Providing Vision and Leadership for the Future of the HVAC and Sheet Metal Industry

PANDEMICS AND PRODUCTIVITY: QUANTIFYING THE IMPACT

MITIGATION AND PRODUCTIVITY IMPACTS FOR SHEET METAL, HVAC AND MECHANICAL CONTRACTORS

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FOUNDATION
A Chance to Grow

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MITIGATION AND PRODUCTIVITY IMPACTS FOR SHEET METAL, HVAC AND MECHANICAL CONTRACTORS

July 2020

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Dan Doyon, *Director at Maxim Consulting*, works with construction-related firms to solve complex business challenges to drive revenue and profitability. His broad experience in business process improvement across construction and related industries provides him with a unique perspective to identify and solve operational issues. His subject expertise includes organizational assessments, strategic business planning, financial planning and analysis, technology, organizational design and transition, productivity improvement, peer groups and prefabrication system design. With Doyon's guidance and recommendations, companies have driven over $160B in top line sales growth and hundreds of millions in operational savings and improved processes.

Brian Lightner, *Associate Director at Maxim Consulting*, is responsible for client evaluation and implementation of processes. He has worked with construction firms, including the first ISO 9000 certified General Contractor in the U.S., to lead process improvement initiatives. He is keenly aware of the challenges that contractors face, including in their field operations. Lightner's areas of expertise include project planning/scheduling/execution; field productivity assessments; project recovery; and process improvement/integration/standardization. His experience with both construction specialties and highly successful general contractors allow him to execute many exemplary field operation and productivity studies.

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EXECUTIVE SUMMARY

Overview

Pandemics negatively impact construction productivity. To date, no resource existed to aid contractors in quantifying these impacts for the purpose of seeking equitable compensation for lost productivity, adequately pricing upcoming work that will take place under pandemic driven work rules and conditions, and properly formulating financial projections that take into account stress on cash flow due to both decreases in productivity and the associated increases in overhead costs.

In late April 2020, New Horizon's Foundation retained Maxim Consulting Group, LLC to quantify these impacts so that industry contractors have a practical resource useful for mitigating pandemic related productivity losses. The study builds on and correlates to similar work published in ELECTRI International's "Pandemics and Construction Productivity: Quantifying the Impact" study.

Two methods are used to quantify the magnitude of pandemic related productivity losses and are described in detail in Parts I and Part II of this paper.

Part I - Pandemic Mitigation Tracking

A random sample of over 20,000 labor hours collected from Sheet Metal, HVAC and Mechanical contractors to date **indicates 8.7% of hours available on projects to do productive work are lost due to mitigation requirements such as PPE management, cleaning & disinfection, access rules, and extra administration time. Identical sampling methods used in the ELECTRI study indicated similar results for electrical contractors on over 92,000 hours sampled. The combined average loss on mitigation for MEP contractors is 8.8% on over 113,000 hours. It is reasonable to expect that if these hours were available, crews would be putting work in place**.

The combined sample sets of the two studies provide a convincing quantification of losses on mitigation tasks – contractors should prepare change orders to seek direct financial compensation for these lost hours as well as use this data to adjust scope and pricing for future work under similar conditions.

Part II - Productivity Benchmarking

Our study indicates an overall 9.2% average productivity impact on Sheet Metal, HVAC and Mechanical contractor productivity as a result of the pandemic. These productivity losses are *additive* to the mitigation impact of 8.7%, to produce a total productivity impact of 17.9%. These may occur due to non-mitigation related impacts including, but not limited to: extra mobilizations/demobilizations, work fatigue from anxiety and excess absenteeism, social distancing effects, off-shift work, altered delivery & material receiving, inspection and cleaning requirements, etc. **Based on the current data, there are over 85 minutes of lost productivity per day per employee's 8-hour work period**.

Companies that have trended lower in productivity losses have established, organized, and trained their teams with new pandemic mitigation processes and procedures. Additionally, they have monitored and shifted work activities to accommodate required distance spacing between team members. Leaving pandemic-related productivity losses of this magnitude unaddressed is a significant problem for contractors. For specialty contractors a loss of *10% labor productivity* often results in a *100% loss in project profitability*. **This means that on average in the study results, contractors are losing over 7% on projects**. The magnitude of this issue represents a very real threat to a contractor's ability to remain in business if left unmitigated. Worse, the nature of productivity losses is a lag effect that often goes unnoticed by conventional projection and reporting systems until it is too late. The true financial impact of productivity losses can take as long as 3-6 months to fully play out in a company's finances. Cash flow projections based on assumptions that do not include excess production costs and associated overhead costs can easily foster a false sense of security. This ripple effect is broadened as company resources (labor, equipment and management) assumed to be available to execute

new billable work are delayed as a result of slower productivity on existing work. It is only a matter of time before these impacts catch up to a company's cash flow cycles.

Contractors that adopt this information and put plans in place earlier are better equipped to weather the negative impact of pandemic driven productivity losses.

The average baseline productivity impact of:

8.7% (Mitigation) + 9.2% (Productivity) = 17.9% (Total Productivity Impact)

is substantial. Contractors should utilize this information to price an equitable adjustment properly employing both the Pandemic Change Order Calculator provided with this study and the study itself as backup verification for the impact.

