



*Tennessee Department of Transportation  
Office of Internal Audit*

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*Government Accountability Professionals*

**Audit of Project Change Orders and Other Contract  
Modifications**

**Interim Report I: Data Analysis**

Date Issued:  
October 21, 2013

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**EXECUTIVE SUMMARY**  
**October 21, 2013**

<b>Results in Brief</b>	<b>Recommendations</b>
<p>An audit of the Change Order and other Contract Modifications has been initiated.</p> <p>Key audit objectives were as follows:</p> <ul style="list-style-type: none"> <li>• <i>Are there projects where change orders are most prevalent?</i></li> <li>• <i>Is there a specific change order classification that accounts for the frequency of change orders?</i></li> <li>• <i>What is TDOT's overall change order rate?</i></li> <li>• <i>What are the primary drivers for change orders and contract modifications?</i></li> </ul> <p>The key audit objectives will be ascertained in full in the subsequent part of this two-part audit report. This interim report was designed to provide management with preliminary information regarding the overall objectives of the audit.</p>	<p><b>There are no recommendations at this time for this portion of the audit.</b></p>

## TABLE OF CONTENTS

INTRODUCTION.....	4
AUDIT INITIATION.....	4
OBSERVATIONS AND RECOMMENDATIONS .....	16
<i>The first part of this audit focused on data analysis and     evaluative considerations. There are no observations and     recommendations at this time; consequently, management     responses are not required.</i> .....	16
GENERAL AUDIT INFORMATION.....	17
<i>PROFESSIONAL STANDARDS</i> .....	17
<i>SCOPE AND METHODOLOGY</i> .....	17
<i>CRITERIA</i> .....	17
<i>STAFF ACKNOWLEDGMENT</i> .....	17
APPENDIX A. MANAGEMENT RESPONSES .....	18

# INTRODUCTION

## AUDIT INITIATION

The Audit of the Project Change Orders and Other Contract Modifications was conducted to fulfill the annual audit plan devised by the previous Internal Audit administration. Because of staffing considerations, the audit was subdivided into two portions. The first part of this two-part audit used 50 months of Site Manager data to assess the influence of geography, contractor, classification, type and project cost on the frequency of change orders. Part two of the audit will focus on providing objective, systematic, and substantive examination of the data analytics result to determine the root causes of the variances noted and put forth pragmatic recommendations to enhance efficiency in process flows.

## BACKGROUND

In the construction environment, it is not uncommon to experience difficulties completing projects within the original scope of work. The Tennessee Department of Transportation (TDOT) is not immune to such experiences. Consequently, contractual documents are issued to accommodate the additional work; these contractual documents are classified as *Change Orders* or *Supplementary Agreements*. In its most basic form, change orders are essentially modifications to the original contractual agreement and eventually become part of the contract once properly executed. Change orders have a variety of root causes including: errors in design and specifications, unforeseen site conditions, utility conflicts, prevailing weather conditions, and other unanticipated preconstruction activities.

Within TDOT, the Construction Division is responsible for the preparation of proposals and letting to contract all Tennessee Department of Transportation (TDOT) highway and bridge projects. Additionally, the division is also responsible for contract administration, defining project specifications, pre-qualification of all contractors, approval of all first tier subcontracts for road and bridge construction, and overseeing the Change Order process.

TDOT's change order process is governed by Policy 355-01. In its previous version, the policy listed three distinct approval categories. The policy was revised in September 2012 and now reflects four defined categories for change orders and the appropriate levels of approval for each category. A summary comparison of Policy 355-01 can be seen on Exhibit A below.

