

ARCHITECTURAL ENGINEERING

# A Case Study in Lean Construction: Southland Industries

By Robert M. Leicht John I. Messner Elnaz Asadian

Sponsored by Lean Construction Institute, ELECTRI International, New Horizons Foundation, and John R. Gentile Foundation

> Case Study No. 07 July 2023

> > The Pennsylvania State University Architectural Engineering University Park, PA 16802 USA

©Copyright

### Summary

Southland's operations stand out due to their in-house design and engineering capabilities, which allows them to initiate a value-focused process from the design phase. By capitalizing on the vertical integration of their design, fabrication, construction, and operational departments, Southland is able to embed a culture of improvement in all aspects of their processes. To facilitate this approach, Southland has established shop facilities in or near their offices, which enable their engineers to actively engage in both the constructability and operational needs of their designs, as well as direct involvement in the prefabrication process. This involvement allows for built-in quality to be considered in the shop while also maximizing their off-site fabrication, resulting in improved safety, faster on-site assembly, and reduced waste across the whole project lifecycle. Southland's success extends from the continuous improvement mindset built-in to their operations. By engraining cross-training and design for manufacturing as core principles, the internal understanding of how Southland contributes to the value stream of a given project is at the forefront of their efforts. This approach is supported by their strong focus on process improvement, which extends beyond the typical construction emphasis on field production and permeates all aspects, from safety to collaborative design. By implementing this approach across their operations, Southland has been able to consistently deliver reliable, high-quality, high-value projects to their clients.

2

## Company Overview

Southland Industries is a design-build mechanical contractor. Started as a small furnace company in 1949, Southland has grown to one of the largest mechanical contractors in the US. Headquartered in Garden Grove, CA, Southland currently has more than a dozen offices spanning from California to Virginia, with current or past projects in over half of the states in the US, with company revenue close to \$2 Billion annually.

Core Values:

- **People** We provide significant opportunities for personal and professional growth and a work environment that is progressive, exciting, supportive, and fun.
- Integrity We act with unyielding ethics and honesty and inspire trust by doing the right things, saying what we mean, and meeting our commitments.
- **Collaboration** We work together as one team to ensure that our actions and decisions are in the best interest of our customers, partners, employees, and company.
- Safety We steadfastly protect the health and well-being of our employees, as well as those affected by our work.
- Innovation We think creatively and pursue continuous improvement to generate opportunities and provide inspired, visionary solutions for our customers.
- Accountability We choose to rise above our circumstances and take the necessary ownership to achieve our desired objectives for ourselves, our customers, and each other.
- **Sustainability** We responsibly conserve our natural resources and seek ways to eliminate waste from everything we do.

By The Numbers

### Southland Industries

Founded in 1949, Southland is the nation's most progressive MEP contractor, with offices in the **Pacific Northwest, Northern California, Southern California, Mountain West, Texas, and Mid-Atlantic regions.** 



Figure 1. Company Overview

#### Scopes:

Southland performs mechanical piping, plumbing, and sheet metal across their offices, with some sprinkler installation. In addition to construction, Southland has extensive prefabrication facilities used to support both prefabrication of their systems and modular capabilities for projects that support it. Further, Southland stands out from their peers through their in-house design capabilities. More than 75% of Southland's projects include either design-build or design-assist scope, with many of those projects being delivered under integrated project delivery (IPD) multi-party contracts that include Southland as a signatory partner.

## Case Study Process

In January of 2023, the Penn State Research Team investigators conducted a site visit, interviews, and observations of the operations at two construction projects for Southland's Union City Office in northern California, based just south of San Francisco. In total, 12 interviews were conducted with personnel from various roles, including superintendents, foremen, safety manager, construction manager, project manager, preconstruction executive, project executive, project engineers, and design engineer. The notes from the interviews and observations were reviewed to identify themes and the alignment of observed practices with principles of continuous improvement. Following the visit, the case study was documented and shared with personnel at Southland for validation. The case study document contains a description for how the behaviors and approaches to continuous improvement are implemented at Southland to support their construction operations.

## Overview of Continuous Improvement Construction Implementation

Southland's approach stands out due to their combined process alignment – both in the shop-to-field flow of installation work and their design and construction processes. Southland stands out because of their emphasis on integrated lean project delivery. Growing out of their integral design-fabrication-construction in-house capabilities, having in-house design allows Southland to differentiate themselves from the approach that most contractors adopt of trying to maximize fabrication for a given design.



Southland focuses on Design for Manufacturing and Assembly (DFMA). DFMA allows Southland to use the construction process and constraints as an input to the mechanical system design requirements. Using the construction needs as input allows the design team to work with the field leadership to ensure not only that the design is constructible, but also that they are seeking opportunities to improve quality through their focus on shop fabrication, modular assemblies, skidding, and kitting of parts to an extent not possible in less integrated contracts and projects. Taking this further – their adoption of lean philosophy into company culture and processes engages all of these processes, not simply their shop and field efforts.

