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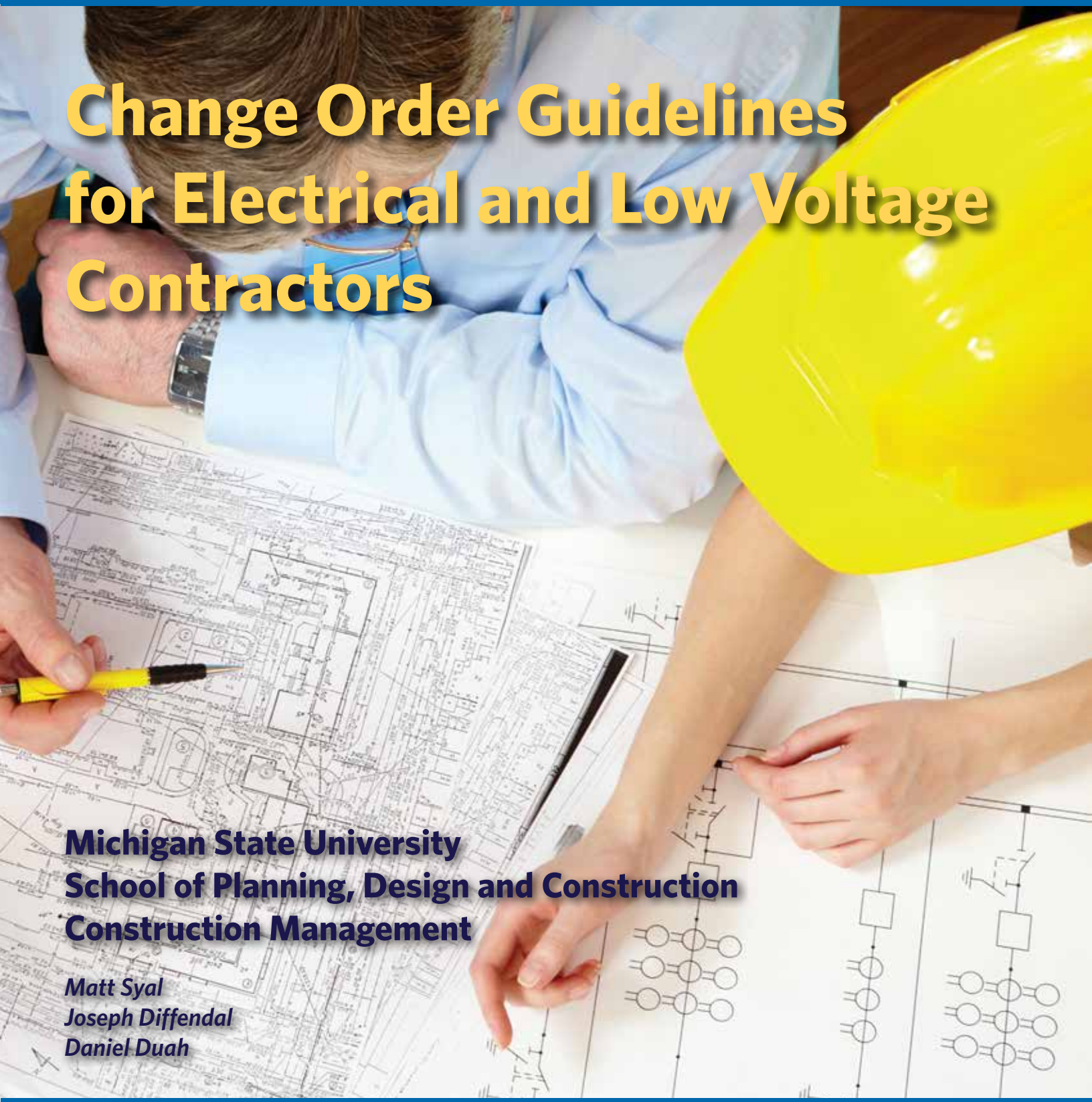
Change Order Guidelines for Electrical and Low Voltage Contractors



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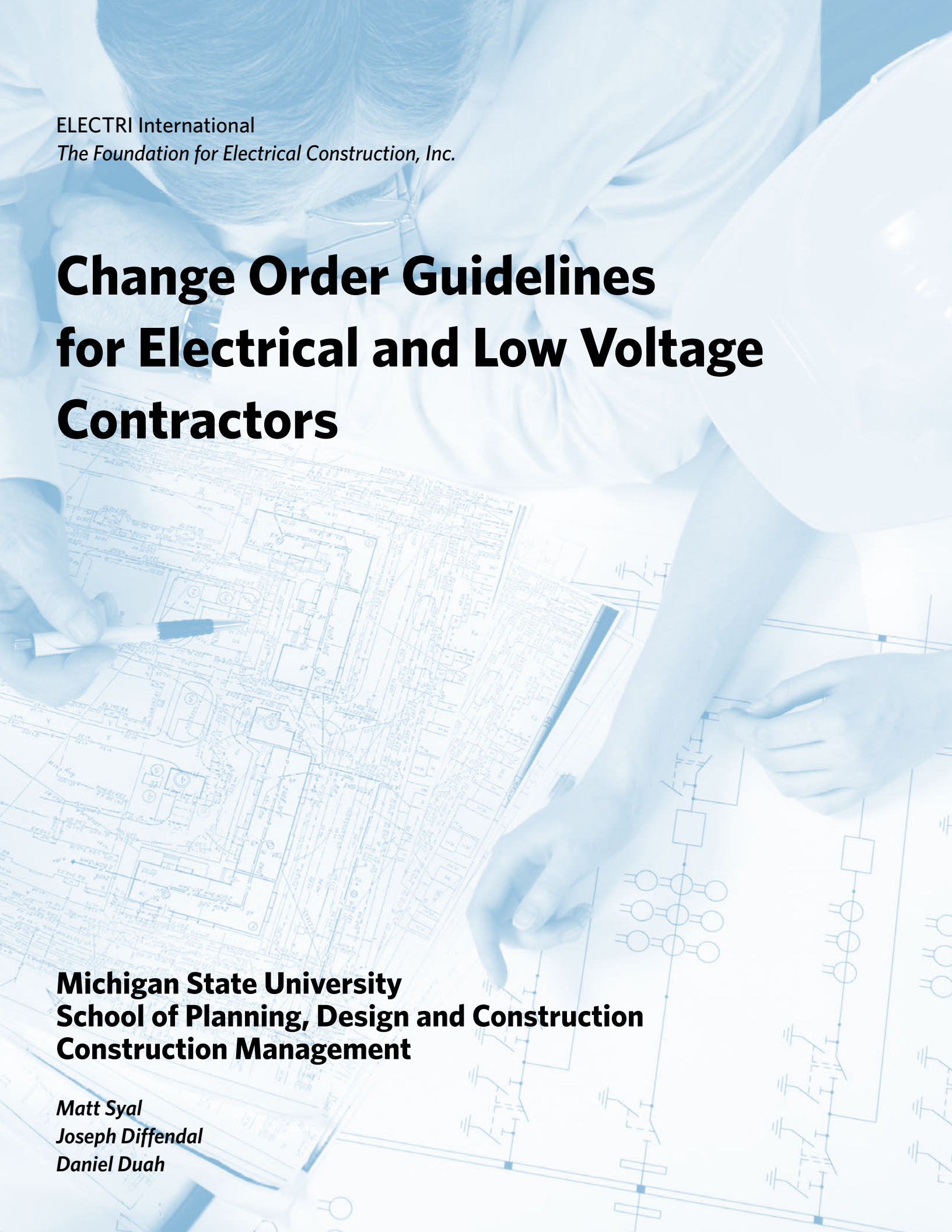

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The Foundation for Electrical Construction, Inc.

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ELECTRI Council

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Table of Contents

1. Introduction

Change orders are an essential part of every construction project. They are issued to accommodate changes to the construction contract, generally by the owner or designers to the general contractor (GC) or the construction manager (CM). In most cases, the GC/CM, in turn, requests the related trades subcontractor to provide a change order proposal. A change order is defined as a written order, agreed upon by the owner, contractor and designer, authorizing changes to the scope of the work, the contract sum, and the contract time (AIA-A201-2007, ConsensusDocs 200-2012).

Electrical and low voltage contractors are routinely asked to prepare change order proposals on construction projects. The single most common area of dispute in the change order process is its cost. Among cost-related disputes, items related to recoverable direct cost, overhead-profit percentages, and impact factors resulting in consequential costs constitute the vast majority of the disagreements. All types of change orders can have these disagreements but change orders that do not address an agreed upon price are particularly prone to disagreements. Subcontractors presenting change orders face the double task of dealing with GCs/CMs in addition to owners/designers.

Change orders have been a topic of interest for the ELECTRI Council since its beginning. ELECTRI International has conducted the following studies on change orders and related topics, and this study will complement the efforts of these earlier initiatives:

- Impact of Overtime on Electrical Labor Prod.: A Measured Mile Approach (Hanna 2011)
- The Impact of Variation on Electrical Contractor Profitability (Daneshgari & Budd 2004)
- Stacking of Trades for Electrical Contractors (Hanna *et al.* 2002)
- Quantifying the Cumulative Impact of Change Orders for Electrical Contractors (Hanna 2001)
- Impact of Change Orders on Labor Efficiency for Electrical Construction (Hanna *et al.* 1999)
- Change Orders – The Academy of Electrical Contractors (Beck 1996)

The two obvious cost categories of a change order include direct costs and overhead-profit costs. Direct costs are easily identifiable and quantifiable. Overhead-profit costs are generally quantified as a percentage of the direct cost or of the total change order amount. In addition, there is a third category of costs, known as consequential costs due to impact factors. These are difficult to identify and quantify and, therefore, are a source of conflict and controversy when included in a change order.

