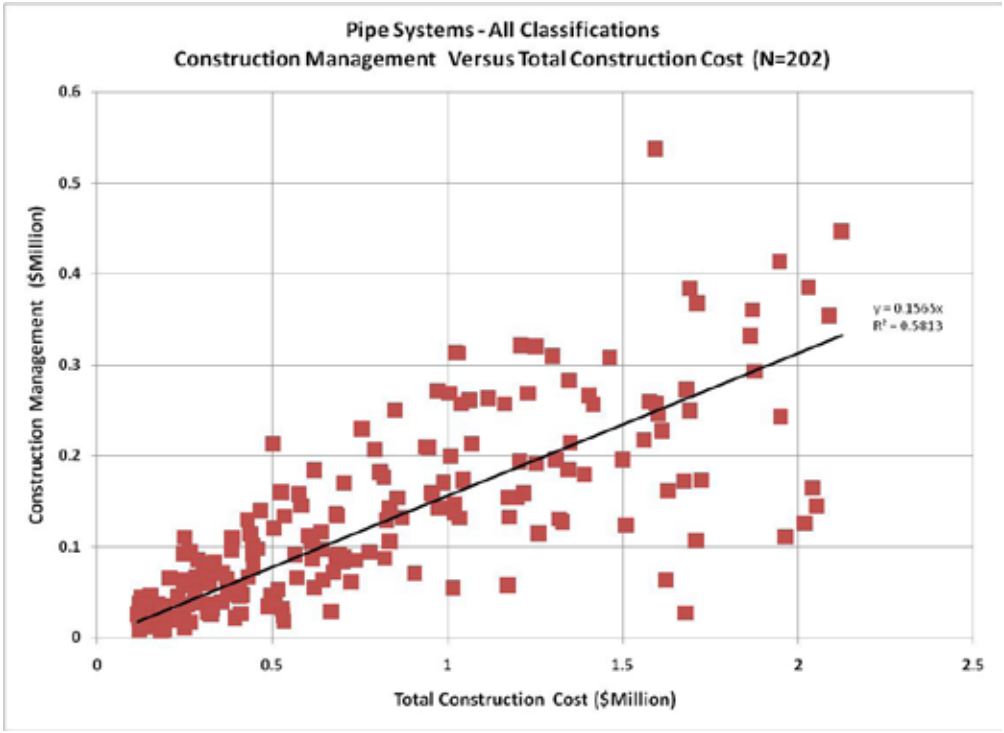

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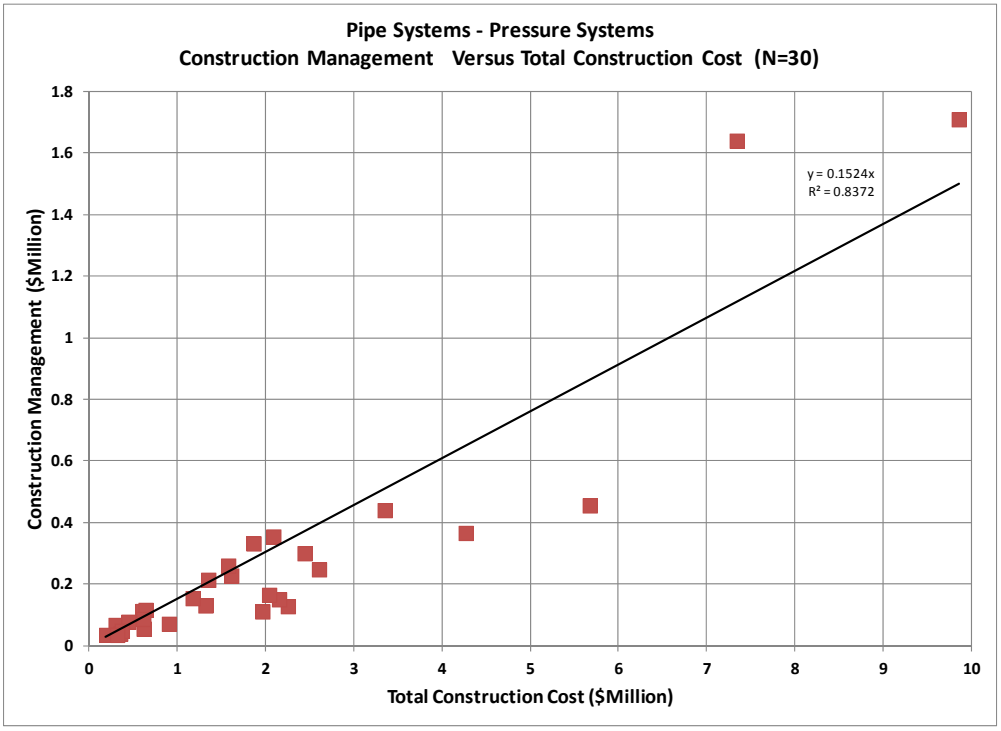

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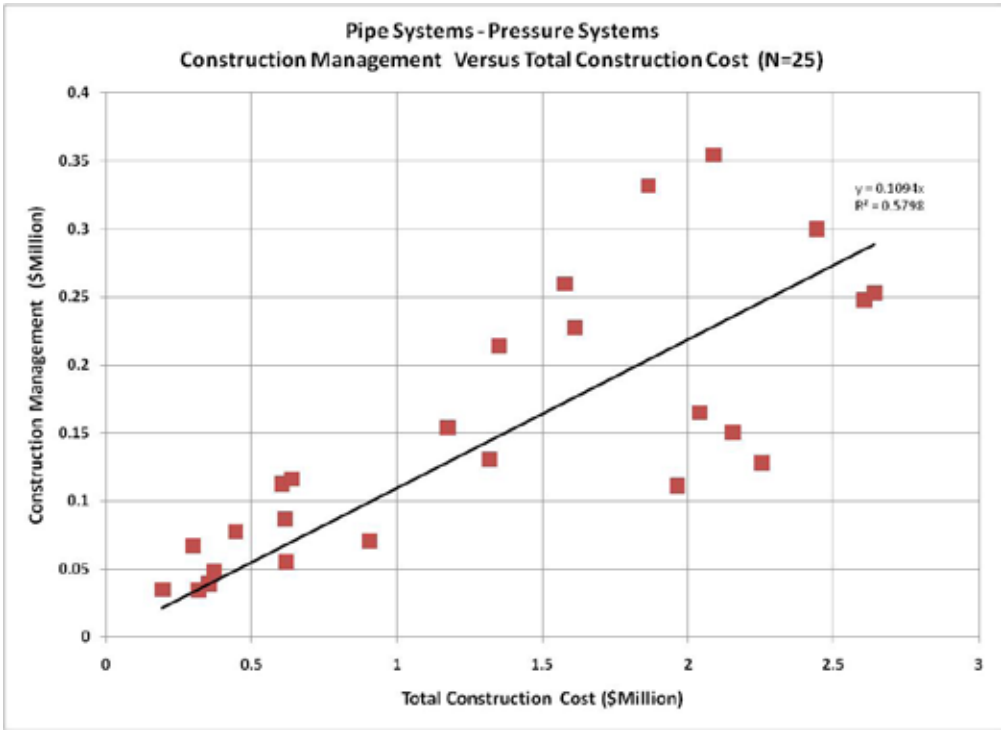

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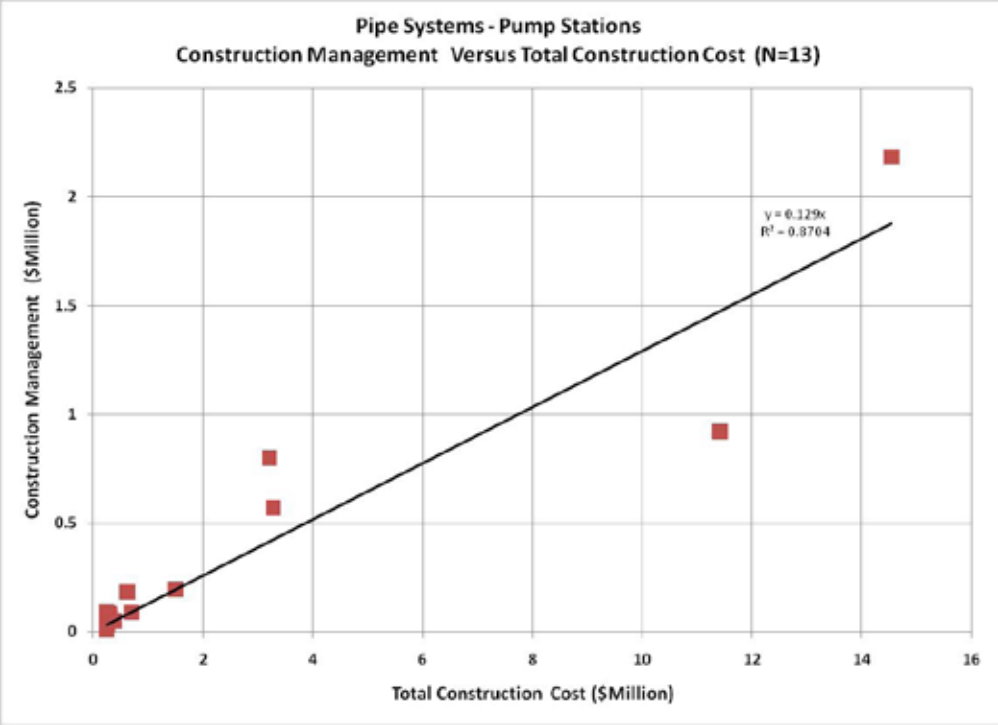

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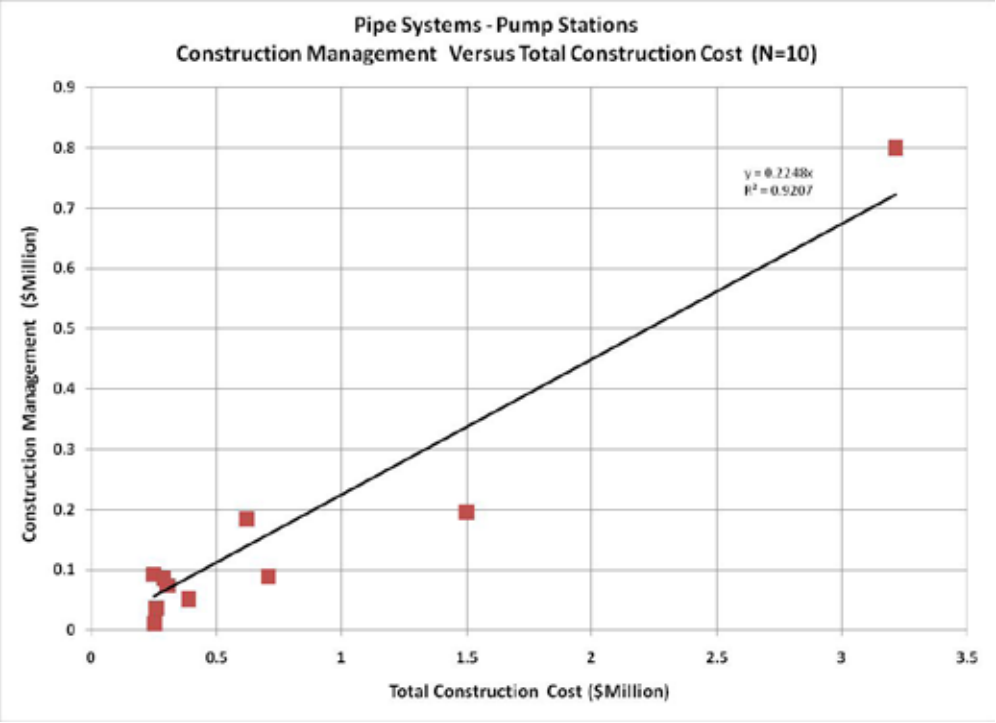

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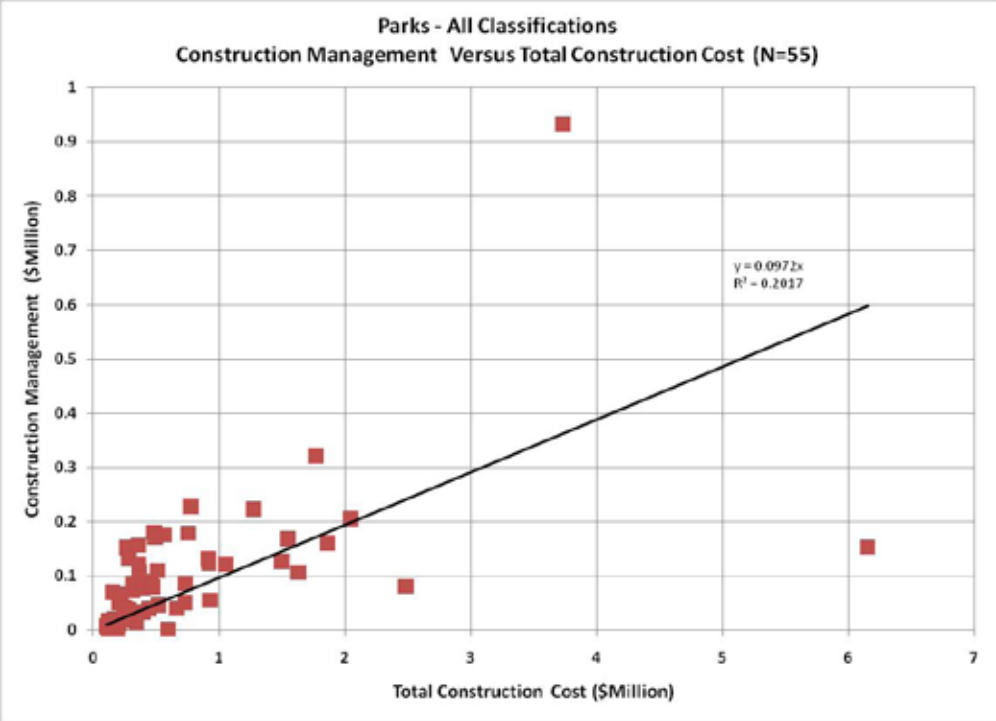