PART I - PANDEMIC MITIGATION TRACKING

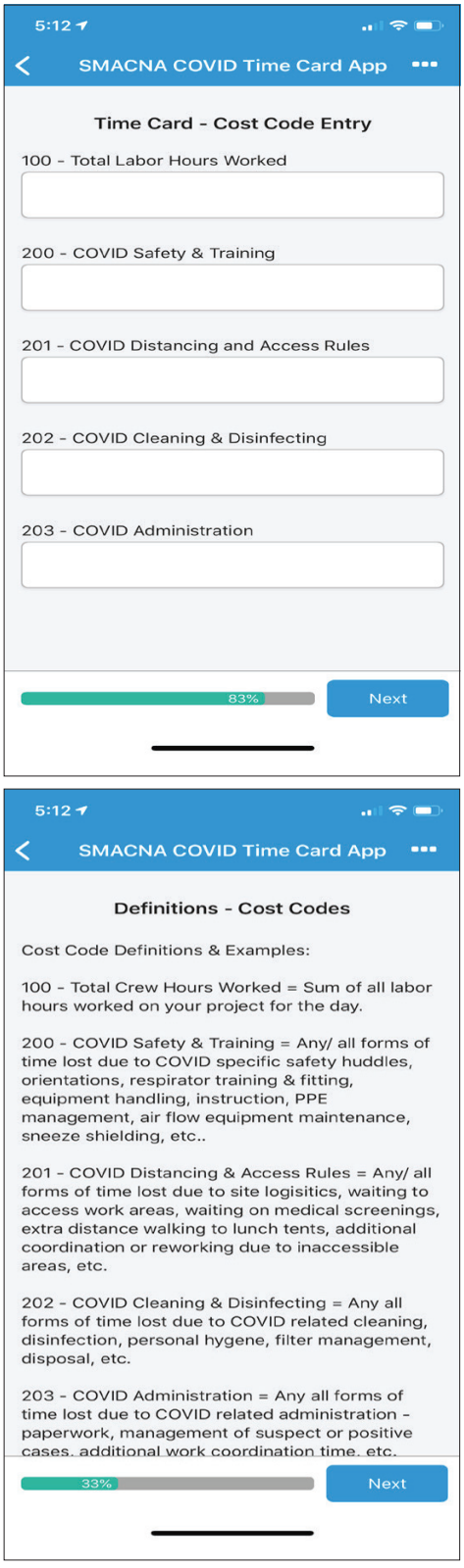
Objective

The objective of Pandemic Mitigation Tracking is to quantify lost productivity directly associated with jobsite pandemic mitigation requirements such as PPE management and training, health screenings, cleaning and disinfecting, job site access and administration, all instituted to minimize exposure.

Data Collection and Methodology

Labor hours on impacted projects were collected from field supervisors on a daily basis via an application developed by the consultants for iOS and Android smartphones and tablets. Data collection began on April 30th, 2020 and concluded on July 3, 2020. *Figure 1* shows the interface used by field supervision to enter time as well as the definitions provided to participants for normalizing data:

Figure 1: Application interface for entering daily time and included definitions for participants.



A single data point for this research represents time reported to five standardized time codes, per project, per day. Standard definitions for each time code normalize the data across the range of participants in the sample and were provided to participants in both a PDF instruction manual as well as embedded in the application itself. The time codes and definitions are:

- 100 – Total Hours Worked = Sum of all labor hours worked on the project for the day.
- 200 – COVID Safety & Training = Any/all forms of time lost due to COVID specific safety huddles, orientations, respirator training & fitting, etc.
- 201 – COVID Distancing & Access Rules = Any/all forms of time lost due to site logistics, waiting to access work areas, waiting on medical screenings, extra distance to lunch & break areas, etc.
- 202 – COVID Cleaning & Disinfecting = Any/all forms of time lost due to COVID related cleaning and disinfection of tools, equipment, and personal effects (including handwashing.)
- 203 – COVID Administration = Any/all forms of time lost due to COVID related administration, paperwork, management of suspected cases, additional work coordination meetings, etc.

Participants also categorized the type of crew for which time is reported. Crew types included are:

- HVAC/Sheet Metal Crew
- Mechanical Crew
- Plumbing Crew
- Composite (Combined Trades) Crew

Taken in combination with the results published in the ELECTRI study, the quantification provides a thorough cross section of impact across all the MEP trades.

Definitions of activities for each time code category were determined from:

- Local, state and federal government guidelines for social distancing
- OSHA's 'Guidance on Preparing Workplaces for COVID-19'
- OSHA's 'Interim Enforcement Response Plan for Coronavirus Disease 2019'
- Firsthand accounts provided by contractors.

Participants received instruction for using the data collection tools via a combination of methods:

- Recorded Webinar
- PDF Instruction Manual
- Instructions and FAQ embedded in the application
- Direct access to the research project's consultants via phone, text or email for questions and technical support

Each day, the consulting team reviewed sample size and geographic coverage using a heat map linked to the sample data set.

The analysis of the data collected centers on a simple argument: **It is reasonable to expect that the percent of labor hours, on average, that a contractor loses on jobsite pandemic mitigation requirements are hours not available to produce work at estimated rates of production and/or rates of production as defined in resources such as recognized manuals of labor units published by trade associations**.

Sample Set

Figure 2 provides a table that depicts the breakdown of hours collected and tasks coded to mitigation related activities for New Horizons Foundation – Sheet Metal, HVAC and Mechanical contractors.

Figure 2: State Distribution of Mitigation Data (New Horizons Foundation + ELECTRI).