## Exhibit A – Change Order Policy Comparison

		Category 1	Category 2	Category 3	Category 4
		<b>Major Change</b>	<b>Significant Changes</b>	<b>Intermediate Changes</b>	<b>Minor Changes</b>
<b>Policy 355-01 September 1, 2012 - Current</b>	<b>Monetary Value of the Change</b>	Alters the original contract account by more than \$300,000	Alters the original contract amount by more than \$150,000 but less than or equal to \$300,000 Changes original contract account by more than 10% of original amount. Any change to a unit bid price. Any change to a special provision or contract provision.	Alters the original contract amount by more than \$25,000 but less than or equal to \$150,000	Any monetary change less than or equal to \$25,000
	<b>Completion Date Changes</b>	Cumulative change to completion date in excess of 180 days	Cumulative change to completion date in excess of 90 days but less than or equal to 180 days	Cumulative change to completion date less than or equal to 90 days	—
	<b>Approving Authority</b>	Regional Director; Director of Construction; Commissioner of Transportation before work begins; FHWA before work begins; If work must begin before CO is approved, verbal approval must be obtained from the Commissioner of Transportation and FHWA	Regional Director; Director of Construction Asst. Chief Eng. of Operations before work begins; FHWA before work begins; If work must begin before CO is approved, verbal approval must be obtained from the Commissioner of Transportation and FHWA	Regional Construction Supervisor FHWA	Project Supervisor FHWA
<b>Policy 355-01 January 6, 2006 - August 31, 2012</b>		<b>Category 1</b>	<b>Category 2</b>	<b>Category 3</b>	
		<b>Major Change</b>	<b>Intermediate Changes</b>	<b>Minor Changes</b>	
	<b>Monetary Value of the Change</b>	Alters original contract account by more than \$250,000	Alters original contract account by more than \$150,000 but less than or equal to \$250,000 or alters the total original amount by more than 10% of original contract	Any change or addition other than Major Change or Intermediate Change	
<b>Completion Date Changes</b>	Cumulative change to working time/completion date in excess of 7.5% of the original contract time	Cumulative change to working time/completion date not in excess of 7.5% of the original contract time, or Any change to a unit bid price, or Any change to a special provision or contract provision.	Any change or addition other than Major Change or Intermediate Change		

<b>Approving Authority</b>	Regional Director; Director of Construction Commissioner of Transportation Director of Construction and FHWA before work starts  In emergency, verbal approval from Construction Division and FHWA.	Regional Director, Director of Construction, Assistant Chief Engineer of Operations, Director of Construction, and FHWA before work starts  In an emergency, verbal approval from Construction Division and FHWA.	Regional Director FHWA Regional Director only before work starts	
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Source: *TDOT Policies* (<http://home.tdot.state.tn.us/policy/policies/355-01.pdf>)

### Data Analytics

Data analytics (DA) or data analysis is the business intelligence (BI) tool that focuses on the examination of the qualitative and quantitative aspects of raw data for the purpose of drawing conclusions to provide information useful in making decisions. In various industries, data analytics is used primarily to allow companies and organizations to make better business decisions. In more scientific endeavors, it is utilized to verify or disprove existing models or theories. In the auditing field, data analytics focuses on inference and deriving a conclusion as a precursor to risk measurement and substantive (detailed dollar-value) testing.

The art and science of data analysis is divided into three types namely: confirmatory data analysis (CDA), where existing hypotheses are proven true or false, exploratory data analysis (EDA), where new features in the data are discovered, and qualitative data analysis (QDA) is used draw conclusions from non-numerical factors. Within the auditing realm, data analysis is used to determine whether the systems in place effectively protect assets, create operational efficiencies, and enable the organization to succeed in accomplishing overarching goals.

For this portion of the audit, EDA is employed to develop an understanding of the business interrelationships, dependencies, cost drivers, and deliverables as they pertain to project change orders and other contract modifications.

### Definition of Terms Used in the Evaluation

In order to ensure that technical terms have no ambiguity, and to provide uniformity in describing the concepts, the following are the definition of terms used throughout this exploratory exercise.

**Additive Change Order** – change orders that increases the overall cost of the contract, in dollars.

**Change Order Cost** – is the dollar value of an individual change order, whether additive or reductive.

**Change Order Rate** – is the ratio of the total number of change orders per contract.

**Contract/Project Value** – is the value, in terms of dollars, of the individual contract; this is a unique characteristic of each contract but can also be utilized in relative terms when comparing individual contract values to other contract values within the population.

