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Analysis Method Comparison of On-Time and On-Budget Data

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PREFACE

The research reported herein describes the process of answering the question: “Are the NMDOT On-Time and On-Budget analysis results as reported in NCHRP 20-24(37) Project – *Measuring Performance Among State DOTs* – Phase I, accurate?”. It compares results from two data analysis methods; one from AASHTO/SCoQ and one from NMDOT. Descriptions of NMDOT data quality issues and recommended remedies are offered.

ABSTRACT

New Mexico Department of Transportation results for On-Time and On-Budget performance measures as reported in (AASHTO/SCoQ) NCHRP 20-24(37) Project – *Measuring Performance Among State DOTs* (Phase I) are lower than construction personnel know to exist. The presumption by the Department was that the AASHTO/SCoQ Project Phase I applied an analysis model not representative of NMDOT business practices. The Research Bureau was tasked to answer the question: “Are the NMDOT On-Time and On-Budget analysis results as reported in NCHRP 20-24(37) Project – *Measuring Performance Among State DOTs* Phase I, accurate?”. Review of the AASHTO/SCoQ Project’s Phase I Analysis Model and the Project’s analysis method resulted in the discovery of problematic methods of analysis including the application of “implied” estimates. The Research Bureau analyzed Phase I data using an analysis method more representative of NMDOT business practices and absent of statistical error created by estimates. NMDOT On-Time performance was revealed to be 170% higher than reported for the strict measure and 220% higher than reported for the lenient measure. NMDOT Fiscal Year 2006 data was analyzed using NMDOT analysis methods and showed results proportionate to NMDOT analyzed Phase I results. Further, AASHTO/SCoQ results for Phase II are closely proportionate to NMDOT calculated results for Phase I and FY06 data. It was concluded that NCHRP 20-24(37) Project Phase I On-Time calculations are not accurate and that the Phase I On-Time analysis model is not representative of NMDOT business practices. Quality problems with Phase I, Phase II and FY06 data called into question the fitness of the data for use in performance benchmarking; it is probable that low quality data contributed to low On-Time results. While data entry behavior is the most obvious source of low quality data, other unexplored factors may be contributing to mediocre performance results. Data relevance,

quality, and analysis model issues were discussed with the AASHTO/SCoQ Project and this dialogue resulted in both AASHTO/SCoQ and NMDOT moving toward more equivalent analysis models. Two state DOT's were interviewed for their data quality assurance practices and the information was incorporated into data quality improvement recommendations. Recommendations for continued research into measure modeling, measure comparability, and data quality are made. Recommendations are made for administrative improvements.

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DEFINITIONS

AASHTO/SCoQ - American Association of State Highway and Transportation Officials, Standing Committee on Quality.

Adjusted Days - Total number of days (net) added to or deleted from the Contract Time via Supplemental Agreement (Change Order).

Bid Days - Number of total days originally offered by bidder within which work will be completed.

Calendar Day Contract - Each and every day shown on the calendar, beginning and ending at midnight. Suspensions are allowed. There is no provision for weather days, weekends or holidays. This type of contract can be used where time and user impacts are more critical.

Charged Days - For Working Day projects, number of days Project Manager determines are completed work days up to the date that project is determined to be substantially complete. For Calendar Day projects, each and every calendar day up to substantial completion date, not including suspensions.

Dual Day Contracts - Dual Day count is a method of bidding to allow the contractor to mobilize and prepare to construct the project without time being charged against the contract except for the overall mandatory physical completion date. The intent is to reduce the time on the roadway and the impact to the traveling public while providing the contractor with the flexibility of managing their corporate workload. A physical completion date is established by the agency and should take into account seasonal issues such as warm weather items being completed later in the project, staffing issues, public concerns, etc. The calendar days allowed on the roadway should be established based on a reasonable time to complete the project where work is executed aggressively on a daily basis.

Finalled - The status of a project once the State Construction Engineer signs a letter of final project acceptance.

Mandatory Completion Date Contracts - A contract in which the date on which the project shall be completed is specified in the contract. This may be either the “Substantial Completion” date or the “Physical Completion” date as specified in the contract. If neither is specified it means “Substantial Completion”. These contracts should only be used when there is a specific date by which the contract must be completed. This may be for either political or physical reasons; however there should generally be no extensions to this type of contract. If there are delays beyond the control of the contractor, the Department should be willing to accelerate the construction to meet the mandatory completion date.

NCHRP - National Cooperative Highway Research Program.

NMDOT - New Mexico Department Of Transportation.

NTPD - Notice To Proceed Date. Written notice to the Contractor to proceed with the contract work including, when applicable, the beginning date of contract time.

ORGC - Original Completion date. The date originally offered by bidder to be the completion date of the project.

Physical Completion - All the work is physically completed on the project and it is accepted by the Project Manager. All documentation required by the contract and by law does not necessarily need to be furnished by this date.

SiteManager - Transport SiteManager is a comprehensive client/server based construction management tool. It provides for data entry, tracking, reporting, and analysis of contract data from contract award through finalization.

SWKC - Substantial Work Completion date. The point at which the project is complete such that it can be safely and effectively used by the public without further delays, disruption, or impediments as requested by the Contractor and approved by the District Construction Engineer.

VDOT - Virginia Department Of Transportation.

Working Day Contract - Each day exclusive of Saturdays, Sundays, and holidays as set out in Subsection 101.3 [Subsection C., Section 7 of 18.27.2.7 NMAC], Terms and Definitions, on which work can be effectively prosecuted for six hours or more is charged. Suspensions and partial suspensions are allowed. The project manager has the most control over time on this type of contract. This contract type may be used if time or road user impacts are not critical.

1.0 INTRODUCTION

1.1 BACKGROUND

From 2004 through 2005, the New Mexico Department of Transportation participated in a pilot AASHTO/SCoQ project of seven state DOTs engaged in the discovery and development of a state to state comparative performance approach. The formative process and consequent results were reported on in the publication NCHRP 20-24(37) Project – *Measuring Performance Among State DOTs* (Phase I). The goal of the AASHTO/SCoQ project is to “offer a way to compare DOT performance data on issues of strategic importance and share knowledge about best practices among agencies”(1, p viii).

In 2005, the Phase I detailed data request was carried out by NMDOT with extreme haste and unexpectedness. The period of time allowed for the request was minimal and key staff in the NMDOT Construction Bureau vacated their positions in the middle of the data collection process. A private contractor was brought in at the last moment to prevent non-participation, but time was not available to perform a careful data query or data quality inspection. NMDOT supplied data that had missing dates and other missing information and a project’s “finalized” status was not provided. The data pool was limited to all projects that should have been completed during the period 2001 to 2004.

VDOT, the agency performing the Phase I NCHRP 20-24(37) Project data analysis, “imputed” an estimated “implied” completion date to NMDOT data where such dates were missing. The estimated date was not accompanied by confidence or error estimates of accuracy. Performance was calculated by a series of conditional selection algorithms that relied heavily on the estimated completion date and just as heavily on the absence of an actual completion date. In addition, at least one of these algorithms deviated from the conditional criteria specified in the

Phase I AASHTO/SCoQ Project Analysis Model causing analysis error.

The results of the NMDOT On-Time and On-Budget performance analysis were reported in NCHRP 20-24(37) Project – *Measuring Performance Among State DOTs* (Phase I). NMDOT suspected the results were not representative of actual performance. NMDOT construction personnel had first hand knowledge that actual On-Time performance was higher than reported. The Quality Assurance Bureau asked the Research Bureau to recalculate the data and to describe any data quality issues that the Research Bureau came in contact with during the process. A Research Advisory Committee was formed from personnel from the Construction Bureau, Quality Assurance Bureau, and the Research Bureau. This committee asked that the research include data quality improvement recommendations. An Analysis Model Committee was formed from personnel from the Construction Bureau and Research Bureau.

In 2006, the AASHTO/SCoQ Project entered into a formal phase, known as Phase II, which engaged the participation of 12 more state DOTs. NMDOT participated in another detailed data request of very short deadline and the On-Time and On-Budget results were higher than in Phase I. The data pool was limited to all projects that should have been completed during the period 2001 to 2005.

At this time, the AASHTO/SCoQ Project's primary challenge is in designing an 'apples to apples' performance measure comparison approach. The Project is still in its formative development in this regard. States vary broadly in regards to operational definitions of measures, written definitions of measures, data quality, measurement methods, measurement tools, scheduling and budgeting practices, planning and design practices, as well as in regards to a host of other geographic, climatic, demographic, social, economic, administrative, infrastructural, and political variables. The degree of control that a DOT has over these variables and, thus, over

construction delivery performance, varies from one DOT to another. Valid and reliable comparison of one DOT to another is a technical and practical undertaking of great challenge.