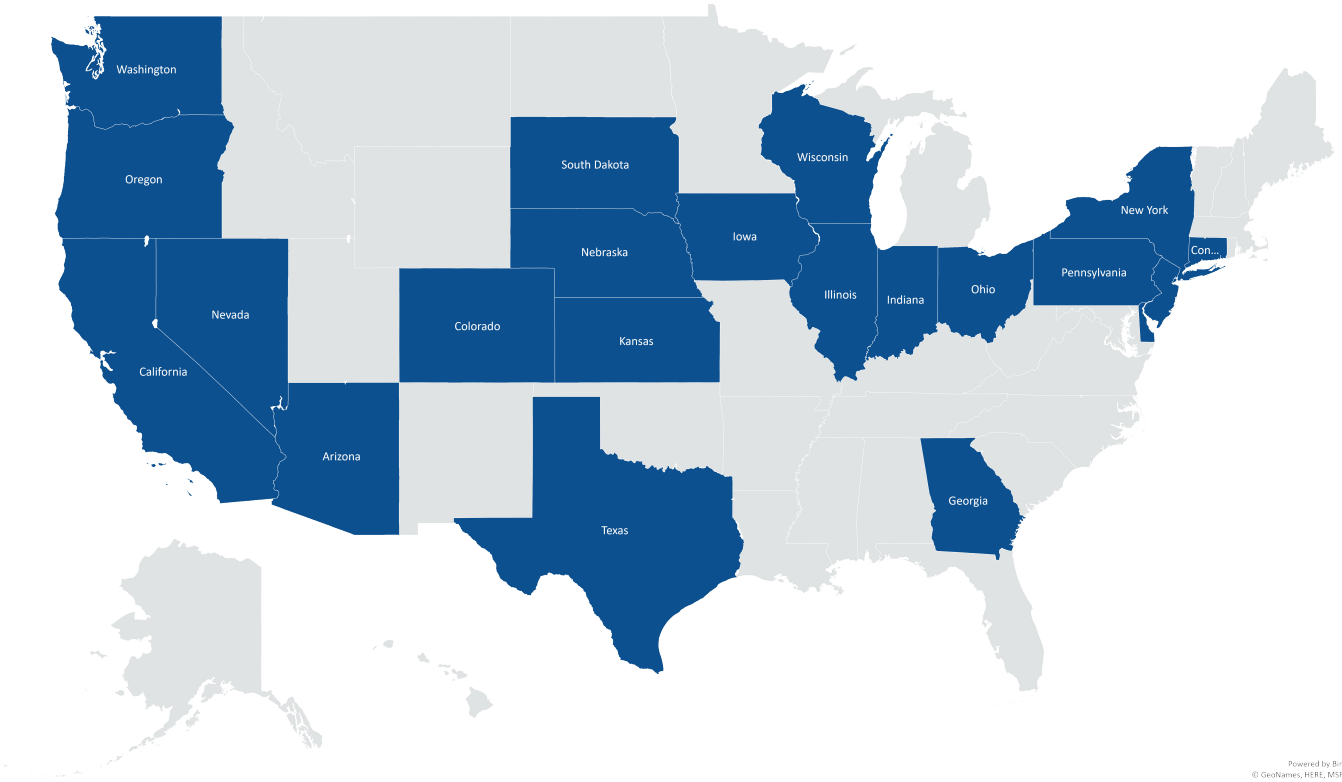


Figure 3 provides a table that depicts the breakdown of hours collected and tasks coded to mitigation related activities for the New Horizons Foundation study, covering all MEP trades.

Figure 3: Mitigation Hours by Task Code (New Horizons Foundation).

	Total Hours	% of Total Hours	% of Mitigation Hours
Total Hours Available	*20,893*		
Mitigation Hours: Safety & Training	470	2.2%	25.9%
Mitigation Hours: Distancing & Access Rules	439	2.1%	24.1%
Mitigation Hours: Cleaning & Disinfecting	580	2.8%	32.0%
Mitigation Hours: Administration	326	1.6%	18.0%
Total	**1,815**	**8.7%**	**100%**

