

MSU Scorecard Analysis - Executive Summary #2

MSU Center for Construction Project Performance Assessment and Improvement (C2P2ai)

Funding Provided by MSU office of Vice President of Finance and Operations

January 17, 2011

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Section I: Executive Summary

This report follows the previous report dated March, 2009, completed by the Center for Construction Project Performance Assessment and Improvement (C2P2ai), School of Planning, Design and Construction, Michigan State University. In the first report, data of the Contractor Scorecards and MSU Scorecards dated prior to March, 2009 were analyzed.

By April, 2010, approximately 350 scorecards were collected, details on each type and collection period is show in Table 1 below. This report continues to analyze the Contractor scorecards based on the 2010 year data, and also with the combined data of 2009 and 2010. Due to the small number of completed scorecards for the MSU, A/E, and Customer scorecards, the data from 2009 and 2010 were combined to allow analysis.

Table I.1: Scorecards collected by type and year

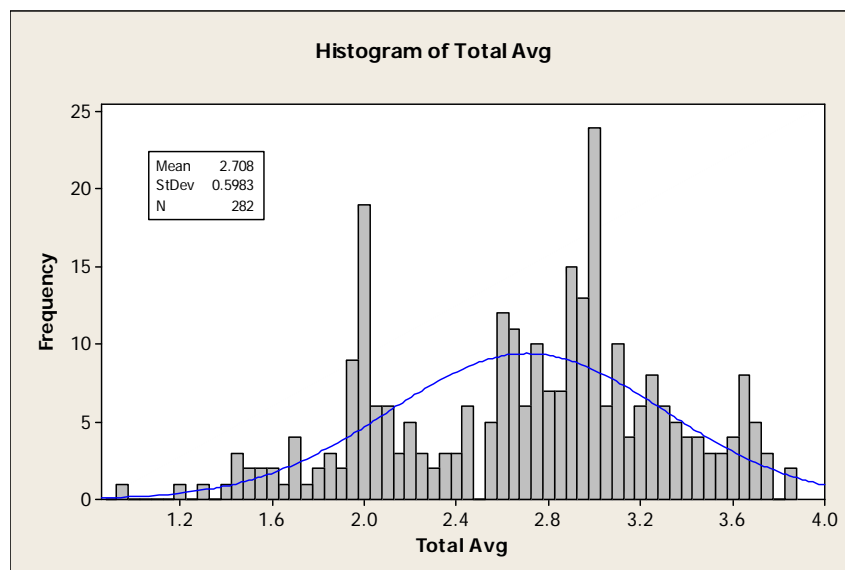
Scorecard	Contractor	MSU	A/E	Customer
2009	120	11		
2010	166	7	31	8
Total	286	18	31	8

Findings Summary

Contractors Scorecard

Combining all the data in the two years, 2009 and 2010, scheduling is still the most underperforming aspect and Project Management is the best performing. The overall average score is 2.71 with a standard deviation of ± 0.60 (see Figure I.1; Four is the best possible score).

Figure I.1: Frequency distribution for Contractor Scorecard averages (2009 and 2010 scores)



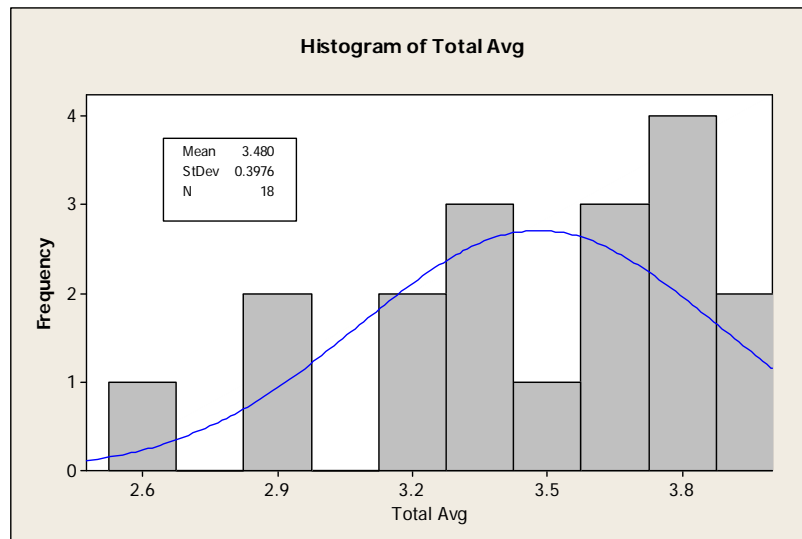
A summary of findings for Contractors Scorecards are as follows:

- Contractors were rated slightly higher (better) on interruptions than on timely closure of issues, which means that MSU's assessment is that contractors try to avoid negative impacts on MSU operations rather than tending to a timely closure of rework items.
- Scheduling received the lowest scores, and the highest standard deviation. The level of compliance with the MSU scheduling specifications is not rated on the scorecards, which prevents analyzing their impact. This could be considered for the 2011 scorecard.
- The 2009 and 2010 show contractors performing slightly better on estimating and costing change orders than processing the changes.
- MSU strongly believed contractors were committed and responsive. The coordination and RFI/Change Order process were close to the overall average of 2.71.
- Warranty performance was rated higher to than doing Punch List and Documentation.