Three performance measure data sets are reported on for this research report. The original Phase I data set as reported on in the AASHTO NCHRP 20-24(37) Project – *Measuring Performance Among State DOTs*, Phase II data for the same project, and the Department’s Fiscal Year 2006 data.

1.2 PROBLEM

NMDOT results for On-Time and On-Budget performance measures as reported in NCHRP 20-24(37) Project – *Measuring Performance Among State DOTs* are lower than construction personnel know to exist. It appears that the AASHTO/SCoQ Project might have applied an analysis model not representative of NMDOT business practices. If calculations were performed on the same data using a more representative analysis model, NMDOT performance measure percentages might be more accurate.

1.3 OBJECTIVES

To answer the question “Are the NMDOT On-Time and On-Budget analysis results as reported in NCHRP 20-24(37) Project – *Measuring Performance Among State DOTs* Phase I, accurate?”; to develop a set of On-Time and On-Budget definitions and analysis methods representative of the Department’s actual business practices; to compare NMDOT calculated Phase I and FY06 analysis results with AASHTO/SCoQ Project Phase I and Phase II analysis results; and to describe data quality problems.

1.3.1 Specific Objectives and Questions

1) To develop a NMDOT Analysis Model for On-Time and On-Budget analysis.

- What On-Time and On-Budget definitions, business rules and methods of analysis does

NMDOT want to apply when calculating On-Time and On-Budget percent totals?

- 2) To apply the NMDOT Analysis Model to the Phase I NMDOT data.
 - When applying NMDOT On-Time and On-Budget definitions, business rules and methods of analysis [Treatment A], what are NMDOT's Phase I percent totals for On-Time and On-Budget?
- 3) To document the ASHTO/SCoQ Project's Phase I Analysis Model.
 - What On-Time and On-Budget definitions, business rules and methods of analysis did the ASHTO/SCoQ Project apply when determining NMDOT On-Time and On-Budget percent totals for Phase I?
- 4) To apply AASHTO/SCoQ Project's Phase I Analysis Model to NMDOT FY06 data¹.
 - When applying the ASHTO/SCoQ Project's On-Time and On-Budget definitions, business rules and methods of analysis [Treatment B], what are NMDOT Fiscal Year 2006 percent totals?
- 5) To apply the NMDOT Analysis Model to the NMDOT FY06 data.
 - When applying NMDOT On-Time and On-Budget definitions, business rules and methods of analysis [Treatment A], what are NMDOT's Fiscal Year 2006 percent totals for On-Time and On-Budget?
- 6) To compare the results of the analyses and determine accuracy of AASHTO/SCoQ Phase I calculations.
 - What are the proportional differences between Treatment A results [NMDOT methodology] and Treatment B results [AASHTO/SCoQ methodology] where $H_0: A = B$ and $H_1: A \neq B$ or $H_2: A > B$? Are AASHTO/SCoQ Phase I calculations accurate?

¹ This objective became obsolete as the Project's analysis model has changed.

7) To identify NMDOT data quality factors that contribute to lost counts in On-Time and On-Budget measures and estimate impact.

- What NMDOT data quality factors contribute to lost counts in On-Time and On-Budget measures, and to what degree?

8) To survey a selection of states reporting high performance results in the NCHRP March 2006 Project report for data quality practices.

- What data quality assurance methods work best for a selection of states reporting high performance results in Phase I?

2.0 METHODOLOGY

2.1 METHODS

Data sets for Phase I (January 2001 through December 2004), Phase II (January, 2001 through June 30, 2006) and FY06 (July 2005 thorough June 2006) were acquired from the Construction Bureau. Gross receipts tax information for Phase I and Phase II data was acquired and integrated. Substantial Completion Date information for Phase I data was acquired and integrated. Discussion about data collection and data query methods took place with the Construction Bureau and the AASHTO/SCoQ Project. The NMDOT Analysis Model underwent several revisions as analysis and data collection proceeded. Phase I and FY06 data underwent NMDOT Analysis Model calculations. Data quality reviews were performed during the process of requesting data, interacting with the data, analyzing the data, comparing data quality within Site Manager, comparing the quality of data in SiteManger to the data provided from the data requests, analyzing the VDOT Phase I analysis spreadsheet, and as a result of discussion with the Construction Bureau. Interviews with VDOT were performed to gather information on their Phase I calculation spreadsheet. Two other state DOT's were interviewed for their data quality assurance best practices. The Research Bureau was tasked with coordinating the data collection for Phase II. Analysis results on data sets were graphically compared for performance percentages. Other comparisons included project pool differences, missing records, and performance measure definitions.

2.2 LIMITATIONS

Phase I and FY06 data was analyzed without the Finaled/Non-Active parameter. During FY06 data analysis, project data was altered as project managers continued to enter data for projects. As a result, the FY06 data analysis is a snapshot in time.

Actual participatory quality review of the data querying process was not performed. It is not known if the querying process resulted in intrinsic biases or what quality issues were uncovered during the querying process.

The Construction Bureau was not able to provide an expanded Phase II data request necessary for research analysis and, as a result, several quality and result comparisons could not be performed.

The Phase I and Phase II data had evident quality limitations. Phase I, 37% of Calendar Day projects were missing Substantial Completion Dates. For Phase II, 17% of Calendar Day projects were missing Substantial Completion Dates and these projects were withdrawn the final data set. Do the 17% missing dates indicate projects with low performance results, poor reporting and poor project management? The answer is not known.

SiteManager quality checks revealed evidence of inaccurate and inconsistent PM data entry. These issues included days charged and days suspended after Substantial Completion Date, days not accounted for, no charge days for days that should have been charged and days charged that should not have been charged. Other anomalies included uncoordinated update behavior in regard to adjustments and evidence of problems related to understanding specification definitions. On review of these issues, the Analysis Model Committee began to question the valid use of Charged Days and adjustment and suspension data.

A query report was used to collect gross receipts data. A check on a few values against SiteManager reports revealed some differences in sum amounts. The explanation offered by the Construction Bureau contractor was that the database query report was old and had not been revised.

2.3 DELIMITATIONS

Quality review was performed as a part of the hands on process of collecting, reviewing and analyzing the data. The Construction Bureau performed all database queries.

2.4 THE NMDOT ANALYSIS MODEL

The initial analysis model developed by the Analysis Model Committee incorporated adjustments to time and budget from the original amounts so that the base line of comparison was made to the adjusted amounts and appeared thus:

A1. For Working Day projects:

To calculate time:

If $(\text{Bid Days} + \text{Adjusted Days}) \geq (\text{Charged Days} + \text{or} - \text{adjustments})$, then “On-Time”

To calculate cost:

If $(\text{Bid Amount} + 10\% \text{ of bid}) \geq (\text{Final Cost: Bid Amount} + \text{Change Order Amount} - \text{Gross Receipts Tax})$, then “On-Budget”

- Record pool parameters for Phase I data: Finaled or active project with Substantial Completion Date. If Substantial Completion Date missing then the record is withdrawn from the calculation pool.
- Record pool parameters for FY06 I data: Finaled or active project with Substantial Completion Date. If Substantial Completion Date missing then the record is withdrawn from the calculation pool.

Charged time for Working Day projects was to include the addition or subtraction of corrective adjustments but this data could not be easily collected by the Construction Bureau. For Working Day projects, error prone Charged Days could not be replaced with the number of days between

Notice to Proceed Date (NTPD) and Substantial Completion Date (SWKC) because Working Day projects, inherently, have no expected or estimated completion date, have no mandatory work days, by specification definition, have no weekend or holiday days that can be charged.

A2. Calendar and Mandatory Completion Day projects:

To calculate time:

If $(\text{Bid Days} + \text{Adjusted Days}) \geq \text{days between Notice to Proceed Date and Substantial Completion Date}$, then “On-Time”

To calculate cost:

If $(\text{Bid Amount} + 10\% \text{ of bid}) \geq (\text{Final Cost: Bid Amount} + \text{Change Order Amount} - \text{Gross Receipts Tax})$, then “On-Budget”

- Record pool parameters for Phase I data: Finaled or active project with Substantial Completion Date, or if missing, Adjusted Completion Date, or if missing, Original Completion Date.
- Record pool parameters for FY06 I data: Finaled or active project with Substantial Completion Date. If Substantial Completion Date missing then the record is withdrawn from the calculation pool.
- Charged time for Calendar Day projects is to be estimated by days between Notice to Proceed Date and Substantial Completion Date. The Construction Bureau considers this approach to be more accurate than using the Charged Days field.