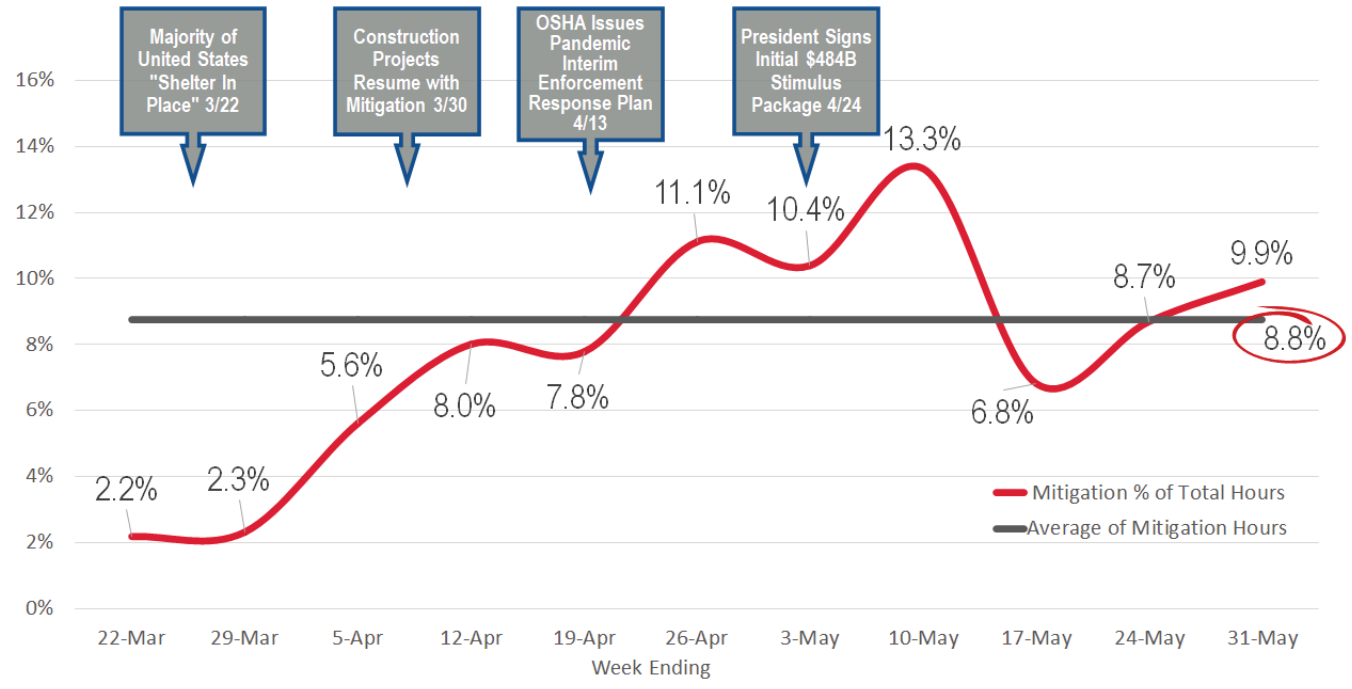
Figure 4 provides a table that depicts the breakdown of hours collected and tasks coded to mitigation related activities for combined New Horizons Foundation and ELECTRI studies, covering all MEP trades.

Figure 4: Mitigation Hours by Task Code (New Horizons Foundation + ELECTRI).

	Total Hours	% of Total Hours	% of Mitigation Hours
Total Hours Available	*113,213*		
Mitigation Hours: Safety & Training	2,229	1.94%	22.0%
Mitigation Hours: Distancing & Access Rules	4,081	3.6%	40.3%
Mitigation Hours: Cleaning & Disinfecting	2,839	2.5%	28.1%
Mitigation Hours: Administration	968	0.8%	9.6%
Total	**10,117**	**8.8%**	**100%**

Figure 5 provides a view of week over week mitigation percentage over the course of reporting in the combined studies.

Figure 5: Mitigation Hours as a Percent of Total Hours by Week (New Horizons Foundation + ELECTRI).



Summary Findings

On average, 8.8% of hours provided to impacted projects are lost by MEP trades as a result of mitigation tasks at the time of this publication.

Of the 8.8% loss, 22.0% of it is lost due to safety & training requirements, 40.3% is lost due to distancing and access requirements, 28.1% is lost due to cleaning & disinfecting, and 9.6% is lost due to administration.

These numbers can and should be used by contractors in the preparation of change orders, the pricing and adjusting of scope in upcoming work on impacted projects, and to 'stress' test financial projections.

In general, contractors should not be required to itemize the 8.8% loss into sub-categories since all categories require management on active projects during a pandemic. Federal distancing guidelines, OSHA requirements, and the resulting general contractor and subcontractor safety plans apply to most active projects, regardless of region or type. For example, the following existing standards are referenced by OSHA as applicable in times of pandemic and apply to all projects across the country:

- 29 CFR § 1904, Recording and Reporting Occupational Injuries and Illness.
- 29 CFR § 1910.132, General Requirements - Personal Protective Equipment.
- 29 CFR § 1910.133, Eye and Face protection.
- 29 CFR § 1910.134, Respiratory Protection.
- 29 CFR § 1910.141, Sanitation.
- 29 CFR § 1910.145, Specification for Accident Prevention Signs and Tags.
- 29 CFR § 1910.1020, Access to Employee Exposure and Medical Records.
- Section 5(a)(1), General Duty Clause of the OSH Act.

It is possible that local, state, owner driven, or contractor-specific mitigation requirements could affect the degree and complexity required to comply with mitigation requirements. **In such cases, contractors should use the 8.8% mitigation loss as a baseline from which modifications specific to their situation are made**. Factors to consider are provided in the section entitled "Roadmap" below.

Is the situation improving with time? It is too early to tell. It is reasonable to expect that early uncertainty surrounding the necessity and degree of mitigation requirements will ease as the specific disease is better understood and enforcement agencies more clearly define requirements. It is also reasonable to expect that contractors will improve their ability to cope with mitigation requirements as time goes on, provided they know what to expect. Until then, contractors should consider several factors to assess the degree of impact they will experience that will modify the current average including:

- GC/CM/Owner Site-Specific Safety Plans
- GC/CM Site Logistics Plans
- Quality of Work Coordination
- Local, state, or other modifiers to Federal Guidelines

With the number of hours and projects sampled, 8.8% is a solid calculation of the current average mitigation loss experienced daily by contractors across the country with a margin of error of ±1%.

Roadmap

Contractors should utilize the average loss in productivity in the following scenarios:

- Use the average provided as either direct calculation of loss in the preparation of change orders requesting relief for the time lost managing pandemic mitigation requirements or as backup to negotiations of change orders currently pending.
- Use the average provided as a multiplier on active projects to forecast financial projections, schedule impact, and resource availability.
- Use the average provided as a multiplier for estimating projects that will require pandemic

mitigation factors as projects re-open and for future projects, assuming prolonged mitigation requirements.