2009 - 2010 MSU Score card

Contractors believe MSU performed best on management aspects with an average score of 3.67, score is 2.71 with a standard deviation of ± 0.40 (see Figure I.2; Four is the best possible score). Other factors related to the owner scorecard also received high scores, considering 4 is the best score. For example, the least performing factor was quality, but still received an average of 3.37. There were no outliers and no score under 2.0. In comparing to the 2009 results, the average total score in 2010 improved slightly, from 3.33 to 3.48 while the standard deviation almost remained unchanged.

Figure I.2: Frequency distribution for Owner Scorecards averages (2009 and 2010 scores)



A summary of findings for Owner Scorecards are as follows:

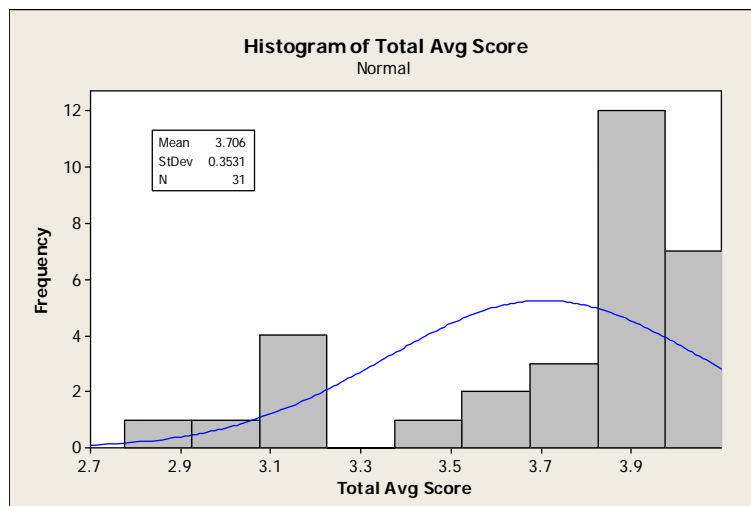
- Contractors gave bidding documents quality a lower score compared to others in the category of quality.

- Timely decisions received the lowest score compared to others in the scheduling category.
- With a few exceptions, the majority of contractors think that MSU does a good job in paying the approved invoices within 30 days and is reasonable in dealing with changes. On the other hand, MSU got the worst score in timely processing of change orders
- MSU was scored high in the management category, with the smallest average score being 3.39 (out of 4).

2009 - 2010 A/E Score card

Notwithstanding the limited pool of data for A/E scorecard (MSU assessment of A/E services), professional services received a very high score in every factor on the scorecard. The average score of all the factors is 3.71, with a standard deviation of ± 0.35 (see Figure I.3; Four is the best possible score). The management process used by the A/E received the highest scores, as well as the communication process.

Figure I.3: Frequency distribution for A/E Scorecards averages (2010 scores)



2009 - 2010 Customer Score card

The end-user evaluation of the construction process, consider data from the 2009 and 2010 Customer Scorecard. Given the amount of data were only 8 scorecards, no statistical analysis was conducted.

Overall, the customer rated all the indicators with a high score. Specifically, among 8 scorecards, where each scorecard has 11 indicators, for a total of 88 indicators, there was only one indicator rated with a score of 1; 3 indicators had a 2 score; and 12 indicators received a 3 score; and the remaining 72 indicators were assessed with the maximum score (4 out of 4). It is also interesting to note that 3 scorecards achieved maximum score for every indicator.

Conclusion and recommendation

Continuing with the scorecards process will allow developing a database that can be used to identify vendors with the highest performance. Meanwhile, the return ratio of the Owner scorecards should be improved to an equivalent number of Contractor scorecards.

It is our understanding that CPA and EAS will reconsider the time and frequency of completing the scorecards. Currently, the scorecards are completed at substantial completion, which misses the project closeout performance. In addition, consideration should be given as to whether quarterly evaluations would afford vendors, and MSU, the time to address issues reported in the scorecards. We also recommend that safety issues be considered and integrated into the scorecards.

Refinement of the customer scorecard is under consideration, within the POE project currently underway at CPA.

The analysis in this report reveals that among three analyzed scorecards, the professional services' performance was evaluated as being excellent. On the other hand, MSU and Contractors' performance slightly vary in each factor and indicators. Some factors and indicators achieved very high scores while others were evaluated at or below average. This points toward improvement opportunities in Contractors and MSU performance on construction projects, which was also pointed out in the first report.

Improvement Opportunities:

- Contractors:
 - Schedule reports
 - Processing change orders
 - Closeout documentation
- MSU:
 - Quality of bidding documents
 - Timely decisions
 - Timely processing of change orders

For next steps, the C2P2ai team will:

- Conduct interviews with contractors and designers to evaluate the process and whether a different form of feedback is warranted.
- work with CPA and EAS:
 - To implement modified scorecards for 2011.
 - To develop a follow-up process for low scoring indicators, specifically those on the Contractor scorecards.
 - Some of this follow-up was conducted informally by Brad Bull. With Brad's reassignment to FRIB, and Leisa William-Swedberg's promotion to MSU Construction Superintendent, she will now be handling these scorecards.
 - Consider the frequency and timing of requesting scorecards.
 - Find an appropriate way to aggregate the data so that vendors can be given personalized scoring reports.

Section II: Detailed Scorecard Analysis and Findings

Section II: Detailed Scorecard Analysis and Findings

The remainder of the report presents detailed results and is only meant to show the source of the findings in the Executive Section.