#### Southland's DFMA Approach:

In the pursuit of excellence, the design approach at Southland emphasizes not only the functionality but also the practical aspects of construction. They prioritize the constructability of components, ease of installation, and future flexibility, recognizing their pivotal role in project success. By integrating the lean philosophy into their design process, Southland fosters a culture of continuous improvement that begins

at the project's inception and continues throughout its lifecycle.

Southland's engineers and designers strive to create optimal assemblies by selecting systems that incorporate modular elements and repetition of engineered assemblies. They actively seek feedback from field experts during the design process, enabling them to make adjustments early and minimize the need for rework or changes at the job site. Additionally, Southland benefits from having large prefabrication facilities located in or near their offices, allowing for efficient quality control checks before assemblies are shipped to the job site (Figure 3). This **vertical integration** approach combines efforts of different functional groups, including design, construction, operation and maintenance, allowing them control over every aspect of the construction process, from the initial design to the completion of the finished project.



Figure 3. Prefabricated ground source heat-pump rack

One of the primary advantages of vertical integration is that it gives Southland greater control over the quality of their work and the timeline of their projects. By owning and operating all of the business units involved in the design to construction information supply chain, Southland can ensure that all aspects of the project use the construction needs as input to design and leverage the cross-disciplinary teams to ensure problems are addressed quickly and effectively. This can lead to faster project completion times and higher-quality products, which help them to build a strong reputation and win repeat business. Another advantage of vertical integration is that it can help to reduce costs by allowing the designers to emphasize the cost implications of decisions early. Additionally, vertical integration helps to reduce waste

by recognizing the process that will be used to fabricate and construct the systems, ultimately improving greater construction efficiency.

Vertical integration is an effective business strategy in Southland's approach, allowing them to control the construction process to improve quality, reduce costs, and increase efficiency. Southland's commitment to excellence and continuous improvement demonstrates how a proactive approach construction process and quality in design can yield impressive results.

#### **DFMA for Safety**

In addition to time, cost, and quality, another key driving factor behind Southland's DFMA approach is integrating safety in the design and engineering of their components for installation. A notable example of Southland's commitment to safety and efficiency is their prefabrication of ductwork for a vertical riser passing through a high-risk shaft. By prefabricating the individual ducts and assembling them off-site into large sections, workers were able to avoid working inside the confined space of the shaft, significantly improving safety and indirectly saving costs.



Figure 4. Installation of a prefabricated duct

Another example of how vertical integration results in benefits can be observed in a simple solution from a project that modified the duct riser support detail to remove the welding connection to the middle of their risers. By creating a simple support that could be field adjusted without welding, they were able to eliminate the cumbersome and dangerous welding process at height. While motivated by safety concerns, this initiative has also positively impacted productivity, scheduling, and cost.



Figure 5.25' x 2'-6" x 6' modular tube steel frame supporting 10' tall SS exhaust stacks at bio tech facility.

#### **Maximizing Prefabrication:**

Southland seeks to maximize off-site manufacturing to improve safety and quality while simultaneously reducing cost and schedule uncertainty for system installation. In pursuit of this objective, Southland has consistently worked to expand not only the components and assemblies they fabricate, but has also begun delivering pretested assemblies complete with tagging and insulation, requiring only lifting and connection on the job site. This effort moves the assemblies closer to a single-piece flow when arriving at the project.

To expand their manufacturing efforts, Southland has adopted a multi-trade approach that includes sheetmetal, piping, plumbing, as well as some electrical, structural and finishes for certain scopes. By utilizing this approach, Southland is capable of assembling completed racks and delivering them as a single package for on-site installation.

Southland also invites their peers, such as other specialty contractors, to work on shared scopes in

Figure 6. Prefabricated rack for in-wall plumbing rough-in

Southland's prefabrication facility to assemble components that are elements of the manufactured racks, providing a full package. These integrated racks reduce the amount of time workers need to spend working at height on ladders or lifts, improving safety and the flow of installation through congested

project areas. This collaborative approach requires effective engagement with the design and upfront coordination with other trade partners.