Factors that should be considered as modifications to the baseline average include but are not limited to:

- Detailed knowledge of federal, OSHA, and CDC applicable guidelines and directives.
- Local and state modifiers or additions to federal, OSHA, and CDC guidelines and directives.
- Availability and clarity of owner, GC/CM project specific safety plans.
- Project specific characteristics that influence social distancing and logistics.
- Relationship with the GC/CM.

Contractors should look to SMACNA for news and information regarding additional training and education as well as referrals for support and assistance in developing change order requests.

PART II – PRODUCTIVITY BENCHMARKING

Objective

The aim of the Productivity Benchmarking had three parts:

1. To measure sheet metal, mechanical and plumbing contractor companies' pre- and post-pandemic productivity;
2. To measure the impacted tasks by market segment, project/job type and geographic area;
3. Provide analysis, summary findings and a roadmap to operationalize the results.

In order to achieve the objective, the research consultants established a model to normalize data and provide a consistent and structured manner to collect and analyze the productivity data. More specifically, they:

- Documented specific tasks designed by a New Horizons Foundation-designated task force – this enabled us to collect percent completed and hours for common tasks across companies;
- Constructed a formalized data gathering process from multiple sheet metal, mechanical and plumbing contractors across the US;
- Defined specific critical dates that impacted contractor productivity (i.e. – Shelter in place orders);
- Measured, tracked, mapped and analyzed the data provided by contractors;
- Built analytics models to generate insights into data and summarized the results;
- Utilized a double-blind methodology with only the project leader (Maxim Consulting) knowing which contractor's data are aggregated in the results to ensure confidentiality;
- Provided contractors who participated in the study an individualized profile of their results versus the national numbers to further assist in quantification.

Data Collection and Methodology

The Collection Process

The data collection process involved the generation of large amounts of data from contractors providing the information in a formalized Microsoft Excel file template.

For each data point, we collected the following information from contractors:

- Market Segment
- Project ID
- Project/Job Name
- Project/Job Type
- Location City
- Location State
- Contact Person

- Contact Person Phone
- Week Start Date
- Week End Date
- Task Code
- % Complete
- Number of Hours

We provided the contractors with specific selection options for the Project/Job Type:

- Chemical
- Commercial Facilities
- Communications
- Critical Manufacturing
- Dams
- Defense Industrial Base
- Emergency Services
- Energy
- Financial Services
- Food and Agriculture
- Government Facilities
- Healthcare and Public Health
- Information Technology
- Nuclear Reactors, Materials, and Waste
- Transportation Systems
- Water and Wastewater Systems
- Other

We provided the contractors with specific selection options for the Market Segment:

- Shop - Sheet Metal
- Shop - Piping
- Shop - Plumbing
- Field - Sheet Metal
- Field - Piping
- Field - Plumbing
- Architectural Sheet Metal

We provided the contractors with specific selection options for the Task Code for each Market Segment:

Market Segment	**Task Code**	**Definition**
Shop - Sheet Metal	Duct (Pounds Per Hour)	Includes galvanized weight as you measure it, nominal, with or without waste, per your shop standards, including connectors, reinforcing.
Shop - Sheet Metal	Fittings	As above, if you segregate galvanized fitting weight/production. It can be included above with ductwork, in which case this cell will be empty.
Shop - Sheet Metal	Prefabrication/ Assemblies/ Modularization	Any work that is tracked in assembling finished joints of ductwork, fittings, and accessories or in line components, if you separate that in your shop.
Shop - Piping	Hangers and Supports	Generally all labor cutting, labeling, assembling clevis hangers, unistrut or racks.

Market Segment	Task Code	Definition
Shop - Piping	Weld Inches (Aggregate)	Includes cutting, handling, prep, tack and welding, loaded to the door.
Shop - Piping	Joint Inches (Aggregate)	Includes prefabrication of all other joint types, plastic, grooved joint, brazed or refrigeration.
Shop - Plumbing	Hangers and Supports	Generally all labor cutting, labeling, assembling clevis hangers, unistrut or racks.
Shop - Plumbing	Underground Sanitary Waste and Vent	Includes all cast or plastic cutting and assembly or kitting.
Shop - Plumbing	Above Ground Sanitary Waste and Vent	If you don't segregate this work, include it above. This would include fixture batteries and carriers.
Shop - Plumbing	Domestic Water	All work on copper, PEX, prefabrication and kitting.
Shop - Plumbing	Storm Drain	All work on cast or plastic systems, prefabrication and kitting.
Shop - Plumbing	Natural Gas	All cutting, prefabrication and kitting.
Shop - Plumbing	Specialty Systems	Headwall prefab, water treatment, skids or other assemblies not coded in Domestic systems above.
Shop - Plumbing	Fixtures and Trim	Prefabrication work assembling components and trim.
Shop - Architectural Sheet Metal	Single Ply Panel Systems	Single Ply Panel Systems.
Shop - Architectural Sheet Metal	Ornamental	Railings, Column Covers, specialty/custom architectural metal products fabrication.
Field - Sheet Metal	Hangers and Supports	All layout, inserts or anchors, and hangers, whether cable, rod or strap, trapeze and seismic, if any.
Field - Sheet Metal	Rough In - Risers	If risers are a segregated task from other LP and MP work.
Field - Sheet Metal	Rough In - Low Pressure	All labor downstream of terminal boxes, and all 2" or lower pressure class, whether it's supply, return or exhaust, and in line accessories, as well as hangers if you don't segregate hanger labor.
Field - Sheet Metal	Rough In - Medium Pressure	All supply air duct labor downstream of AHUs and upstream of terminal boxes, in line accessories, and hangers if you don't segregate hanger labor.
Field - Sheet Metal	Air Distribution and Trim	All grilles, registers and diffusers, terminal devices, louvers, flex and taps, if not installed in rough in.