In order to reduce expected data quality error the model was changed to the following:

B1. For Working Day projects:

To calculate time:

If $(\text{Bid Days}) \geq (\text{Charged Days})$, then “On-Time”

To calculate cost:

If $(\text{Bid Amount}) \geq (\text{Final Cost: Bid Amount} + \text{Change Order Amount} - \text{Gross Receipts Tax})$, then “On-Budget”

- Record pool parameters Phase I data: Finaled or active project with Substantial Completion Date. If Substantial Completion Date missing then the record is withdrawn from the calculation pool.
- AASHTO/SCoQ Record pool parameters Phase II data: Finaled project within period. If project not finaled then record is withdrawn from the calculation pool. AASHTO applied an estimated completion date for their project pool parameter. NMDOT withdrew records from the calculation pool that had missing Substantial Completion Dates.
- Record pool parameters FY06 I data: Finaled or active project with Substantial Completion Date. If Substantial Completion Date missing then the record is withdrawn from the calculation pool.

B2. For Calendar Day and Mandatory Completion Day projects:

To calculate time:

If $(\text{Original Completion Date}) \geq (\text{Substantial Work Completion Date})$, then “On-Time”

To calculate cost:

If $(\text{Original Bid Amount}) \geq (\text{Final Cost: Bid Amount} + \text{Change Order Amount} - \text{Gross Receipts Tax})$, then “On-Budget”

- Record pool parameters Phase I data = Finaled or active project with Substantial Completion Date, or if missing, Adjusted Completion Date, or if missing, Original Completion Date.
- Record pool parameters for Phase II data = Finaled project with Substantial Completion Date. If Substantial Completion Date missing then the record is withdrawn from the calculation pool. AASHTO calculated and applied an estimated completion date for their project record pool parameter.
- Record pool parameters for FY06 data = Finaled or active project with Substantial Completion Date. If Substantial Completion Date missing then the record is withdrawn from the calculation pool.

Initially, all data was intended to be pooled by Substantial Completion Date. Because of problems with missing data in that field, a varied pooling approach was applied.

Liquidated damages and incentives could not be subtracted from Final Cost as the data could not be acquired from the Construction Bureau. As a result, it was not included in the calculations.

Post research Department discussion on how to best model, measure and calculate On-Time and On-Budget performance has currently assigned the NMDOT analysis models above to continued in-development status. See Appendix A for the Different NMDOT Stringent On-Time Analyses chart.

2.5 THE PHASE I, AASHTO/SCOQ PROJECT ANALYSIS MODEL (2)

2.5.1 Project Records Pool

For all periods for which “on time” performance is computed, the pool of projects used for the computation are those with original-scheduled completion dates in that period.

For all periods for which “on budget” performance is computed, the pool of projects used for the computation are all projects with project acceptance dates in that period.

2.5.2 Original, Implied Original, and Scheduled Completion Dates

When a project record does not have the field “original scheduled completion date” populated, then an “*implied* original scheduled completion date” is computed for that project. For these contracts that do not specify fixed dates for completion, the original expectation is that the project will span over a specified number of work days, with allowances to be made for bad weather and other events that would cause work to be suspended. Thus the “*implied* original scheduled completion” date is computed by adding $\frac{7}{5}$ original planned days to $\frac{7}{5}$ work suspension days to the original let date for the contract. Note that since original planned days and work suspension days are work days, not calendar days, each of those figures are divided by 5 and then multiplied by 7 prior to adding them to the let date to arrive at a new calendar date.

2.5.3 Performance Measure On-Time Definition 1

The first “on time” definition compares actual projection completion to public expectation – which would be based on the original scheduled completion date or the original planned number of days. Business rules for the computation are as follows:

- Fields used in the computation are:
 - Acceptance date
 - Original scheduled completion date
 - Actual days charged to the project
 - Days originally planned for the project
 - Work suspended days
- The measure is calculated as follows:

On-Time Definition 1, Part 1

- For all project records that have the “original scheduled completion date” field populated, the project is considered to be “on time” when the acceptance date is

on or before the original scheduled completion date.

On-Time Definition 1, Part 2

- When the “original scheduled completion date” field is not populated, the project is considered to be “on time” when the actual days charged to the project is less than or equal to the sum of the days originally planned for the project plus work suspended days.
- The “on time” performance measure is the percentage of total projects that were completed “on time.” That is, (# of projects that were originally scheduled for completion during the period that were completed “on time”) divided by (total # of projects that were originally scheduled for completion during the period). To determine which projects were originally scheduled for completion during the period, we look first to the field “original scheduled completion date;” if that field is not populated, we look to our computed “implied original scheduled completion date.”

2.5.4 Performance Measure On-Time Definition 2

The second “on time” definition compares actual project completion to the current agreement with the contractor – which would include time extensions through work orders due to supplemental agreements. Business rules for the computation are as follows:

- Fields used in the computation are:
 - Acceptance date
 - Original scheduled completion date
 - Time extensions through work orders due to supplemental agreements
 - Current scheduled completion date (which is the sum of the previous two fields)
 - Actual days charged to the project
 - Days originally planned for the project
 - Additional days planned for the project through work orders due to supplemental agreements
 - Current days planned for the project (which is the sum of the previous two fields)
- The measure is calculated as follows:

On-Time Definition 2, Part 1

- For all project records that have the “current” scheduled completion date field populated, the project is considered to be “on time” when the acceptance date is on or before the current scheduled completion date. The current scheduled completion date differs from the original scheduled completion date by time extensions allowed through work orders.

On-Time Definition 2, Part 2

- When the “current” scheduled completion date field is not populated, the project is considered to be “on time” when the actual days charged to the project are less than or equal to the sum of current days planned for the project plus work suspended days. Current days planned for the project are the sum of the days originally planned for the project plus additional days planned through work orders due to supplemental agreements.
- The “on time” performance measure is the percentage of total projects that were completed “on time.” That is, (# of projects that were originally scheduled for completion during the period that were completed “on time”) divided by (total # of projects that were originally scheduled for completion during the period). To determine which projects were originally scheduled for completion during the period, we look first to the field “original scheduled completion date;” if that field is not populated, we look to our computed “implied original scheduled completion date.

2.5.5 Performance Measure On-Budget Definition 1

The first “on budget” definition is a strict one. It compares the actual final payments to the contractor to the original bid amount accepted for the job. Business rules for the computation are as follows:

- Fields used in the computation are:
 - Bid amount
 - This should be the original amount bid by the contractor.
 - This figure should not include any amounts built-in for contingencies.
 - For many DOTs, this is the same as “contract award amount.”
 - Final payments to contractor
 - This figure should not include any amounts for preliminary engineering and the like. It should be limited to the amount paid to the contractor for this work.
 - This field is sometimes referred to as “final cost.”
- The measure is calculated as follows:

- For each project, if final cost is less than or equal to the original bid amount, then the project is considered “on budget;” otherwise, it is not.
- The “on budget” performance measure is the percentage of total projects that were completed “on budget.” That is, (# of projects accepted during the period that were completed “on budget”) divided by (total # of projects with acceptance dates during that period).

2.5.6 Performance Measure On-Budget Definition 2

The second “on budget” definition allows for a 10% contingency, which is fairly standard in the industry. This definition compares final payments to the contractor to the original bid amount plus 10%. Business rules for the computation are as follows:

- Fields used in the computation are the same as those used for the first “on budget” definition (see above).
- The measure is calculated as follows:
 - The budget for each project is computed as 110% times the original bid amount.
 - For each project, if final cost is less than or equal to 110% times the original bid amount, then the project is considered “on budget;” otherwise, it is not.
 - The “on budget” performance measure is the percentage of total projects that were completed “on budget.” That is, (# of projects accepted during the period that were completed “on budget”) divided by (total # of projects with acceptance dates during that period).

2.6 THE PHASE II, AASHTO/SCoQ PROJECT ANALYSIS MODEL

At this time, the Phase II methods appears to be similar to nominal Phase I analysis methods but dissimilar to VDOT spreadsheet analysis methods: 1) estimated completion dates were only used to define the project pool for Working Day projects and not used for computational purpose; however, the estimated date was not accompanied by confidence or error estimates of accuracy. In addition, the accuracy of the AASHTO estimated completion date cannot be determined by this research as the Construction Bureau was not able to provide data fields that would have allowed such analysis. It is recommended that an in-depth analysis of the Phase II calculations be performed at the next stage of this research.

3.0 RESULTS

3.1 THE PHASE I, AASHTO/SCoQ PROJECT VDOT ANALYSIS SPREADSHEET

VDOT performed project pool selection procedures on NMDOT data by imposing an imputed, implied/estimated Original Completion Date for any project missing an actual Original Completion Date. If a project's implied (or actual) completion date did not fall between the project pool dates (2001 through 2004), it was discarded.