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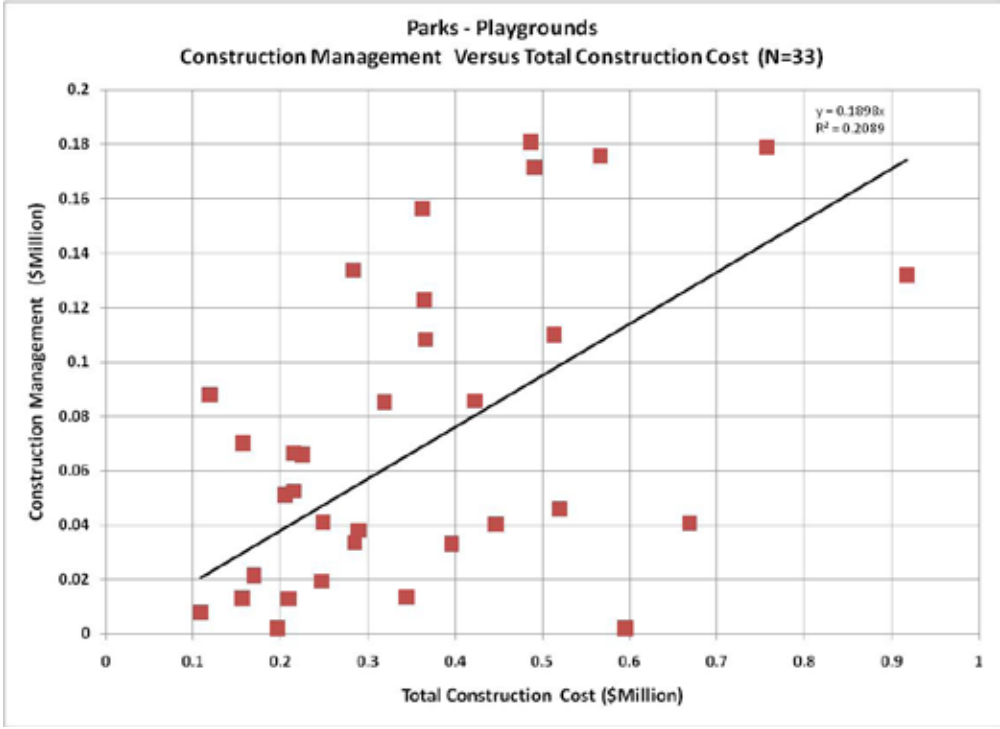

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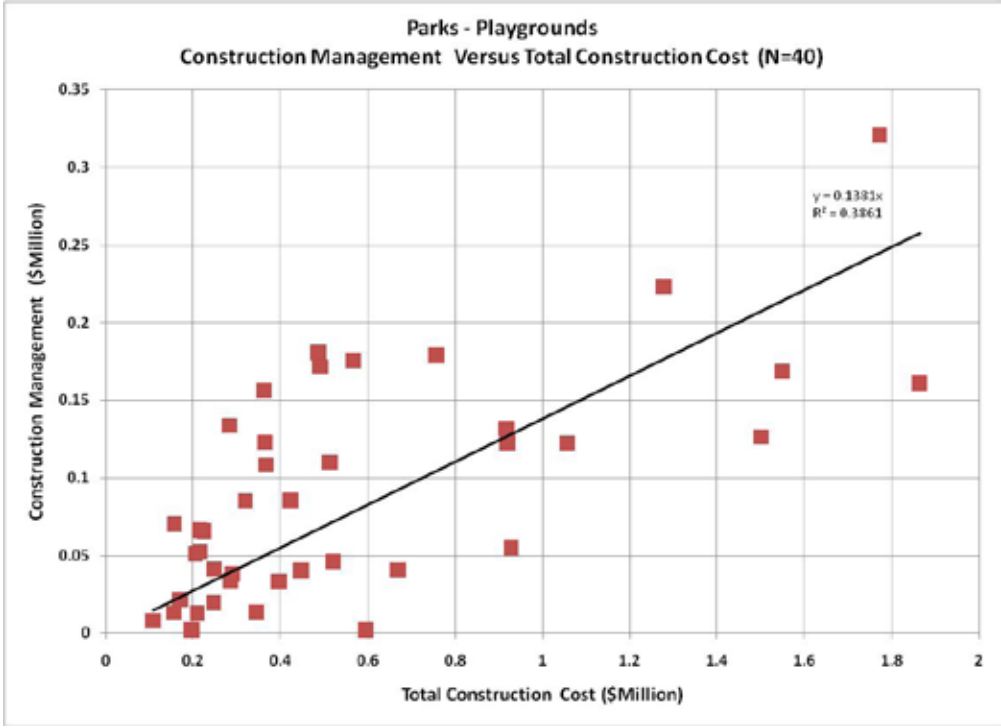

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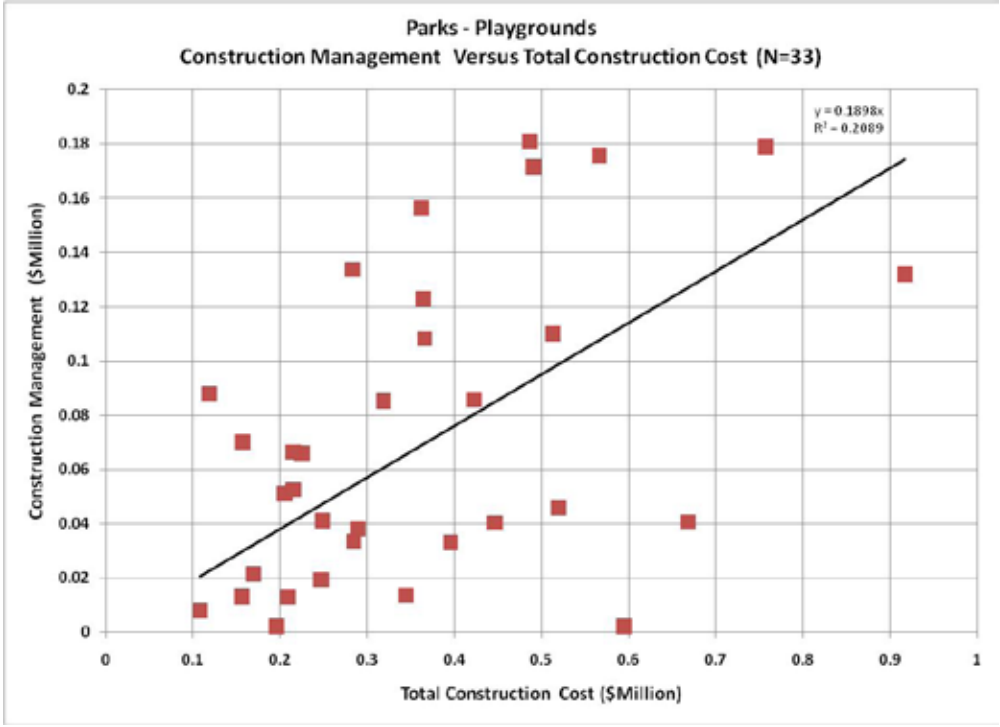

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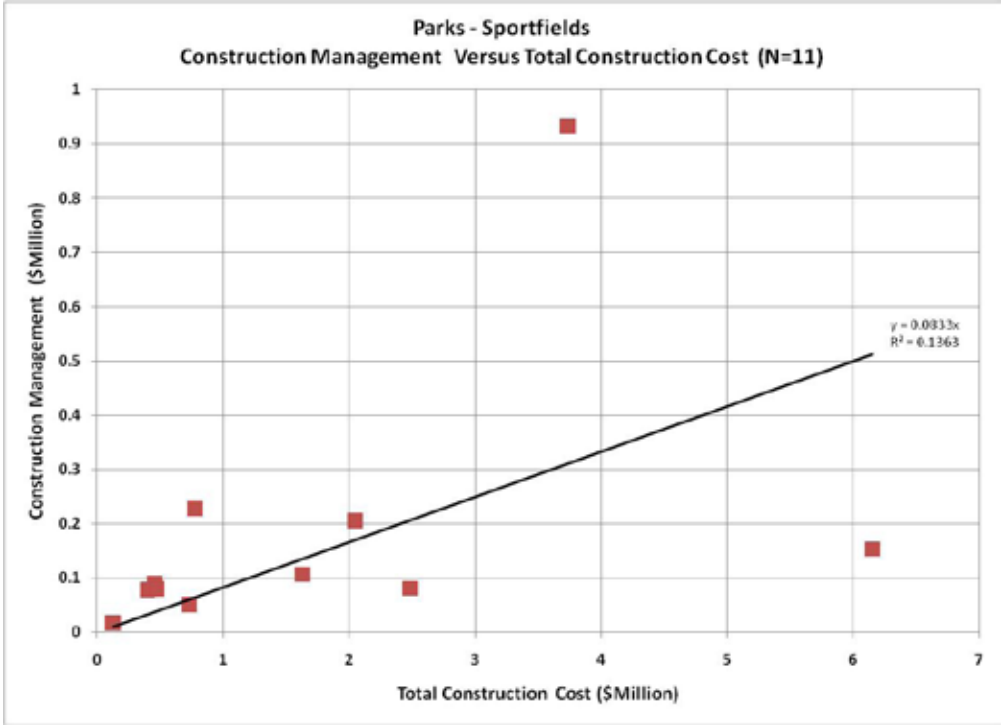

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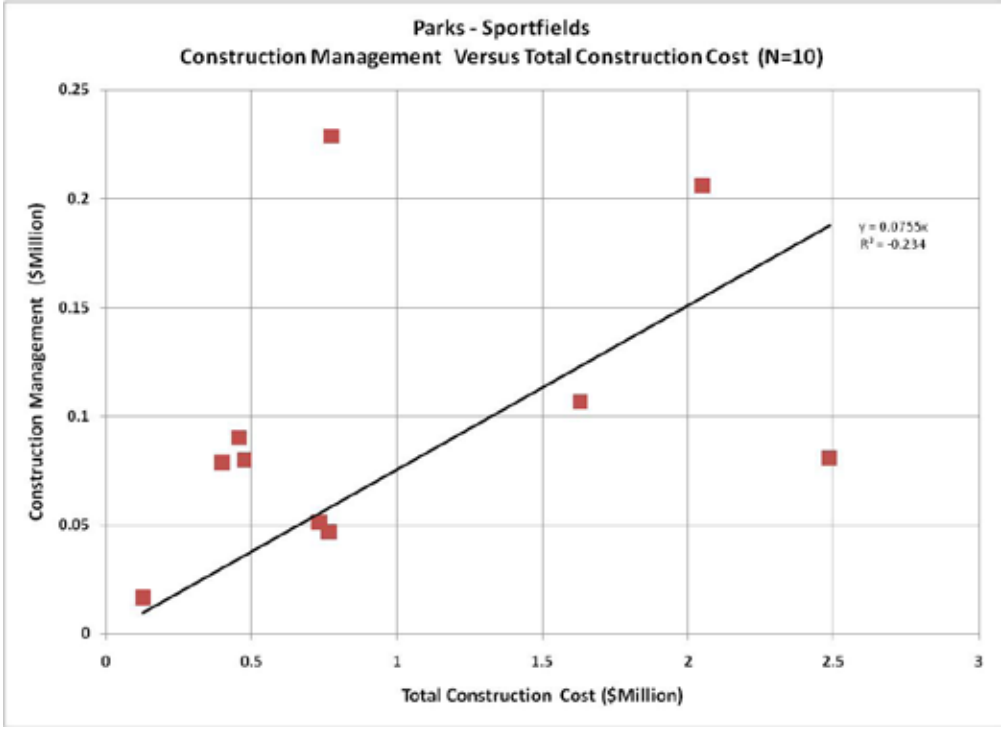
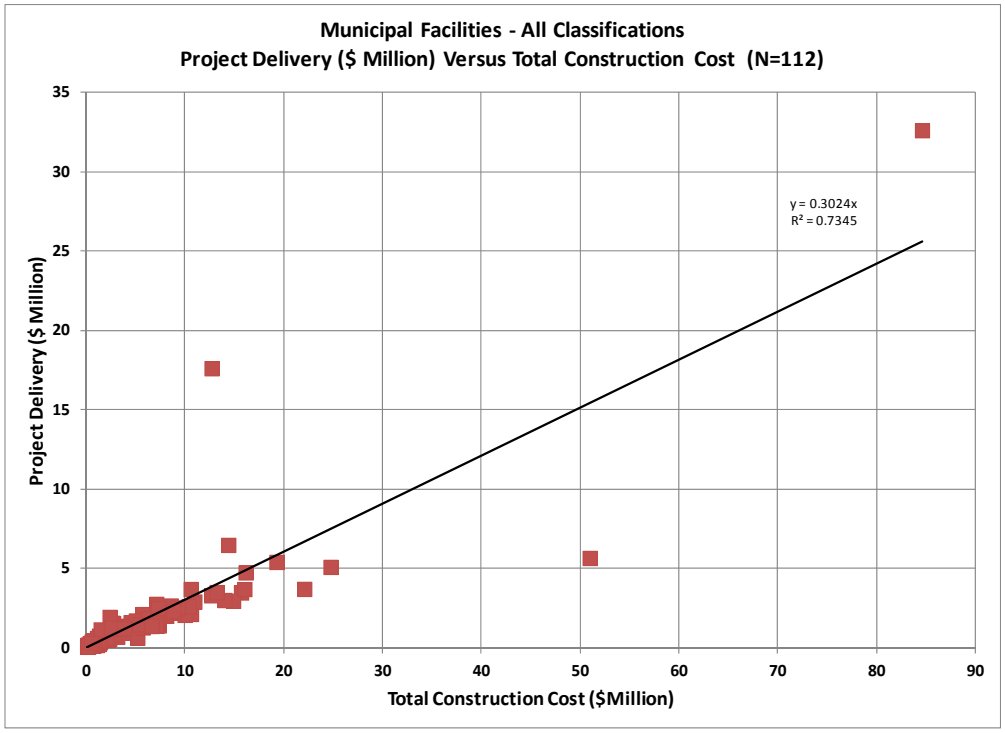


CURVES GROUP 3

Project Delivery Cost
vs
Total Construction Cost

All Projects



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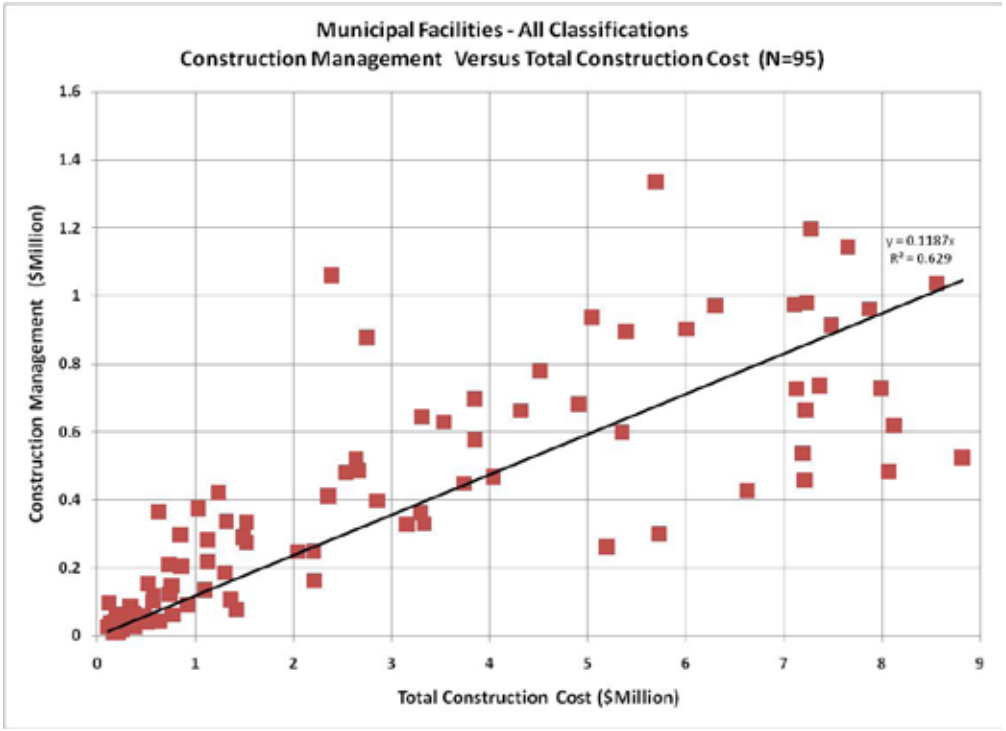

