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A REVIEW OF PERFORMANCE MEASURES IN THE SHEETMETAL CONSTRUCTION INDUSTRY

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EXECUTIVE SUMMARY

This paper documents the current performance measures within the sheet metal construction industry in the US and Canada. The construction sheet metal industry is crucial for fabricating and installing components like heating, ventilation, air conditioning (HVAC) systems, ductwork, roofing, and architectural features, ensuring buildings' integrity, functionality, and energy efficiency. Key Performance Metrics (KPMs) have proven successful in monitoring and measuring industry performance. Tailored KPMs that provide measurable insights into various operational dimensions are essential for the sheet metal industry to maintain a competitive advantage. These metrics help translate complex project dynamics into actionable data, fostering a culture of continuous improvement and strategic decision-making. The paper emphasizes the importance of KPMs in guiding sheet metal firms through production, project management, and adopting new initiatives.

The study involved interviews with firms of varying scales across the US and Canada, ranging from local firms with less than $10 million in annual revenue to national firms exceeding $500 million. These firms engaged in diverse projects, including commercial, residential, industrial, and advanced technology sectors. The interviewed firms prioritized KPMs in five main areas: shop fabrication, virtual design and construction (VDC), field installation, financial tracking, and safety. Some firms also tracked logistics, marketing, project manager performance, and strategic goals. Data collected included worker labor hours, material quantities, and costs. Productivity was measured in pounds per worker hour (lbs/hr) or square footage per worker hour (SF/hr). Some firms also tracked material turnover rates and waste percentages to identify quality issues.

On-site installation metrics focused on worker productivity, measured in lbs/hr or SF/hr, and production rates, such as linear feet per workday. Firms also tracked the consistency of work packages between shop and field installation to ensure efficient resource allocation.

Financial metrics included project billings, receivables, cash position, and profitability. Firms tracked these metrics to assess financial health and project risk, with some conducting weekly tracking and forecasting.

VDC metrics varied among firms, with some tracking hours spent on modeling and detailing tasks. Firms aimed to align VDC efforts with shop and field work packages to streamline material measures and improve project coordination.

Safety metrics included standard industry measures like days away, restricted, or transferred (DART) rates, lost time incident rates (LTIR), and recordable incident rates. These metrics helped firms maintain safety standards and manage insurance rates.

The paper highlights the limitations of traditional KPMs in capturing the unique aspects of sheet metal construction. Generic metrics often fail to address the precision and material intricacies specific to this industry. The static nature of conventional KPMs also struggles to adapt to the dynamic conditions of sheet metal projects.

To address these challenges, the authors recommend developing tailored, dynamic KPMs that reflect the specific needs of sheet metal construction. This approach would enhance the industry's ability to respond to evolving design requirements, material variations, and client expectations.

1. INTRODUCTION

The sheet metal construction industry is critical in the broader construction field. It involves fabricating and installing sheet metal components in structures, ranging from HVAC systems and ductwork to roofing and architectural features, as well as large-scale industrial applications and custom specialty fabricated components. This industry is pivotal in ensuring buildings' integrity, functionality, and energy efficiency. Sheet metal fabrication is a complex activity involving various materials (grades of steel, aluminum, etc.), machines, tools, and technologies to produce a large spectrum of unique products in their design, size, and batch sizes. The installation process for sheet metal is very distinct, with a wide array of use-space requirements spanning the construction industry. Owing to these factors, the performance measurement in sheet metal becomes an endeavor and a challenge for managers.

In the landscape of sheet metal construction, key performance measures (KPMs) are pivotal across various dimensions, ensuring operational success and adaptation to emerging trends. As the construction project unfolds, general-use KPMs become the focus of project management. Project completion, budget adherence, or detailed measures such as quality metrics are used as tracking insights to ensure on-time, precise, and effective execution. These metrics become the arc of the project, resulting from the alignment in the preconstruction and fabrication processes, determining a project's ultimate success, such as elements shown in *Figure 1*.

A comprehensive set of KPMs, woven into the process and lifecycle of sheet metal construction, becomes the guide as firms address the stages of planning, piloting, and adopting new initiatives. As trends emerge and the industry evolves, companies must be poised to meet challenges and pursue resilience, innovation, and continuous improvement.

Figure 1: a) Sheetmetal Assemblies Are Ready to Be Shipped, and b) Components Are Ready to Be Assembled in a Shop.

The significance of KPMs in construction lies in their ability to translate complex project dynamics into measurable and actionable insights. In the sheet metal industry, where success hinges on precise coordination of resources and timelines, KPMs are effective continuous improvement tools for firms, project managers, and related stakeholders. Through KPMs, we can gain insights to identify strengths, weaknesses, and improvement areas across a project portfolio. In essence, KPMs are not mere measures but instruments guiding the construction firm toward efficiency, transparency, and project success.