Content-wise, the 2010 scorecards are the same as those used in 2009. Each type of scorecard consists of a number of critical success factors that MSU wished to track. For any of the factors on a scorecard, a relative weight was used to reflect a factor's contribution to the overall scores. Under each factor, multiple indicators were used to further define each of the success factors. These indicators were also assigned a second system of weight. Tables II.1 to II.4 provides all scorecards with a summary of all indicators with the double-weight system.

It is worth noting that the performance indicators are measured by the reviewer either qualitatively or quantitatively and assigned a score between 1 to 4, with 1 representing poor performance and 4 representing excellent performance. For measuring each performance indicator, the scorecard suggests brief guidelines that direct the reviewer to any relevant data before making the decision.

Scorecard Analysis

In the first step of analysis, data is presented in a descriptive statistics table, which includes the mean value, the standard deviation, the minimum and maximum value, the median, the first and the third quartiles. These values provide a general picture of how the data are distributed. This is followed by box plots, produced as a graphic aggregation of all the results.

Following statistical analysis, an in-depth analysis provides insight about the indicators in each factor. The average score of each indicator is compared and contrasted. This score is the mean score of the indicators for one type of scorecard in the period of analysis. For example, the average score of QL1, as an indicator for quality factor, for the 2010 contractor scorecard is provided based on 166 QL1 data points.

Finally, a histogram representing total average scores is introduced to reflect the spread in the indicators for each type of scorecard.

It is important to note that the total average score for a specific factor is determined by incorporating the factor and the indicator weight. For instance, the total average score for the MSU scorecard is calculated by multiplying each indicator's score with its weight, then summing up all the results in each factor, incorporated by that factor's weight, and then dividing by the total indicator's weight to get the average score.

Table II.1: Scorecard structure (Contractor Scorecard)

Score-card	Factor	Factor weight	Indicator	Indicator weight	Short explanation
Contractor <i>(MSU evaluate Contractor)</i>	Quality	25%	QL1	6	Timely closure of rework items
			QL2	7	Interruptions to operations
			QL3	11	Qualitative rating
	Schedule	20%	SH1	4	Performance against milestones
			SH2	4	Schedule
			SH3	4	Schedule reports
			SH4	11	Qualitative rating
	Cost	20%	CS1	11	Project changes
			CS2	8	Processing of changes
	Management System	20%	MG1	4	Coordination
			MG2	4	RFI/Change order Process
			MG3	4	Responsiveness
			MG4	4	Commitment to MSU
			MG5	4	Qualitative rating
	Close Out	15%	CL1	4	Punch list
			CL2	7	Records drawing & documentation
			CL3	3	Warranty performance

Table II.2: Scorecard structure (Owner Scorecard)

Score-card	Factor	Factor weight	Indicator	Indicator weight	Short explanation
MSU (Owner) <i>(Contractor evaluate MSU)</i>	Quality	25%	QL1	5	Design management
			QL2	5	Quality bidding documents
			QL3	5	Understanding work
			QL4	2	Responsiveness
			QL5	5	Relative Quality Rating
	Schedule	15%	SH1	5	Timely decisions
			SH2	3	Work by owner coordination
			SH3	2	Schedule reasonable
			SH4	5	Relative Schedule Rating
	Cost	25%	CS1	8	Prompt payment
			CS2	5	Reasonableness with changes
			CS3	5	Timely processing of changes
			CS4	6	Relative Cost Rating
	Management System	25%	MG1	5	Fair and reasonable
			MG2	5	Contract terms & conditions
			MG3	5	Internal communications
			MG4	5	Fair procurement process
			MG5	5	Relative Management rating
	Close Out	10%	CL1	3	Punch list
			CL2	4	Contract close out
			CL3	3	Relative Closeout rating

Table II.3: Scorecard structure (A/E Scorecard)

Score-card	Factor	Factor weight	Indicator	Indicator weight	Short explanation
A/E Professional Services	Bidding	25%	BDD	1	“Biddable” documents
	Coordination	15%	CDN	1	Information incorporate
	Communication	25%	CMM	1	Responsiveness of A/E firm
	Management	10%	MGT	1	Professional & fair manner
	Schedule	25%	SCH	1	Meet design milestones

Table II.4: Scorecard structure (Customer Scorecard)

Score-card	Factor	Factor weight	Indicator	Indicator weight	Short explanation
Customer	Estimating	10%	ES1	5	Estimator contact
			ES2	5	Estimator interaction
	Design	50%	DS1	10	Project requirements
			DS2	10	Design & budget review
			DS3	10	Design expectations
			DS4	10	Contribution during design
			DS5	10	Design schedule expectations
	Constructi on	40%	CN1	10	Quality of work
			CN2	10	Professional Contractor
			CN3	10	Safe and clean work site
			CN4	10	Contractor interaction