Electrical and low voltage contractors must often address situations where they are not allowed to include in the change order all of their direct cost items and/or an appropriate percentage of overhead-profit. Most electrical and low voltage contractors believe that change orders are generally not profitable for them. As a result, they end up doing the change order work with a smaller markup than the initially bid project. In addition to lack of adequate cost recovery, change orders often have a negative impact on the project's overall progress and budget due to their impact on rest of the project.

Low Voltage (LV) Contractors

Low Voltage (LV) contractors have certain unique aspects when compared to medium voltage or high voltage electrical contractors. Many electrical contractors (EC) are diversifying their business by adding LV capabilities. If LV contractors are not part of an electrical contractor's firm, they generally work as a subcontractor to the EC. However, when the LV work is part of an overall "controls" contract, the roles can be reversed and the ECs may end up working as subcontractors to "controls" contractors. An LV contractor is generally the last one out on a project. Frequently, this timing factor has an impact on change order pricing.

Overhead and consequential costs have additional significance for the LV contractors because of their unique role on a project and may be due to one or more of the following aspects:

- The LV contractor's role is mostly towards the end of the project, leading to more time spent with designers and owners;
- LV contractors are expected to "tie-up" all the loose ends on the project, even if many tasks are not in the LV's scope of work or responsibility;
- Owners may have fully or partially occupied the building, disrupting the LV contractor's work due to crowding, the need to work around the owner's operations, demands for quiet work areas, the need to deal with facility security, etc.;
- An LV contractor's change order may have higher pricing for certain cost items (e.g., high-end electronic gear and visual equipment) due to the specialized nature of their work, material cost escalation, skilled worker training, etc.;
- Because owners and GC/CM's may not fully understand the scope of the LV contractors' work, the LV's part in a change order may not be identified in a timely fashion; and
- As a result of the above-noted aspects, owners may develop a misleading perception of the change order and hold LV contractors disproportionately responsible for delays in the project completion

Scope and Methodology

The main purpose of this project is to develop guidelines that provide a systematic, standardized, fair process for the pricing of change orders for electrical and low voltage contractors. This study identifies various costs categories and items, investigates overhead-profit practices, and identifies various impact factors and methods used to calculate associated consequential costs. Although the main focus of this effort is on electrical contractors, interactions with and/or input from many related industry groups, as referenced below, are also taken into consideration.

The methodology used for this research included a review of academic and industry literature, comparison of standard contract documents, industry surveys, analysis of court cases and case studies, and interactions with other subcontractors' and owners' groups:

1. **Literature Review:** Published literature was reviewed from academic, industry, and construction finance sources. The sources for the academic literature review were: Mrozowski et al. (2004), Civitello (2008), Bora (2012), and RS Means (2013). Industry literature was obtained from: Toronto Change Order protocol (Toronto 2010), past ELECTRI reports (Beck 1996, Hanna et al. 1999, Hanna 2001, Hanna et al. 2002, Daneshgari & Budd 2004, Hanna 2011), Mechanical Contractors Association of America (MCAA 2012), Plumbing, Heating, Cooling Contractors Association's Educational Foundation (PHCC-EF 2013), RS Means (R.S. Means 2013), SDC Associates' Change

Order Seminar Booklets (SDC 2009), Sheet Metal and Air Conditioning Contractors' National Association's (SMACNA) Change Order Impact computer tool (SMACNA 2002, SMACNA 2005). Construction finance literature sources included: NCHRP 2003, NECA Financial Performance Annual Reports 2010, and CFMA 2013.

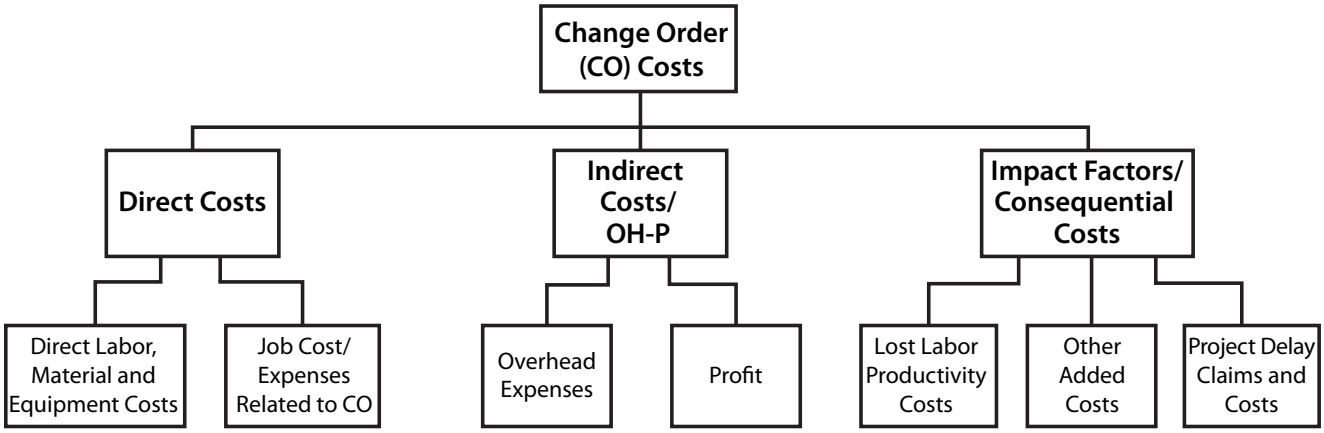
2. **Standard Contract Documents:** Four major standard contract documents were analyzed and compared: American Institute of Architects (AIA A201-2007 and A401-2007) ConsensusDocs (200-2012 and 750-2012), Engineers Joint Contract Document Committee (EJCDC C700-2007 and C523-2013)), and Canadian Construction Documents (CDCC 2-2008 and CCA 1-2008).
3. **Industry Surveys:** Three separate surveys were conducted with members of the National Electrical Contractors Association (NECA), the ELECTRI Council, and the Construction Owners Association of America (COAA).
4. **Court Cases:** Several relevant court cases were compiled and analyzed.
5. **Case Studies:** A number of case studies were collected from ELECTRI Council members and from public sources.
6. **Interactions / Input from Other Subcontractors' Groups:** There were interactions with two other subcontractors' groups - Sheet Metal and Air Conditioning Contractors' National Association (SMACNA) and Plumbing, Heating, and Cooling Contractors Association (PHCCA).
7. **Interactions / Input from Owners' Groups:** The following owners' groups helped provide a broader perspective for this research: Construction Owners Association of America (COAA), Construction Users Roundtable (CURT), and National Association of Construction Auditors (NACA). As a result of these interactions, COAA invited the researchers to present their work at their Fall 2013 conference in San Diego, CA and also allowed the researchers to survey their members.

Cost Categories: Change order costs can be broken down into three major categories

- Direct Costs
- Indirect Costs / Overhead-Profit
- Consequential Costs due to Impact Factors

Each of the above-noted cost categories and their subcategories as shown in **Figure 1.**

Figure 1: Cost Categories for a Change Order (CO)



2. Change Order Templates

The following templates can be helpful for electrical contractors for preparing change orders. **Table 1** provides a summary change order template. Subsequent tables provide details of various rows in the summary table. The numbering of subsequent tables corresponds with the row numbers in Table 1. For example, the row containing "Direct Cost-Labor" is detailed in Table I.1, the row containing "Indirect Cost-Overhead Percentage" is expanded in Table II.1, and so on.

Table 1: Summary Change Order Template

Summary Change Order Template	
I. DIRECT COSTS*	
1. Labor (per attached breakdown)	
2. Labor Burden (per attached breakdown)	
3. Material (per attached breakdown and quotes)	
4. Equipment (per attached breakdown, quotes and/or rental schedule)	
5. Related Job Costs / Expenses (per attached breakdown)	
Subtotal: A	
II. INDIRECT COSTS	
1. Overhead % (modified to use as % of total direct costs, per attached calculations) (A X %): B	
Subtotal (A+B):	C
2. Profit % (C X %):	D
III. CONSEQUENTIAL COSTS (per attached breakdown and justification OR reserve the right to submit later)	
1. Lost Labor Productivity Cost (add to direct labor cost OR provide separately here)	
2. Other Added Costs (add to direct job costs/expenses OR procide separately here)	
3. Delay Days and Costs (provide here OR indicate to provide later)	
Subtotal:	E
Total Change Order Cost:	C+D+E

**Major sources of information/rates: 1. NECA Manual of Labor Units (NECA Labor 2011) 2. NECA Tool & Equipment Schedule (NECA Equipment 2013) 3. Electrical Price Guide - Trade Service (EPG 2014) 4. R.S. Means Electrical Cost Data (RS Means 2014)*

These tables/templates are the result of the data collected and analyzed from various sources as described above in the section "Scope and Methodology" *(page 2)*. Details of the analysis supporting these tables/templates is provided in Chapters 3, 4, and 5.