Market Segment	Task Code	Definition
Field - Sheet Metal	Dry Side Equipment	Including AHU's, DOAS, VFR components, built up housings, fans, hoods, roof-mounted equipment, filters, and essentially all equipment not accounted for in the duct rough-in above (e.g. terminal devices if reported separately).
Field - Piping	Risers	All HVAC piping in risers, if tracked separately.
Field - Piping	Hangers and Supports	All layout, inserts or trapeze systems, seismic if reported separately from the rough in categories.
Field - Piping	Heating and Cooling Water	HVAC piping, whether welded or grooved, or small-bore copper, including work in Central Plants or equipment rooms, including condenser water.
Field - Piping	Condenser/Steam/ Refrigerant	Split system DX, or distribution piping for VRF systems.
Field - Piping	Wet Side Equipment	Towers, Chillers, Cooling Towers, Pumps, Heat Exchangers, DX Condensers, DOAS or VRF components.
Field - Plumbing	Hangers and Supports	Generally, all labor cutting, labeling, assembling clevis hangers, unistrut or racks.
Field - Plumbing	Underground Sanitary Waste and Vent	Includes all cast or plastic cutting and assembly or kitting.
Field - Plumbing	Above Ground Sanitary Waste and Vent	If you don't segregate this work, include it above. This would include fixture batteries and carriers.
Field - Plumbing	Domestic Water	All work on copper, PEX, prefabrication and kitting.
Field - Plumbing	Storm Drain	All work on cast or plastic systems, prefabrication and kitting.
Field - Plumbing	Natural Gas	All cutting, prefabrication and kitting.
Field - Plumbing	Medical Gas	Medical Gas.
Field - Plumbing	Specialty Systems	Headwall prefab, water treatment, skids or other assemblies not coded in Domestic systems above.
Field - Plumbing	Fixtures and Trim	Prefabrication work assembling components and trim.
Field - Architectural Sheet Metal	Building Enclosure Components	ACM composite panels, light gauge skin, metal panels (insulated and non-insulated).
Field - Architectural Sheet Metal	Metal Roofing	Zinc, Copper, Steel and other metal alloys constructed using standing seam, flat seam and other methods.

Market Segment	Task Code	Definition
Field - Architectural Sheet Metal	Flashing	Thin pieces of impervious material installed to prevent the passage of water into a structure from a joint or as part of a weather resistant barrier system.
Field - Architectural Sheet Metal	Ornamental	Railings, Column Covers, specialty/custom architectural metal products installation.

Data Set

Figure 6: State Distribution of Productivity Data.