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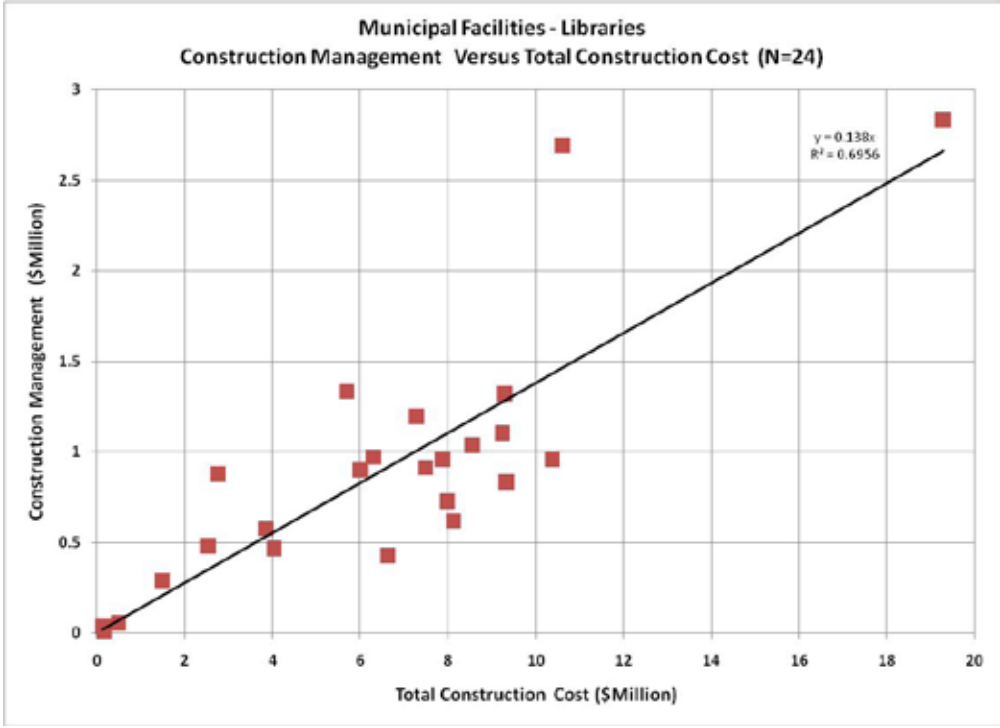

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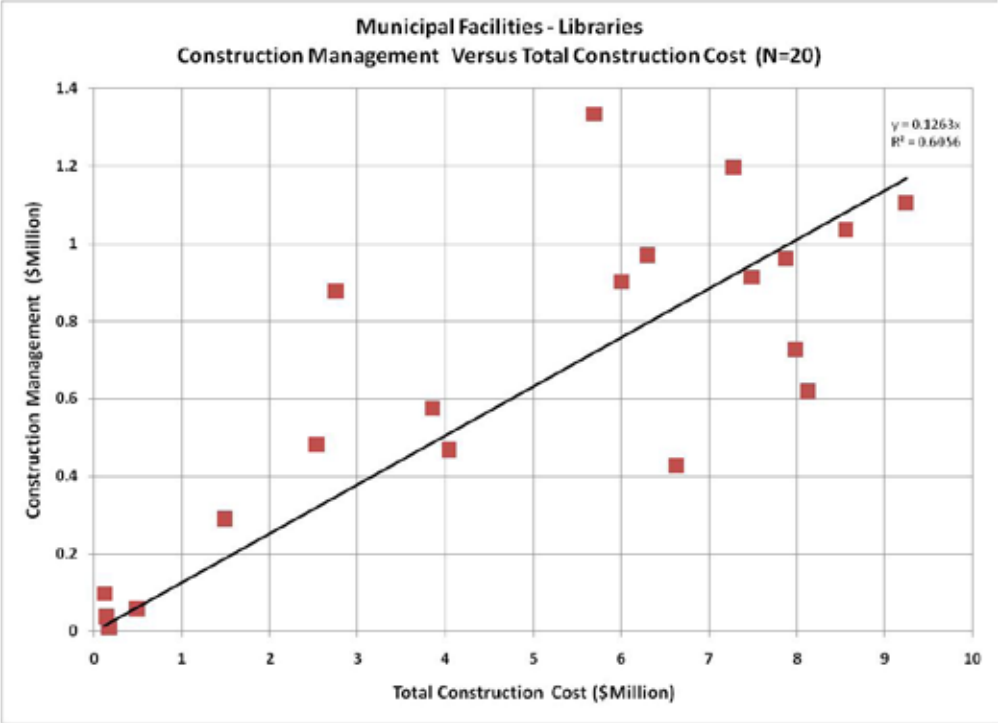

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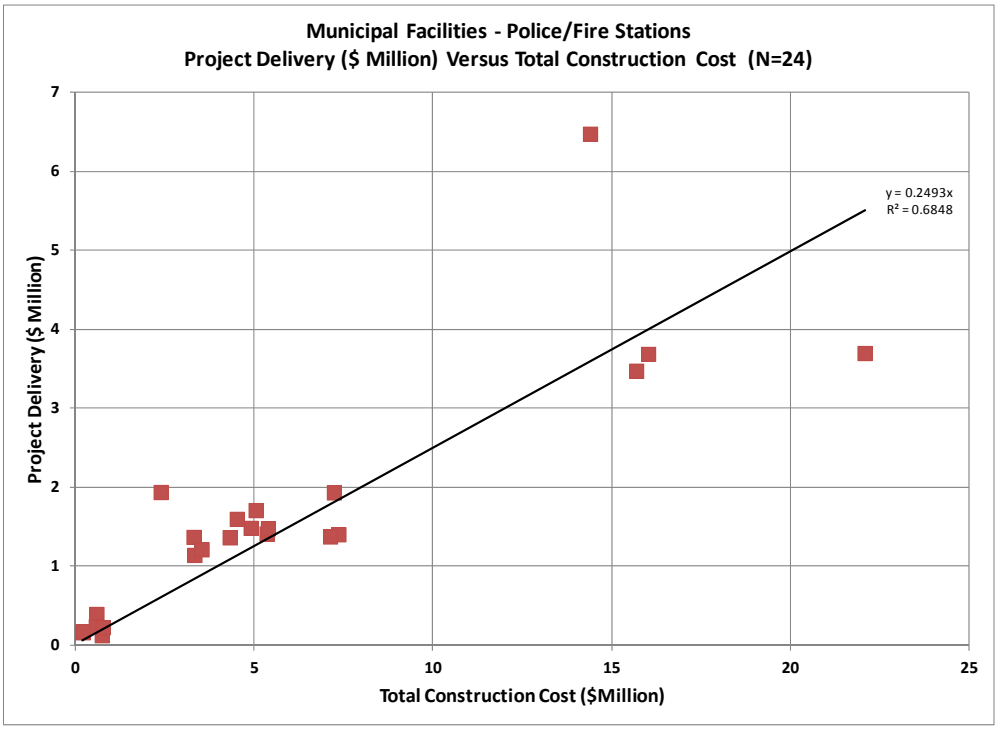

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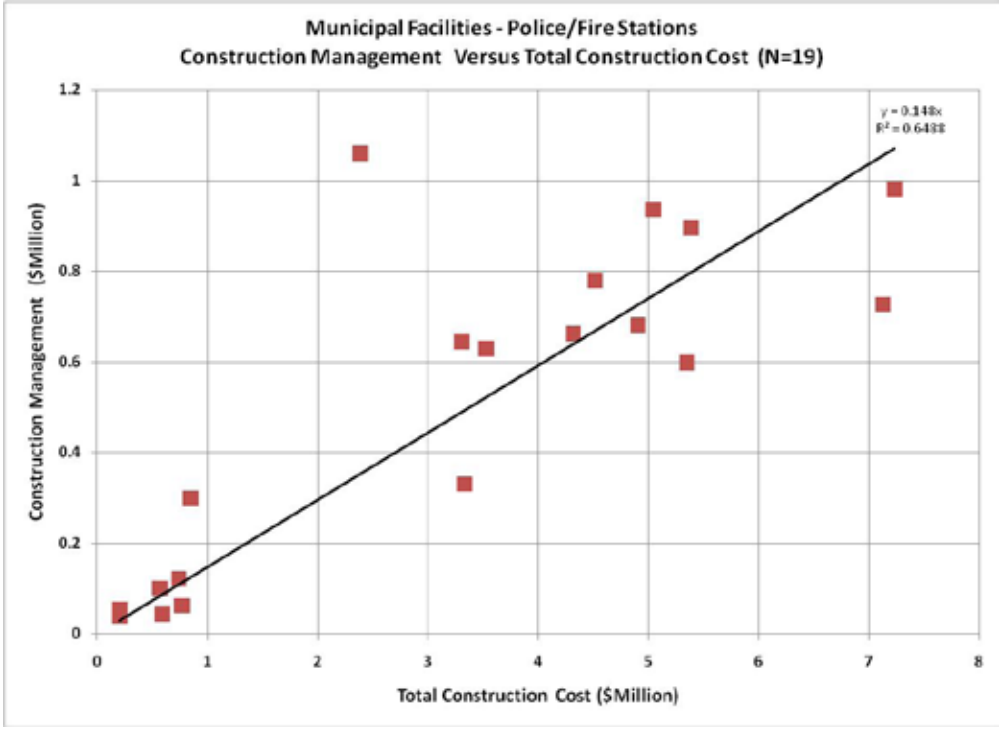

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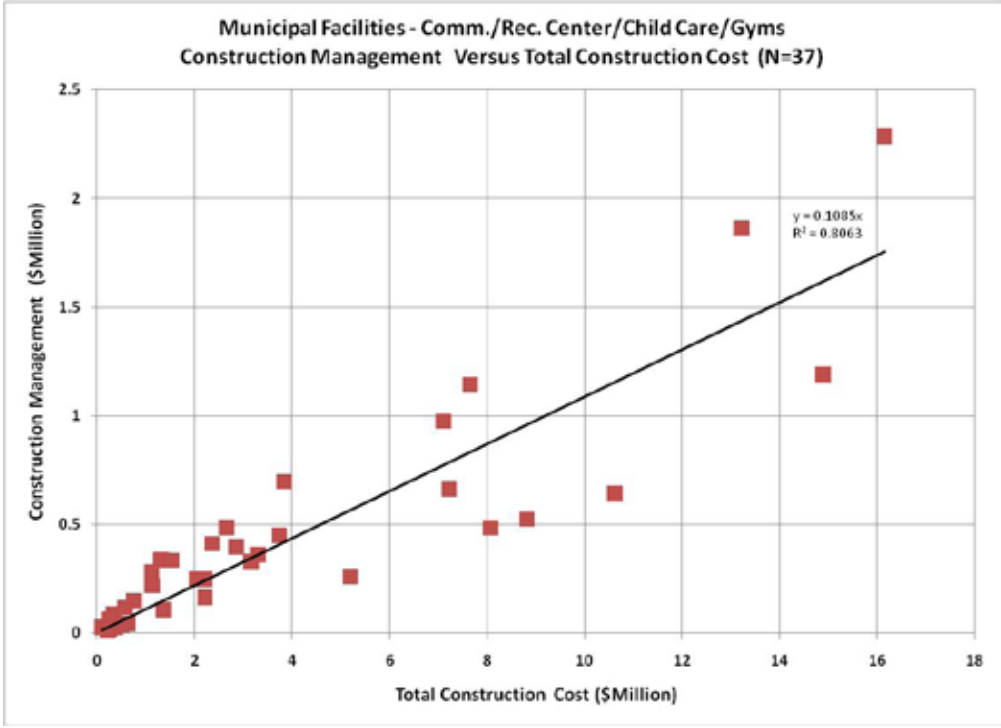

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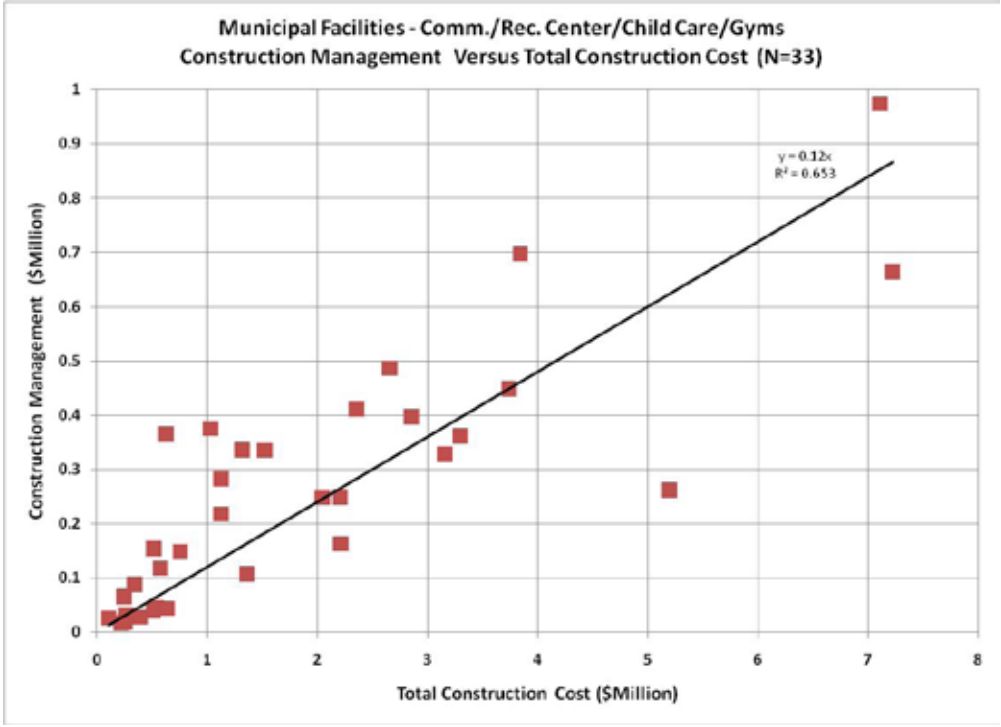