As the construction landscape evolves, the role of KPMs becomes increasingly pronounced in embracing data-driven decision-making. This transition is driven by the recognition that traditional, experience-based approaches can be augmented and often outpaced by the insights derived from data analytics when the right software, models, and tracking measures are in place. KPMs bridge the wealth of data available to the transformative decisions required for the ultimate success of the project and the firm. In adopting a data-driven perspective, firms must be able to use KPMs to measure performance retrospectively and better predict and shape their success in selecting the right projects and partners.

2. KPMS BY PROJECT PHASE

In the preconstruction phase, Key Performance Metrics (KPMs) form the blueprint for success, shaping the trajectory of projects before the ground is even broken. Here, the emphasis is on metrics like the accuracy of project cost estimates, bid-to-win ratios, and the efficiency of the planning process. The precision of these KPMs sets the foundation for financial viability and decision-making. For instance, a high bid-to-win ratio may indicate effective cost estimation and a competitive edge. In contrast, discrepancies between estimated and actual costs can signal areas for improvement in preconstruction processes or recognition of which GCs are collecting your bids but not awarding you projects. As such, preconstruction KPMs act as the compass guiding the use of your resources toward project feasibility and success of winning work.

Transitioning to off-site fabrication and logistics, KPMs take on a new dimension, focusing on efficiency, cost-effectiveness, and quality control. Throughput metrics measure the pace of fabrication, ensuring timely production of components, while first-pass yield becomes a benchmark for quality. Logistics KPMs, such as delivery times and inventory turnover, are important in the off-site context, considering both shop output and outside supply chain for minimizing delays. For example, a low inventory turnover rate might signal excess stock and inefficiencies in material management. In this phase, KPMs serve as a dynamic orchestration, harmonizing the intricacies of fabrication and logistics to streamline the off-site construction process.

As construction moves on-site, KPMs shift to emphasize safety, productivity, and project schedule. Productivity KPIs measure the efficiency of labor and equipment use, ensuring that resources are not being wasted or costing excess money when not being used. Additionally, adherence to project schedules becomes a key factor. In a holistic sense, the leading KPMs in construction create a narrative that spans from the initial planning stages to the culmination of on-site activities. Each phase is interconnected, with the success of one contingent upon the performance in the preceding stages. This connectivity, guided by thoughtful KPMs, defines the firm's ability to adapt, optimize, and deliver projects that meet and exceed expectations. The evolution of KPMs throughout these phases mirrors the dynamic nature of construction, showcasing how these metrics serve as a compass, orchestrating success from conception to completion.

KPMs encounter challenges in capturing the intricate complexities of sheet metal construction projects. One significant limitation lies in the generic nature of many traditional KPMs used in the construction industry. Metrics commonly applied may not account for the unique processes, precision requirements, and material intricacies specific to sheet metal construction. The one-size-fits-all approach fails to address the nuances that distinguish sheet metal projects from other forms of construction. Producing sheet metal components often involves evolving design requirements and frequent adjustments. Traditional KPMs struggle to accommodate changes in real time, limiting their effectiveness in reflecting the fluid nature of construction projects. This limitation undermines the ability to respond promptly to design modifications, material variations, and evolving client expectations.

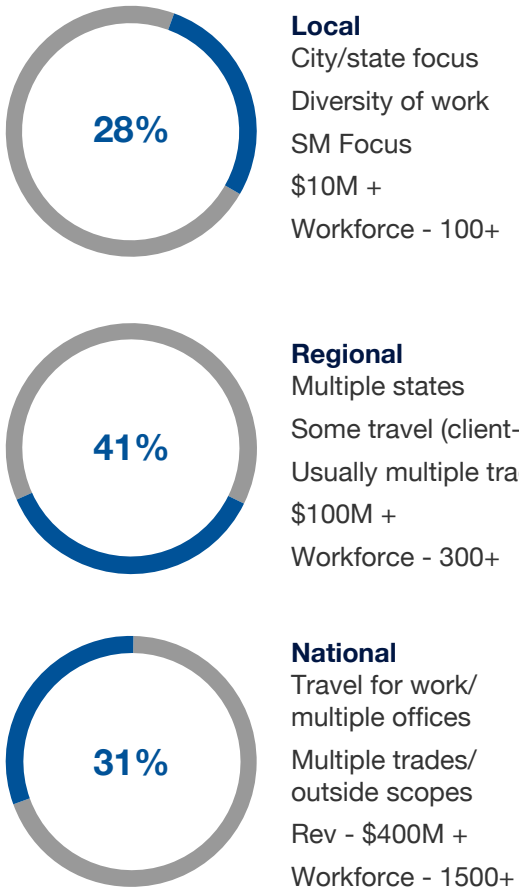
Furthermore, the holistic nature of sheet metal construction, which includes precision fabrication, assembly, and detailing, poses challenges to KPMs that focus on general construction processes. To address this shortfall, a series of interviews with leading sheet metal contractors were performed to learn about the array of measures used throughout the different scales and processes that span the sheet metal construction industry across the US and Canada.