A project was considered "Active" if the actual completion date was missing, and "Active" projects were not included in On-Budget calculations. In addition, "Active" projects were considered "Late" for On-Time calculations. In the VDOT spreadsheet, for the period 2001-2004, 134 projects were given "Active" status.

Within the VDOT spreadsheet, it at first appeared that a missing completion date defaulted the calculation to On-Time by Number of Days (Def 1, Part 2) (See section 2.5), an On-Time determination calculated from a comparison of charged days to days originally planned for + work suspended days. However, in practice, this default was overridden to On-Time by Original Date (Def 1, Part 1). As a result, all projects were actually calculated by On-Time by Original Date (Def 1, Part 1) using the implied or actual completion date.

VDOT calculated an implied Current Scheduled Completion Date by adding their implied Original Completion Date to actual Adjusted Days, something which was intended to be part of the Definition 1, Part 2 calculation. However, as stated above, On-Time by Number of Days (Def 1, Part 2) had been overridden by On-Time by Original Date (Def 1, Part 1).

As a result, 17 projects that were missing Original Completion Dates and that would have been calculated as "On-Time" by way of On-Time by Number of Days (Def 1, Part 2), were given the "Late" status, and 16 of those same projects that would have been "On-Time" by way

of On-Time by Number of Days (Def 2, Part 2) were also assigned “Late” status.

In comparing actual Original Completion Date to VDOT’s implied Original Completion Date from a sample of 151 projects that have the actual completion date, all of the 151 projects were imputed an implied completion date later than the actual Original Completion Date by an average of 191 days (maximum 1395, median 132, minimum 12). It is assumed that this error was applied to the 66 remaining projects that were missing the actual completion date. The implied Original Completion Date was used as the project pool selection criteria for projects where the actual completion date was missing.

For all projects, for the VDOT created calculated fields - Current Scheduled Completion Date, Number of Days Allowed, Number of Days Allowed with Time Extensions, Number of Days Charged, and Number of Shutdown Days – time was multiplied by 7 and divided by 5 in an attempt to proportionally represent each project as a five day a week project. This in effect increases all time values by roughly 1.4 times. While the proportional changes were equal from project to project, the procedure discounted NMDOT time and counting rules for Working Day projects and misrepresented actual time lines.

3.2 PHASE I NMDOT ANALYSIS MODEL - RESULTS

The Phase I data set was analyzed using most of the parameters of the NMDOT Analysis Model in its later form including subtraction of Gross Receipts Tax from each project’s final cost amount.

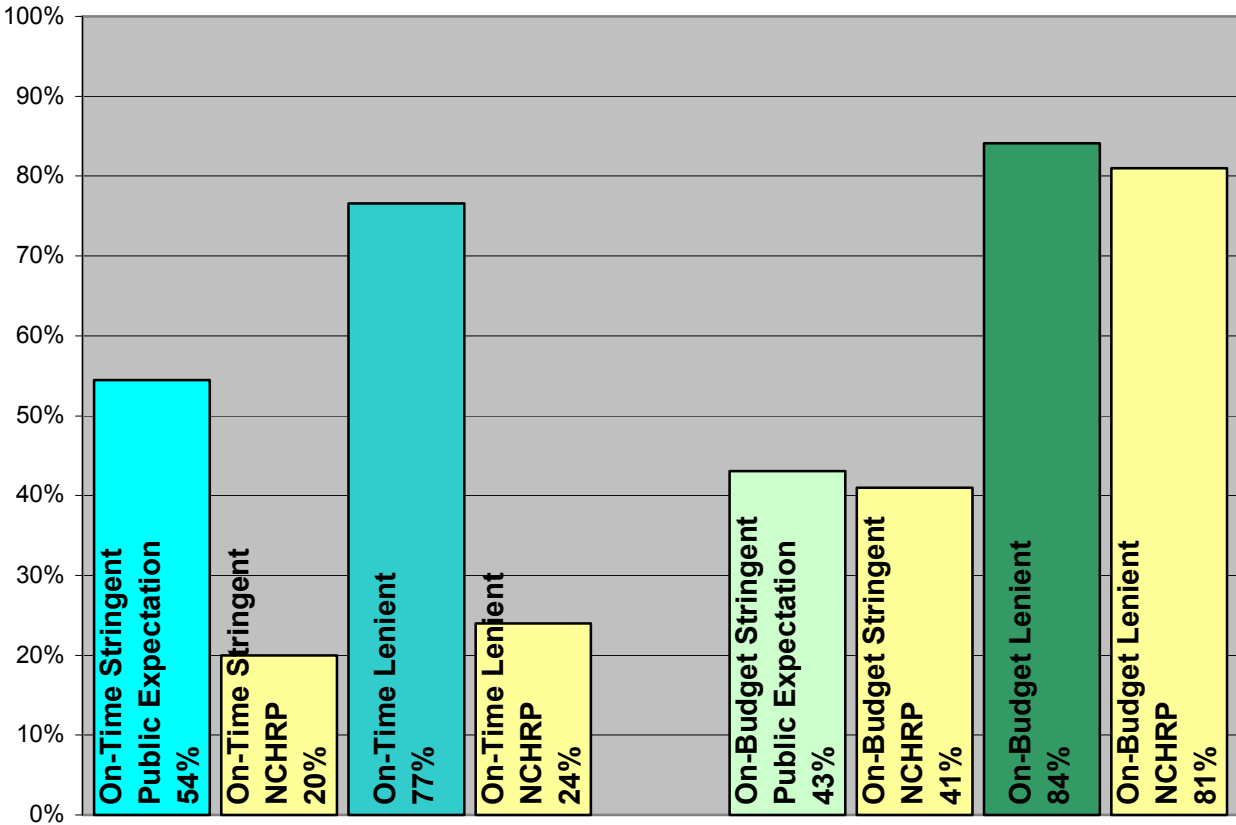
Occasionally, GRT information was not available and the subtraction could not be performed. A database query report was used to collect gross receipts values.

The “Finaled” parameter was not available for this data set. Projects were pooled primarily by Substantial Completion Date.

TABLE 1 Phase I NMDOT Analysis Results Table.

Performance Measure	% Stringent	Record Pool	Measure	% Lenient	Record Pool	Measure	NCHRP Stringent	NCHRP Lenient
AD (Working Day) On-Time	68%	50	34	90%	50	45		
AD (Working Day) On-Budget	46%	50	23	72%	50	36		
CD (Calendar Day) On-Time by dates	47%	95	45	69%	95	66		
CD (Calendar Day) On-Budget pooled by various kinds of completion dates	42%	152	64	88%	152	134		
Overall On-Time	54%	145	79	77%	145	111	20%	24%
Overall On-Budget	43%	202	87	84%	202	170	41%	81%

On-Time and On-Budget Phase I (2001 through 2004) Overall NMDOT Calculation Compared To AASHTO/NCHRP Calculation



WD = Working Day projects; CD = Calendar Day projects; NTPD = Notice to Proceed Date;
SWKC = Substantial Work Completion date; ORGC = Original Completion date

- On Time Stringent = For WD: IF Days Charged \leq Original Bid Days THEN "On-Time"; For CD: IF SWKC \leq ORGC THEN "On-Time"
- On Time Lenient = For WD: IF Charged Days \leq Bid Days + Adjusted Days THEN "On-Time"; For CD: IF number of days between NTPD and SWKC (standing in for Charged Days) \leq Bid Days + Adjusted Days THEN "On-Time"
- NCHRP Analysis Results
- On Budget Stringent= IF Bid Amount + Change Order Amount – GRT (Final Amount) \leq Original Bid Amount THEN "On-Budget"
- On Budget Lenient = IF Bid Amount + Change Order Amount - GRT (Final Amount) \leq Bid Amount + 10% THEN "On-Budget"

FIGURE 1 Phase I NMDOT Analysis Results Chart.

3.3 PHASE II AASHTO/SCoQ ANALYSIS MODEL - RESULTS

The Phase II data set was provided to the AASHTO/SCOQ Project with the Gross Receipts Tax subtracted from each project's final cost amount. The quality issues regarding GRT have been mentioned in section 3.2. For Phase II Calendar Day projects, 17% of the data was missing Substantial Completion Dates and was withdrawn the final data set provided to AAHSTO.

The Construction Bureau was not able to provide data that would have allowed the following analysis:

1) The AASHTO/SCOQ Project applied an estimated Scheduled Completion Date as the inclusion criteria for the Working Day project pool. The accuracy of the AASHTO Phase II estimated completion date can be determined with the provision of appropriate data.