**Net Change Order** – or total change order, is the sum of all additive and reductive change orders for a given contract, in dollars.

**Population** – the population defined herein are the transactional records provided to Internal Audit by the Construction division, as contained within Site Manager. For this evaluation, we received 2,310 change order records covering the period August 8, 2008 through February 7, 2013. Of the 2,310 records, 482 of were omitted from consideration because they were classified as time adjustments that did not have a corresponding dollar value attached to the change.

**Rate of Change Order Costs** – or rate of costs, is the percentage rate derived by the dividing the net change order cost by the contract value.

**Reductive Change Order** – change orders that reduce the overall cost of the contract, in dollars.

**Scope** – the time period covered by the records provided. For this evaluation, the scope included 1,828 change order records, with an attached dollar value, from the period August 8, 2008 through February 7, 2013.

**Total Change Order Amount** – is the cumulative dollar value of all change orders within the population attributable to a particular contractor.

**Total Contract Amount** – is the cumulative value (sum) of all original bid amounts within the population attributable to a particular contractor.

## Population Parameter

Defined below are the numerical measurements that describe the overall characteristics of the change order and the bid amount population. Throughout this EDA, we will employ a variety of statistical techniques on the data to provide baseline information that can be utilized to infer something about the parameter.

### Exhibit B.1 – Statistical Summary

Statistical Description of Change Order Population	
Count	1,828
Sum	\$113,918,919
Sum Of Positive Values	\$125,335,621
Sum Of Negative Values	-\$11,416,702
Absolute Value	\$136,752,323
Mean	\$62,319
Median	\$16,659
Mode	\$30,000
Variance (square of the $\sigma$ )	\$64,200,684,977
Standard Deviation ( $\sigma$ )	\$253,379
Standard Error	\$5,926
Coefficient Of Variation	4.07
Relative Error	0.10
Skew	10.94
Kurtosis	180.48
Maximum	\$5,590,625
Minimum	-\$1,329,261
Range	\$6,919,886
Third Quartile (75th Percentile)	\$55,847
First Quartile (25th Percentile)	\$4,958
Variance From Normal	-4.51%

Source: Internal Audit analysis

**Exhibit B.2 – Statistical Summary**

<b>Statistical Description of Bid Amount Population</b>	
Count	784
Sum	\$4,098,846,859
Sum Of Positive Values	\$4,098,846,859
Sum Of Negative Values	\$0.00
Absolute Value	\$4,098,846,859
Mean	\$5,228,121
Median	\$1,243,087
Mode	#N/A
Variance (square of the $\sigma$ )	\$114,129,114,574,907
Standard Deviation ( $\sigma$ )	\$10,683,123
Standard Error	\$381,540
Coefficient Of Variation	2.04
Relative Error	0.07
Skew	4.30
Kurtosis	26.11
Maximum	\$104,669,817
Minimum	\$13,198
Range	\$104,656,620
Third Quartile (75th Percentile)	\$3,951,330
First Quartile (25th Percentile)	\$580,896
Variance From Normal	-17.39%

*Source: Internal Audit analysis*

• **OBJECTIVES AND CONCLUSIONS**

1. *Is geographical location a contributing factor for the prevalence of change orders?*

**Generally yes.** Results of the analysis performed have indicated that geographical location may be a factor in the amount and prevalence of change orders. Region 1, and to a lesser extent, Region 2’s terrain may be a significant contributing factor when considering project costs. Consequently, projects developed for the region may require additional planning work to eliminate what may appear to be higher than average rate of costs and change order values. Additional test of details will be required to fully ascertain the impact of geography on the pervasiveness of change orders.

Tables C.1 and C.2 below provide a summary of activity by region and their comparative averages.