Table I.1: Direct Labor Costs Based on Overall Analysis

"Direct Cost - Labor" Template				
	Units	Unit $	Comments	Total $
1A. LABOR COST ITEMS—Allowed				
Labor Wages and Burden*				
Supervision and Related Field Office Personnel				
Room, Board and Travel Allowance				
Supervision (other than foreman)				
Change Order Preparation and Processing				
1B. LABOR COST ITEMS—Maybe / Depends				
Estimating and Expediting				
Main Office Personnel in Project Offices				

**Note: use labor rate and burden on a journeyman basis unless specified otherwise*

Table I.2: Sample Labor Burden Breakdown

(A)	**BASE WAGE**			$-
	Taxable Fringes: *Base Wage x (A)*			
	Vacation/Holiday	% or $		$-
	Sick Pay	% or $		$-
	Holiday Pay	% or $		$-
	Others (specify):	% or $		$
(B)	**TOTAL TAXABLE FRINGES**			$-
(C)	**TOTAL TAXABLE WAGE** —	**(A+B)**		$-
	Non-taxable Fringes: *Applied to Base Wage x (A)*			
	Health, Vision Insurance	% or $		$-
	Life Insurance	% or $		$-
	Accidental Insurance	% or $		$-
	Pension / Retiree benefit	% or $		$-
	Apprentice / Training	% or $		$-
	Service Charges	% or $		$-
	Others (specify):	% or $		$-
(D)	**TOTAL NON-TAXABLE FRINGES**			$
(E)	**TOTAL TRADE RATE** —	**(C+D)**		$
	Taxes and Burden: *Applied to Total Taxable Wage*			
	F.I.C.A. x (C)	% or $		$-
	F.U.T.A. x (C)	% or $		$-
	S.U.T.A. / M.E.S.C. x (C)	% or $	(From SUTA Rates)	$-
	Workers' Comp. x (C)	% or $	(From WC Rates)	$-
	Contractors' Liability Ins. x (C)	% or $		$-
	Bonds Allowance x (C)	% or $		$-
	Small Tools Allowance x (C)	% or $		
	Safety x (C)	% or $		
	Communication x (C)	% or $		
	Others (specify): x (C)	% or $		
(F)	**TOTAL TAXES and BURDEN**			$-
(G)	**TOTAL LABOR RATE** —	**(E+F)**		$-

Sources: UMich 2014, MI-NECA, Case Studies

Table I.3 & 4: Direct Material and Equipment Costs Based on Overall Analysis

"Direct Cost - Material and Equipment" Template				
	Units	Unit $	Comments	Total $
3A & 4A. MATERIAL AND EQUIPMENT COST ITEMS - Allowed				
Materials				
Equipment and Rental				
Transportation of Material & Equipment				
Storage / Handling of Material & Equipment				
Temporary Facilities				
Inspection / Testing of Material & Equipment				
Small / Hand Tools (not owned by workers)				
Non-hazardous Waste Clean-up				
Restocking and Cancellation				
3B & 4B. MATERIAL AND EQUIPMENT COST ITEMS - Maybe / Depends				

Table I.5: Direct Job Costs/Expenses Based on Overall Analysis

"Direct Cost - Job Costs / Expenses Related to CO" Template				
	Units	Unit $	Comments	Total $
5A. JOB COST / EXPENSE ITEMS - Allowed				
Bonds, Security and Project Insurance				
Sales Taxes				
Permit Fees				
Subcontractor Costs				
Job Office-related Operation Costs				
Licenses and Certifications				
Special Consultants' Fees				
Safety Measures and Equipment				
Water, Power, and Fuel Costs				
Mobilize and Demobilize				
Special Project Requirements (e.g., LEED)				
5B. JOB COST / EXPENSE ITEMS - Maybe / Depends				
Drawings, Documents and Printing				
Parking				
Shop Expenses*				
Guaranties and Warranties				

** May include shop labor, material procurement, handling, delivery, inventory control, equipment costs and maintenance, depreciation, utilities, rent, insurance, consumables, etc.*

Table II.1A: OH Percentage Based on Overall Analysis

Change Order OH as % of Total Price	
Source	**Average %**
Electrical Industry Survey Responses (average)	***19.16%** **(23.70%)**
Transportation Research Board report on Contractors' Home Office Overhead — Electrical Contractors (NCHRP 2013)	
Construction Financial Management Association — Moss Adams LLP (CFMA 2013)	
NECA Financial Performance Annual Report (2010)	

*This OH % is for applying to total Change Order amount. Convert this %s for applying to total of Direct Costs by using the formula and example below:

(% for Direct Cost) = (% for total CO amount)/(1 - % for total CO amount)
e.g., If the OH % is 20% on the total CO amount of $100
then the OH % for the Direct Cost of $80 = 0.20/(1-0.20) = 0.20/0.80 = 0.25 or 25%

(Based on this formula the above-noted OH of 19.16% of total CO amount should equal 23.70% of Direct Cost)

Table II:1B: Sample Overhead Costs Breakdown

Sample Ovehead Costs Breakdown	
Item	**% of Sales/Revenue**
Main Office Operations:	
Personnel: salaries, benefits, bonuses, etc.	
Office Utilities: telephone, internet, gas, electric, water, etc.	
Office Equipment: computers, data, photocopy, fax, etc.	
Office Furniture	
Education and Training	
Company-wide Safety Initiatives	
Business Licenses	
Corporate Business Insurance	
Legal Fees, Accounting and Royalties	
Advertising and Marketing	
Autos and Auto Insurance	
Storage and Equipment Yard	
Shop Operations	
Dues and Subscriptions	
Rent or Mortgage	
Property Taxes	
Other Corporate Overhead	
Project-Related:	
Estimating (not related to CO)	
Scheduling (not related to CO)	
Timekeeping (not related to CO)	
Other Project-Related OH	
Total Overhead Percentage*	%
*If applying as % of direct costs, convert it by using (this %)/(1-this %)	

Table IIIA: Potential Impact Factors by Categories

Labor Productivity-related Factors *(may decrease productivity or increase labor hours—can be used to add to labor hrs. in the change order or submit as separate claim)*	**Added Cost Factors** *(may increase change order costs—can be used to add cost to the change order or submit as separate claim)*	**Project and Field Conditions–related Factors** *(may cause project delays—can be used to indicate potential delay on the change order and then, later submit a delay claim)*
Stacking of Trades	Increased Contract Administration	Capacity Issues
Morale and Attitude	Cash Flow Interruption	Altered Conditions
Reassignment of Manpower	Delayed Retainage Release	Ripple Effect
Crew Size Inefficiency	Lost Profits	Cumulative Impact of Change orders
Concurrent Operations	Increased Job cost Accounting	Coordination Time
Dilution of Supervision	Lost Opportunity Costs	Season and Weather Changes
Learning Curve	Reordering of Parts	Phasing and Sequence
Errors and Omissions	Premiums for Purchasing Materials	
Beneficial Occupancy	Material Escalation Costs	
Joint Occupancy	Supervision Time for Another Project	
Site Access	Interest/Finance Charges	
Logistics	Depreciation	
Fatigue	Canceled Contracts	
Ripple Effect		
Overtime		
Season and Weather Changes		
Aggravation & Stress		
Interference & Disruptions		
Down or Idle Time		
Acceleration		
Working in Finished Areas		
Congested Drawings		
Suspension of Work		
Phasing and Sequence		

Long & Carter 2013, Toronto 2010, MCAA 2012, SMACNA 2005, PHCC-EF 2013, RS Means 2013

Table IIIB: Methods and Techniques to Quantify Impact Factors/Consequential Costs

No.	METHOD / TECHNIQUE (Source References)
1.	**Toronto Change Order Protocol/MCAA Percentage Method (Toronto 2010, MCAA 2012)**
2.	**Stacking of Trades –Hanna Method (Hanna et al. 2002)**
3.	**Measured Mile Approach (Hanna 2011, DeVries 2012, Long and Carter 2013)**
4.	Cumulative Impact of Change Orders Method (Hanna 2001)
5.	RS Means Method for Electrical Change Order Work (RS Means 2013)
6.	US Army Corps of Engineers Impact Studies (Vorster & De La Garza 1990, Fuerst et al. 1991)
7.	NAVSEA's Relative Importance Method (Jozwick 2005)
(Note: The top three methods are discussed in detail with examples in Chapter 5)	

Table III.1: Impact Factors and Productivity Loss Percentages

Factors	% of loss if condition is:		
	Minor	**Average**	**Severe**
1. Stacking of Trades Operations take place within physically limited space with other contractors. Results in congestion of personnel, inability to locate tools conveniently, increased loss of tools, additional safety hazards and increased visitors. Optimum crew size cannot be utilized.	10%	20%	30%
2. Morale and Attitude Excessive hazard, competition for overtime, over-inspection, multiple contract changes and rework, disruption of labor rhythm and scheduling, poor site conditions, etc.	5%	10%	15%
3. Reassignment of Manpower Loss occurs with move-on, move-off men because of unexpected changes, excessive changes, or demand made to expedite or reschedule completion of certain work phases. Preparation not possible for orderly change.	5%	10%	15%
4. Crew Size Inefficiency Additional men to existing crews "breaks up" original team effort, affect labor rhythm. Applies to basic contract hours also.	10%	20%	30%
5. Concurrent Operations Stacking of this contractor's own force. Effect of adding operation to already planned sequence of operations. Unless gradual and controlled implementation of additional operations made, factor will apply to all remaining and proposed contract hours.	10%	20%	30%
6. Dilution of Supervision Applies to both basic contract and proposed change. Supervision must be diverted to (a) analyze and plan change, (b) stop and replan affected work, (c) take off, order and expedite material and equipment, (d) incorporate change into schedule, (e) instruct foreman and journeyman, (f) supervise work in progress, and (g) revise punch lists, testing and start-up requirements.	10%	15%	25%
7. Learning Curve Period of orientation in order to become familiar with changed condition. If new men are added to project, effects more severe as they learn tool locations, work procedures, etc. Turnover of crew.	5%	15%	39%