3. DEMOGRAPHICS

The sheet metal firms (see *Figure 2*) ranged in scale from less than $10 Million in revenue per year to more than $500 Million.

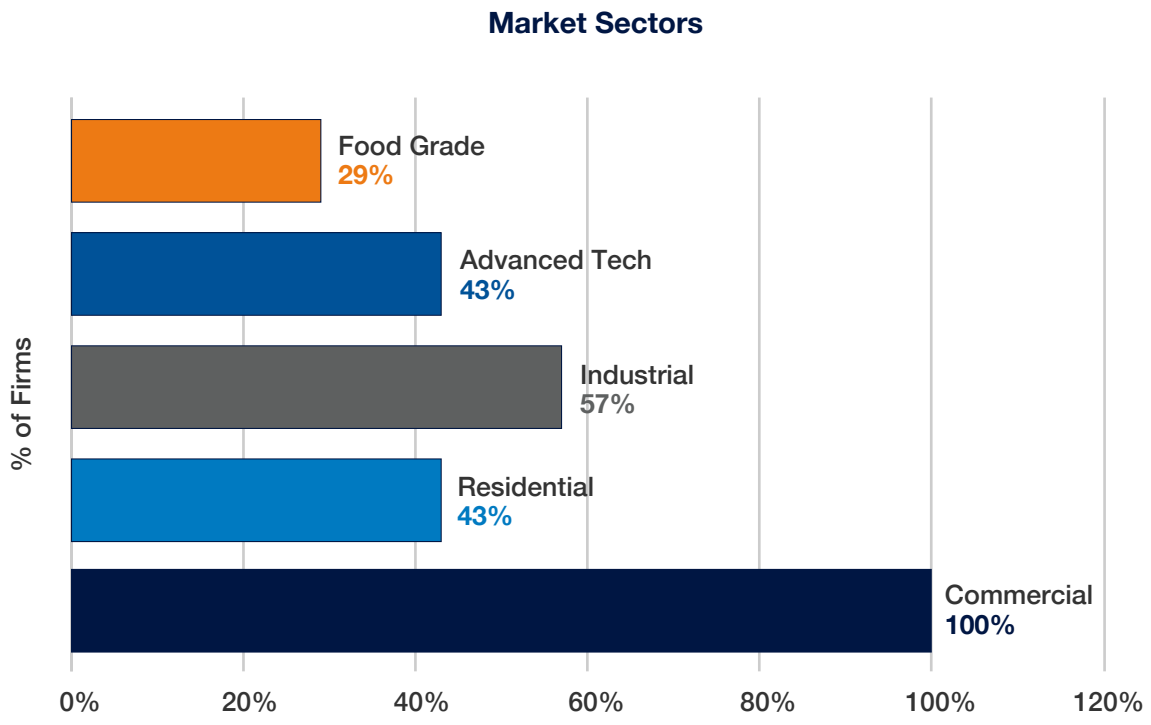
- The Local-scale firms worked within a set radius from their headquarters, typically with one primary office. They almost exclusively performed sheet metal construction activities, with little to no other trade scopes included. Their projects ranged in type to match the local city and region's economy, from commercial construction to large-scale residential work, often with some industrial or other facility types included. Their workforce averaged around 100 workers on a reasonably steady basis.
- Regional firms typically work across several states within a continuous geography, though specific clients often get them to travel outside of their typical domain. These firms had some trades outside sheet metal, most commonly mechanical piping. Their workforce typically exceeds 300 workers in shop and fieldwork.
- National firms had offices across multiple states and commonly traveled for work outside their primary geographic regions. They had multiple trades, with many performing scopes of work ranging from electrical work to heavy civil work. The workforce commonly exceeded 1,500 workers across their operations.

Figure 2: Summary of Firms Interviewed



Across the array of firms, there was variation in the scale and type of work performed (see *Figure 3*). Commercial building construction, ranging from education and high-rise projects to healthcare, was included as a scope by all firms interviewed. Approximately half of the firms engaged in advanced technology work, such as data centers or biopharmaceutical work, as well as industrial projects, such as manufacturing facilities or automotive plants. Some firms did work in the residential sector, but this tended to be multi-family work. A small group of firms moved into FDA-level food-grade system installation as well.