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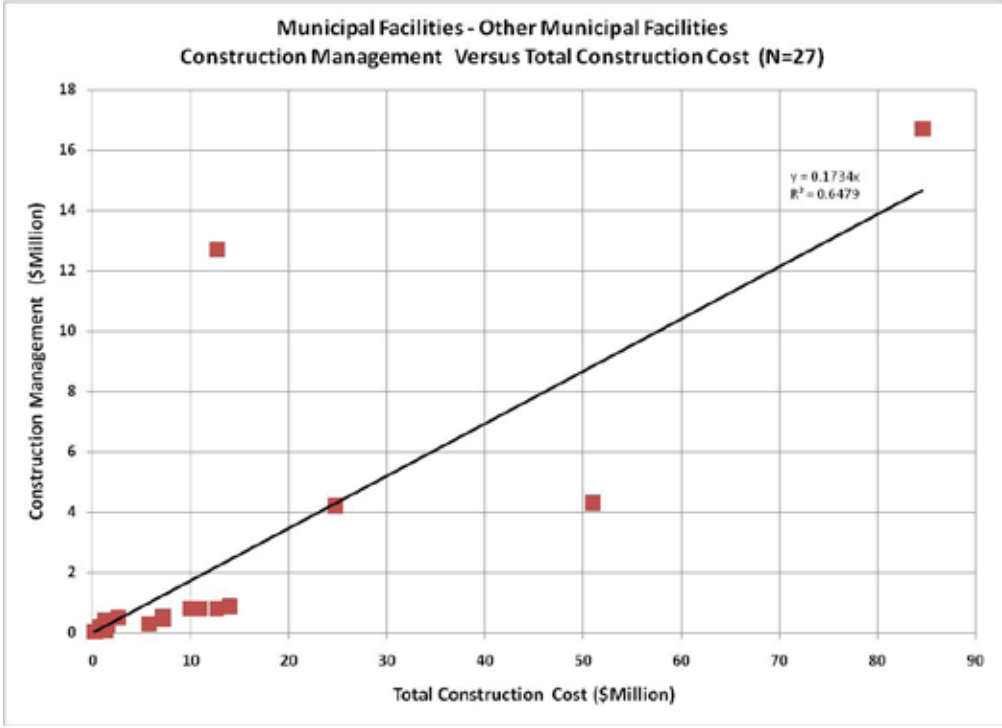

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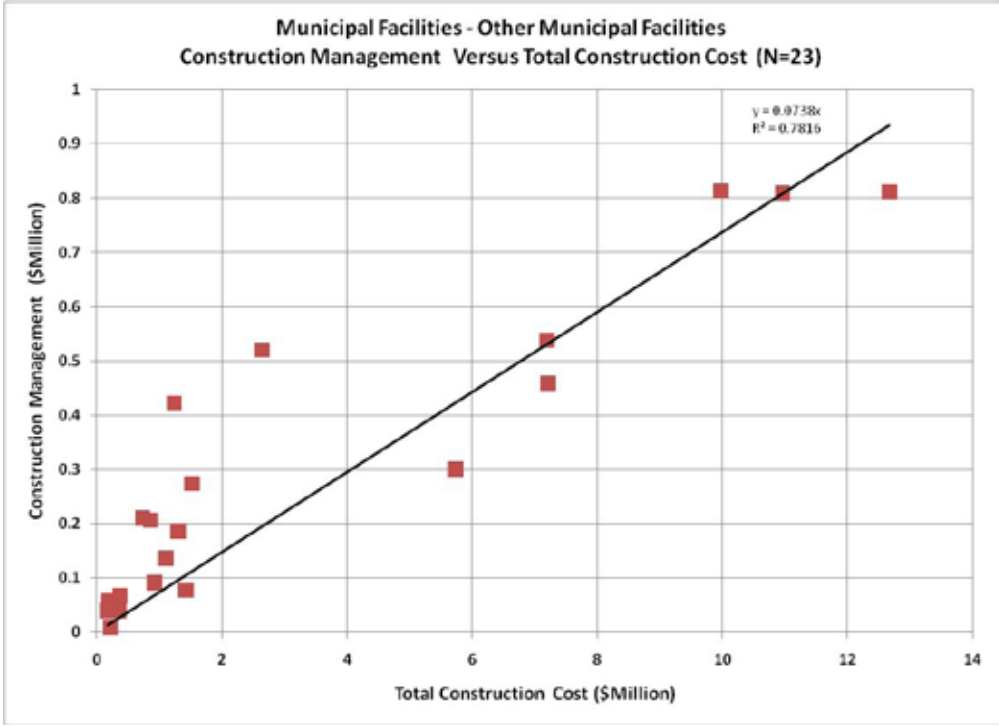

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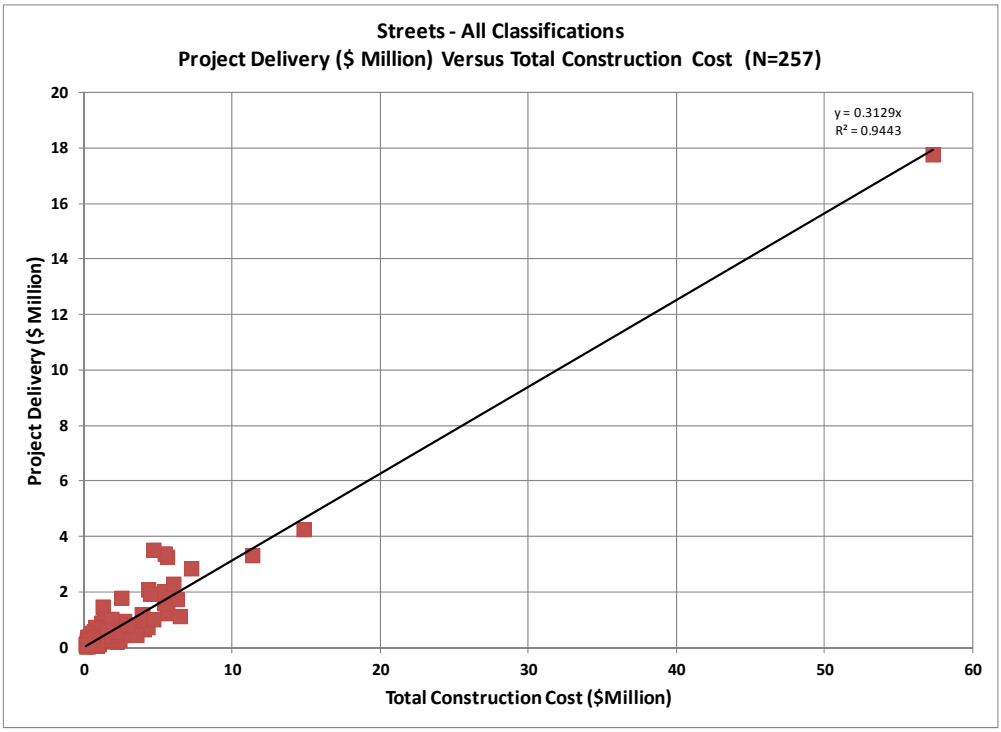

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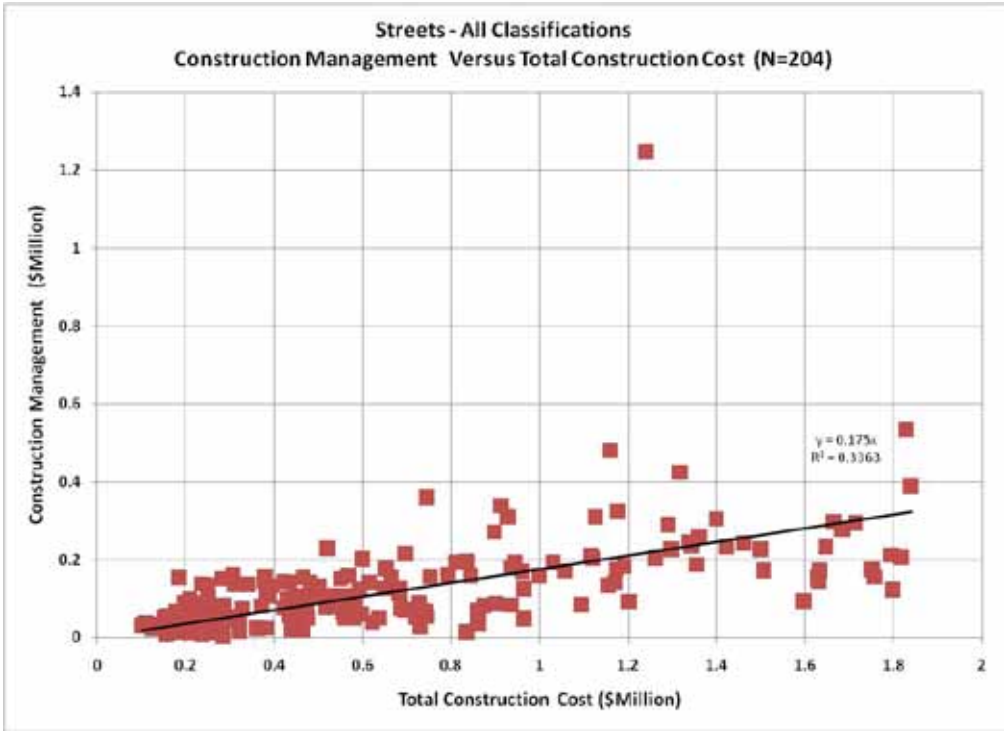

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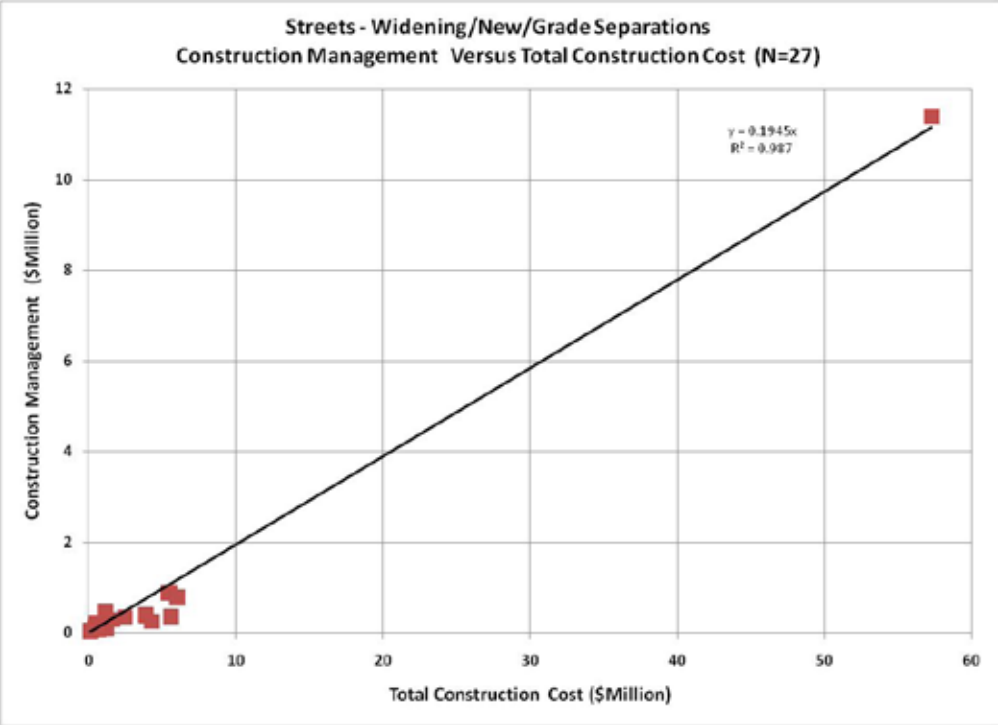

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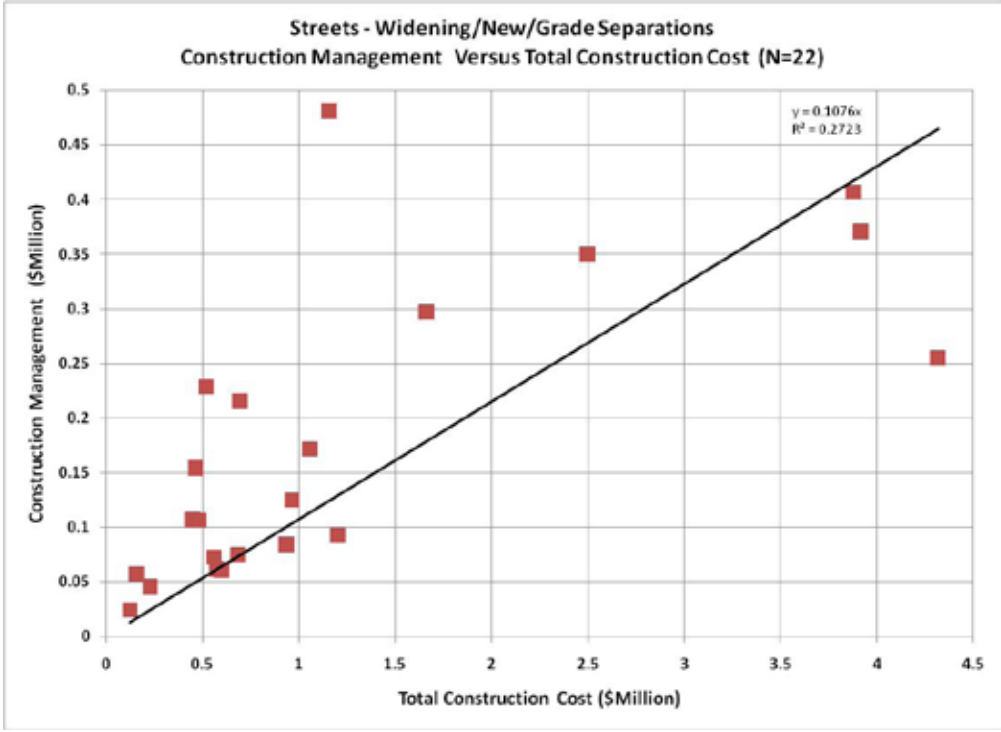