**Exhibit C.1 – Change Order Summary by Region**

Region	Total Contract Values	Net Change Orders	Number of Change Orders	Number of Contracts	Rate of Costs
1	\$ 1,024,380,244	\$ 36,290,100	606	229	3.54%
2	761,301,908	24,276,959	266	140	3.19%
3	1,263,456,914	32,547,913	476	223	2.58%
4	1,049,707,792	20,803,947	480	192	1.98%
<b>Totals</b>	<b>\$ 4,098,846,859</b>	<b>\$ 113,918,919</b>	<b>1828</b>	<b>784</b>	<b>2.78%</b>

*Source: Internal Audit analysis*

**Exhibit C.2 – Average Change Orders by Region**

Region	Average Contract Value	Average Change Order Value	Average Number of Change Orders per Project
1	\$ 4,473,276	\$ 59,885	2.65
2	\$ 5,437,871	\$ 91,267	1.90
3	\$ 5,665,726	\$ 68,378	2.13
4	\$ 5,467,228	\$ 43,342	2.50

*Source: Internal Audit analysis*

2. *Is there a specific change order classification that accounts for the frequency of change orders?*

**Generally yes.** Results of the analysis performed have indicated that particular types of change orders account for a majority of the observed change orders. However, a significant portion of the observed change orders were collectively classified as miscellaneous. This condition may also be indicative that misclassification is possibly occurring. Within the miscellaneous category, the sub classification “contract conversion” accounted for 185 of 781 (24 percent) instances and a cumulative change order cost of approximately \$30.28 million. The primary cause of the “contract conversion” category was the one-time transformation from (manual) paper contracts to the electronic Site Manager. The contracts that were in existence prior to implementation of Site Manager were collectively classified as contract conversions. The other significant sub-classification within the miscellaneous category was “additional work”. Additional work accounted for 234 of the 781 (30 percent) instances and a cumulative value of \$14.86 million. Other significant change order classifications were plan modifications and design omissions.

**Exhibit D – Quantitative Analysis of Change Orders by Classification**

Change Orders by Reason Type	Total Cost of Change Orders	Number of Change Orders
Miscellaneous	\$ 58,807,669	781
a. Contract Conversion	≈ \$ 30.28 M	185 of 781
b. Additional Work	≈ \$ 14.86 M	234 of 781
Plan Modification	\$ 19,481,423	347
Design Omission	\$ 11,922,464	285
Utilities	\$ 8,872,623	76
Time Adjustment	\$ 4,621,171	47
Force Account	\$ 4,195,835	49
Traffic Control	\$ 2,531,080	103
Environmental	\$ 2,523,799	75
Soils & Geology	\$ 2,483,258	22
Price Adjustment	\$ 104,793	28
Value Engineering	\$ (1,625,196)	15
<b>Grand Total</b>	<b>\$ 113,918,919</b>	<b>1828</b>

Source: Internal Audit analysis

3. *Are change orders concentrated on particular categories?*

**Generally yes.** The analysis indicated that regardless of the policy in place, change orders follow a normally accepted pattern. Category 1 change orders reflect a higher dollar value assessment, as expected. Conversely, Category 3 and 4 changes account for the greater volume

of the change orders; also as expected. However, what can only be discerned after considerable tests of details is whether the categories are being utilized to break-up an otherwise large change order into several smaller change orders to enable avoidance of more extensive administrative reviews and approvals. Additionally, the breaking apart of larger change orders into multiple smaller change orders may also be utilized to expedite the time requirements. Extensive substantive testing and test of details will be required to ascertain the inference.