Figure 3: Summary of Market Sector Focus Across Firms Interviewed



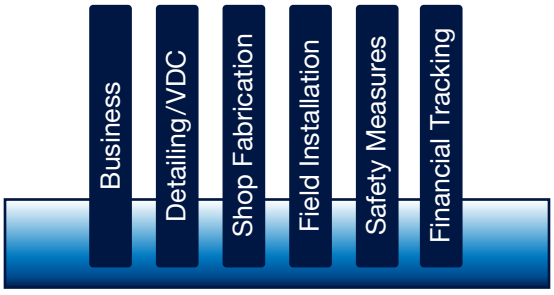
4. OPERATIONAL TRACKING PRIORITIES

Across all the firms and individuals interviewed, the priorities for Key Performance Metrics (KPMs) focused on six areas, as summarized in *Figure 4*: Shop fabrication, virtual design and construction (VDC) for detailing and coordination, field installation at project sites, financial tracking for projects and the firm, and safety measures. Some firms extended this tracking to additional areas, such as logistics and trucking, marketing, project manager performance, and firm or regional-level strategic goals.

4.1 Business Development

One of the leading areas of measurement for firms was lead tracking and pursuing new projects. Under the broad heading of business development, the efforts put into estimating and bidding, finding future work, and forecasting the backlog and commitments to already awarded projects play a critical role in supporting financial viability.

Figure 4: Key Performance Metrics Across Firms



Data collection

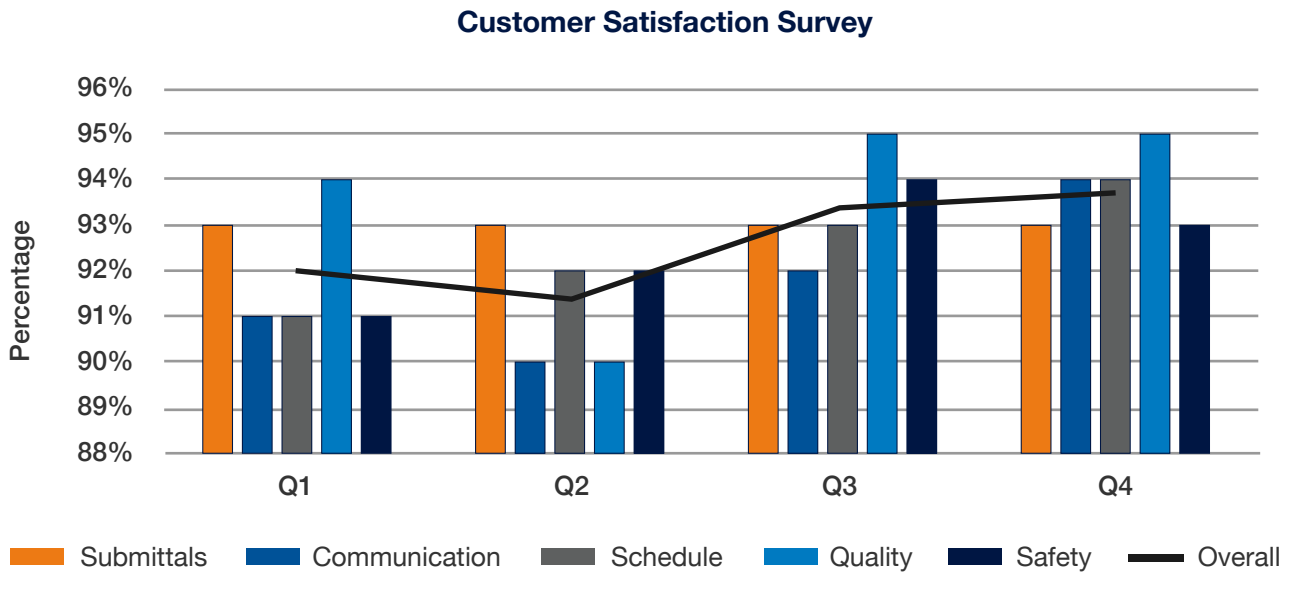
To consider the projects, both current and future, firms focused on both the project and the value of the work committed or scoped in bid documents. The estimates from the bidding process serve as the primary resource for procurement timelines and labor commitments for tracking the backlog of the field workforce, management, and back-of-house and shop support hours needed.

Business Development and Sales Measures

Beyond the direct tracking of work and forecast financial and labor commitments, often a year to 18 months out, many firms considered their work against their strategic targets – what percentage, by count or dollar value, was for repeat customers, were in targeted delivery methods – with many preferring negotiated projects. Facility types and GC breakdowns were also common in understanding their market diversity and considering how saturated the market was, in simple terms, and how much room for growth is available in the current region or with the current partners or clients. Similarly, as economic forecasts shift the types of work, the ability to identify avenues for diversifying your work when appropriate. These allowed leadership to identify how aggressive future pursuits might need to be, using charts of backlog, roll-off, and financial status to ensure work stability.