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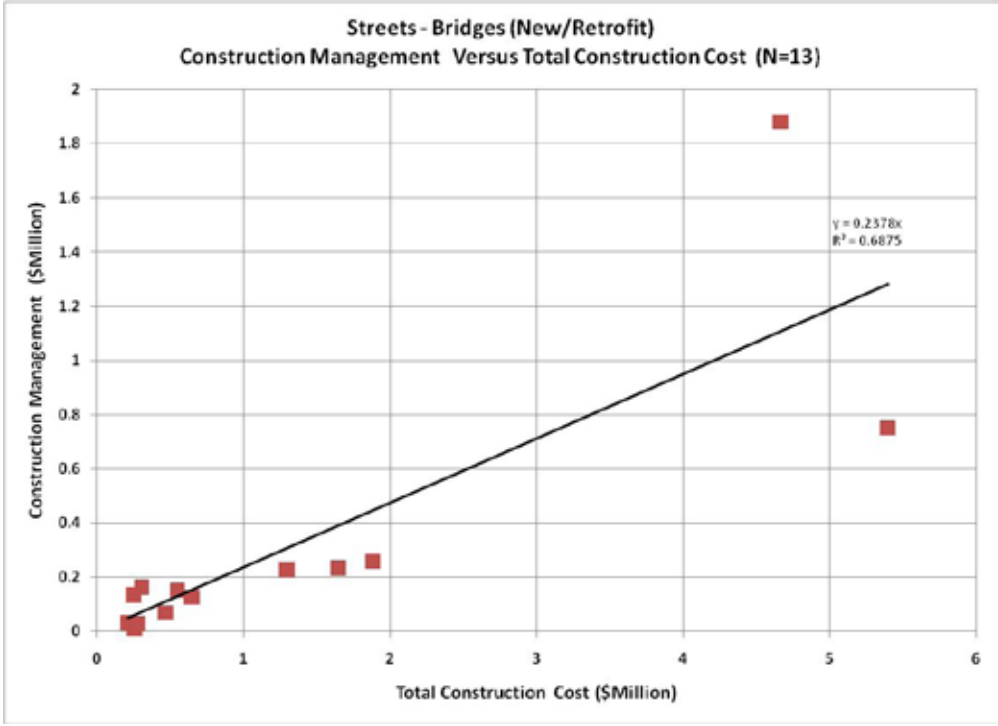

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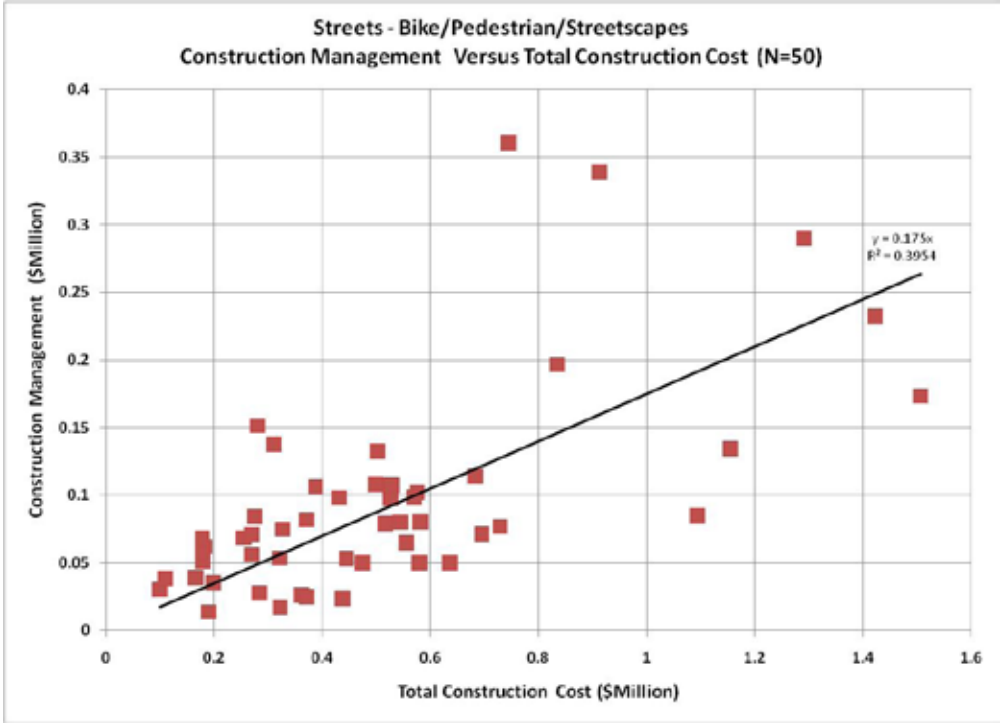

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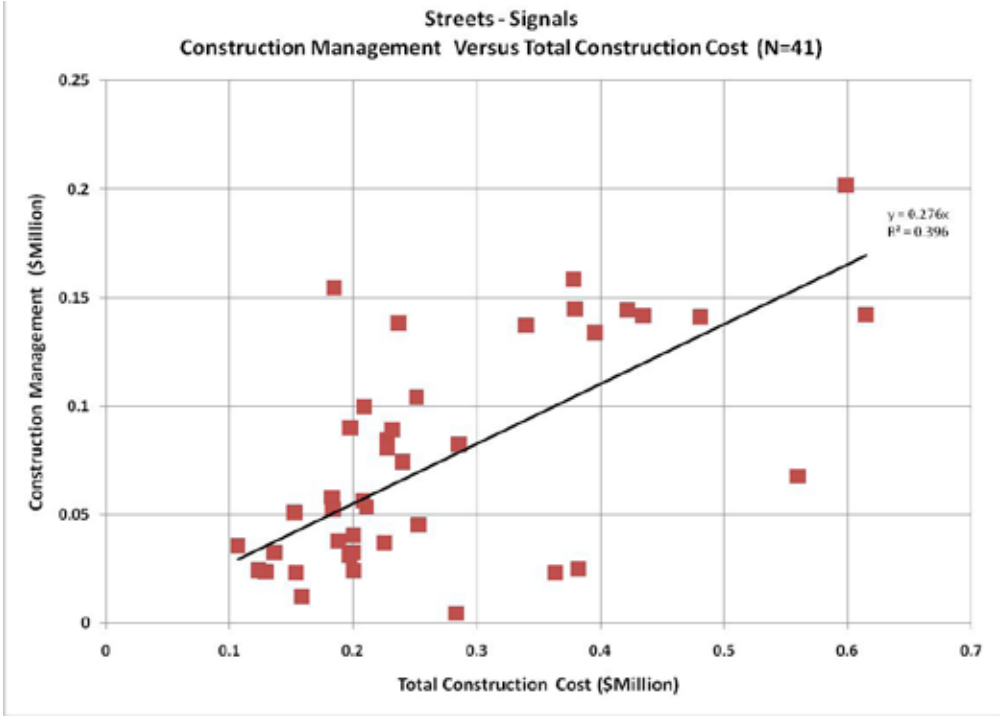

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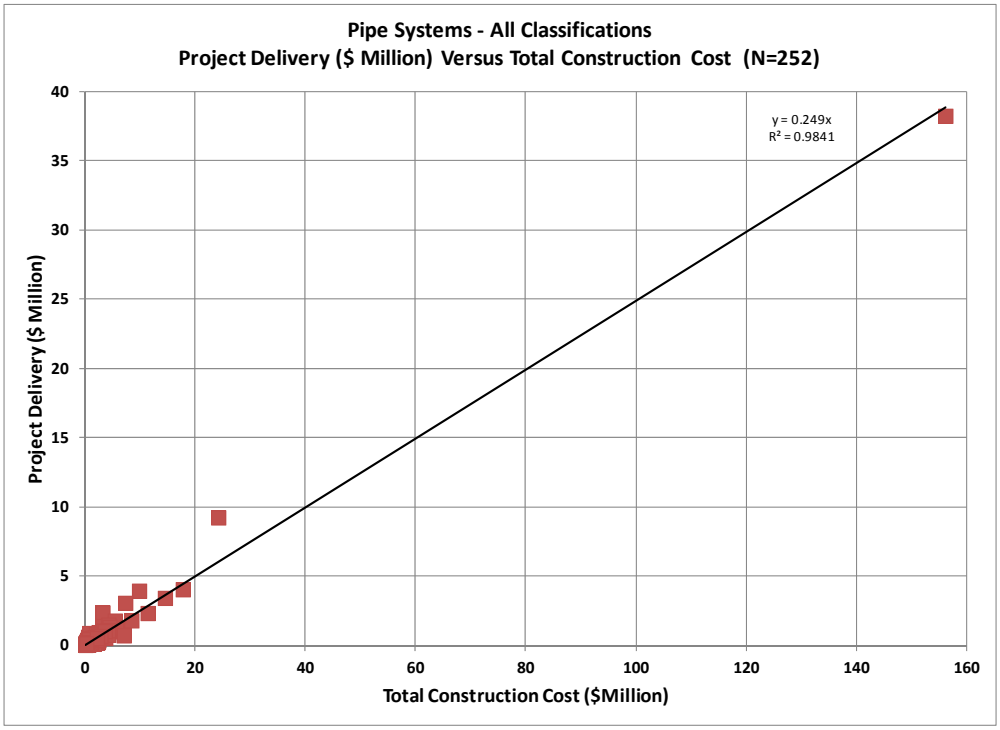

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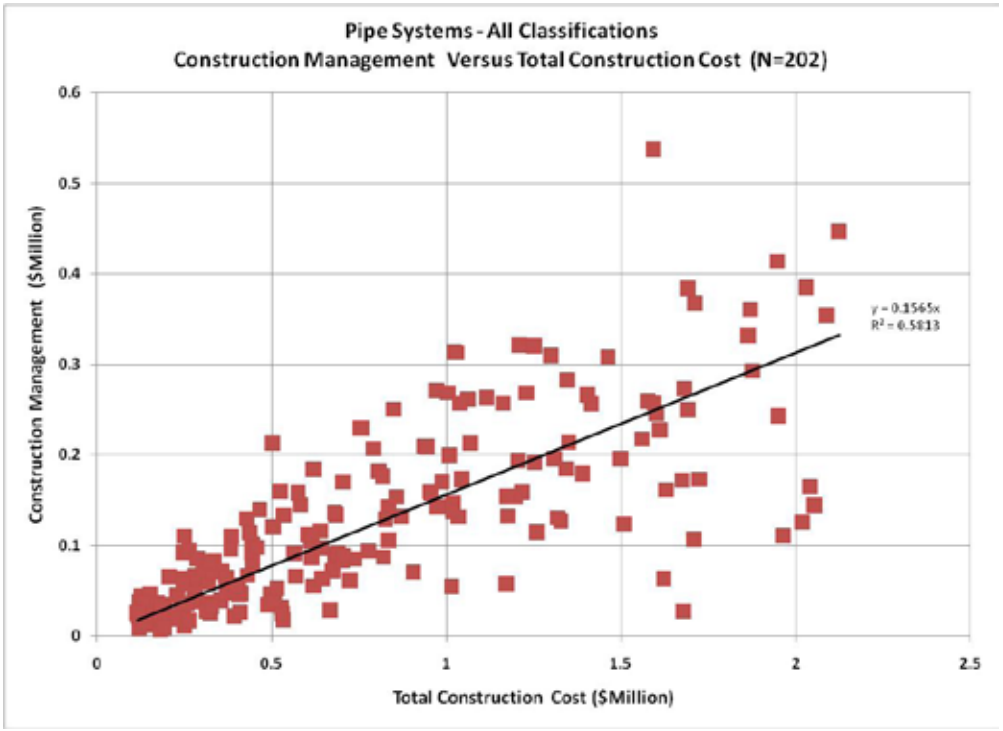

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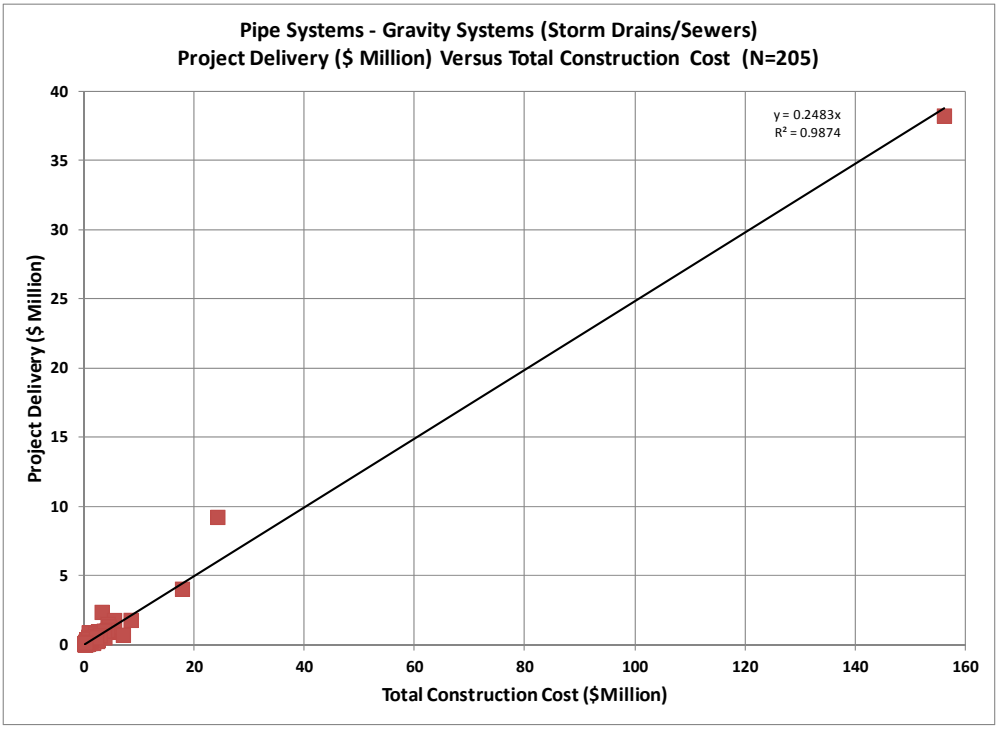