2) The Construction Bureau withdrew 17% of Calendar Day project records from the Phase II data request because they were missing substantial completion dates. The effect of the withdrawn data on analysis results can be determined with the provision of appropriate data.

3) A quality comparison of Phase I and Phase II data can be performed with the provision of appropriate data.

4) The AASHTO Project requested that each project record include a Contract Final Voucher Date. Instead, the Construction Bureau provided projects that had been "Finaled" as a substitute strategy. According to AASHTO, other states provided projects that were both active and finaled. Projects with finaled status present a skewed frequency distribution because the volume of projects is less for the last and current year than later years. When projects are pooled regardless of finaled status, the distribution of projects is more even across years. The effect of the "Finaled" pooling on analysis results can be determined with the provision of appropriate data.

5) Stratified analysis would allow insight into year to year performance improvements, project budget size performance differences, and individual contractor performance.

As mentioned in section 2.2, SiteManager quality checks revealed evidence of inaccurate and inconsistent PM data entry as well as uncoordinated data update behavior. The quantitative effect of these issues on data quality could not be explored in the time span of this research but is thought to be of corrective concern by the Construction Bureau.

TABLE 2 Phase II AASHTO/SCoQ Draft Analysis Results Table.

Projects with an Estimated or Actual Scheduled Completion Date Between 2001-2005 & A Final Payment Voucher				
	WD Projects	CD Projects	Total	%
ON-BUDGET -Strict Measure				
At or Under Budget	32	42	74	41%
Over Budget	47	59	106	59%
Totals	79	101	180	
ON-BUDGET -Lenient				
At or Under Budget	59	88	147	82%
Over Budget	20	13	33	18%
Totals	79	101	180	
ON-TIME - Strict Measure				
On Schedule	60	48	108	58%
Behind Schedule	19	53	72	42%
Totals	79	101	180	
ON-TIME - Lenient Measure				
On Schedule	74	71	145	81%
Behind Schedule	5	30	35	19%
Totals	79	101	180	

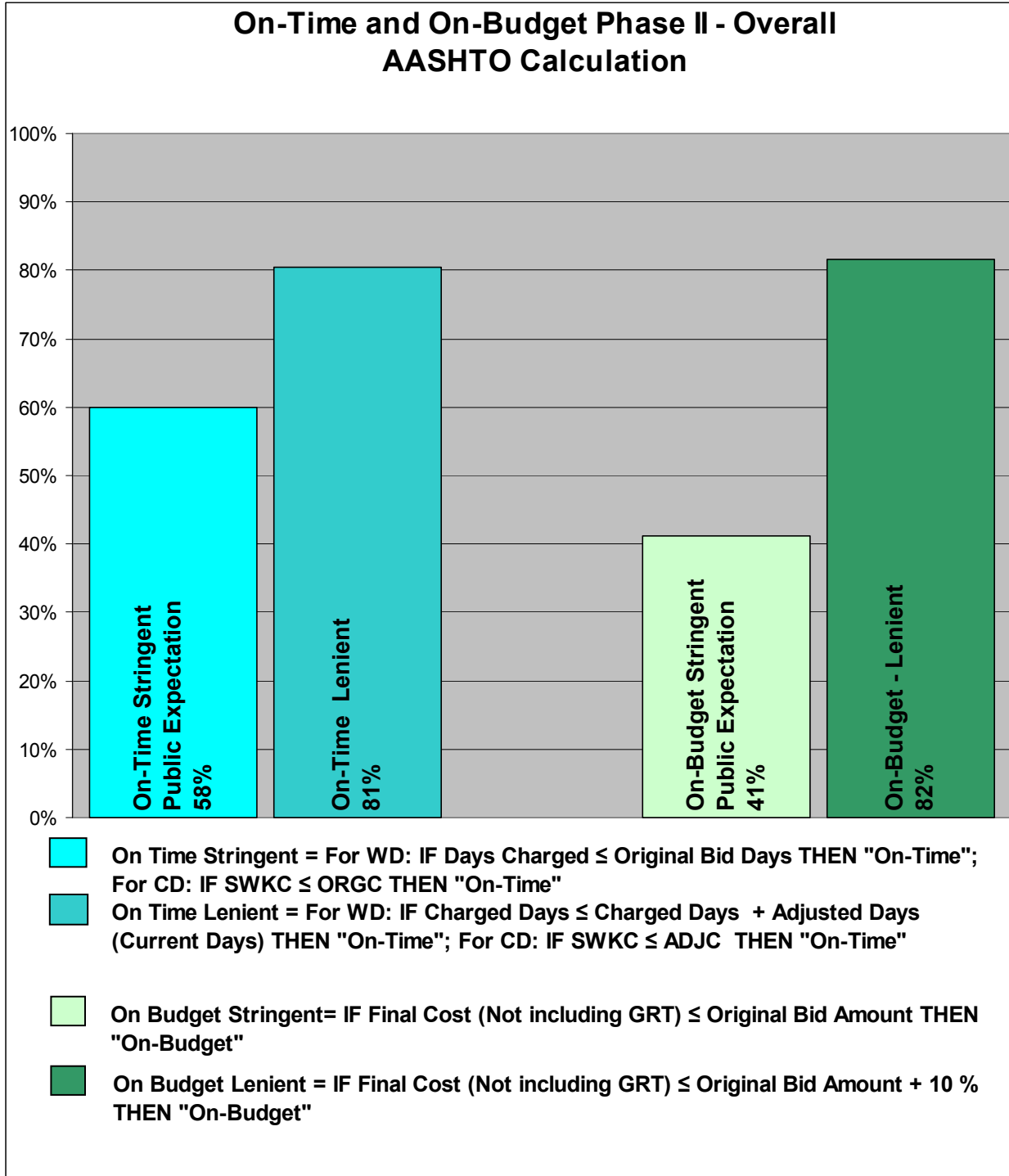


FIGURE 2 Phase II AASHTO/SCoQ Analysis Results Chart.

3.4 FISCAL YEAR 2006 NMDOT ANALYSIS MODEL - RESULTS

Projects pooled by Substantial Completion Date.

TABLE 3 FY06 NMDOT Analysis Results Table.

FY06 On-Time and On-Budget Results				
	% On Time Stringent	% On Budget Stringent	% On Time Lenient	% On Budget Lenient
Mandatory Completion Date Projects	40%	40%	100%	60%
Calendar Day Projects	43%	57%	57%	86%
Working Day Projects	61%	33%	83%	89%
Overall Results	53%	40%	80%	83%