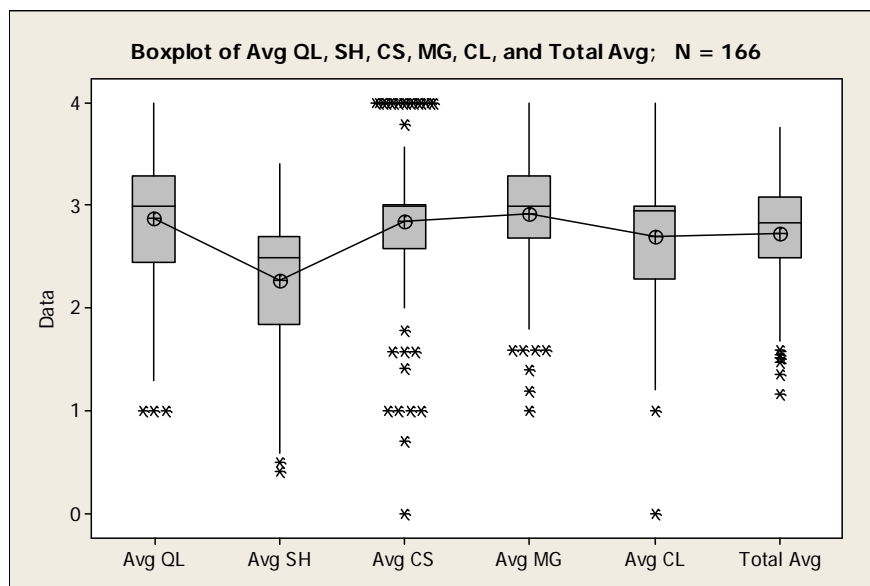
2010 Contractor Scorecard

For the 2010 scorecards, the following descriptive statistics are listed in Table II.5: Average Quality, Average Schedule, Average Cost, Average Management, Average Close-out, Total Average. Figure II.1 shows a box plot of each of the factors that make up the contractor scorecard.

Table II.6: Descriptive Statistics (2010 Contractor scorecard)

Variable	Mean	StDev	Minimum	Q1	Median	Q3	Maximum
Avg QL	2.9	0.7	1.0	2.4	3.0	3.3	4.0
Avg SH	2.3	0.7	0.4	1.9	2.5	2.7	3.4
Avg CS	2.9	0.7	0.0	2.6	3.0	3.0	4.0
Avg MG	2.9	0.6	1.0	2.7	3.0	3.3	4.0
Avg CL	2.7	0.6	0.0	2.3	2.9	3.0	4.0
Total Avg	2.7	0.5	1.2	2.5	2.8	3.1	3.7

Figure II.1: Box plot of the Average Scores of the Contractor Scorecards' Factors



The line shown in the box plot figure connects all the means score under each category. On average, the Contractor gets the highest score on Management factor and lowest on Scheduling factor. The average total score was 2.7 (out of four) with a standard deviation of ± 0.5 .

It is worth to note that there was a clustering of data under CS and MG. This cluster caused by their first quartiles Q1 and third quartile Q3 were too close, which means most of data of these factors fall into Q1 and Q3 range. This can be understood that, with a few exceptions, most of the contractors were evaluated around the median score of Cost and Management factors.

The in-depth analysis of each of the performance categories in the contractors' scorecard shows the following trends:

- Quality:

Indicator	QL1	QL2	QL3
<i>Avg. each Indicator</i>	2.82	2.86	2.91

On average contractors get a little higher score on Interruptions to Operations than the other indicators, which mean the contractors tried to perform better on avoiding negative impacts on MSU operation than timely finishing items.

- Schedule:

Indicator	SH1	SH2	SH3	SH4
<i>Avg. each Indicator</i>	2.77	2.61	2.57	2.62

This factor gets the worst performance score on average. In particular, Schedule Reports receives a lower score on average. Performance against milestones is slightly better.

In comparing to the 2009 results, the score under these Schedule categories still remain the lowest ones.

- Cost:

Indicator	CS1	CS2
<i>Avg. each Indicator</i>	2.91	2.79

The contractors perform slightly better on estimating and costing change orders than processing of changes. This bodes well for the Contractors.

- Management:

Indicator	MG1	MG2	MG3	MG4	MG5
<i>Avg. each Indicator</i>	2.82	2.83	3.01	3.13	2.78

Collectively, this is the factor with the better contractor performance. Contractors were assigned the highest score in Commitment to MSU indicator, specifically in appraising MSU of impending issues to budget and schedule. The other indicators for the "Management" factor also get high scores. Overall, MSU seemed to be most satisfied with the management factor.

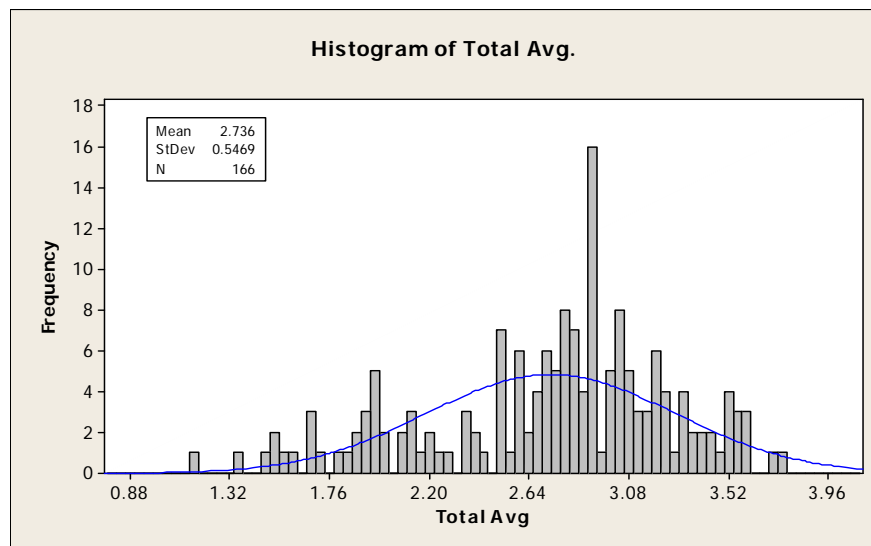
- Closeout:

Indicator	CL1	CL2	CL3
<i>Avg. each Indicator</i>	2.76	2.59	2.92

The scores for the closeout indicate Contractors focus more on their punch-list than records drawing and documentation. However, the Contractors were still assigned a good score on warranty performance.