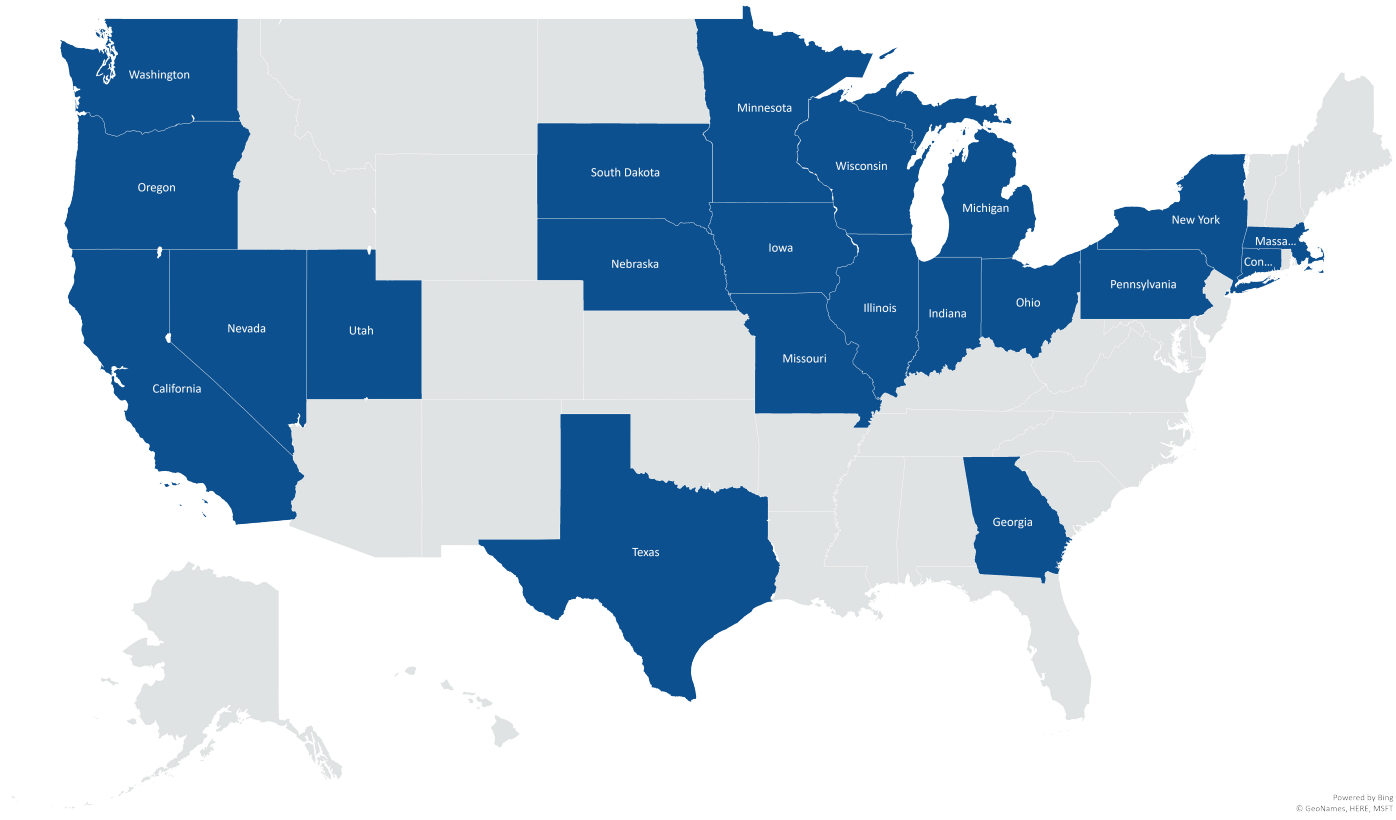


Figure 7: Concentration Heatmap of Sample Set Data Areas of United States.

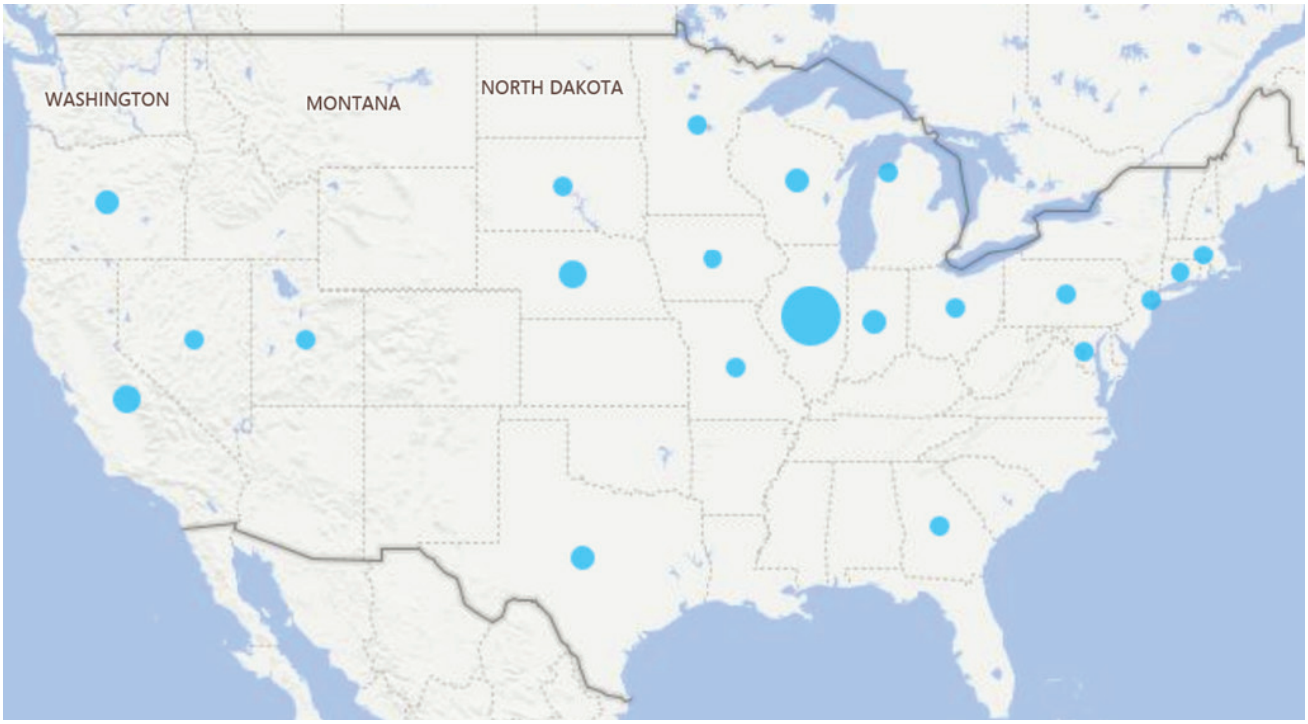
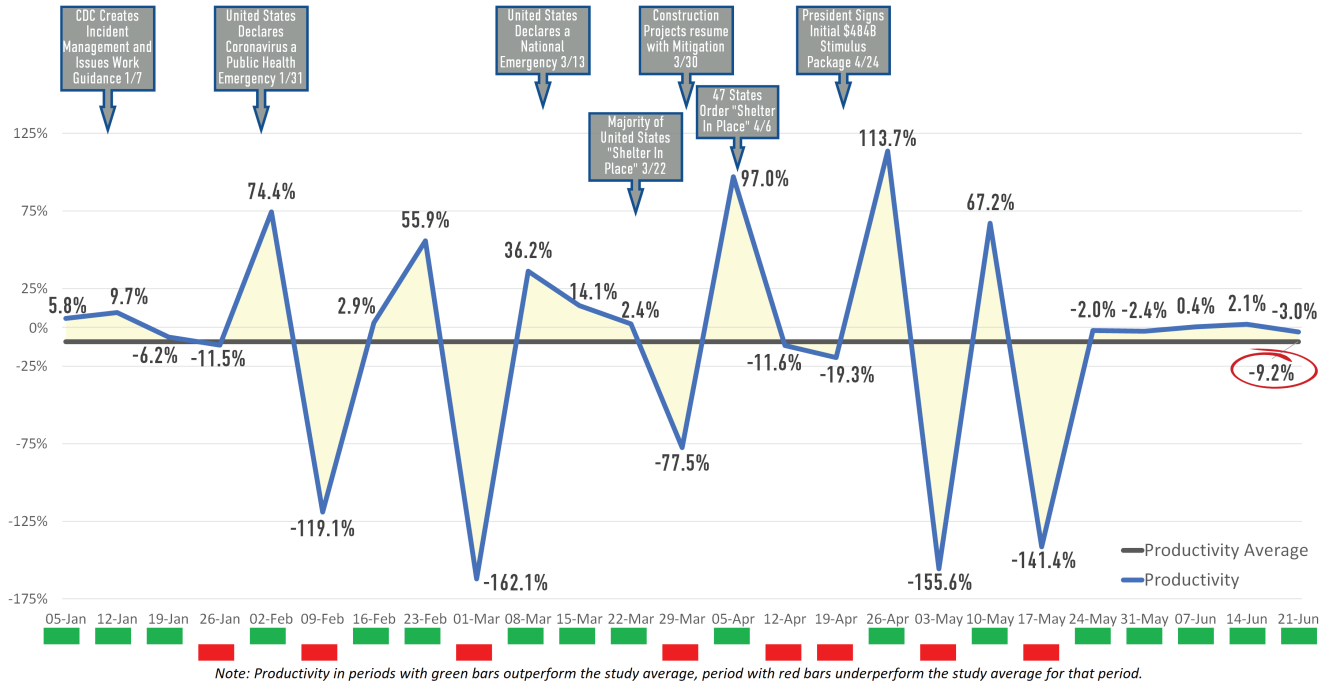