Factors	% of loss if condition is:		
	Minor	**Average**	**Severe**
8. Errors and Omissions Increases in errors and omissions because changes usually performed on crash basis, out of sequence or cause dilution of supervision or any other negative factors.	1%	3%	6%
9. Beneficial Occupancy Working over, around or in close proximity to owner's personnel or production equipment. Also badging, noise limitations, dust and special safety requirements and access restrictions because of owner. Using premises by owner prior to contract completion.	15%	25%	40%
10. Joint Occupancy Change causes work to be performed while facility occupies by other trades and not anticipated under original bid.	5%	12%	20%
11. Site Access Interferences with convenient access to work areas, door man-lift management or large and congested worksites.	5%	12%	30%
12. Logistics Owner furnished materials and problems of dealing with his storehouse people, no control over material flow to work areas. Also contract changes causing problems of procurement and delivery of materials and re-handling of substituted materials at site.	10%	25%	50%
13. Fatigue Unusual physical exertion. If on change order work and men return to base contract work, effects also affect performance on base contract	8%	10%	12%
14. Ripple Changes in other trades' work affecting our work such as alteration of our schedule. A solution is to request, at first job meeting, that all change notices/bulletins be sent to our Contract Manager.	10%	15%	20%
15. Overtime Lowers work output and efficiency through physical fatigue and poor mental attitude.	10%	15%	20%
16. Season and Weather Changes Either very hot or very cold weather.	10%	20%	30%

MCAA 2012, Toronto 2010

3. Analysis of Direct Cost Items

This chapter provides details on the data collection and analysis to determine the allowable direct cost items in a change order.

It is sometimes difficult to determine when an element of expense can be directly charged in a change order (Civitello 2008, SDC Associates 2009, Case Western 2011). Although a large number of costs can be somewhat easily assigned to an allowable direct cost category, there continues to be a debate about certain costs. Many times, the nature of construction change orders makes the identification and inclusion of these costs difficult and contentious.

This section investigates various direct costs and how they are generally defined in academic literature, industry standards, federal regulations, and standard contract documents/agreements. It also combines conclusions from the literature, industry practices, survey findings from the members of the National Electrical Contractors Association (NECA) and ELECTRI Council, case studies; and the review of relevant court cases to analyze allowed and disallowed direct costs in change orders.

Change Order Provisions in Standard Construction Contract Documents/Agreements:

Table 3.1 identifies the location of change order-related provisions, procedures, and terminology in the four major standard construction contract documents/agreements.

Table 3.1: Change Order-Related Articles in Standard Contract Documents

Owner and General Contractor Agreements (Prime Contracts)		
Contract – Revision	**Type**	**Article/Part**
AIA A201 – 2007	General Conditions	Article 7
ConsensusDocs 200 - 2012	Standard Agreement & General Conditions	Article 8
EJCDC C-700 – 2007	General Conditions	Articles 10,11,12
CDCC 2 – 2008	Stipulated Price Contract	GC Part 6
General Contractor and Subcontractor Agreements (Subcontracts)		
Contract – Revision	**Type**	**Article/Part**
AIA A401 – 2007	Standard Agreement	Article 5
ConsensusDocs 750 - 2012	Standard Agreement	Article 7
EJCDC C-523 – 2013	Construction Subcontract	Articles 9
CCA 1 – 2008	Stipulated Price Contract	SCC Part 6

The standard forms of these documents/agreements can be modified or changed in supplementary conditions. Each of these documents/agreements has fairly similar language in their articles and includes parts that define how change orders shall be processed, priced, and what costs are recoverable.

Direct Cost Items Compiled from Various Sources

As the first step, it is important to identify which of the direct costs are identified in standard contract documents and/or in other academic and industry literature. The four major contract documents are fairly similar regarding direct cost items. As shown in **Table 3.2,** the four standard contract documents have identified 24 direct cost items. This list was expanded to 31 direct cost items after reviewing other sources including surveys, case studies, legal cases and academic and industry literature (SMACNA 2002, Civitello 2008, SDC Associates 2009, Toronto 2010, MCAA 2012, PHCC-EF 2013).

Table 3.2: Direct Cost Items Identified in Standard Contract Documents and Other Sources

No.	Direct Cost Category	AIA A201 - 2007	ConsensusDocs 200 - 2012	EJCDC C-700 - 2007	CCDC 2 - 2008	Other Sources
Labor Costs						
1	Labor Wages and Burden	7.3.7.1	8.3.1.3.1	11.01.A.1	6.3.7.1	
2	Supervision and related Field Office Personnel	7.3.7.5	8.3.1.3.2	11.01.A.1	6.3.7.1	
3	Supervision (other than Foreman)		8.3.1.3.2	11.01.A.1 Excluded	6.3.7.1	Industry Literature
4	Main Office Personnel in Project Offices	Not Stated	8.3.1.3.2	11.01.B.1 Excluded	6.3.7.1	
5	Room, Board and Travel Allowance	Not Stated	8.3.1.3.4	11.01.A.5.a	6.3.7.3	
6	Estimating and Expediting	Not Stated	Not Stated	Excluded	6.3.7.1	
7	Change Order Preparation and Processing	Not Stated	Not Stated	Not Stated	6.3.7.1	
Material and Equipment Costs						
8	Materials	7.3.7.2	8.3.1.3.5	11.01.A.2	6.3.7.5	
9	Equipment and Rental	7.3.7.2 and 3	8.3.1.3.5 and 8	11.01.A.2 and 5	6.3.7.6	
10	Small / Hand Tools (owned vs. not owned by workers)	7.3.7.3 Excluded	8.3.1.3.7 (Not Owned)	11.01.A.5.c (Not Owned)	6.3.7.5 (Not Owned)	
11	Transportation	7.3.7.2	8.3.1.3.5	11.01.A.2	6.3.7.4	
12	Storage/ Handling	Not Stated	8.3.1.3.5	11.01.A.2	Not Stated	
13	Inspection/ Testing	Not Stated	8.3.1.3.5	Not Stated	6.3.7.10	
14	Temporary Facilities	Not Stated	8.3.1.3.7	11.01.A.5.b	6.3.7.7	
15	Nonhazardous Waste Cleanup	Not Stated	8.3.1.3.14	Not Stated	6.3.7.16	
16	Restocking and Cancellation					Surveys and Literature

Table 3.2 shows these 31 direct cost items as "labor," "material and equipment," and "job cost/expenses". In addition, the research identified ten direct cost items that are specifically disallowed in one or more of these sources. These ten items are not listed in Table 3.2 but are discussed in the next section.

Most of the above-noted items are relatively easy to quantify but many of these can be difficult to quantify and depend on the scope, type and circumstances related to a change order. One such item, "change order preparation and processing" can have significant impacts on the contractor and the project. As per a research study conducted in Canada (Fayek & Nkua 2001), it takes an average of three hours to prepare and administer a change order by general contractors, with the range being one to six hours. The average time was based on the following activities:

Table 3.2: continued

No.	Direct Cost Category	AIA A201 - 2007	ConsensusDocs 200 - 2012	EJCDC C-700 - 2007	CCDC 2 - 2008	Other Sources
Job Costs/Expenses Related to Change Order						
17	Job Office-related Operation Costs incl. Printing, Photos, Data, & Phone	Not Stated	8.3.1.3.12	11.01.A.5.h	6.3.7.15	
18	Water, Power, & Fuel Costs	Not Stated	8.3.1.3.13	11.01.A.5.g	Not Stated	
19	Bonds, Security and Project Insurance	7.3.7.4	8.3.1.3.9	11.01.A.5.i	6.3.7.13	
20	Sales Taxes	7.3.7.4	8.3.1.3.10	11.01.A.5.d	6.3.7.14	
21	Permit Fees	7.3.7.4	8.3.1.3.11	11.01.A.5.e	6.3.7.11	
22	Licenses and Certifications	Not Stated	8.3.1.3.11	11.01.A.5.e	6.3.7.12	
23	Subcontractor Costs	Not Stated	8.3.1.3.6	11.01.A.3	6.3.7.9	
24	Special Consultants' Fees	Not Stated	Not Stated	11.01.A.4	Not Stated	
25	Safety Measures and Equipment	Not Stated	Not Stated	Not Stated	6.3.7.17	
26	Mobilize and Demobilize					Surveys and Literature
27	Special Project Requirements (e.g., LEED)					Surveys and Literature
28	Drawings, Documents and Printing					Industry Literature
29	Parking					Industry Literature
30	Shop Expenses					Industry Literature
31	Guaranties and Warranties					Industry Literature

- Design review/verification
- Site inspection
- Sending of quote request to trades
- Updating change order log
- Providing clarifications
- Preparation of quotation
- Receipt of approved change order and submitting to trades
- Schedule revisions
- Drawing revisions
- Posting of changes in specifications / drawings
- Layout and trade compliance
- Accounting processing of change in payment requisitions

The average time was based on the assumption that every single trade quote is received on-time and is accurate. The average was also based on the understanding that the change order is not revised or cancelled by the owner.

The overall processing time also has a significant impact on this cost item. In a study of 1,135 change order items for university projects in the United States, Mrozowski et al. (2004) found that it took an average of 196 days to process change orders including 134 days for initiating change orders. The delayed processing time was found to not only increase the change order preparation and processing costs but also cause project delays, disrupt project cash flow, adversely affect relationships, and increase administrative costs.