Taking the average for all the five factors on the contractor scorecard and graphing results in the following histogram. This graph illustrates the score of the Contractors varies in a significant way, with the distribution more skewed to the right and one peak appears around the 3.0 score. While we are reporting the average, it is more accurate to consider the median values because the distribution is not following a Normal distribution.

Figure II.2: Frequency distribution for the average value for all five factor scores on the contractor scorecards (2010 scores)



2009 - 2010 Contractor Scorecard

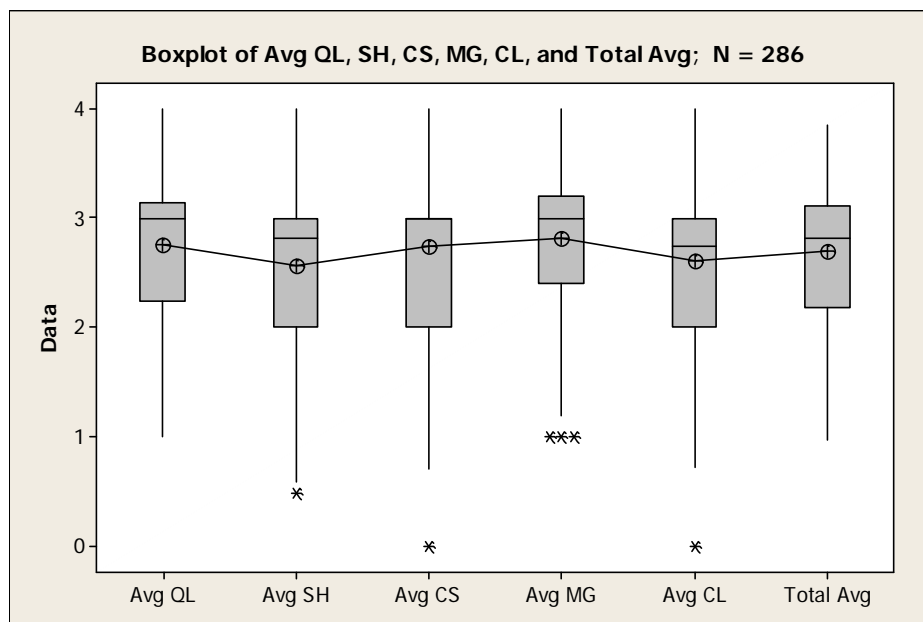
Considering data from the 2009 and 2010 Contractor scorecards, result in the following, as shown in Table II.6. Figure II.3 illustrates a box plot, similar to the one shown in Figure II.1.

Combining all the data in the two years, 2009 and 2010, the shape of the line connecting all the mean scores remains practically the same as that for 2009 and 2010 when drawn separately. Again, the 2009 and 2010 combined data show that scheduling is still the most underperforming aspect and Project Management is the best performing. The overall average score is 2.71 with a standard deviation of ± 0.598 .

Table II.6: Descriptive Statistics (Contractor Scorecard 2009/2010)

Variable	Mean	StDev	Minimum	Q1	Median	Q3	Maximum
Avg QL	2.8	0.7	1.0	2.3	3.0	3.1	4.0
Avg SH	2.6	0.8	0.5	2.0	2.8	3.0	4.0
Avg CS	2.7	0.7	0.0	2.0	3.0	3.0	4.0
Avg MG	2.8	0.6	1.0	2.4	3.0	3.2	4.0
Avg CL	2.6	0.6	0.0	2.0	2.8	3.0	4.0
Total Avg	2.7	0.6	1.0	2.2	2.8	3.1	3.9

Figure II.3: Box plot of the Average Scores of the 2009/2010 Contractor Scorecards' Factors



The in-depth analysis below compares indicators under each aspect based on the data of the two years.

- Quality:

Indicator	QL1	QL2	QL3
<i>Avg. each Indicator</i>	<i>2.71</i>	<i>2.77</i>	<i>2.77</i>

The aggregate data for 2009 and 2010 indicate that contractors were rated slightly higher (better) on interruptions than on timely closure of issues, which means that MSU's assessment is that contractors try to avoid negative impacts on MSU operations rather than tending to a timely closure of rework items. Overall, quality as a factor received a 2.76 average score (out of 4.0).

- Scheduling:

Indicator	SH1	SH2	SH3	SH4
<i>Avg. each Indicator</i>	2.65	2.51	2.49	2.54

Once again, this factor is the lowest score. The highest indicator is performance against milestones, and the lowest is schedule reports. It is important to note that this factor had the highest standard deviation, at ± 0.782 .

- Cost:

Indicator	CS1	CS2
<i>Avg. each Indicator</i>	2.80	2.68

The 2009 and 2010 show contractors performing slightly better on estimating and costing change orders than processing the changes.