In addition, several commented on comparing their efforts in hours pursuing work for different contractors against the work awarded to them to ensure they invested their time with firms awarding them projects. Further, several tracked their profitability working with each GC and the specific superintendents from the GC they worked with, sometimes used as a 'desirability' ranking or rating across their customers to help prioritize future work pursuits. Further, some firms use feedback to evaluate customer satisfaction or similar mechanisms to ensure they meet their customers' needs on projects to help support winning future work, as shown in *Figure 5*.

Figure 5: Customer Satisfaction Survey Results



4.2 Detailing & Virtual Design and Construction

The measurement and tracking of the work put into modeling, detailing, and coordinating the scopes of work to support shop fabrication and installation were among the most varied among the participants.

Data collection

All firms tracked the time their modeling and detailing personnel spent on projects, but some chose to break out the work into drawing deliverables associated with work packages. Some firms also attempted to assess the quality and clarify the project design documents to help with how much additional work might be needed for some projects. Most firms also kept a record of the detailing ductwork quantities for a project, including the total, completed, and remaining detailing quantity in lbs. and percentages.

Detailing and VDC Measures

Firms that characterized deliverables often had the modelers or detailers estimate the hours needed for each delivery and then track the percentage of time they spent on those sheets or model packages. In this fashion, deliverable production could be tracked and forecasted as hours per deliverable and each deliverable as a % of the VDC budget.

In projects with less clarity or smaller breakdowns, many firms tracked against a percentage of the project associated with VDC and detailing tasks, tracking the hours vs. budgeted hours as a whole.

Several of the firms were in the process of shifting or had recently shifted to using modeling software that worked more fluidly with their shop equipment. This enabled the field and shop work packages to be more easily scoped and captured in the detailing process. It also allowed detailed data inherent to the modeling tools to support better, more precise material measures in the shop and field installation processes.

4.3 Shop Fabrication

Within the data measurement for shop fabrication of ductwork, fittings, insulation for lined duct, and some specialized materials, there were some common data collection points and measures across firms.

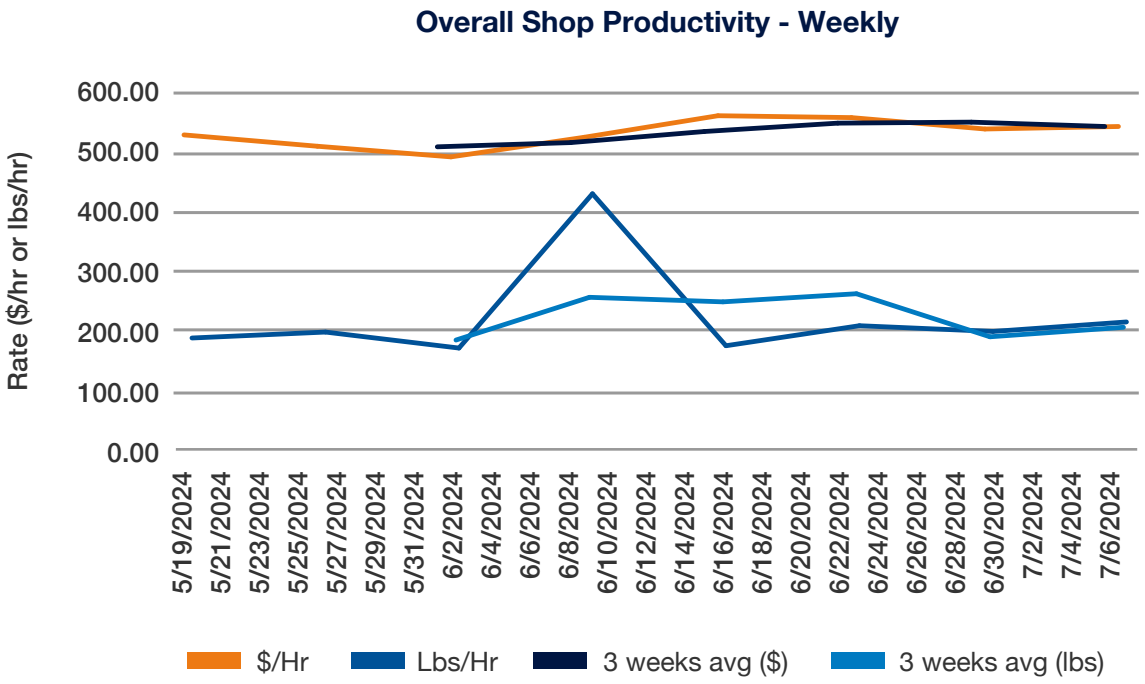
Data collection

Key data points that all firms collected were worker labor hours, grouped by the breakdown of shop activities. The most common divisions included the use of coil lines, fitting assembly, distinguishing spiral from rectangular ductwork, and often a separate area and tracking for specialized materials, such as grease duct. In parallel with hours, the groupings of measures linked those activities to the quantity of material, typically in pounds (lb), though sometimes in material area, square footage (SF), particularly as the material gauge increased. Other data points included the specific material and labor costs, as well as time that assemblies or components spend to move through specific spool processes or sat in storage before shipping to site.