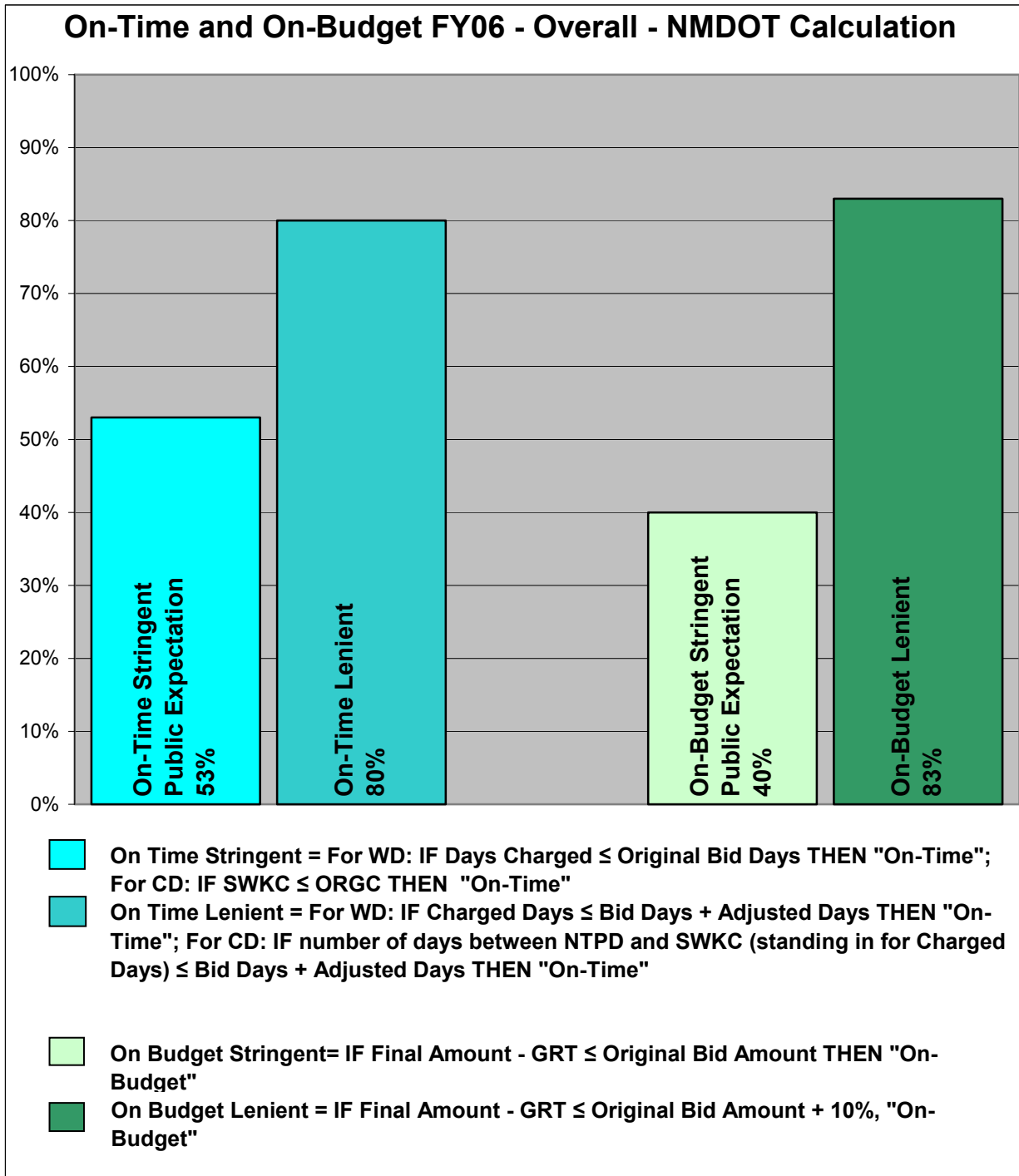


FIGURE 3 FY06 NMDOT Analysis Results Chart.

3.5 COMBINED ANALYSIS RESULTS: PHASE I, PHASE II, AND FY06

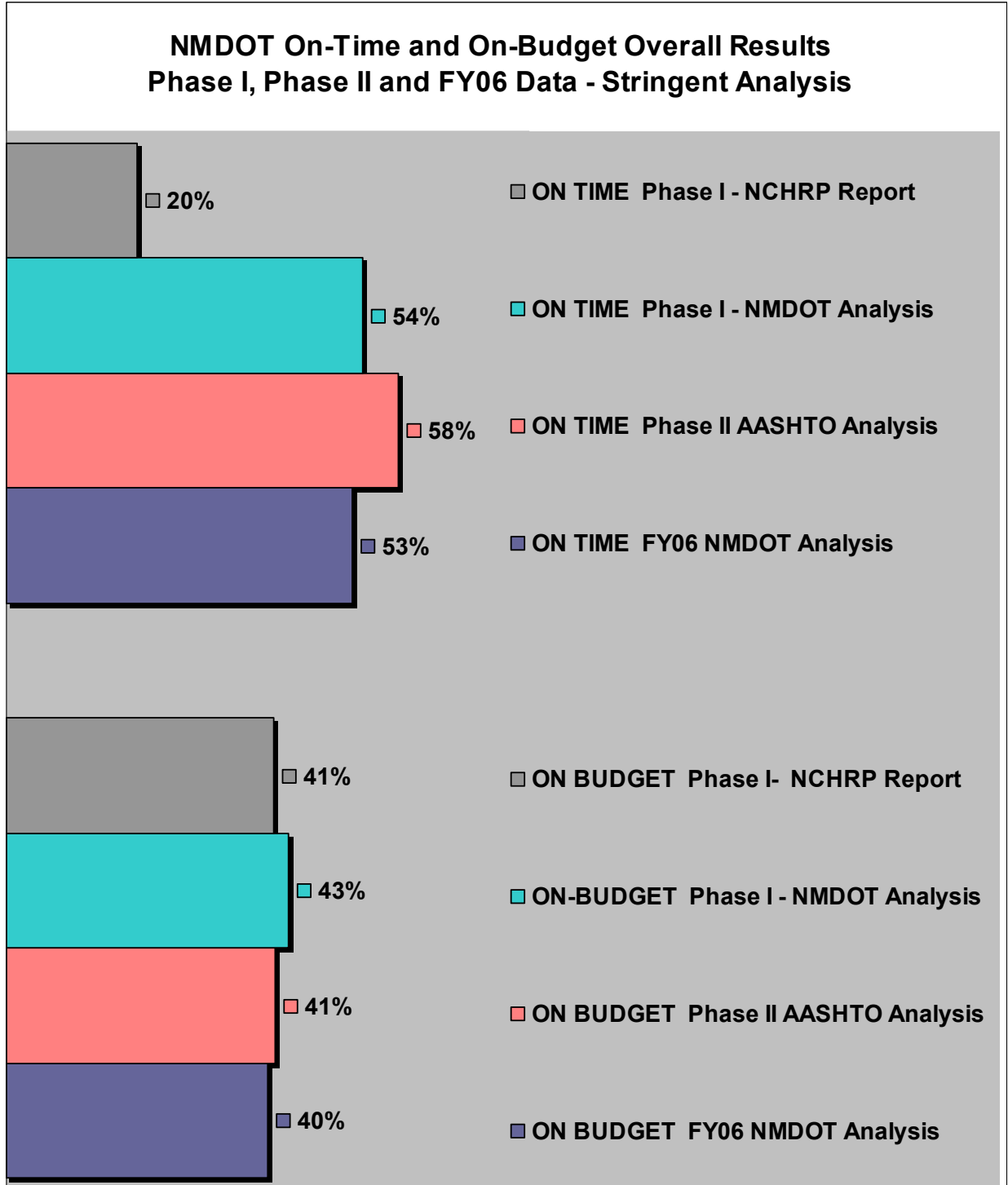


FIGURE 4 Phase I, Phase II and FY06 Stringent Analysis Comparison Chart.

3.6 RELEVANT FINDINGS BY STATE

Two states were interviewed for their data quality assurance practices. Missouri runs Impromptu reports on SiteManager data every week for purposes of error checking. One report looks at the Project Manager's diary to make sure that all data entry is accurate and consistent and not contradictory with other data sources. They also produce a report that compares charge days to liquidated damages to change orders. The reports are easy to create and several people know how to create new kinds of reports as the need arises. They perform regular Project Manager training to increase the quality of PM diary entry.

Virginia DOT runs regular reports on PM data entry. They send a data quality report to each PM after each completed project to let them know how well they did.

4.0 CONCLUSIONS

This research began with a hypothesis by the Department that the AASHTO/SCoQ Project Phase I analysis model was not representative of NMDOT business practices which resulted in inaccurate measurement of the Department's performance. This presumption set aside in-depth and comprehensive examination of all business practices that might have contributed to low or inaccurate Phase I results. The Research Bureau was tasked to recalculate the On-Time and On-Budget analysis results as reported in NCHRP 20-24(37) – *Measuring Performance Among State DOTs* , to note any quality issues that arose during the recalculation process, and to make recommendations related to data quality improvement. An additional task, coordination of the AASHTO/SCoQ Project Phase II detailed data request, was added mid-project.

Review of the AASHTO/SCoQ Project's Phase I Analysis Model and the Project's analysis spreadsheet resulted in the discovery of well intentioned but problematic methods of analysis including the "imputing" of "implied" original completion dates for project pooling and On-Time calculation purposes. These "implied" dates were not accompanied by confidence or error parameters and the dates lacked accuracy. The most significant impact of the implied date experiment was to discard projects that should have been included in the project pool and to arbitrarily decide that all active projects could not be considered On-Time. To be fair, NMDOT data quality was less than optimum in quality. The estimated dates were again applied by the Project's Phase II analysis but were used only for project pooling purposes. However, again, the estimated dates were not accompanied by confidence or error parameters.

The Research Bureau analyzed Phase I data using an analysis method more representative of NMDOT business practices and absent of statistical error created by estimated dates. Projects were pooled and On-Time performance was calculated by actual dates. Projects were pooled and

performance was calculated regardless of active or non-active status. Using these methods, NMDOT On-Time performance was revealed to be 170% greater than reported (*l, p 5*) for the stringent measure and 220% greater than reported (*l. p 6*) for the lenient measure.

NMDOT Fiscal Year 2006 On-Time and On-Budget data was analyzed using NMDOT analysis methods and showed results proportionate to NMDOT analyzed Phase I results. Further, AASHTO/SCoQ Phase II calculated results are closely proportionate to NMDOT calculated results for Phase I and FY06 data. It can be observed in Figure 4 that NMDOT On-Time and On-Budget performance has been fairly even over time, ignoring effects of poor data quality.