- Management:

Indicator	MG1	MG2	MG3	MG4	MG5
<i>Avg. each Indicator</i>	2.70	2.73	2.92	3.01	2.70

Over the 2009 and 2010 period, Management was still the best factor with the highest average scores. Among them, MSU strongly believed contractors were strongly committed to MSU. Responsiveness also received a rather good score, nearly as well as commitment. Coordination and RFI/Change Order Process are fairly good indicators.

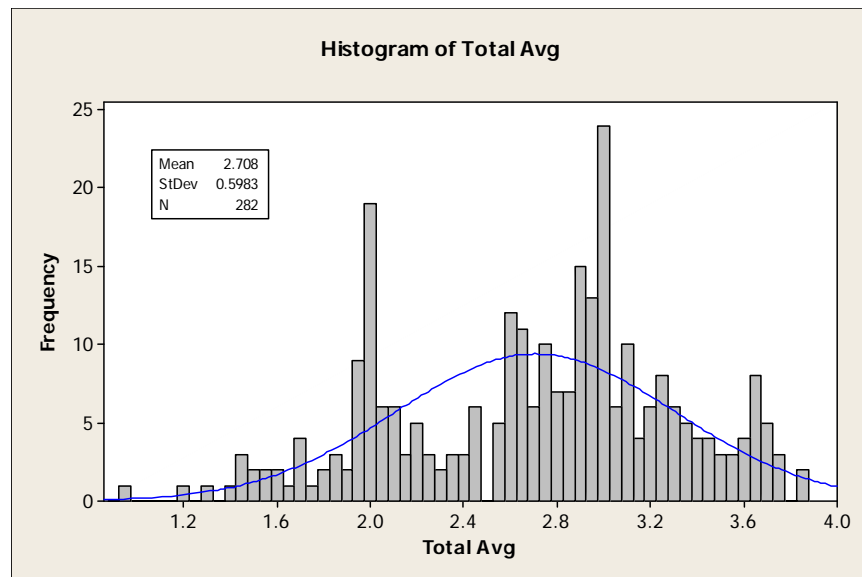
- Project Closeout:

Indicator	CL 1	CL 2	CL 3
<i>Avg. each Indicator</i>	2.62	2.53	2.81

The Contractors were rated better on Warranty Performance than doing Punch List and Documentations.

Figure II.4 shows a histogram of the average for all five factors scores on the contractor scorecards. The histogram illustrates the score of the Contractors varies in a significant way, with a bimodal distribution, characterized by the two peaks. One appears around the 2.0 score and the other around 3.0. This shape implies that the total average score dropped in 2010.

Figure II.4: Frequency distribution for the average value for all five factor scores on the Contractor Scorecards (2009 and 2010 scores)



2009 - 2010 MSU Score card

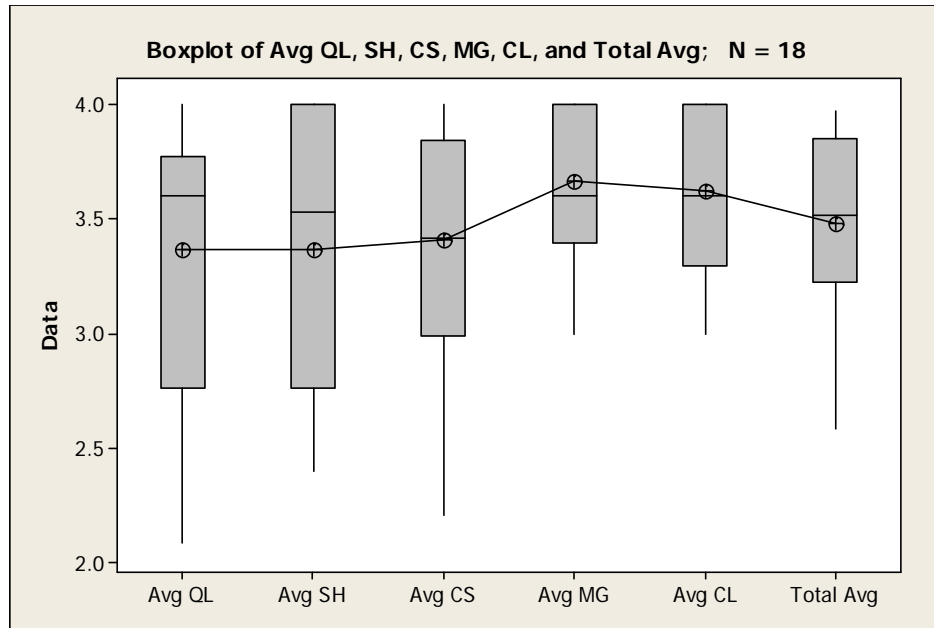
The contractors evaluation of MSU, considering data from the 2009 and 2010 Owner Scorecard, results in the following, as shown in Table II.7. Figure II.5 illustrates a box plot, similar to the one shown in the Figure II.1.