Shop measures

Using the tracked data points, all firms accounted for worker productivity, most commonly by pounds per worker hour (lbs/hr) for each line or production area, such as those in *Figure 6*. Some shops also tracked area per worker hour (SF/hr), again most often when shops were working with noticeably heavier gauge materials. Some of the larger shops tracked the turnover rate for material. A few additional items were tracked, such as material waste percentage, typically by weighing scrap sheet metal against the weight shipped to projects. This can serve as an indicator of quality problems when the scrap % increases unexpectedly. In addition, labor efficiency in dollars per pound was tracked. This measure essentially flips the traditional productivity measure, allowing shops to look at the cost per pound or content to make and install duct or other sheet metal scopes.

Figure 6: Example Shop Productivity Tracking



4.4 Project (on-site) Installation

Within the data measurement for on-site installation of ductwork and sheet metal components, KPMs sought to manage the risk around site labor variation, which is critical to business success.

Data collection

Key data points that all firms collected were individual worker hours and often crew hours. The crew hours were highlighted for projects with consistent assemblies and work activities that simplified tracking when consistent production rates and crew sizes were foreseeable for an extended project period. Sheet metal material was tracked to quantify work installed, commonly in lbs. of sheet metal, but square foot area and sometimes linear foot of assembly were tracked. Smaller items and components were typically tracked by the instance, such as counting each diffuser or each terminal unit, such as VAV boxes or fan coil units.

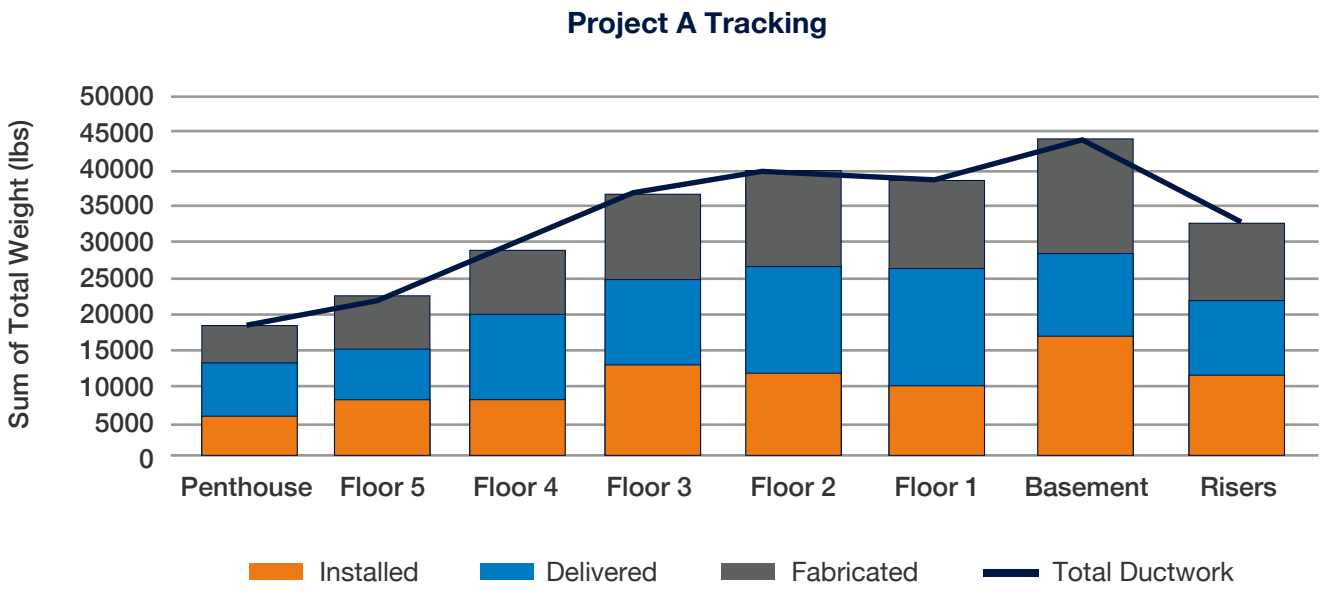
Field measures

Using the tracked data points, all firms accounted for worker productivity in lbs. per hour or area (SF) per hour. Production was sometimes tracked, reporting in the linear foot (LF) per workday or crew day; similarly, components (e.g., diffusers) were often tracked as items per day. For projects with high repeatability, the pace of work in terms of the turnover rate of floors or sub-sections of a project was sometimes tracked to simplify the collection and analysis of work installation. The savvier firms had systems in place to align the project's work breakdown to how shop materials were organized and delivered, such as *Figure 7*. The data from the installed work could easily be noted, and the data from models could be used to quickly link material data to corresponding budgets for worker hours if the front-end planning aligned these well.