Thus, it is concluded that NCHRP 20-24(37) Project Phase I On-Time calculations are not accurate and that the AASHTO/SCoQ Phase I On-Time analysis model is not representative of NMDOT On-Time business practices.

The overall quality of data used for research was not good. Projects could not be pooled or calculated confidently because of missing or corrupt data. Project Manager data entry quality issues point to serious needs for improved data entry practices. SiteManger database query difficulties point to the need for improved methods and personnel skills. The quality of the querying process utilized to collect the research data is uncertain. In addition, additional data required for quality cross check could not be obtained.

Thus, it is concluded that Phase I, Phase II and FY06 data quality issues create uncertainty in the fitness of data for use in performance benchmarking. It is also concluded that neither NMDOT nor AASHTO/SCoQ analytical results can be said to be clearly representative of NMDOT actual On-Time, performance. NMDOT performance may be greater than either

analytical approach could ascertain. A lack of research investigation into NMDOT On-Budget data quality deters conclusions on On-Budget results.

The NMDOT analytical model went through several changes. Justification for these changes was derived from observations, data manipulations, discussions and key informant explanations and recommendations. Further changes and expansions are expected in the next stage of this research.

5.0 RECOMMENDATIONS

The following recommendations are made to promote the development of process improvements that support Department performance measure benchmarking capacity:

1) Systemic fragmentation of data resources was uncovered in the course of this research. NMDOT and national agendas describe On-Time and On-Budget project delivery needs that can be met by improved performance measurement management systems. In reference to the new NMDOT Strategic Priority Plan (draft), specifically in regard to construction project delivery systems, it is recommended that data quality and performance management systems that ensure accountability in management and delivery of NMDOT's initiatives, projects and operations be established and integrated in order to deliver services On-Time and On-Budget; that benchmarking performance models be developed that tie into national AASHTO/SCoQ performance models; and that further research be done to support the Department's knowledge management and performance management needs.

2) Problems of fragmented, inaccurate, missing, and non-collected data were uncovered in the course of this research. A comprehensive investigation of these problems was not performed. It is recommended that an independent contractor, in collaboration with a NMDOT employee oversight team, perform a comprehensive in-depth investigation of all SiteManger data quality problems and correct them, and give recommendations for process improvement. Users should be surveyed for data fields that need to be added to SiteManger and for outcomes that are not currently being measured. Sources of data external to SiteManger should be collected and compared to the AASHTO/SCoQ Project Phase I and II SiteManger data/data analysis for data quality and error verification. The independent contractor, in collaboration with a NMDOT employee(s) oversight team, should perform this comprehensive, in-depth

investigation of all SiteManager data quality problems, including the above activities, correct them and give recommendations for specific process improvements to aid in improving and meeting future On-Time/ On Budget targets and performance goals .

3) Data entry quality problems and lack of SiteManager data quality assurance processes were uncovered in the course of this research. It is recommended that the Construction Bureau implement a data quality assurance system that includes timely and effective rectification of problems. Rectification should include, but not be limited to, data quality training and data quality standards compliance.

4) Difficulties in obtaining data for this research revealed issues of long term over-dependence on contracted SiteManger services. It is recommended that the Department develop and sustain internal capacity for utilization and management of SiteManager to include recommendations for the knowledge management of key and critical information related to SiteManager and training and competencies associated with key personnel to perform these services. This need was repeated by several key personnel.

6.0 IMPLEMENTATION

The NMDOT Analysis Model more accurately calculated and, thus, increased NMDOT On-Time and On-Budget performance results. The Department has implemented plans to rectify data quality problems with Project Manager data entry training. The Research Advisory Committee has developed a research project implementation plan from this report's recommendations.

7.0 REFERENCES

- 1) American Association of State Highway and Transportation Officials. *Measuring Performance Among State DOTs*, NCHRP Report 20-24 (37). AASHTO Standing Committee on Quality, 2006. www.transportation.org/sites/quality/docs/MeasuringPerformance.pdf
- 2) American Association of State Highway and Transportation Officials. *Benchmarking State DOTs' Project Delivery Cost and Schedule Performance*, Draft NCHRP Report 20-24 (37). AASHTO Standing Committee on Quality, 2007
- 3) American Association of State Highway and Transportation Officials Standing Committee on Quality, Performance Measure Subgroup Committee. *Performance Measures Benchmarking Project "On Time" and "On Budget" Definitions*. Internal document. November 2, 2005.

8.0 APPENDIX A

TABLE 4 NMDOT AASHTO/NCHRP Phase II Detailed Data Request Field Descriptions

General Data Required		
Fields Required	TRNS*PORT Field Name ¹	Explanation of Data Use
Unique Contract Identifier	t_cont.cont_id; Excel field name: "cont_id"	Number, contract id, etc. used to identify each contract.
Contract Type (If available)	t_cont.wrk_t; Excel field name: "wrk_t"	Description of contract's general work category, e.g. reconstruction, rehabilitation, signalization, for possible grouping of all contracts by work type.
Budget Data Required (Provide only for contracts with a final voucher date)		
Fields Required	TRNS*PORT Field Name	Explanation of Data Use
Contract Final Voucher Date	N/A Only FNLD projects selected so the final voucher has to have been paid; Excel field names: "fnld_status", "fnld_qtr", and "fnld_yr"	Contracts without a final voucher date or equivalent may have additional unreported costs & will be excluded from the analysis. We need evidence that all major costs for a project have been charged.
Original Contract Award Amount	t_cont.tot_bid_amt; Excel field name: "tot_bid_amt"	Baseline for measuring contract cost performance. This field should be the same as the winning contractor's bid. Be sure it does not include any contingency (e.g. for cost increases).
Final Cost	t_cont.tot_bid_amt + t_cont.net_c_o_amt – Gross Receipts Tax; Excel field name: "final_cost"	Specifies total payments to contractors and is used to calculate on-budget performance against original award amount.
On-Schedule Data Required (Provide for All Contracts)		
Fields Required	TRNS*PORT Field Name	Explanation of Data Use
Type of Contract - Work or Calendar	t_cont.tm_chrg_t; Excel field name: "tm_chrg_t"	Determines method required/data reporting needs for calculating schedule performance.
Notice to Proceed	t_cont.crit_dt.crit_dt_t = NTPD + t_cont.crit_dt.actl_dt; Excel field name: "ntpd_actl_dt"	Used, if necessary, to estimate equivalent calendar completion date for work day contracts. Also may be used for further analysis of work day and calendar day contracts.
On-Schedule Data Required (Provide for Calendar Day Contracts Only)		
Fields Required	TRNS*PORT Field Name	Explanation of Data Use
Original Specified Completion Date	t_cont.crit_dt.crit_dt_t = ORGC + t_cont.crit_dt.actl_dt; Excel field name: "orgc_actl_dt"	Baseline for measuring schedule performance on calendar day contracts.
Current Specified Completion Date with Time Extensions	t_cont.crit_dt.crit_dt_t = ADJC + t_cont.crit_dt.actl_dt; Excel field name: "adjc_actl_dt"	Adds any net time change resulting from work/change orders issued during the contract.
Contract Acceptance Date or Substantial Completion Date	t_cont.crit_dt.crit_dt_t = SWKC + t_cont.crit_dt.actl_dt; Excel field name: "swkc_actl_dt"	The field you pick should be the best parameter used in your state to represent the point at which a project is "open to traffic" (i.e. some additional minor work may be required, but no lane closures or other major work will take place). It will be compared against the original completion date to compute on-time performance.
On-Schedule Data Required (Provide for Work Day Contracts Only)		
Fields Required	TRNS*PORT Field Name	Explanation of Data Use
Original Number of Work Days Allowed	t_cont.bid_da; Excel field name: "bid_da"	Used as the baseline for measuring schedule performance on work day contracts.
Shutdown Days/Work Suspended days	t_diary.cred_da_val = 1; Excel field name: "no_charge"	Used to impute an equivalent calendar completion date for work day contracts.
Current Number of Work Days Allowed with Time Extensions That Would be Included in Days Charged	t_cont.bid_da + t_cont.tot_adj_da; Excel field name: "cur_da"	This includes any net change in the number of work days resulting from work or change orders issued during the contract.
Days Charged to Date	t_diary.cred_da_val = 0; Excel field name: "charged"	Used to impute actual on-schedule performance
¹ TRNS*PORT field names are those used by NMDOT.		