Table II.7: Descriptive Statistics (MSU Owner Scorecards 2009/2010)

Variable	Mean	StDev	Minimum	Q1	Median	Q3	Maximum
Avg QL	3.4	0.6	2.1	2.8	3.6	3.8	4.0
Avg SH	3.4	0.6	2.4	2.8	3.5	4.0	4.0
Avg CS	3.4	0.5	2.2	3.0	3.4	3.8	4.0
Avg MG	3.7	0.3	3.0	3.4	3.6	4.0	4.0
Avg CL	3.6	0.4	3.0	3.3	3.6	4.0	4.0
Total Avg	3.5	0.4	2.6	3.2	3.5	3.9	4.0

The average total score was 3.48 with a standard deviation of ± 0.397 . As shown in the Figure 5, the contractors believe MSU performed best on the management aspect with an average score of 3.67. The other factors also received high scores. The least performing factor was considered the quality aspect, but still getting an average of 3.37. It is worth to note that there were no outliers and no score under 2.0. In comparing to the 2009 results, the average total score in 2010 improved slightly, from 3.33 to 3.48 while the standard deviation almost remained unchanged.

Figure II.5: Box plot of the Average Scores of the MSU Scorecards' Factors



Following is the in-depth analysis of each indicator within each aspect.

- Quality:

Indicator	QL1	QL2	QL3	QL4	QL5
<i>Avg. each Indicator</i>	3.06	2.89	3.78	3.44	3.72

On average, MSU was rated highest score in understanding the work, which means that contractors believe MSU was very knowledgeable about the work being performed. On the other hand, MSU received the lowest score in the quality of bidding documents indicator, which may indicates there are ambiguities or questions which contractors had about the documents.

- Schedule

Indicator	SH1	SH2	SH3	SH4
<i>Avg. each Indicator</i>	3.11	3.44	3.17	3.67

MSU received the same average score on the scheduling factor that it did on quality. Both were the lowest scores of the MSU scorecards, but again a 3 out of 4 is really not low in absolute terms. Contractors rated coordination of work done by owner as one of the highest in the scheduling factor. Timely decisions and reasonableness of specifics schedule indicators were rated almost the same scores.

- Cost:

Indicator	CS1	CS2	CS3	CS4
<i>Avg. each Indicator</i>	3.50	3.61	2.78	3.67

Similar to last year results, MSU is rated with a high variation in the cost category. With a few exceptions, the majority of contractors think that MSU does a good job in paying the approved invoices within 30 days and is reasonable in dealing with changes. On the other hand, MSU got the worst score in timely processing of change orders.

- Management:

Indicator	MG1	MG2	MG3	MG4	MG5
<i>Avg. each Indicator</i>	3.67	3.61	3.39	3.83	3.83

This received the highest score, similar to last year's score. On average, all the indicators in this factor were rated very high score. The least score, at 3.39 (out of 4) is contract terms and conditions. Almost all contractors rated MSU the maximum score in procurement process.

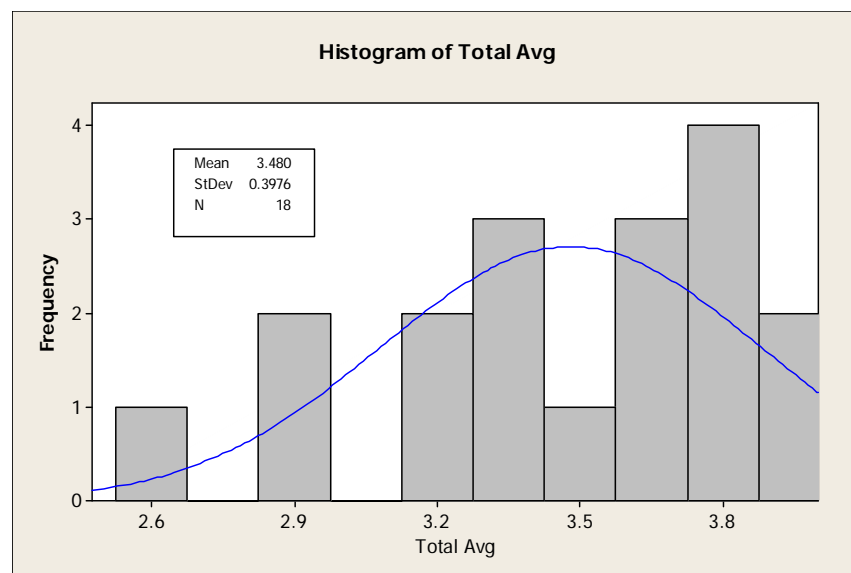
- Close out:

Indicator	CL1	CL2	CL3
<i>Avg. each Indicator</i>	3.61	3.56	3.72

MSU was scored nearly the same to the 2009 scorecards with respect to handling punch list items and contract closeout indicators.

Figure II.6 is a histogram of the average for all five factors scores on the Owner Scorecard. Overall, MSU was rated to be significantly high in all scorecard factors. The distribution is skewed to the left, with the center around 3.5.