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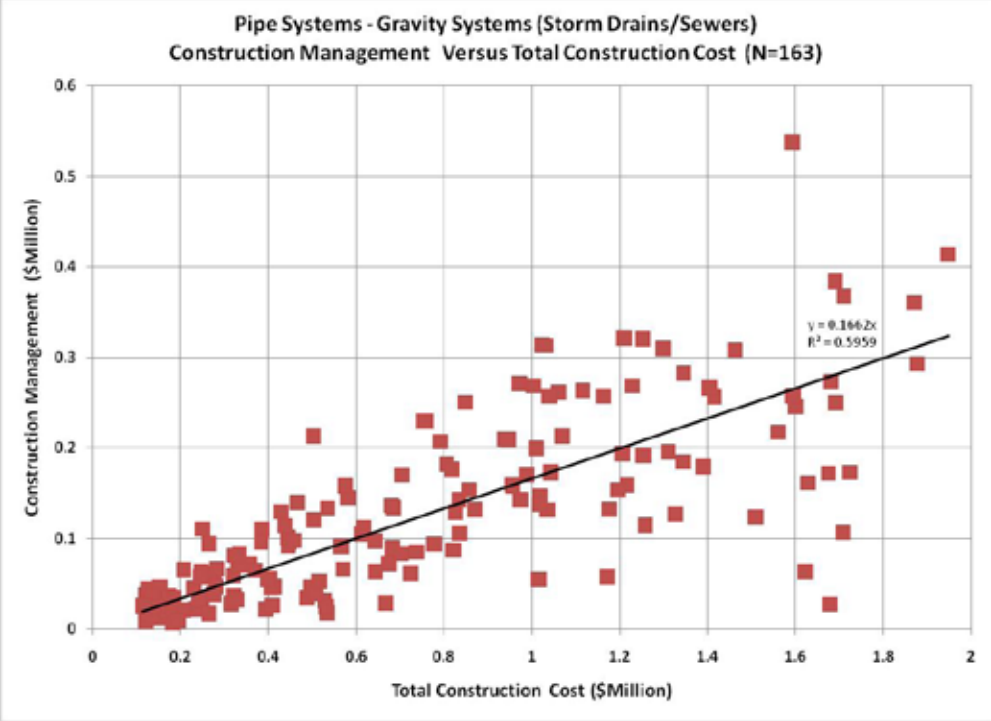

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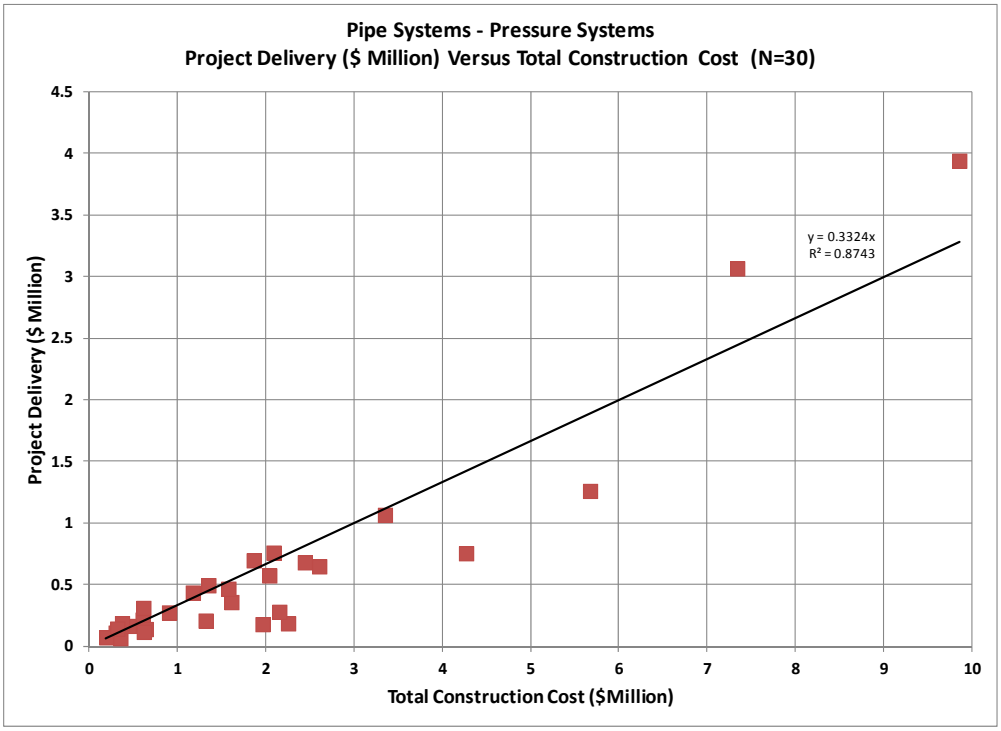

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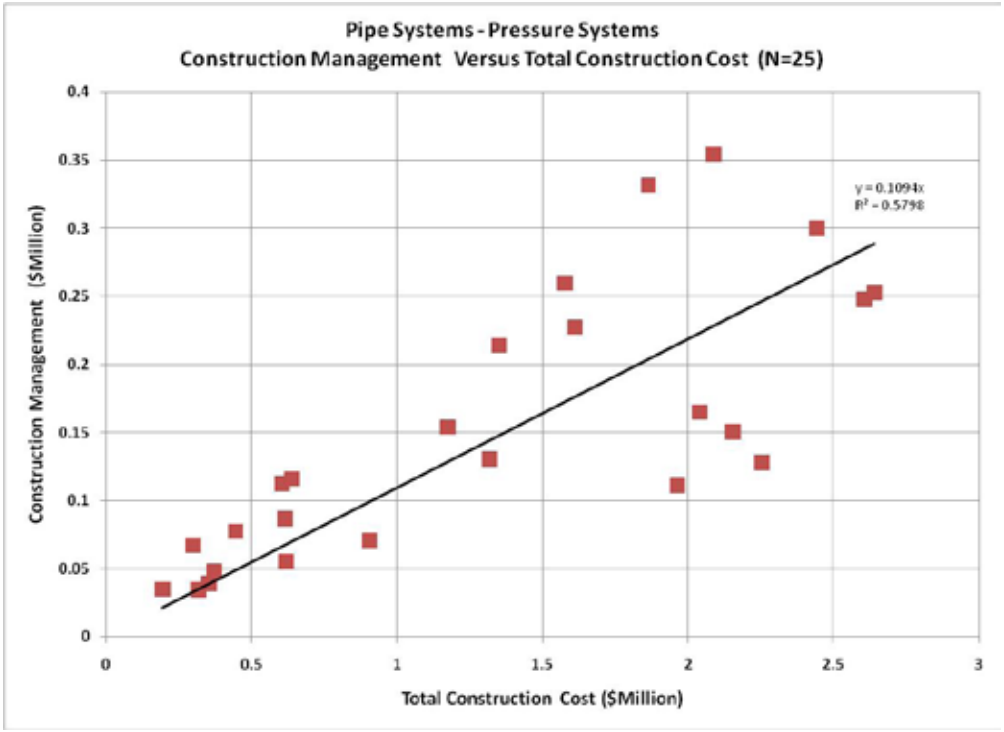

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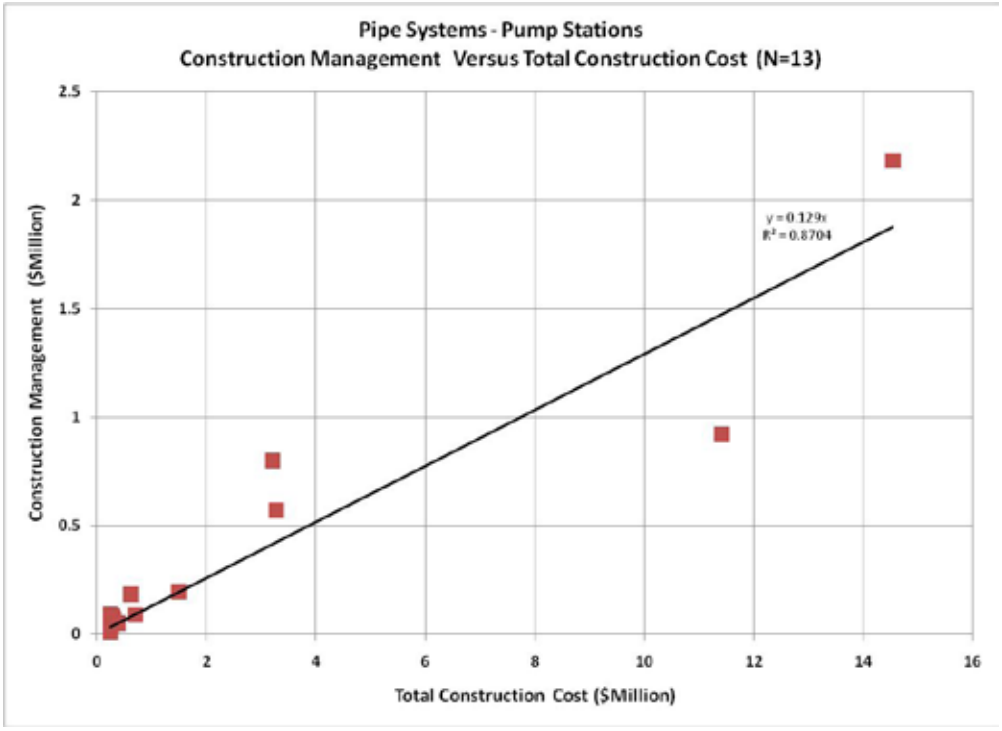

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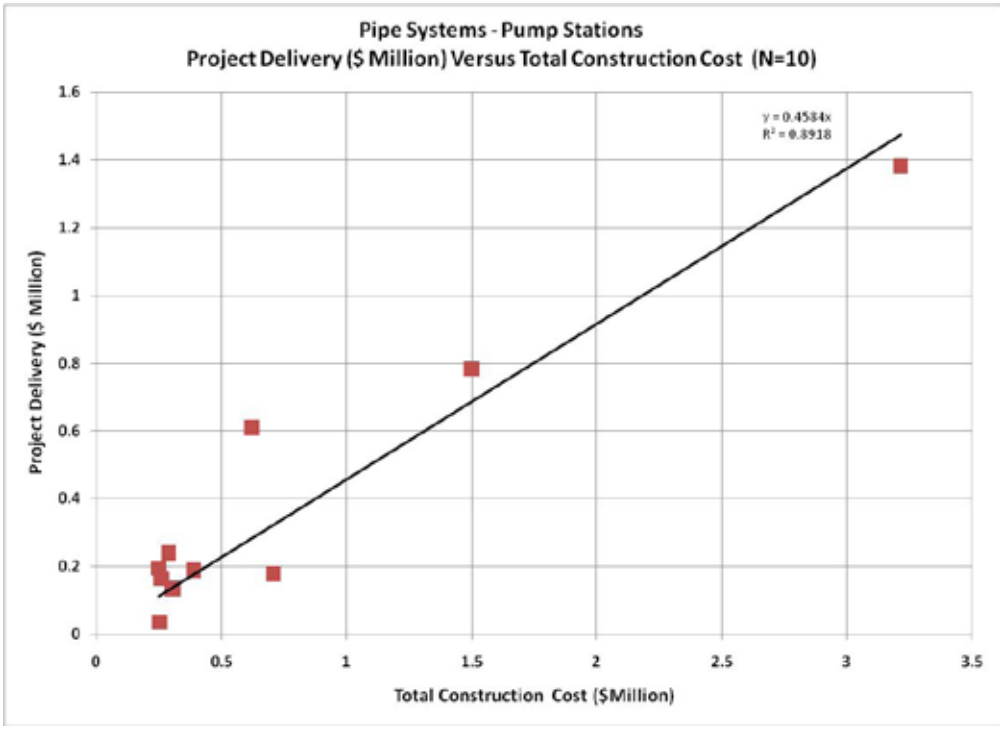

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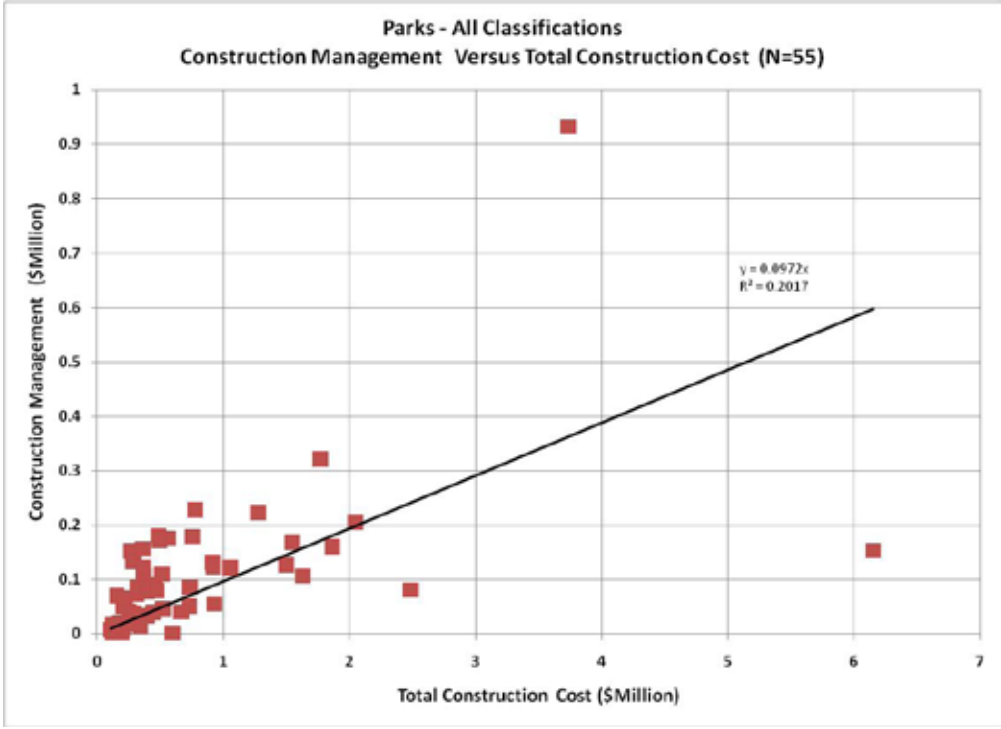

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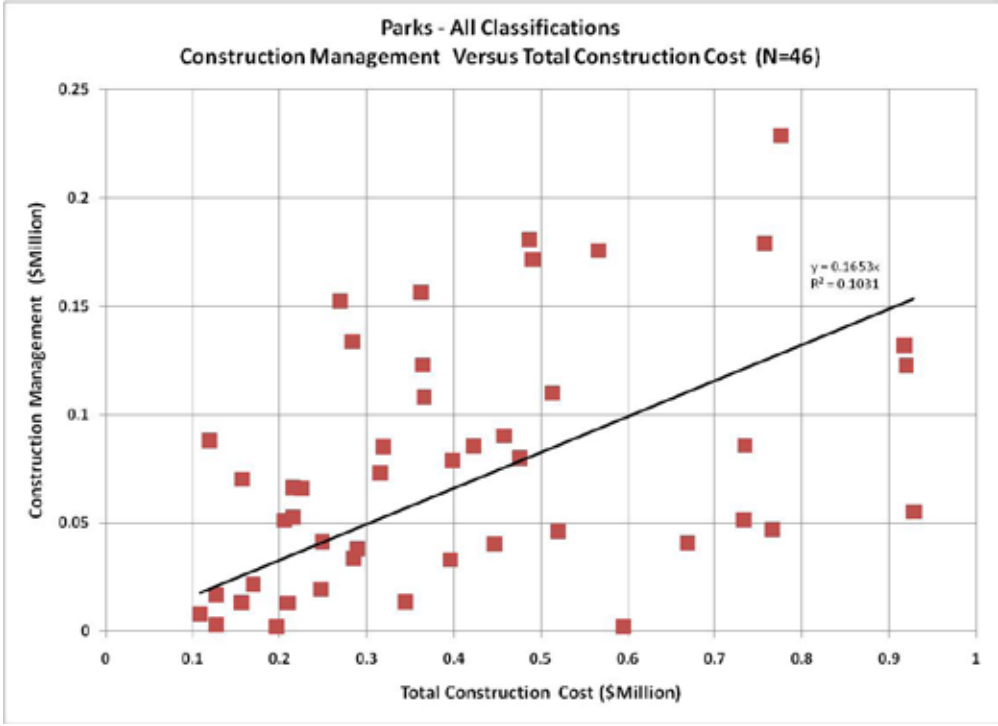