Analysis of "Allowed," "Maybe/Depends," and "Disallowed" Direct Cost Items

All identified direct cost items were analyzed using a weightage system. The weightage system was designed based on the relative importance of the information source, as perceived by the research team. The standard contract documents were given higher weightage than other sources. For each source, a positive score was assigned if an item was allowed, a negative score if specifically disallowed/excluded, and a zero score if the item is not mentioned. Specifically, the weights assigned to each source were as follows:

- **Standard Contract Documents:** These were assigned the weight of "1" since these documents directly influence the change order costs and are developed and scrutinized by multiple stakeholders (AIA A201-2007; ConsensusDocs 200-2012; EJCDC C-700-2007; and CDCC 2-2008).
- **Federal Law Cases/Regulations/Documents:** A weight of "0.5" was assigned since these documents can only relate to particular change orders (1985 U.S. App.; 1992 U.S. Claims, 59 Fed. Cl. 168; 2003 U.S. Claims, 64 Fed. Cl. 229; FAR 2005; 26 Cl. 1155; 2005 U.S. Claims & 773 F.2d 960).
- **Electrical Contractors' Survey:** A weight of "0.5" was assigned since these surveys are completed by one group of stakeholders (NECA and ELECTRI surveys).
- **Case Studies:** A weight of "0.5" was assigned since they relate to particular change orders and express the view of one set of stakeholders (case studies provided by various contractors and from public sources).
- **Industry Standards:** A weight of "0.5" was assigned because the standards express the view of a particular sector of the construction industry (SMACNA 2002, Toronto 2010, MCAA 2012, PHCC-EF 2013).
- **Literature Review:** A weight of "0.5" was assigned because of the general nature of the information (Civitello 2008).

The total weight, which is the sum of the individual weights for each source for every cost item, is assigned to the total column and the following criteria was used for the results (**Tables 3.3, 3.4 and 3.5**):

1. If a cost item scores a total weight of ≥ "+1," it is categorized as "allowed",

Table 3.3: "Allowed" Cost Items Based on Overall Analysis

ITEMS	Total	Comments	AIA 201 - 2007	ConsensusDocs 200 - 2012	EJCDC C 700 - 2007	CCDC 2 - 2008	Legal Cases and Federal Regulations	Surveys	Case Studies	Industry Standards (incl. MCAA & Toronto Protocol)	Literature Review
Weights	(±)		**1**	**1**	**1**	**1**	**0.5**	**0.5**	**0.5**	**0.5**	**0.5**
Labor Wages and Burden	6.5	Allowed	●	●	●	●	◒	◒	◒	◒	◒
Materials	6.5	Allowed	●	●	●	●	◒	◒	◒	◒	◒
Equipment and Rental	6.5	Allowed	●	●	●	●	◒	◒	◒	◒	◒
Supervision and Related Field Office Personnel	6.0	Allowed	●	●	●	●		◒	◒	◒	◒
Bonds, Security and Project Insurance	6.0	Allowed	●	●	●	●		◒	◒	◒	◒
Transportation of Material & Equipment	6.0	Allowed	●	●	●	●		◒	◒	◒	◒
Sales Taxes	6.0	Allowed	●	●	●	●		◒	◒	◒	◒
Permit Fees	6.0	Allowed	●	●	●	●		◒	◒	◒	◒
Subcontractor Costs	5.0	Allowed		●	●	●	◒	◒		◒	◒
Job Office-related Operation Costs	4.5	Allowed		●	●	●		◒		◒	◒
Room, Board and Travel Allowance	4.0	Allowed		●	●	●		◒		◒	
Storage / Handling of Material & Equipment	4.0	Allowed		●	●			◒	◒	◒	◒
Temporary Facilities	3.5	Allowed		●	●	●				◒	
Licenses and Certification	3.0	Allowed		●	●	●		◓		◒	
Inspection / Testing of Material & Equipment	3.0	Allowed		●		●		◒		◒	
Small / Hand Tools (not owned by workers)	2.5	Allowed	○	●	●	●				◒	
Non-hazardous Waste Clean-up	2.0	Allowed		●		●		◓		◒	
Special Consultants' Fees	2.0	Allowed			●			◒		◒	
Safety Measures and Equipment	2.0	Allowed				●				◒	◒
Water, Power and Fuel Costs	2.0	Allowed			●	●					
Restocking and Cancellation	1.5	Allowed						◒		◒	◒
Supervision (other than foreman)	1.5	Allowed		●	○	●				◒	
Mobilize and Demobilize	1.0	Allowed						◒		◒	
Change Order Preparation and Processing	1.0	Allowed				●				◒	◓
Special Project Requirements (e.g., LEED)	1.0	Allowed						◒		◒	

Allowed ● = +1 ◒ = +0.5 No Notation = 0 Disallowed ◓ = -0.5 ○ = -1

Disclaimer: This material does not reflect the views or practices of Michigan State University. This list is by no means exhaustive.

2. If a cost item scores a total weight of ≤ "–1," it is categorized as "disallowed", and
3. All cost items with a score between "+1" and "–1" are categorized as "depends."

Tables 3.3, 3.4 and 3.5 are further reorganized by dividing all costs items in three major categories as defined in Table 3.2:

- Labor (Table 3.6, *page 22*)
- Material and Equipment (Table 3.7, *page 23*)
- Job Costs/Expenses related to Change Order (Table 3.8, *page 23*)

The above-noted analysis highlights differences among various sources of change order pricing information and also reflects the confusion among project stakeholders (owners, GCs, CMs, designers and subcontractors). This analysis can serve as a helpful tool for reducing confusion among these stakeholders about allowing or disallowing direct cost items in a change order.

Table 3.4: "Maybe/Depends" Cost Items Based on Overall Analysis

ITEMS	Total	Comments	AIA 201 - 2007	ConsensusDocs 200 - 2012	EJCDC C 700 - 2007	CCDC 2 - 2008	Legal Cases and Federal Regulations	Surveys	Case Studies	Industry Standards (incl. MCAA & Toronto Protocol)	Literature Review
Weights	(±)		**1**	**1**	**1**	**1**	**0.5**	**0.5**	**0.5**	**0.5**	**0.5**
Drawings, Documents and Printing	0.5	Maybe/Depends								◗	
Parking	0.0	Maybe/Depends						◖ ◗		◗	
Shop Expenses	0.0	Maybe/Depends						◖ ◗		◗	
Guaranties and Warranties	0.0	Maybe/Depends								◗	◖ ◗
Estimating and Expediting	(0.5)	Maybe/Depends			○	●		◖ ◗		◗	◖ ◗
Main Office Personnel in Project Offices	(0.5)	Maybe/Depends		●	○	●		◖ ◗		◖ ◗	◖ ◗

Allowed ● = +1 ◗ = +0.5 No Notation = 0 Disallowed ◖ = -0.5 ○ = -1

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Table 3.5: "Disallowed" Cost Items Based on Overall Analysis

ITEMS	Total	Comments	AIA 201 - 2007	ConsensusDocs 200 - 2012	EJCDC C 700 - 2007	CCDC 2 - 2008	Legal Cases and Federal Regulations	Surveys	Case Studies	Industry Standards (incl. MCAA & Toronto Protocol)	Literature Review
Weights	(±)		**1**	**1**	**1**	**1**	**0.5**	**0.5**	**0.5**	**0.5**	**0.5**
Advertising and Telephone (non-job related)	(1.0)	Disallowed						◠		◠	
Auto Insurance	(1.0)	Disallowed						◠		◠	
Dues and Subscriptions	(1.0)	Disallowed						◠		◠	
Sales and Marketing	(1.0)	Disallowed						◠		◠	
Property Taxes and Business Licenses	(1.0)	Disallowed						◠		◠	
Corporate Business Insurance	(1.5)	Disallowed						◠	◠	◠	
Legal Fees, Accounting and Royalties	(1.5)	Disallowed						◠		◠	◠
Timekeeping	(2.5)	Disallowed			○			◠	◠	◠	
Main Office Operations	(3.0)	Disallowed			○			◠	◠	◠	◠
Small / Hand Tools (if owned by workers)	(5.0)	Disallowed	○	○	○	○		◠	◠	◒	◠

Allowed ● = +1 ◒ = +0.5 No Notation = 0 Disallowed ◠ = -0.5 ○ = -1

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Table 3.6: "Allowed" Cost Items by Categories (Labor-Material & Equipment-Job Costs/Expenses)

ITEMS	Total	Comments	AIA 201 - 2007	ConsensusDocs 200 - 2012	EJCDC C 700 - 2007	CCDC 2 - 2008	Legal Cases and Federal Regulations	Surveys	Case Studies	Industry Standards (incl. MCAA & Toronto Protocol)	Literature Review
Weights	(±)		**1**	**1**	**1**	**1**	**0.5**	**0.5**	**0.5**	**0.5**	**0.5**
Labor											
Labor Wages and Burden	6.5	Allowed	●	●	●	●	◒	◒	◒	◒	◒
Supervision and Related Field Office Personnel	6.0	Allowed	●	●	●	●		◒	◒	◒	◒
Room, Board and Travel Allowance	4.0	Allowed		●	●	●		◒		◒	
Supervision (other than foreman)	1.5	Allowed		●	○	●				◒	
Change Order Preparation and Processing	1.0	Allowed				●				◒	◑
Material and Equipment											
Materials	6.5	Allowed	●	●	●	●	◒	◒	◒	◒	◒
Equipment and Rental	6.5	Allowed	●	●	●	●	◒	◒	◒	◒	◒
Transportation of Material & Equipment	6.0	Allowed	●	●	●	●		◒	◒	◒	◒
Storage / Handling of Material & Equipment	4.0	Allowed		●	●			◒	◒	◒	◒
Temporary Facilities	3.5	Allowed		●	●	●				◒	
Inspection / Testing of Material & Equipment	3.0	Allowed		●		●		◒		◒	
Small / Hand Tools (not owned by workers)	2.5	Allowed	○	●	●	●				◒	
Non-hazardous Waste Clean-up	2.0	Allowed		●		●		◑		◒	
Restocking and Cancellation	1.5	Allowed						◒		◒	◒
Job Costs / Expenses Related to CO											
Bonds, Security and Project Insurance	6.0	Allowed	●	●	●	●		◒	◒	◒	◒
Sales Taxes	6.0	Allowed	●	●	●	●		◒	◒	◒	◒
Permit Fees	6.0	Allowed	●	●	●	●		◒	◒	◒	◒
Subcontractor Costs	5.0	Allowed		●	●	●	◒	◒		◒	◒
Job Office-related Operation Costs	4.5	Allowed		●	●	●		◒		◒	◒
Licenses and Certification	3.0	Allowed		●	●	●		◑		◒	
Special Consultants' Fees	2.0	Allowed			●			◒		◒	
Safety Measures and Equipment	2.0	Allowed				●				◒	◒
Water, Power, and Fuel Costs	2.0	Allowed			●	●					
Mobilize and Demobilize	1.0	Allowed						◒		◒	
Special Project Requirements (e.g., LEED)	1.0	Allowed						◒		◒	