Some other items and measures were considered: for smaller projects, the managers may track the scope in terms of labor hours per entire job rather than smaller breakouts. Similarly, several firms had means to translate their field tracking quickly to earned value measures, both for simple analysis of progress and financial forecasting, as well as project billing to GCs.

Some of the firms considered the consistency of the work packages as organized between the shop and field installation to ensure consistency in the hours and crew needs to schedule and manage the work.

Figure 7: Example Project Work Package Tracking by Material Weight



4.5 Safety Tracking

The data and measures within safety management align closely with industry-standard measures and reporting (see *Figure 8*).

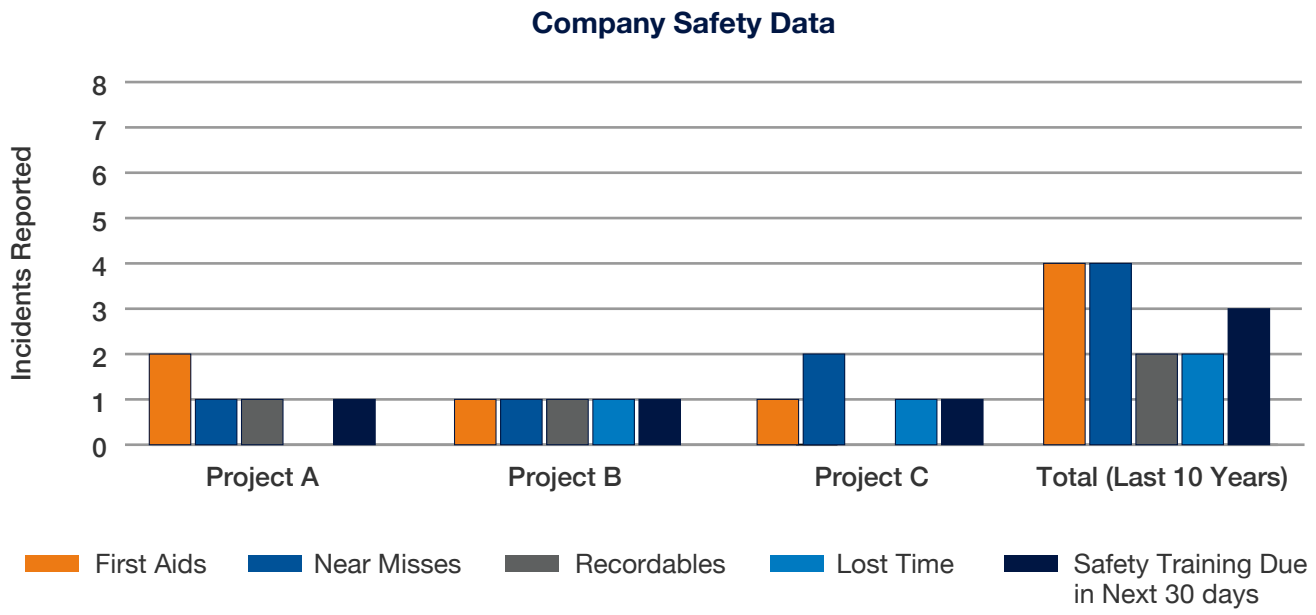
Data collection

In addition to tracking field workers' and shop hours, firms consistently reported tracking first aid, incidents, and OSHA recordable days since an accident or injury had occurred, as well as safety planning, such as toolbox talk reports, job hazard planning sheets, or notecard submissions.

Safety Measures

All firms tracked the standard safety reporting for construction, including days away, restricted, or transferred (DART) rates, lost time incident rates (LTIR), and recordable incident rates (RIR). These were also used to support their experience modification ratio (EMR) for insurance rates.

Figure 8: Snapshot of Safety Data



4.6 Financial Tracking

Within financial measurement, the data and measures are considered primarily to project financial and cash flow health. Still, some consideration is given to how that influenced the financial success of the office and the firm.

Data collection

All firms tracked some common financial items, such as those in *Figure 9*, for project billings, receivables from the GC/project, money received, the amount of retention being held per project, overall revenue, and change order value, particularly for open change orders.