#### First Run Studies:

In Lean Construction, a "first run study" refers to the process of testing and refining a new construction process or system before full-scale implementation. This method aims to identify and address any potential problems or inefficiencies in the new process or system before they cause issues in the scaledup installation across the project. Southland employs this method to ensure superior products are sent to the project. For every project that requires new systems, unique assemblies or project-specific details, Southland's engineering team plans and designs the new process or system. The engineers work closely with detailers to ensure the design meets the intended requirements when the detailers first develop the fabrication-level detailing needed. This engagement extends into the shop, where the engineers can visit or review the first run of an assembly, similar to a mock-up, to ensure the fabrication aligns with the intended design performance. It further allows for direct constructability feedback by the craft to improve the design in the future, address fabrication difficulties that can be fixed before the next iteration, and also identify potential operational considerations before anything is sent to the project site. Throughout the process, the team visits the shop facility to monitor and evaluate the results of the first run study, looking for any issues or concerns that need to be addressed. Based on these evaluation results, the new process or system is refined and improved with immediate opportunities to make changes to ensure performance. Once the first run study has been completed and the new process or system has been refined, the revised process is put into action to quickly get refined solutions to the construction project for installation.

By conducting these first run studies, Southland can identify and address design or assembly challenges before they become field problems that slow down a crew of craft workers, potentially across multiple trades, saving time and money and improving the overall quality of the project. This approach embodies Southland's lean construction philosophy, which emphasizes continuous improvement and focuses on maximizing value while minimizing waste.

#### Lean Culture and Continuous Improvement:

Southland recognizes the critical role that a positive culture plays in sustaining lean. They firmly believe that fostering a culture where adhering to the correct approach is pivotal to cultivating a thriving company

and lean culture. Within this culture, respect for people, innovation, and safety are at the heart of their operations. These cultural and behavioral aspects are embedded in Southland's process and methods, helping to easily standardize their processes.

The mindset of respect for people is woven into Southland's operations. They prioritize the well-being of their crews on job sites. Simple approaches, such as a whiteboard in the shop facility to collect suggestions, demonstrate the consideration for employees who may feel uncomfortable speaking out, providing them with an easily accessible yet anonymous platform to communicate their needs (Figure 7).



Figure 7. Respect for People

Southland initiates each project with a comprehensive review meeting involving team members from each department to discuss and plan the design and construction strategy based on the insights and knowledge gained from previous projects. This meeting enables them to identify potential challenges, risks, and winning strategies for the new project. Leaders from the division's, design and operational teams, and department heads actively participate in these discussions. By leveraging the lessons learned from previous projects, Southland ensures that they constantly evaluate and improve their value stream by exploring all options for the best possible outcomes for their clients. They make sure to engage every team member in the review process, from apprentices to leaders, to create an inclusive environment where everyone has a voice. This approach encourages innovation and ideas, which are carefully evaluated for potential implementation in future projects, resulting in continuous improvement and growth.

#### Safety Approach: Using A3 Thinking

Southland's safety approach prioritizes the improvement of work efficiency, safety, and productivity by minimizing field risks and uncertainties. They employ safety A3 meetings, which provide a platform to summarize incidents, investigate their root causes using the 5Whys methodology, and develop action items in the form of an A3 report. To increase transparency and clarity, they supplement this report with visual aids. The report is created through the collaboration of various stakeholders, including field leaders, safety representatives, and direct leadership of those involved in incidents or injuries, as well as workers and supervisors. This process ensures the collaborative input and review of multiple perspectives, while working to identify methods or procedures to reduce or remove the potential repetition of the safety incident. The safety A3 report is then shared with the safety leadership group, team members, and other offices nationwide to increase awareness and ensure everyone in the company learns for future projects (Appendix A).

#### **Training and Mentoring:**

Southland employs extensive training to support their employees' learning and development. Southland has implemented a champion program to introduce lean concepts and tools to their employees. Rather than limiting personnel to only formal training sessions, champions help them understand these concepts through mentoring, coaching, and practical applications. The mentorship program at Southland is a highly valuable developmental opportunity for its employees, as it allows them to receive guidance and support from professionals within the organization. Each employee, such as a design engineer, is paired with a mentor who serves as their guide and confidant, providing them with valuable insights and feedback to help them grow in their roles. To maintain consistency in the mentorship program and ensure that all projects are progressing smoothly, mentorship program leads meet on a weekly basis to discuss progress and provide feedback.

Formal training courses are also available to employees. For example, the 5S number game is utilized as a training tool to help personnel understand the concept and apply it in their daily tasks. Southland recognizes the importance of striking a balance between these courses and the mentorship program. By offering both, employees can gain a well-rounded skill set that combines theoretical knowledge with practical experience and hands-on guidance from experienced professionals.

Additionally, to leverage the vertical integration of the firm in the knowledge and skills of the employees, best practice crosstraining sessions are carried out each week for all employees (Figure 8). The weekly sessions cover a wide range of topics, from code requirements to detailed construct procedures, with every person encouraged to share something new and teach others. In addition to the one-hour training session, the information presented is summarized into a one-page format, similar to an A3 approach, to serve as a critical summary of the topic that can easily be referenced. The sessions further create a knowledge management network across the firm by introducing the knowledge experts in different topics to the whole company. Thus, the network of expertise is a tightly woven web easily leveraged for all projects and teams.