TABLE 5 Phase I data comparison of charged days options

For Phase I, Calendar Day projects that have dates: Comparison of "Days Between NTPD & SWKC" with "Number of Days Charged" and with "Adjusted Completion Days"					
CONT_ID	Days Between NTPD & SWKC	NUM_DA_CHRG	Days Charged minus Days Between	ADJ_COMP_DA	Adjusted Completion Days minus Days Between
00000252	468	493	25	469	1
00000658	156	157	1	158	2
00000853	267	144	-123	268	1
00000872	238	233	-5	240	2
00001296	480	405	-75	438	-42
00001490	351	321	-30	608	257
00001662	358	347	-11	359	1
00002102	421	421	0	482	61
00002392	43	48	5	60	17
00002393	239	145	-94	185	-54
00002514R	729	619	-110	576	-153
00002685	214	235	21	162	-52
00002760	51	31	-20	35	-16
00002767R	269	283	14	546	277
00002768	470	335	-135	475	5
00002787A	195	203	8	240	45
00002885	311	318	7	312	1
00003042	155	156	1	156	1
00003102	280	684	404	298	18
00003122	215	202	-13	218	3
00003142	316	191	-125	322	6
00003164	551	573	22	545	-6
00003244	353	235	-118	354	1
00003282R	508	448	-60	530	22
00003313	81	55	-26	84	3
00003329	472	396	-76	473	1
00003343	81	46	-35	60	-21
00003353	141	145	4	144	3
00003360	367	334	-33	368	1
00003363	463	464	1	467	4
00003384R	426	245	-181	271	-155

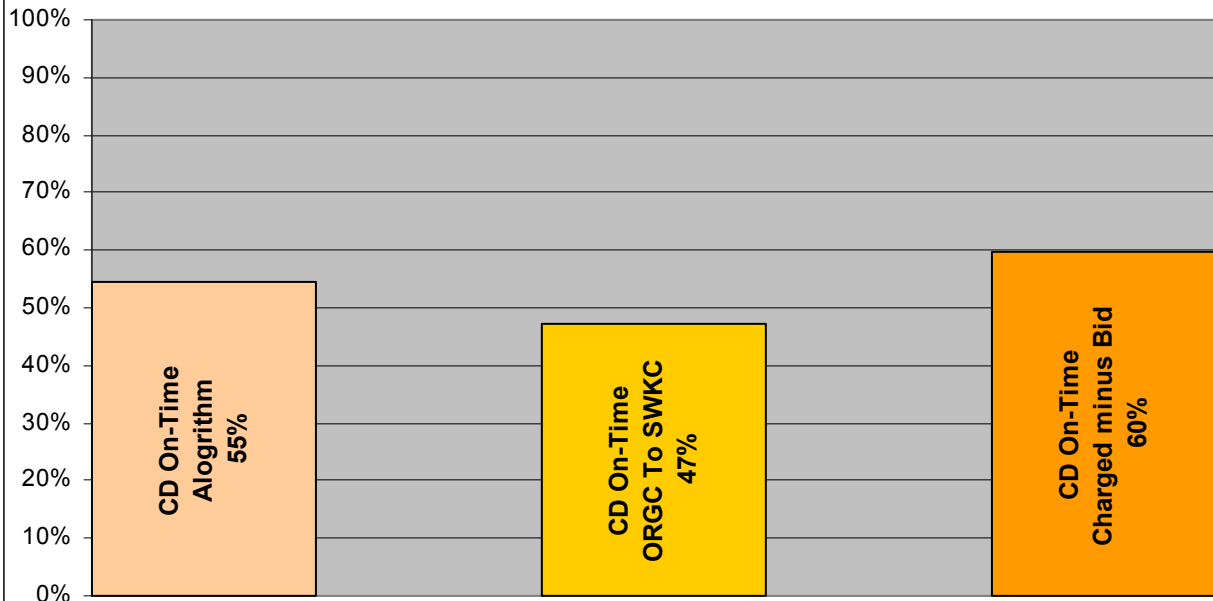
00003392	497	452	-45	498	1
00003397	743	611	-132	745	2
00003398	489	407	-82	490	1
00003400	206	106	-100	272	66
00003401	718	531	-187	704	-14
00003408	585	335	-250	586	1
00003420	150	108	-42	100	-50
00003430	48	105	57	127	79
00003437	196	39	-157	50	-146
00003497	115	100	-15	163	48
00003552	87	60	-27	145	58
00003578	332	304	-28	333	1
00003597	233	234	1	236	3
00003603	151	137	-14	152	1
00003616	480	420	-60	481	1
00003651	380	249	-131	310	-70
00003657	160	71	-89	234	74
00003671	76	80	4	46	-30
00003678	343	228	-115	270	-73
00003681	271	223	-48	295	24
00003691R	150	96	-54	151	1
00003693	89	84	-5	63	-26
00003696	196	146	-50	211	15
00003747	375	188	-187	213	-162
00003752	104	64	-40	175	71
00003779	154	177	23	160	6
00003784	287	221	-66	288	1
00003790	406	99	-307	325	-81
00003825	120	102	-18	90	-30
00003828	1208	203	-1005	199	-1009
00003853	233	147	-86	292	59
00003867R	135	49	-86	136	1
00003868	79	81	2	90	11
00003873	226	227	1	227	1
00003874	201	202	1	202	1
00003876	117	76	-41	185	68
00003914	176	88	-88	223	47
00003917	266	127	-139	100	-166
00003918	109	146	37	200	91

00003936	212	181	-31	231	19
00003988	185	47	-138	60	-125
00003989	125	67	-58	66	-59
00007122R	252	147	-105	287	35
00007226	515	60	-455	60	-455
00007660	81	61	-20	90	9
000084364	56	57	1	60	4
0003912R	196	36	-160	196	0
00084366	44	24	-20	45	1
00084416	56	40	-16	58	2
00084622	151	40	-111	155	4
00084981	21	18	-3	60	39
00085208	82	56	-26	74	-8
00085391	130	126	-4	131	1
00085395	64	62	-2	62	-2
00085621	34	34	0	52	18
00085882	111	114	3	112	1
00086026	144	51	-93	51	-93
00086164	208	48	-160	50	-158
20732874	508	509	1	520	12
26333023	281	269	-12	307	26
28473036	552	591	39	545	-7
30393704	621	368	-253	659	38
33302362	119	120	1	120	1
33943395	459	458	-1	495	36
Average ►	271.2316	208.6210526	-62.61053	254.9052632	-16.3263158
Max ►	1208	684	404	745	277
Min ►	21	18	-1005	35	-1009
Median ►	214	147	-30	213	1
Mode ►	81	48	1	60	1
Standard Dev Pop ►	198.8415	163.8174966	134.3925	177.5837281	130.119819
Variance Pop ►	39537.95	26836.17219	18061.33	31535.9805	16931.1672

TABLE 6 Contract Time Matrix

Working Day	Calendar Day	A+B Bidding	Mandatory Completion Date	Dual-Day Count
<ul style="list-style-type: none"> ▪ Projects With Negligible Impacts To Road User • Anticipated winter shutdowns • Weather days will not be charged. • Only 5 days per week charged 	<ul style="list-style-type: none"> ▪ Decrease Time (Emergency / Event) • Higher Road User Cost Potential • Anticipated winter shutdowns • Weekends will be charged • Complex Construction 	<ul style="list-style-type: none"> ▪ Decrease Time (Emergency / Event) ▪ High Road User Cost Potential ▪ Impact To Local Businesses ▪ Public Perception ▪ Vital Corridor • Limited potential for contract time increases (unknown utilities, unknown site conditions, etc.) 	<ul style="list-style-type: none"> ▪ Decrease Time (Emergency / Event) ▪ High Road User Potential ▪ Impact To Local Businesses ▪ Public Perception ▪ No Alternative Routes ▪ High ADT ▪ Completion date is so important that the Department would accelerate to meet this schedule rather than grant additional time. 	<ul style="list-style-type: none"> ▪ Impact To Road Users ▪ Easier To Manage Owner & Contractor Resources ▪ Impact To Local Businesses ▪ Simple To Complex Jobs ▪ Allows Seasonal Scheduling ▪ Public Perception ▪ Final project completion is not as important as impact to road users. ▪ Ability to suspend for winter if roadway prism is clear of obstructions.

Phase I Data (2001 through 2004) - Calendar Day and Mandatory Day Projects - Contrasting NMDOT Stringent On-Time Analyses



SWKC = Substantial Work Completion date; ORGC = Original Completion date

- IF SWKC Or ORGC Is Null, IF Charged Days <= Bid Days, THEN "On-Time" - OTHERWISE, IF SWKC <= ORGC, THEN "On-Time"**
- IF SWKC <= ORGC, THEN "On-Time"**
- IF Charged Days <= Bid Days, THEN "On-Time"**

FIGURE 5 Contrasting Stringent Phase I On-Time Analyses for Calendar Day Projects.



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