**Exhibit E.1 – Quantitative Analysis of Change Orders by Category  
Using Old Policy 355-01**

Category	Number of Change Orders	Total Change Order Value	Average Change Order Value
CAT1	173	\$ 57,220,080	\$ 330,752
CAT2	123	\$ 7,019,375	\$ 57,068
CAT3	1311	\$ 36,302,495	\$ 27,691
<b>Total</b>	<b>1607</b>	<b>\$ 100,541,951</b>	<b>\$ 62,565</b>

*Source: Internal Audit analysis*

**Exhibit E.2 – Quantitative Analysis of Change Orders by Category  
Using Revised Policy 355-01**

Category	Number of Change Orders	Total Change Order Value	Average Change Order Value
CAT1	19	\$ 7,592,078	\$ 399,583
CAT2	4	\$ 152,564	\$ 38,141
CAT3	95	\$ 4,852,113	\$ 51,075
CAT4	103	\$ 780,213	\$ 7,575
<b>Total</b>	<b>221</b>	<b>\$ 13,376,968</b>	<b>\$ 60,529</b>

*Source: Internal Audit analysis*

*4. Is there a correlation between project size and total change order cost?*

**Generally no.** Results of the analysis performed have indicated that project size had minimal effect on the net change order cost. Statistical analysis showed a correlation factor of 0.417, indicating a weak relationship between the project cost and net change order cost. This phenomenon may be indicative of other factors or cost drivers responsible for total change order cost. It is important to note that a strong relationship does not necessarily indicate causality.

5. *On an individual contractor level, are total change order amounts related to the contractor's total contract amount?*

**Yes.** Although the previous analysis (4) indicated that on the population level, project size has minimal effect on net change order cost, when compartmentalized on a contractor basis, a different result ensues. The analysis indicated that a correlation factor of 0.925 occurs when taking into account individual contractors, indicating that a very strong relationship exists between the total contract amounts and the total cost of change orders. This may not be a unique phenomenon but may actually be the expected trend. However, this may also be indicative of contractor performance issues that may be further studied with other pertinent data and collaborative tests.

**Exhibit F.1 – Top 15 Contractors by Cumulative Contract Value**

Contractor	Total Contract Value	Number of Contracts	Total Change Order Amount	Number of Change Orders
Dement Construction Company, LLC	\$ 329,330,559	34	\$ 9,108,855	124
Delta Contracting Company, LLC	295,752,086	31	2,019,588	75
Highways, Inc.	295,189,504	61	10,456,146	128
Charles Blalock & Sons, Inc.	291,112,517	45	4,155,949	113
Rogers Group, Inc.	266,544,373	39	4,900,909	89
Bell & Associates Construction, L.P.	192,274,980	10	869,119	35
Mountain States Contractors, LLC	177,845,194	19	3,524,110	57
Summers-Taylor, Inc.	171,289,772	39	176,142	75
Ford Construction Company	161,591,124	47	3,171,177	90
LoJac Enterprises, Inc.	140,442,310	23	4,933,100	52
Wright Brothers Construction Company, Inc.	139,229,442	6	2,731,234	11
Eubank Asphalt Paving & Sealing	114,031,468	24	6,006,531	46
BB SmartFix Constructors, LLC	104,669,817	1	4,632,740	62
Hill Brothers Construction Company, Inc.	103,476,943	4	853,396	20
APAC-Atlantic, Inc.	\$ 101,421,189	26	\$ 1,003,077	50

*Source: Internal Audit analysis*

6. *Is the number (count) of change orders correlated to the total contract amount?*

**Generally yes.** On an individual contractor level, the analysis indicated that there is a moderate correlation between the number of change orders and the contractors total contract amount. The calculated correlation factor of 0.677 indicates a slightly strong relationship and would indicate that as a contractor's total contract amount increases, the likelihood of increased incidence of change orders are also likely.