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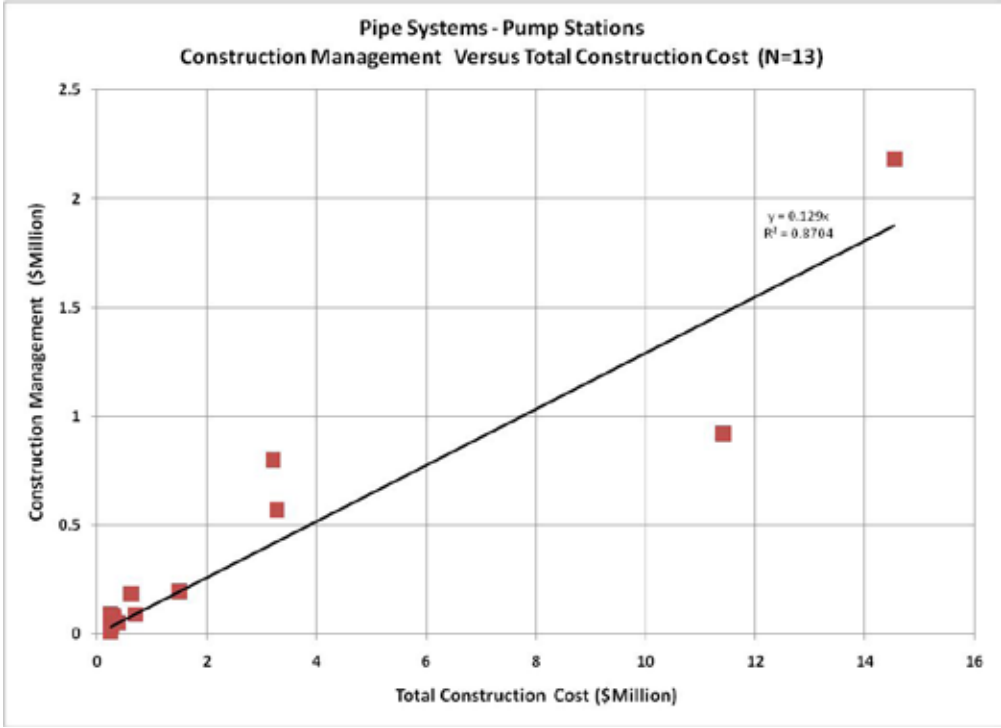

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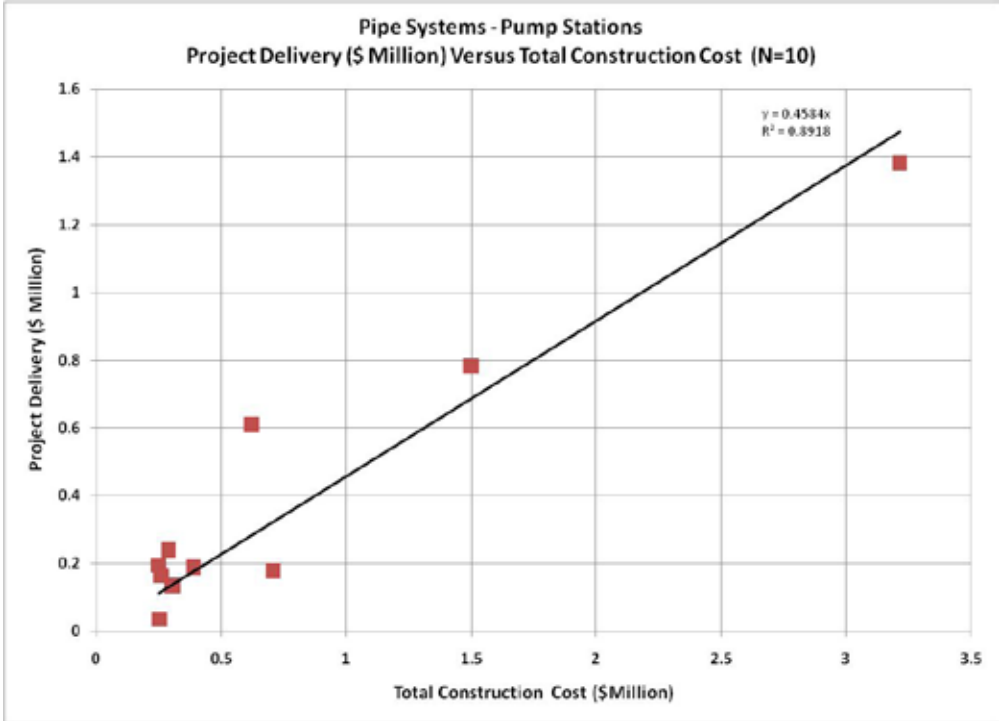

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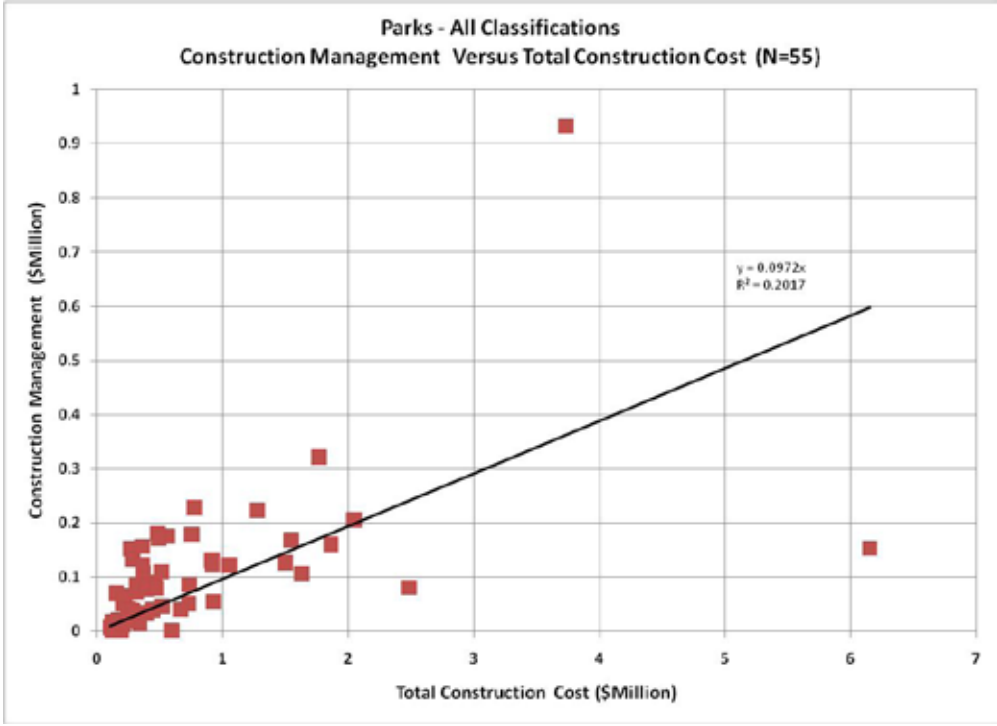

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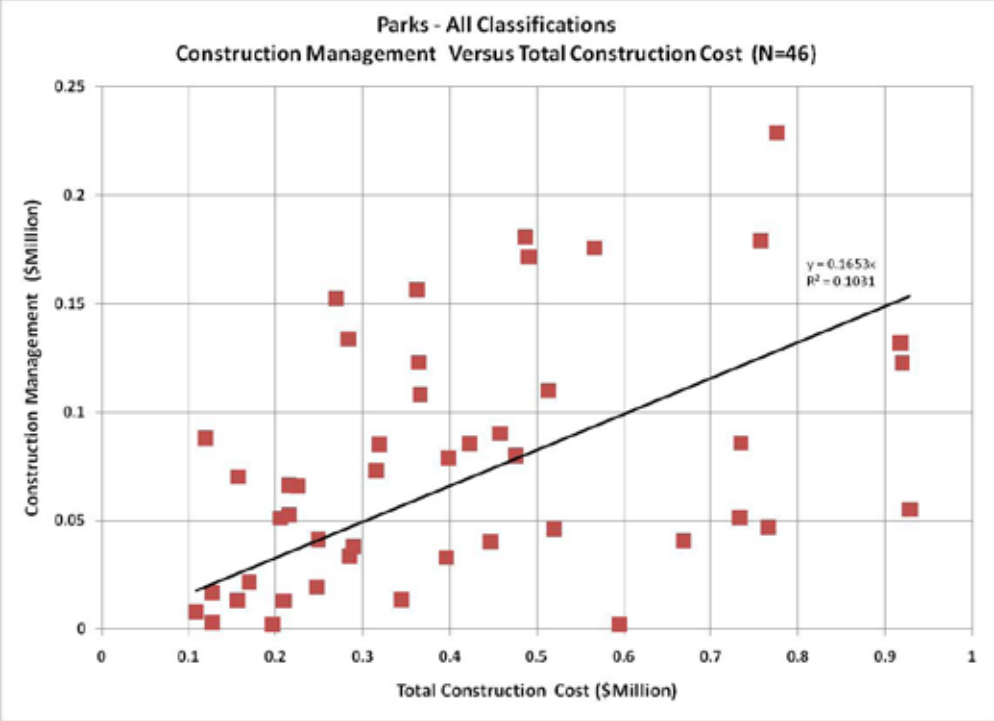

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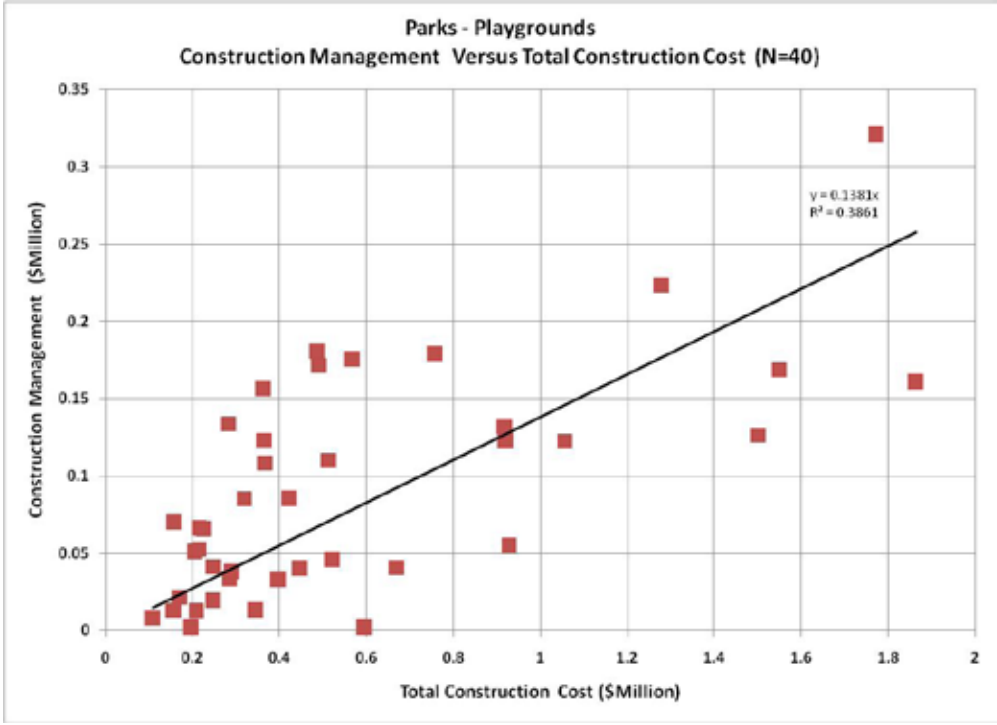

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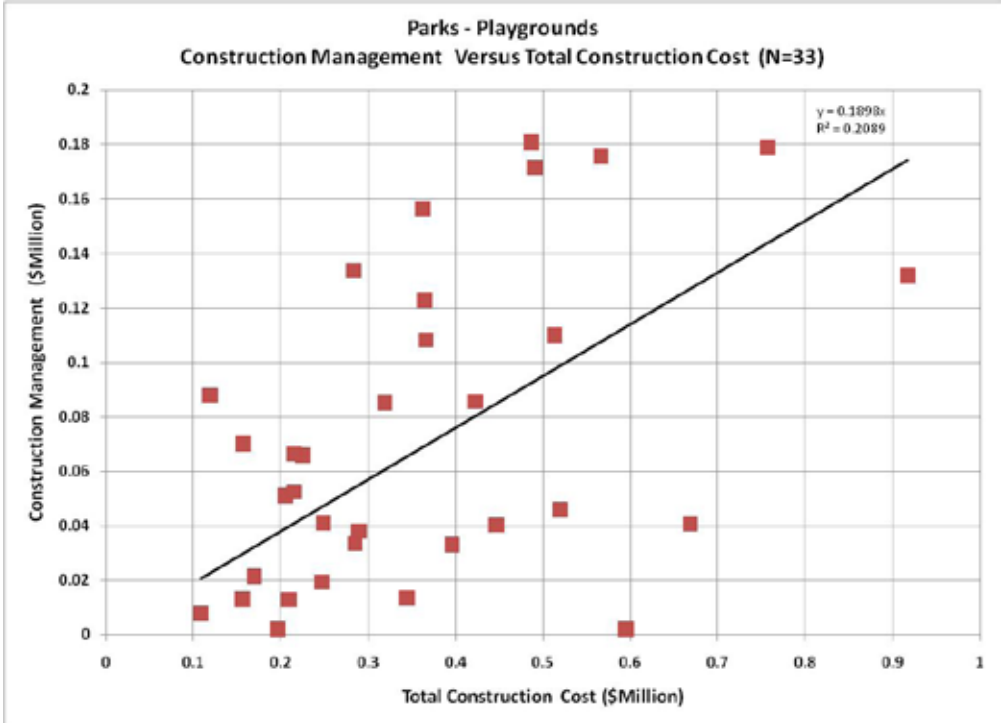