Figure 8: Sheet Metal, Mechanical and Plumbing Contractors Productivity Against Events.



Note: Productivity in periods with green bars outperform the study average, period with red bars underperform the study average for that period.

Summary Findings

Our study indicates an overall 9.2% average productivity impact on Sheet Metal, HVAC and Mechanical contractor productivity as a result of the pandemic. In the larger samples we received in the Midwest regional projects, **we are seeing the productivity loss approaching 11% on average. These productivity losses are *additive* to the mitigation impact of 8.7% (and confirmed by the New Horizons Foundation study data combined with ELECTRI at 8.8%), to produce a total productivity impact of 17.9%**. These may occur due to non-mitigation related impacts including, but not limited to: extra mobilizations/demobilizations, work fatigue from anxiety and excess absenteeism, social distancing effects, off-shift work, altered delivery & material receiving, inspection and cleaning requirements, etc. **Based on the current data, there are over 85 minutes of lost productivity per day per employee's 8-hour work period.**

Roadmap

Companies that have trended lower in productivity losses have established, organized and trained their teams with new pandemic mitigation processes and procedures. Additionally, they have monitored and shifted work activities to accommodate required distance working between team members. Contractors are using plotting pre-hangars (Trimble/HILTI) and the pre-fabrication dynamic to lessen the impact of these productivity tasks, Contractors taking advantage of and maximizing prefabrication disciplines to minimize field crews to increase efficiency.

The baseline impact of 9.2% is substantial. Contractors should utilize this information to price an equitable adjustment properly utilizing this study's associated Pandemic Change Order Calculator provided and this study as backup for the impact. Additionally, contractors should utilize this study as support documentation when requesting price adjustments.

The Pandemic Change Order Calculator can be found here:

www.newhorizonsfoundation.org/pandemiccocalculator/

APPENDICES

Appendix A: Pandemic Mitigation Tracking Data Collection Definitions & Tools

Figure 9: Pandemic Mitigation App Data Collection Tool.

Figure 10: Pandemic Mitigation App Activity Definitions.

Cost Code Definitions		
Cost Code	**Cost Code Name**	**Example activities in Cost Code**
100	Total Crew Hours Worked	Sum of all labor hours worked on your project for the day.
200	COVID Safety & Training	Any/all forms of time lost due to COVID specific safety huddles, orientations, respirator training & fitting, equipment handling, air flow equipment maintenance, sneeze shielding, etc.
201	COVID Distancing & Access Rules	Any/all forms of time lost due to site logistics, waiting to access work areas, waiting on medical screening, extra distance walking to lunch tents, additional coordination or reworking due to inaccessible work areas, etc.
202	COVID Cleaning & Disinfecting	Any/ all forms of time lost due to COVID related cleaning, disinfection, personal hygiene, filter management, disposal, etc.
203	COVID Administration	Any/ all forms of time lost due to COVID related administration, paperwork, management of suspect or positive cases, additional work coordination meetings, etc.

Appendix B: Double-Blind Productivity Benchmark Participant Survey

The research study utilized a double-blind methodology to observe pre- and post-pandemic construction productivity impacted by behavioral interventions. Blinding or masking refers to the withholding of information regarding treatment allocation from one or more research study participants. It is an essential methodological feature of studies that helps maximize the validity of the research results.