**Exhibit F.2 – Top 15 Contractors by Number of Change Orders**

Contractor	Number of Change Orders	Total Change Order Amount	Total of Original Bid Amounts before Changes	Change Order as a % of Total Contract Value
Highways, Inc.	128	\$ 10,456,146	\$ 295,189,504	3.54%
Dement Construction Company, LLC	124	9,108,855	329,330,559	2.77%
Charles Blalock & Sons, Inc.	113	4,155,949	291,112,517	1.43%
Ford Construction Company	90	3,171,177	161,591,124	1.96%
Rogers Group, Inc.	89	4,900,909	266,544,373	1.84%
Delta Contracting Company, LLC	75	2,019,588	295,752,086	0.68%
Summers-Taylor, Inc.	75	176,142	171,289,772	0.10%
BB SmartFix Constructors, LLC	62	4,632,740	104,669,817	4.43%
Mountain States Contractors, LLC	57	3,524,110	177,845,194	1.98%
Simpson Construction Company, Inc.	53	3,317,933	96,822,118	3.43%
LoJac Enterprises, Inc.	52	4,933,100	140,442,310	3.51%
APAC-Atlantic, Inc.	50	1,003,077	101,421,189	0.99%
Eubank Asphalt Paving & Sealing	46	6,006,531	114,031,468	5.27%
Mid-State Construction Company, Inc.	44	1,505,762	32,032,948	4.70%
Transcore ITS, LLC	39	\$ 5,267,054	\$ 39,862,627	13.21%

*Source: Internal Audit analysis*

7. *Are change orders utilized as a way to inappropriately increase the total contract value?*

**Generally no.** The analysis on the entire population indicated that on a contractor level, the change order rate of costs is approximately

4.48% with a standard deviation of 7.5%. Therefore any change order rate that is greater than 19.5% falls under the unlikely category and any change order rate that exceeds 27.03% is in the highly unlikely category. Although there were several instances where the change order rates exceeded the reasonableness criteria, the reasons for the variance from the expected values will have to be ascertained through additional substantive testing.

**Exhibit F.3 – Top 10 Contractors by Change Order Rate of Costs**

<b>Contractor</b>	<b>Total Contract Amount</b>	<b>Number of Contracts</b>	<b>Number of Change Orders</b>	<b>Total Change Order Amount</b>	<b>Change Order as a Percentage of Contract</b>
<b>Hi-View, LLC</b>	\$ 13,356,751	1	18	\$ 7,123,923	53.34%
<b>RoadSafe Traffic Systems, Inc</b>	2,950,459	3	3	1,311,063	44.44%
<b>White Contracting, Inc.</b>	1,734,447	1	6	695,326	40.09%
<b>Vanderbilt Landscaping LLC</b>	132,288	1	1	32,408	24.50%
<b>Superior Pavement Marking, Inc.</b>	1,884,283	1	1	364,196	19.33%
<b>CBM Enterprises, Inc.</b>	775,551	1	3	126,170	16.27%
<b>Charles Deweese Construction, Inc</b>	3,561,021	2	4	547,542	15.38%
<b>Pacific Blasting &amp; Demolition Ltd.</b>	1,992,115	1	3	289,387	14.53%
<b>Elmo Greer &amp; Sons, LLC</b>	87,727,418	4	36	12,450,107	14.19%
<b>Transcore ITS, LLC</b>	\$ 39,862,627	3	39	\$ 5,267,054	13.21%

*Source: Internal Audit analysis*

## OBSERVATIONS AND RECOMMENDATIONS

*The first part of this audit focused on data analysis and evaluative considerations. There are no observations and recommendations at this time; consequently, management responses are not required.*

## **GENERAL AUDIT INFORMATION**

### ***PROFESSIONAL STANDARDS***

The Audit of Project Change Orders and Other Contract Modifications was conducted in accordance with Government Auditing Standards, December 2011 Revision. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our observations and conclusions based on our audit objectives.

### ***SCOPE AND METHODOLOGY***

The audit period focused primarily on change orders covering the 50-month period August 8, 2008 through February 7, 2013.

### ***CRITERIA***

In conducting this portion of the audit, existing processes were not evaluated for compliance with any existing criteria. All evaluations were based solely on results of the objective analysis.

### ***STAFF ACKNOWLEDGMENT***

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## APPENDIX A. MANAGEMENT RESPONSES

*The first part of this audit focused on data analysis and evaluative considerations. There are no observations and recommendations at this time; consequently, management responses are not required*

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