Allowed ● = +1 ◒ = +0.5 No Notation = 0 Disallowed ◑ = -0.5 ○ = -1

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Table 3.7: "Maybe/Depends" Cost Items by Categories (Labor-Material & Equipment-Job Costs/Expenses)

ITEMS	Total	Comments	AIA 201 - 2007	ConsensusDocs 200 - 2012	EJCDC C 700 - 2007	CCDC 2 - 2008	Legal Cases and Federal Regulations	Surveys	Case Studies	Industry Standards (incl. MCAA & Toronto Protocol)	Literature Review
Weights	(±)		**1**	**1**	**1**	**1**	**0.5**	**0.5**	**0.5**	**0.5**	**0.5**
Labor											
Estimating and Expediting	(0.5)	Maybe/Depends			○	●		◡		◡	◡
Main Office Personnel in Project Offices	(0.5)	Maybe/Depends		●	○	●		◡		◡	◡
Job Costs / Expenses Related to CO											
Drawings, Documents and Printing	0.5	Maybe/Depends								◡	
Parking	0.0	Maybe/Depends						◡		◡	
Shop Expenses	0.0	Maybe/Depends						◡		◡	
Guaranties and Warranties	0.0	Maybe/Depends								◡	◡

Allowed ● = +1 ◡ = +0.5 No Notation = 0 Disallowed ◡ = -0.5 ○ = -1

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Table 3.8: "Disallowed" Cost Items by Categories (Labor-Material & Equipment-Job Costs/Expenses)

ITEMS	Total	Comments	AIA 201 - 2007	ConsensusDocs 200 - 2012	EJCDC C 700 - 2007	CCDC 2 - 2008	Legal Cases and Federal Regulations	Surveys	Case Studies	Industry Standards (incl. MCAA & Toronto Protocol)	Literature Review
Weights	(±)		**1**	**1**	**1**	**1**	**0.5**	**0.5**	**0.5**	**0.5**	**0.5**
Labor											
Timekeeping	(2.5)	Disallowed			○			◡	◡	◡	
Main Office Operations	(3.0)	Disallowed			○			◡	◡	◡	◡
Material and Equipment											
Small / Hand Tools (if owned by workers)	(5.0)	Disallowed	○	○	○	○		◡	◡	◡	◡
Job Costs / Expenses Related to CO											
Corporate Business Insurance	(1.5)	Disallowed						◡	◡	◡	
Legal Fees, Accounting and Royalties	(1.5)	Disallowed						◡		◡	◡
Advertising and Telephone (non-job related)	(1.0)	Disallowed						◡		◡	
Auto Insurance	(1.0)	Disallowed						◡		◡	
Dues and Subscriptions	(1.0)	Disallowed						◡		◡	
Sales and Marketing	(1.0)	Disallowed						◡		◡	
Property Taxes and Business Licenses	(1.0)	Disallowed						◡		◡	

Allowed ● = +1 ◡ = +0.5 No Notation = 0 Disallowed ◡ = -0.5 ○ = -1

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4. Analysis of Overhead-Profit Practices and Percentages

This chapter provides a review and analysis of the overhead-profit practices related to change orders. In a change order, the overhead is generally a fixed amount or percentage fee based on the direct costs or the total change order amount. In many cases, the overhead and profit are added together and referred to in the contract as overhead-profit or contractor's fees or markup. In this section, overhead-profit is reviewed based on standard contract agreements, federal regulations, National Electrical Contractors Association (NECA) and ELECTRI surveys, case studies, and literature from academic, industry, and construction finance sources.

Overhead-Profit Clauses and Percentages in Standard Contract Documents (Prime)

The overhead and profit and their percentages are left unidentified in all but one standard document, the EJCDC C-700-2007. This gives the contractor and owner the ability to negotiate the fee and/or percentages based on the nature of the project, the timing of the change order and the work involved in performing the change order. In many instances, owners calculate/propose these percentages based on their past experiences and perceptions. If these values are pre-assigned in the contracts, the contractors should be aware of them and plan accordingly. **Table 4.1** *(next page)* compares details of different contracts and also shows the overhead and profit breakdown for cost items based on EJCDC C-700-2007.

Analysis of Overhead-Profit Practices and Percentages

An analysis, similar to the one performed in Chapter 3, was conducted based on court cases, case studies, survey results, industry standards/manuals and academic literature review. Since most standard contract documents do not provide specific guidance on overhead-profit percentages, other sources including construction finance literature were analyzed in order to arrive at the average overhead-profit percentages.

The analysis in **Table 4.2** *(page 27)* is based on the following 12 sources

1. AIA A201-2007
2. ConsensusDocs 200-2012
3. EJCDC C-700
4. CCDC2 2008
5. law cases and federal acquisition documents
6. surveys
7. averages of case studies
8. RS Means (2013)
9. Industry standards/Toronto Change Order Protocol
10. NCHRP (2003)
11. CFMA (2013), and
12. NECA Financial Performance Annual Reports (2010)

Table 4.1: Overhead and Profit in Standard Contract Documents (Prime)

Document	AIA A201	ConsensusDocs 200	EJCDC C-700	CCDC 2
Version	**2007**	**2012**	**2007**	**2008**
Agreement and General Conditions	Owner and Contractor	Owner and Contractor	Owner and Contractor	Owner and Contractor
Overhead-profit Rates	7.3.3 Mutually acceptable fixed or percentage fee	8.3.1.3 [ ]% for Overhead and [ ]% for Profit	12.01.C.2 15% Contractor Fee, 5% Pass Through & 0% on items in 11.01.A.4 & 11.01.A.5. 5% returned for deductions	6.3.6 Mutually acceptable fixed or percentage fee
Cost Breakdown				
Labor, Fringe and taxes/Payments	Negotiated	Negotiated	15.0%	Negotiated
Equipment			15.0%	
Material			15.0%	
Subcontractor			15.0%	
Pass-Through			5.0%	
Employee, Office, and Minor Expenses			0.0%	
Employee Expenses			0.0%	
Minor Expense			0.0%	
Special Consultants			0.0%	
Deposit, Losses, and Damage			0.0%	
Bonds and Insurance			0.0%	
Utilities, Fuel, and Sanitary Facilities			0.0%	
Unit Pricing			0.0%	

In Table 4.2, the overhead percentage electrical contractors need to run their business averages 19.16%. It should be noted, however, that this is a percentage of the total change order amount because the numbers are based on total sales or total revenues. If the OH percentage is being applied to the total direct costs in the change order, this percentage needs to be revised by using the following formula:

y = x / (1-x), where

y – OH % for applying to the total direct cost

x – OH % for applying to the total change order amount

(also shown in the bottom notes section of Table 4.2)

Based on the above formula and calculation shown in Table 4.2, the 19.16% of the total change order amount is equivalent to 23.7% of the total direct costs of the change order. In addition, the profit percentage is separate and should

be applied after OH is added to the change order. It should be noted that applying a profit percentage to the sum of direct costs and overhead is controversial and many owners and auditors contest this practice (NACA 2014).

The OH percentage from Table 4.2 is within the range of percentages found in various sources and case studies. For example, **Table 4.3** *(next page)* shows the national average of OH-P percentages for electrical contractors as compiled by the NECA financial reports (NECA 2010). Similarly, **Table 4.4** *(next page)* shows the best, typical and worst OH-P percentages found in the case studies.

This analysis may offer a good metric for electrical contractors to use in determining and substantiating overhead-profit percentage. There is clearly a certain level of disconnect between the overhead-profit percentages generally allowed and those calculated/needed by the electrical contractors and the construction industry. However, it should be noted that these percentages are directly influenced by the number of cost items that a contractor is able to justify as "direct cost" in the change order. If contractors can include and recover all of their direct cost items, there will be less concern about the overhead-profit percentage.