Financial measures

In addition to the straightforward assessment of money received versus billed, most firms tracked their cash position to ensure their ability to be sufficiently liquid for ongoing business operations. Cash position was commonly associated with the billing status against forecasted spending on projects to assess under or overbilling on projects. Many firms tracked the payment turnaround time, how long it has passed since bills were submitted, and when payment was received. All of these were tied back to the expected profitability of the project to assess the current financial risk for each project, as well as across the portfolio for the firm. Most projects were expected to track and report every month. Still, many firms had weekly tracking and forecasting to tie labor and material activity spending to these key financial measures more frequently.

Many firms tracked additional items to understand how their costs and financial health related to their operations. Some reasonably common items included indirect costs and rates for projects, such as the shop burden, rental costs for equipment, small tools, safety items, and equipment depreciation. By leveraging all this information, office and firm leadership were better able to assess the return on their personnel for different project types or when working with different general contractors.

Figure 9: Example Earned Value Reporting for Weekly Project Progress Financials

Earned Value

Labor	Budget	Period Earned	JTD Earned	% this Week	% Earned JTD
Direct	$ 397,340.60	$ 24,237.78	$ 314,097.74	6.10%	79.1%
Indirect	$ 35,760.65	$ 2,181.40	$ 28,232.32	6.10%	78.9%
Time & Material	$ -	$ -	$ 37,784.25		100.0%
Re-work	$ 7,946.81	$ 254.30	$ 5,436.00	3.20%	68.4%
Burden	$ 172,008.75	$ 10,402.66	$ 150,364.62	6.05%	87.4%
Total Labor	$ 613,056.81	$ 37,076.13	$ 535,914.94	6.05%	87.4%

Non-labor	Budget	Period Earned	JTD Earned	% this Week	% Earned JTD
Material	$ 274,028.00	$ 16,715.71	$ 233,578.73	6.10%	85.2%
Equipment	$ 13,575.00	$ 1,058.85	$ 11,063.35	7.80%	81.5%
Subcontract	$ 84,637.00	$ -	$ 57,273.86	0.00%	67.7%
Total Non-labor	$ 372,240.00	$ 17,774.56	$ 301,915.94	4.78%	81.1%

4.7 Other KPM Areas

The reported areas reflect primary topics commonly tracked across most, if not all, of the firms studied. However, many firms had unique and diverse metrics to develop or track specific business attributes.

Logistics and Trucking

As a fundamental aspect of construction, transportation plays a key role in most projects, with firms that have shops needing to consider how their logistical operations are performing. Some firms tracked shipments by pounds shipped and others by truck counts. More sophisticated firms tracked their shipping costs and converted them to a cost per pound shipped ($$/lb) to enable them to incorporate a consistent charge across the sheet metal moving from their shop to their projects.

Warranty Costs

Firms sometimes distinguish their callback work for warranty efforts. This first helped them understand quality concerns during installation and their longer-term profitability. Some firms suggested shifting this budget from project costs and using it as 'income' for their service departments rather than burdening their operations personnel with serviced work.

Service Contracts

With service contracts serving as a significant item for many firms, several tracked their conversion rate of construction projects to service contracts. Service work tracking included items like the number of trucks, the days it takes to get bills to clients, and preventative maintenance in hours per technician.

Commissioning and Turnover

The process of commissioning systems, work to complete, and turnover projects were also important for finishing projects and getting retention payments. The work was typically correlated to commissioning-level requirements but tracked hours, re-work or repeat tests, and turnover speed.

5. SUMMARY

Across sheet metal contractors' business areas, the foundational data needed to develop metrics for your business performance is readily available. Work hours, product in weight or components, and financial measures were the core data points and measures that supported firms. Once these key areas are well developed, other business areas can be refined, and strategic measures can be developed to better inform business or sales decisions.

The implications for developing and maintaining a successful array of performance measures for your company are broad. Still, you need to start somewhere and keep the basic process simple until they are easy to track and sustain. In addition, you need to involve the people from across your operations so they understand how to review and interpret the metrics so they can make informed decisions as well. As the process develops, there will be an ongoing need to continue to communicate and train your team to understand and use the metrics, and these conversations should naturally help develop improvements and sometimes new measures to drive your work forward.

While the results presented here are intended to provide a broad cross-section of metrics and measures for sheet metal, they are not comprehensive. Many tools and other data points that could be pivotal to your business were not reported. Regardless, the intent is to provide a point of reference for your scope of work and measures and, hopefully, a few ideas to help you grow the data you can use to understand your operations and guide future business decisions.

Parallel to this white paper, an industry resource for helping you understand your data and develop your measures is also available.