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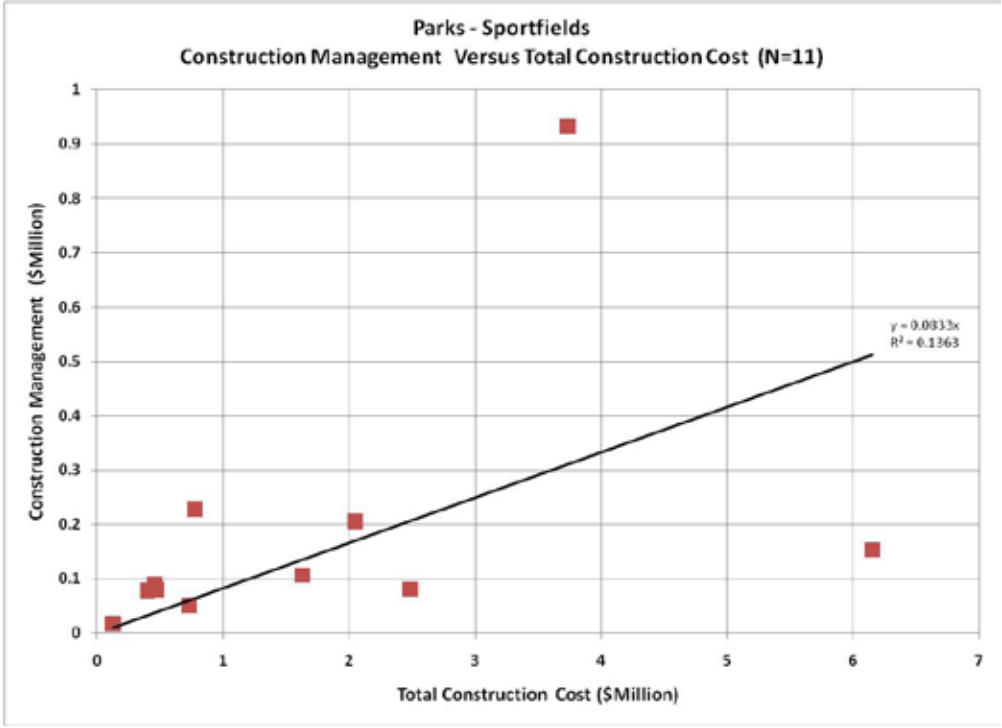

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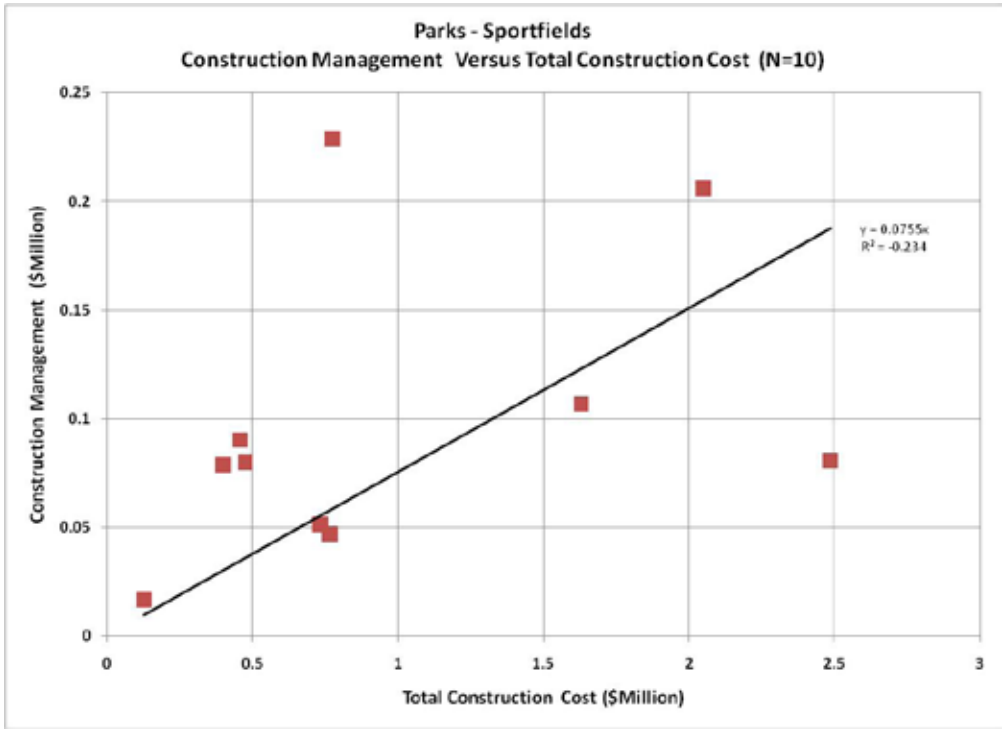

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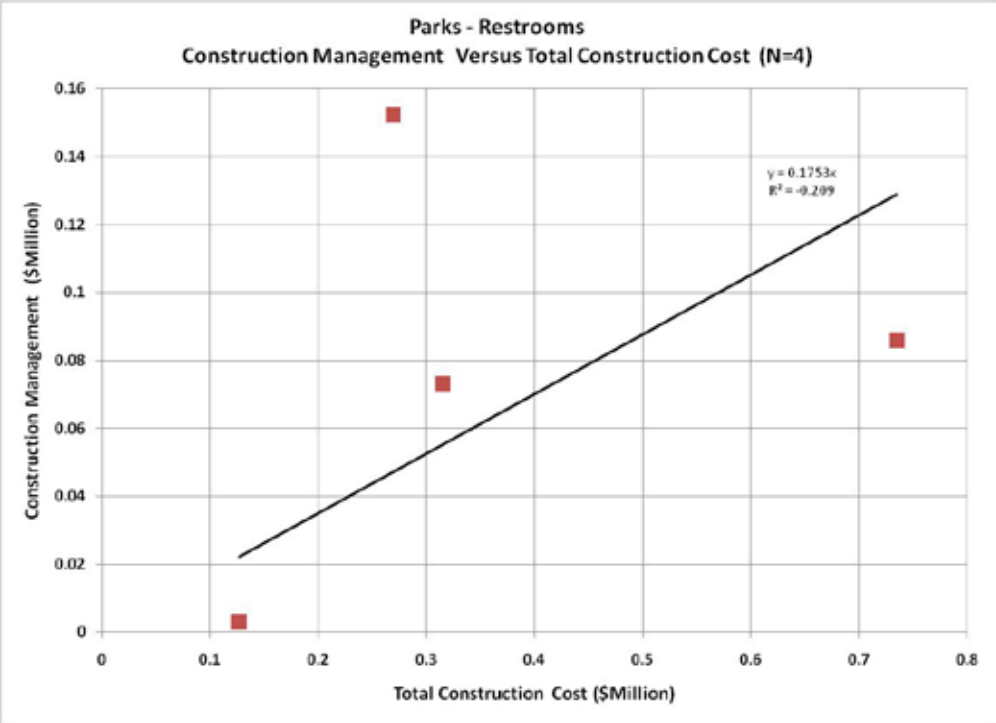

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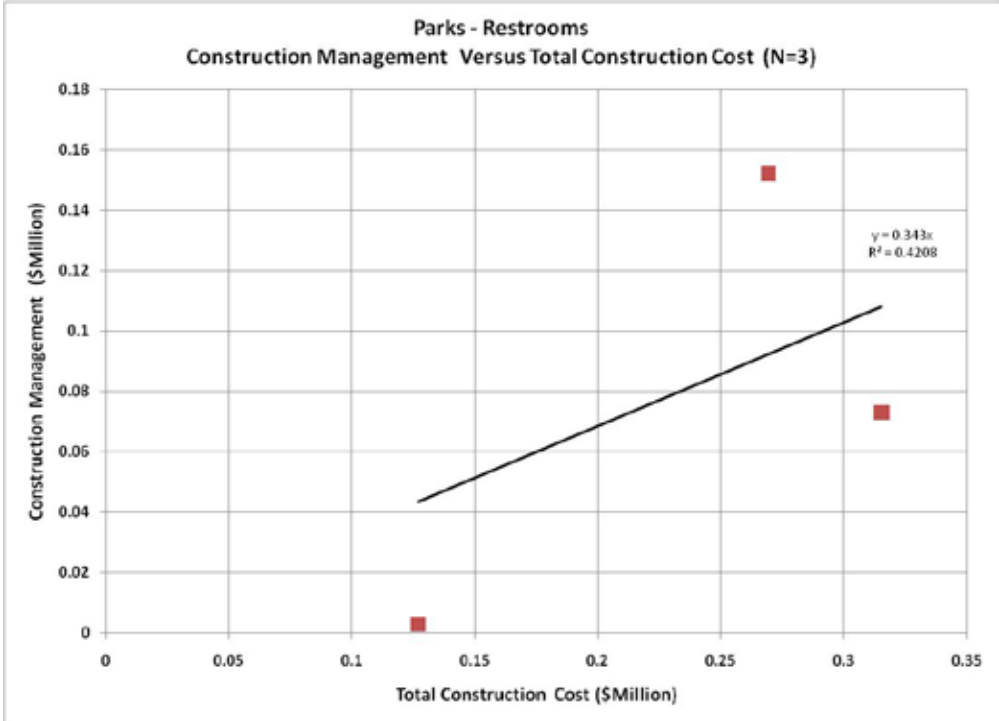

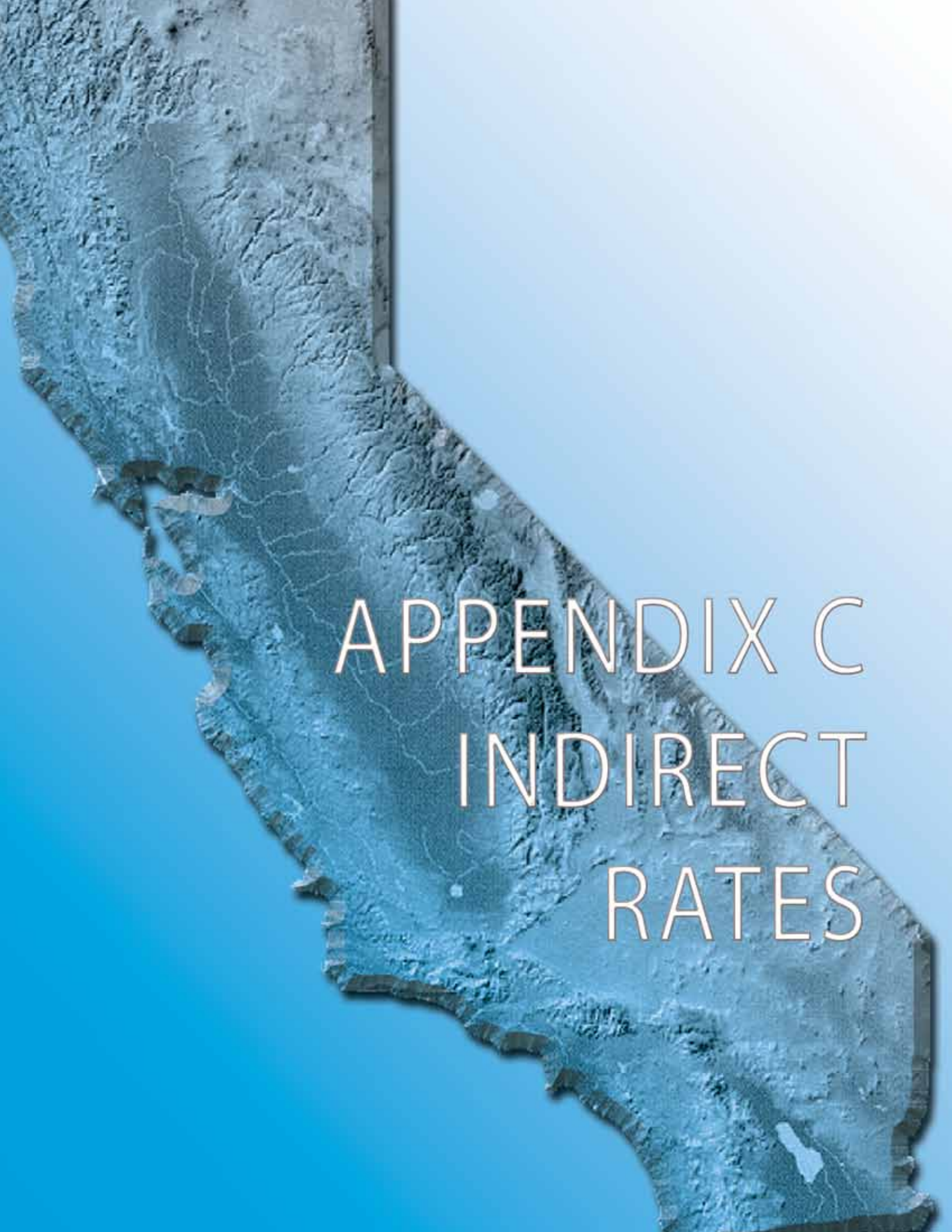

APPENDIX C
INDIRECT RATES

Table C-1
Indirect Rates Applied to Capital Projects

Agency	Fringe Benefits	Compensated Time Off	City Overhead	Department Overhead	Agency Overhead	Indirect Rate Factor[1]	Receive General Fund Support For CIP
City of Long Beach Department of Public Works[2]	41.92%	19.40%	0%	5.53%	49.21%	149.63%	YES
City of Los Angeles Department of Public Works Bureau of Engineering[3]	32.08%	19.65%	20.81%	17.01%	61.43%	150.98%	YES
City of Oakland Department of Engineering & Construction	58.8%	20.86%	24.12%	39.57%	0%	143.35%	NO
City of Sacramento Department of Transportation							NO
Department of Utilities	35.29%	16.76%	15.04%	16.64%	73.40%	157.13%	
	37.17%	18.70%	108.59%			164.46%	
City of San Diego Engineering and Capital Projects	61.75%	16.70%	0%	0%	90.80%	169.25%	NO
City and County of San Francisco Department of Public Works Bureau of Engineering Bureau of Construction Management Bureau of Architecture	31.32%	34.51%	0%	40.29%	59.43%	167.05%	NO
City of San Jose Department of Public Works	42.18%	34.29%	34.33%	26.02%	Included	145.93%	NO

Notes:

[1] This value may be different from the sum of overhead values since the compounding formula may vary by agency.

[2] The City of Long Beach is currently in the process of recomputing its overhead rates. Rates shown in the above table are 2010 rates.

[3] Based on averages of all Bureau program overhead rates provided under CAP 31.

PARTICIPATING AGENCIES

City of Long Beach
Department of Public Works

City of Los Angeles
Department of Public Works
Bureau of Engineering

City of Oakland
Public Works Agency

City of Sacramento
Department of Transportation
Department of Utilities

City of San Diego
Engineering & Capital Projects

City & County of San Francisco
Department of Public Works
Bureau of Engineering
Bureau of Construction Management
Bureau of Architecture

City of San Jose
Department of Public Works

http://eng.lacity.org/techdocs/cabm/