Table 4.2: OH-Percentages Based on the Overall Analysis

Change Order OH&P as % of Total Price													
OH & P Allowed vs. Calculated/ Needed	**Average %**	**AIA 201 - 2007**	**ConsensusDocs 200 - 2012**	**EJCDC C 700 - 2007**	**CCDC 2 - 2008**	**Legal Cases & Federal Regulations**	**Surveys**	**Case Studies Average**	**RS Means (2013)**	**Industry Standards/Toronto Protocol**	**Transportation Research Board report on Contractors' Home Office Overhead - Electrical Contractors (NCHRP 2013)**	**National Construction Financial Management Association - Moss Adams LLP (CFMA 2013)**	**NECA Financial Performance Annual Report (2010)**
OH&P Allowed for Electrical Contractors	13.5%	Negotiated	Negotiated	~15% (See Breakdown)	Negotiated	Varies	15.1%	14.0%	10% (Midpoint of 5-15% range)				
*OH only % calculated/needed by Electrical Contractors for business	*19.16% (23.7%)						18.00%				20.80%	20.84%	17.00%
** Profit %	2-5%												

* These OH %s are for applying to total Change Order amount. Convert these %s for applying to total of Direct Costs by using the formula and example below:
(% for Direct Cost) = (% for total CO amount)/(1 - % for total CO amount)
e.g., If the OH % is 20% on the total CO amount of $100 then the OH % for the Direct Cost of $80 = 0.20/(1-0.20) = 0.20/0.80 = 0.25 or 25%
(Based on this formula the above-noted OH of 19.16% of total CO amount should equal to 23.70% of the Direct Cost)
** profit % is additional
(Therefore, based on this formula the above-noted OH of 19.16% of total CO amount should be equal to 23.7% of the Direct Cost)

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Table 4.3: OH & P Percentage Breakdown from NECA Financial Report (NECA 2010)

Ovehead and Profit % Breakdown (% of Sales) Electrical Contractors' Income Statement (NECA 2010)	
Item	**Average of All Firms**
Total Sales	100.00%
Direct Cost:	
Material	29.93%
Direct Labor Wages	24.94%
Labor Adder	13.40%
Other Direct Job Expense	4.56%
Subcontract Expense	6.63%
Total Direct Costs	**79.46%**
Overhead Breakdown:	
Compensation of Salaried Personnel (including all compensation as well as bonuses, taxes, profit sharing and other employee benefits/burdens)	10.28%
Utilities (including gas, electric, water, and telephone)	0.34%
Rent or Mortgage Costs	0.83%
Education and Training Expenses	0.09%
All other Overhead Expenses	5.46%
Total Overhead Expenses	**17.00%**
Operating Profit	**3.54%**
Gross Income (OH&P)	**20.54%**

Table 4.4: Best, Typical and Worst OH & P from Case Studies

OH & P %s in Change Order Case Studies							
					Project Details		
Case #	**Type**	**OH&P %**	**Pass Through %**	**Cost Comments**	**Owner Type / Cont. Tier**	**Project Type**	**Region**
5	Best	"40% Labor 25 % Materials 5% Equipment"	8%	Costs were clearly defined in the contract	Public / 1	State Government Road Work	Northeast
1	Typical	15% for self preformed work	5%	Recoverable costs allowed: Labor, Materials, Equipment, Subs, Supervision, Bonds and Project Insurance	Public / 1	Educational Building	Midwest
10	Worst	Max. 15% for all contractors combined	None	Owner would only pay 80% of Journeymen's wages. It took over 1-1/2 years to collect the payment.	Public / 2	Airport Building	Southeast

5. Examples of Impact Factors and Consequential Costs

Consequential costs are incurred when the timing and the scope of change order work affects the cost of the change order and/or overall project cost or duration. The factors affecting these costs are referred to as impact factors. These factors are particularly important for electrical and low voltage contractors. Their work is considered labor-intensive and a majority of these factors have negative impacts on the labor productivity. The two most important issues related to impact factors and associated consequential costs are their timely identification and, next, their quantification and inclusion in the change orders.

The issue of consequential costs is indirectly related to the consequential damage waiver clause in the standard contract documents (AIA-A201-2007). Many owners use the consequential damages waiver clause to deny consequential costs to contractors. This has led to several court cases and, in many instances, courts have agreed with the contractors. For example, in the court case Ryan Incorporated Eastern v. Toll Brothers (2002), 43 Fed. Appx. 601 (4th Cir. 2002), the courts made it clear that change order consequential costs are related directly to the finances of the project through the change order provisions and clauses. However, consequential damages are not directly related to the project's financial costs but are related to a breach in the contract. Therefore, the consequential damages waivers in contracts apply only when a breach has occurred by one or more parties. Without a breach, there cannot be a claim of consequential damage and any such waiver should not apply to change order costs. Therefore, consequential costs can be part of the cost of change orders and becomes part of the contract through the change order provisions and clauses.

This section identifies major impact factors and discusses common methods/techniques to calculate their consequential costs. It uses literature review, case studies, surveys and relevant court cases in an attempt to define impact factors and associated consequential costs.

Impact Factors

Several sources have identified impact factors. These sources include - Toronto Change Order Protocol (Toronto 2010); Mechanical Contractors Association of America Guideline for Contractors (MCAA 2012, MCAA 1976), SMACNA (2005), ELECTRI reports by Hanna et al. (1999) and Hanna (2001); and the widely-used academic textbook by Civitello (2008). Some additional factors were identified via surveys conducted with electrical contractors (NECA and ELECTRI Council members) and owners (COAA members).

The Mechanical Contractors Association of America (MCAA) issued a bulletin (no. 58) in 1976, entitled "Factors Affecting Productivity." This document recommended 16 impact factors that can impact productivity and also provided percentages to estimate losses (MCAA 1976). The latest successor to the original MCAA publication (MCAA 2012)

provided some insight into the application of these factors. It also provided some guidelines on a method to quantify productivity inefficiencies caused as a result of these factors.

Many other trade organizations have endorsed or adopted these factors. A consortium of trade organizations in Toronto, Canada, developed a "Change Order Protocol," that uses MCAA factors and provides suggestions about identifying and quantifying these factors (Toronto 2010). Similarly, the Sheet Metal and Air Conditioning Contractors National Association (SMACNA) recommends the use of MCAA factors (SMACNA 2005). The Plumbing, Heating and Cooling Contractors Association (PHCCA) also suggests certain impact factors that are similar to MCAA factors. The PHCC Educational Foundation recommends the Means Electrical Change Order Data book to assist with quantifying these factors. (PHCC-EF 2013, RS Means 2013)

Based on the literature review, industry survey and case studies, and evaluation of court cases, **Table 5.1** (similar to Table IIIA in the templates) provides a compilation of various possible impact factors. These impact factors are divided in three categories based upon their impact on change order pricing: Labor Productivity-related, Added Cost, and Project and Field Conditions-related Factors.

Table 5.1 (similar to Table IIIA): Potential Impact Factors

Labor Productivity-related Factors (may decrease productivity or increase labor hours – can be used to add to labor hrs. in the change order or submit as separate claim)	**Added Cost Factors** (may increase change order costs - can be used to add cost to the change order or submit as separate claim)	**Project and Field Conditions–related Factors** (may cause project delays – can be used to indicate potential delay on the change order and then, later submit a delay claim)

(Long & Carter 2013, Toronto 2010, MCAA 2012, SMACNA 2005, PHCC-EF 2013, RS Means 2013)

(Full Table provided in the templates as Table IIIA, page 11)

Major Techniques/Methods for Quantification of Consequential Costs

As discussed above, there are a number of impact factors that occur as a result of change orders. The key issue is how to identify and quantify these impact factors. Several techniques/methods for the calculation of consequential costs were identified based on the literature review, industry survey and case studies, and evaluation of court cases. Out of various techniques/methods identified, the following have gained a fair amount of acceptance in the construction industry including acceptance by some owners and through court cases. Among the following techniques/methods, ELECTRI International has been involved, in some way, with the first three that are discussed further along with examples.

1. **Toronto Change Order Protocol/MCAA Percentage Method (Toronto 2010, MCAA 2012)**
2. **Stacking of Trades—Hanna Method (Hanna et al. 2002)**
3. **Measured Mile Approach (Hanna 2011, Long and Carter 2013, DeVries 2012)**
4. Cumulative Impact of Change Orders Method (Hanna 2001)
5. RS Means Method for Electrical Change Order Work (RS Means 2013)
6. US Army Corp of Engineers Impact Studies (Vorster & De La Garza 1990, Fuerst et al. 1991)
7. NAVSEA's Relative Importance Method (Jozwick 2005)

Among the three bolded techniques/methods listed above, the "Toronto Change Order Protocol/MCAA Percentage" method is considered easy-to-use and is suitable for all contractors especially those who do not keep extensive records and/or perform analyses of their past work and productivities.

Toronto Change Order Protocol/MCAA Percentage Method (MCAA 2012, Toronto 2010)

Overview: The Toronto Protocol recommends that the labor-hours in change orders should be revised by considering one or more impact factors. MCAA (2012) and Toronto (2010) proposed quantification of impact factors based on a percentage method that is determined by the severity of the impact. Impact conditions are divided into minor, average, and severe, with percentages assigned to each. These percentages denote loss in labor productivity leading to increased labor costs. **Table 5.2** (similar to Table III.1 in the templates) outlines the factors taken into account and percentages assigned by the severity of the conditions.

It should be noted that impact factors such as morale and attitude (as listed in Table 5.1) are difficult to quantify. Hence, such effects can be assumed when certain other factors apply, such as stacking of trades, reassignment of manpower, etc. One must take care to avoid factor duplication, especially for those factors that may be caused by one of the other factors on the list. For example, if ripple effect is causing stacking of trades or overtime fatigue, resulting in inefficiency, those other factors may be taken into consideration, rather than solely the ripple effect. Finally, the specific personnel who witnessed the conditions should evaluate and choose the severity of impact category and also provide justification for the selected classification.