Figure II.6: Frequency distribution for the average value for all five factor scores on the Owner Scorecards



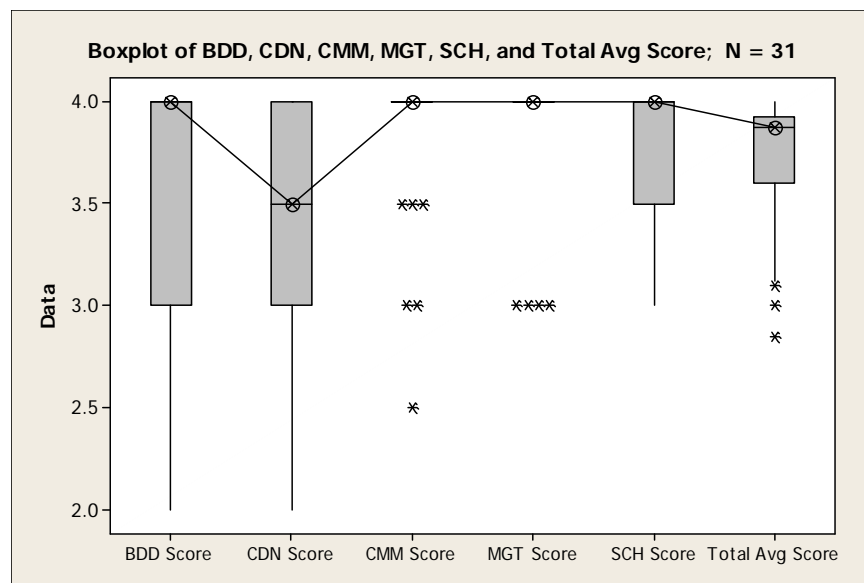
2009 - 2010 A/E Score card

The Professional services evaluation of MSU, considering data from the 2009 and 2010 A/E Scorecard, results in the following, as shown in Table II.8. Figure II.7 illustrates a box plot, similar to the one shown in Figure II.1.

Table II.8: Descriptive Statistics (A/E Scorecards 2009/2010)

Variable	Mean	StDev	Min	Q1	Median	Q3	Max
BDD Score	3.5	0.6	2.0	3.0	4.0	4.0	4.0
CDN Score	3.5	0.5	2.0	3.0	3.5	4.0	4.0
CMM Score	3.8	0.4	2.5	4.0	4.0	4.0	4.0
MGT Score	3.9	0.3	3.0	4.0	4.0	4.0	4.0
SCH Score	3.8	0.4	3.0	3.5	4.0	4.0	4.0
Total Avg Score	3.7	0.4	2.9	3.6	3.9	3.9	4.0

Figure II.7: Box plot of the Scores of the A/E Scorecards' Factors



As shown in the descriptive statistic table and the box plot, professional services received a very high score in every factor. The average score of all the factors is 3.71 out of 4. The management process used by the A/E received the highest scores.

It is interesting to note that, statistically, communication and management factors almost received the absolute score (4 out of 4), with only a few outliers. This can be seen by a cluster of CMM and MGT in the box plot (Figure II.7) and also the first quartiles, the medians, and the

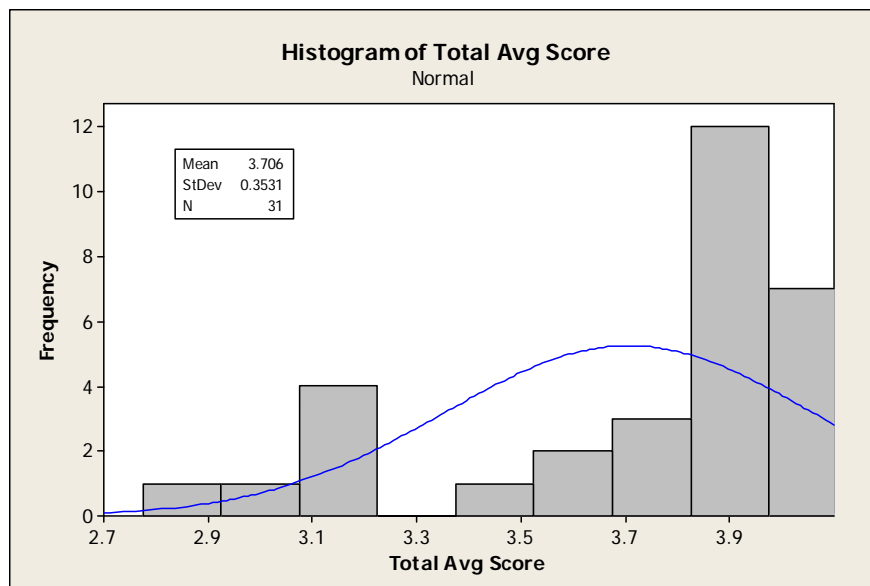
third quartiles in the descriptive statistic (Table II.9), which were all equal to 4. Besides, no single factor received a below-average score, for any of the A/E scorecards analyzed.

Table II.9: Average score of factors of A/E scorecards

	BDD	CDN	CMM	MGT	SCH	Total Score (w/ weight)
Avg. score	3.55	3.50	3.84	3.87	3.79	3.71

Figure II.8 is a histogram of the average for all five factor scores on the A/E Scorecard. Overall, MSU rated Professional Services to be excellent (3.71 out of 4 is an average score). The distribution is approximately normal, with the center around 3.7.

Figure II.8: Frequency distribution for the average value for all five factor scores on the A/E Scorecards



2009 - 2010 Customer Score card

The end-user evaluation of the construction process, consider data from the 2009 and 2010 Customer Scorecard. Given the amount of data were only 8 scorecards, no statistical analysis was conducted.

Overall, the customer rated all the indicators with a high score. Specifically, among 8 scorecards, where each scorecard has 11 indicators, for a total of 88 indicators, there was only one indicator rated with a score of 1; 3 indicators had a 2 score; and 12 indicators received a 3 score; and the remaining 72 indicators were assessed with the maximum score (4 out of 4). It is also interesting to note that 3 scorecards achieved maximum score for every indicator.

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