Table 5.2 (similar to Table III.1): Impact Factors and Productivity Loss %s

Factors	% of loss if condition is:		
	Minor	Average	Severe
1. Stacking of Trades Operations take place within physically limited space with other contractors. Results in congestion of personnel, inability to locate tools conveniently, increased loss of tools, additional safety hazards and increased visitors. Optimum crew size cannot be utilized.	10%	20%	30%
16. Season and Weather Changes Either very hot or very cold weather.	10%	20%	30%

(MCAA 2012, Toronto 2010)

(Full Table provided in the templates as Table III.1, page 12)

Example: Consider a change order for work on a project. Due to a scheduling conflict, this work needed to be performed together with other trades. The resulting lack of room and an insufficient number of available tools ended up in the underutilization of the optimum crew size. Let's assume that the work went on for two weeks and that conditions remained the same during that period.

- Assuming a crew size of 3 laborers, the total labor-hours needed for the job are:

  40 * 2 * 3 = 240 labor-hours

- Now, consider the "stacking of trades" impact factor from Table 5.2. Considering average conditions for this factor, the percentage for productivity loss is 20%.
- **Using the factor from Table 5.2, the adjusted labor hours are:**

  240 hours * 1.2 = 288 hours

Stacking of Trades—Hanna Method (Hanna et al. 2002)

Overview: Stacking of trades is defined as operations that take place within a physically limited space with other trades. Research has established that depending on the complexity of work, each construction worker needs a minimum of 200 to 250 square feet for full productivity. In the normal course of work, contractors calculate labor productivity with the assumption that their workers will be able to perform their work with little interference from other trades. But, in situations such as the result of change orders, workers may end up working in a physically limited space with many other workers. In such cases, contractors should be appropriately compensated for the effects of stacking of trades.

Hanna *et al.* (2002) sought to understand the effects of staking of trades and to develop a methodology to measure its effect on labor productivity, thereby aiming to improve the construction process and also ensure appropriate compensation for contractors. Using literature reviews, contractor interviews, qualitative survey, and quantitative analysis, the study found that the stacking of trades results in (1) restricted work space, (2) an increase in the amount of labor used, (3) a need to work out a planned schedule for such activities, and (4) an increase in crew wait time. All of these factors lead to labor inefficiency and increased cost for the contractor.

Example: ElectricCo has a subcontract for electrical work for an office building for XYZ Inc. Because of a change order ElectricCo had to go back to do some work in the control room. The provision of a scissors lift for use by the carpentry trade and ElectricCo in the control room has led to the stacking of both trades, an observation agreed on by the construction manager, carpentry trade subcontractor, and ElectricCo. Since ElectricCo did not factor this situation into its initial estimate of labor hours for the change order work, ElectriCo adjusted its original time of 150 labor hours for the effect of stacking of trade using the following process:

1. *Calculate Size of Usable Work Area* – Even though the size of the area is 5,400 square feet (90ft x 60ft), the fixed equipment in the control room occupies 1,400 square feet. Thus, the usable work area is 4,000 square feet [5,400 – 1,400].
2. *Calculate Electrical Worker Density (EWD) and Non-electrical Worker Density (NWD)* – ElectricCo had planned to have 4 electricians in the work space and then learned that 20 carpentry trades were scheduled to work in the space.
   a. $\text{EWD} = \frac{\text{Usable work area}}{\text{Electrical workers}} = \frac{4{,}000\text{sq.ft.}}{4} = 1{,}000\text{sq.ft./Electrical worker}$
   b. $\text{NWD} = \frac{\text{Usable work area}}{\text{Non-electrical workers}} = \frac{4{,}000\text{sq.ft.}}{20} = 200\text{sq.ft./Non-electrical worker}$
3. *Convert Electrical Density* – Based on Table 6.1 (from Hanna *et al.* 2002), the electrical density (1,000sq.ft.) is converted to determine the density adjusted value (DAV) of 6.91 (column 2) with a corresponding equation value 1 of 24.69 (column 3).
4. *Convert Non-Electrical Density* – Based on Table 6.2, the non-electrical density (200 sq.ft.) is converted to determine the density adjusted value (DAV) of 5.30 (column 5) with a corresponding equation value 2 of -8.42 (column 6).
5. *Calculate Variable Interaction Term* – Multiply the two adjustment values from steps 3 and 4 to obtain an equation 3 value of 36.62 (6.91*5.30). Use the obtained value of 36.62 in column 7 of Table 6.3 in order to find the Equation Value 3 in column 8. Since the exact value of 36.62 is not available in Table 6.3, the value can be linearly interpolated as follows:

$$(-24.11 - -25.44)/2 * (36.00 - 36.62) - 24.11 = -24.52$$

6. *Enter Values from Steps 3, 4, and 5 into Equation A* – This can be computed as follows:

   Equation A = 8.42 + equation 1 value + equation 2 value + equation 3 value

   Equation A = 8.42 + 24.69 + -8.42 + -24.52 = 0.17

7. *Convert Equation A* – Using Table 6.4 Equation A can be converted to obtain an efficiency value (column 10). Since the exact value of 0.17 is not available in Table 6.4, the value can be linearly interpolated as follows:

   $$(1.22 - 1.11)/0.10 * (0.17 - 0.10) + 1.11 = 1.19$$

8. *Derive Work Duration Adjusted for Stacking of Trades* – this can be obtained by multiplying the original estimated work duration of 150 hours by the efficiency value obtained in step 7 (1.19) to obtain a new activity duration.
9. Therefore, the adjusted labor hours are: 150 hrs. * 1.19 = 178.5 hrs.

Measured Mile Approach (Hanna 2011, DeVries 2012, Long & Carter 2013)

Overview: Labor productivity-related impact factors result in labor inefficiencies and, therefore, increased labor costs. The measured mile method is a widely accepted method for evaluating labor inefficiencies. It compares unit productivity levels during an unimpeded time (measured mile period) to those during impacted time to determine the effect on productivity. Using this method, the following steps are used to quantify productivity loses: (Long & Carter 2013):

1. Determine the type and scope of work to be used in the analysis.
2. Determine the non-impacted (measured mile) and impacted time periods.
3. Calculate contractor's labor productivity of contractor by comparing the measured mile period to the impacted period.
4. Calculate contractor's cost during un-impacted period (measured mile) using work done and measured mile productivity. Include adjustments for any problems caused by contractor during the impacted period but not present during the un-impacted (measured mile) period.
5. Calculate compensation for the contractor using the variance between un-impacted and impacted periods.
6. Include specific write-up of how owner-caused impacts led to the decreased productivity experienced during the impacted period.

Example: BuildCo contractor has been installing a large number of pipes in different parts of a project. On a certain section, BuildCo workers were scheduled to install 2,500 LF of pipe and based on their past experience, they had planned 5,000 labor hours to complete this task. Due to a change order, the pipe installation quantity increased from 2,500 L.F. to 3,200 L.F. and it took them a total of 8,000 labor hours to complete the installation. Using the measured mile method, compensation for the loss in productivity can be calculated as shown in **Table 5.3** *(next page)*.

Table 5.3: Measured Mile Method Computation for Pipe Installation

Description	Uninterrupted Period (Measured Mile)	Planned Change Order Labor Hrs. based on Uninterrupted Period	Actual Labor hrs. based on Change Order-related Interruptions	Variance
Quantity (LF)	2,500	3,200	3,200	700
Labor Hours (LH)	5,000	6.400	8,000	1,600
Productivity (LH/LF)	2.0	2.0	2.5	0.5

Based on Table 1, 1,600 labor hours are due to the loss in productivity because of the change order work. In order to prove the loss, the contractor must be prepared to substantiate the calculations by preparing a graph with cumulative installation per week for similar installations during the uninterrupted period (the measured mile period). In addition, the contractor should maintain a log of the interruptions such as design revisions, RFI log, increased inspections, increased visits and meetings, etc.

6. Conclusion

The main purpose of this project was to develop guidelines that provide a systematic, standardized, fair process for the pricing of change orders for electrical and low voltage contractors. Although the main focus of this effort was on electrical and low voltage subcontractors, the outputs can easily be used by other trade contractors. The information and analysis presented in this document deals with three key areas related to change order pricing:

1. Direct Cost Categories and Items
2. Overhead-Profit Practices and Percentages
3. Impact Factors and Consequential Costs

The analysis was performed based on information from a number of sources. These included: industry and academic literature, four major standard contract documents (AIA, ConsensusDocs, EJCDC and CDCC/CCA), industry surveys (NECA, ELECTRI and COAA), court cases, case studies, interactions / input from other subcontractors' groups (SMACNA and PHCCA), and interactions / inputs from owners' groups (COAA, CURT, and NACA).

The first part of the report provided templates and tables that can assist contractors in preparing change orders. Chapters 3, 4, and 5 provided details and analysis related to each of the above-noted three key areas of this document. Based on the work involved in this project, the researchers offer the following observations:

- There is a fair amount of contradictory information related to change orders in various standard contract documents as well as in other publications;
- Owners are as unsure about many change order related issues as are contractors.
- When it comes to overhead percentages, contractors should think in terms of a percentage of the total change order amount and not as a percentage of direct costs only.
- Most impact factors/consequential costs can either be included as part of directly recoverable costs or as a separate category. In either case, the burden is on the contractor to make a professional case with detailed substantiation/calculations.
- The topic of change orders is ongoing and presents many areas that can be further explored including:
  a. Working with standard contract document groups to revise/clarify language related to change orders,
  b. Compiling a detailed breakdown of overhead costs for firms of different sizes for inclusion in the NECA Financial Performance report, and
  c. Developing case studies/scenarios with illustrations for every impact factor.

It is hoped that the templates/tables provided in these guidelines will be shared by contractors with other project stakeholders (owners, GCs, CMs, designers and subcontractors). It is envisioned that the analysis presented in this report will serve as a helpful tool for reducing confusion and conflict among various project stakeholders.

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