Figure 8. Guidance Memo

#### **Visual Management:**



Figure 9. Visual Management

To promote the shared understanding and communication of key concepts, Southland utilizes visual management (VM). For instance, they leverage visuals to communicate the steps involved in implementing 5S and display them on their job sites to inform and guide their employees to remind team members to sustain the organization of materials and tools. Southland also employs VM to effectively communicate potential hazards

in the shop and for planning work packaging and shop fabrication purposes. One example of this is the use of color coding to designate prefabrication assemblies for specific locations in the project site (Figure 9).

#### 5S – gang box

Southland uses the 5S methodology to organize their work areas, materials, and tools. By following the 5S principles, they can ensure that their job boxes are organized in a logical and efficient manner, making it easier for workers to find what they need and focus on installing work. Additionally, an organized job box, such as (figure 10) can help reduce the risk of lost or damaged tools, saving them money in the long run.



Figure 10. Gang Box 10

# **Concluding Thoughts**

Throughout the visit, it was apparent that Southland Industries had deeply ingrained lean values and strong client orientation in all aspects of their operations. As a result, Southland's pursuit of vertical integration connects all departments. This integration serves to align the company's direction, and Southland has embedded it into its culture and behaviors. In support of their lean implementation, the following practices were observed:

- **Integrated lean design and construction:** Southland's commitment to Continuous Improvement starts with their in-house design process, allowing them to integrate lean principles into the project from the beginning. This approach ensures that they can implement lean practices that might be challenging for trade contractors to execute if they were brought into the project at a later stage.
- Extensive use of prefabrication: Southland benefits greatly from their prefabrication strategy due to their extensive use of DFMA and the integration of their prefabrication facility with their office. They strive to optimize their prefabrication capacity for projects, sending prefabricated assemblies developed in a controlled environment to improve time, cost, quality, and safety management in their operations. This pursuit of perfection through prefabrication is a crucial aspect of Southland's approach.
- **Embed Lean methods into culture and behaviors:** By standardizing their processes and procedures into their culture and behaviors, Southland can ensure consistency and reliability in their work, which enhances the quality and reduces the risk of errors.

By adopting these practices and incorporating them into their culture and operations, Southland Industries has been able to deliver high-quality projects that meet their clients' needs while continuously improving their processes and procedures.

#### **Other Observations**

*Time to Shine* – It was apparent that recent events, specifically recent disruptions that the entire industry felt, appeared to have disrupted some of the consistency of operations in small ways. This was noticeable in items such as natural disconnects that came through working remotely during the COVID-19 pandemic and reductions in in-person training. A brief revisiting of training (e.g., 5S) should help remind personnel of principles and the need to continue to shine and improve daily.

**Standardizing the use of visual management** – The organization of information was very thoughtful; technology was commonly used to speed the collection and analysis of information across projects and crews. However, the information, when presented, was commonly text-based– moving to simple and consistent visuals would enhance the ease of personnel movement across projects to quickly recognize the systems, status, and where they could engage.

## Acknowledgments

The research team would like to thank all the case study participants for their valuable input and support of this research, notably Henry Nutt, III and Ron Heise, for scheduling and facilitating the interviews and project visits.

Leicht, R. M., Messner, J. I., and Asadian, E. (2023). A case study in lean construction: Southland Industries. Case Study No. 07, Architectural Engineering, The Pennsylvania State University, Univ. Park, PA.

11

Appendix A – Example Safety A3 documentation

## **Southland Industries** Jobsite: NorCal /Block 34

Title/Brief Description: Debris in Eye

σ	Background:				Ph		
Backgroun	Trade and Level: Plumber, Journeyman What: Eye Injury – Debris in Eye When: 06/13/2023 Where: Northern California, San Francisco Weather: Clear, Sunny						
	Incident:						
Incident Review	Today at 9:40am, a journeyman plumber was using a hole saw to drill through a metal stud. While they were drilling, a metal shaving went underneath their hardhat visor and landed in their right eye. Onsite Health and safety came out and removed the metal shaving. The employee is fine and returned to work.				Work Set Up     Hole Thr		
S-Why Review	5-Why Review:					Contributing Factors and Root Cause Analysis	
	<ul> <li>1.Why did the employee get a metal shaving in their eye?</li> <li>The employee was drilling with a hole saw through a metal stud and a piece of metal went underneath their hardhat visor.</li> <li>2. Why did the metal shaving go underneath the employee's hardhat visor?</li> <li>The employee did not secure the hardhat visor all the way down</li> </ul>				Root Cause	<b>Root Cause Analysis:</b> The root cause of this in have been wearing a face shield and/or goggle	
	2. W/by did the employee net secure their bardbat viser all the way down?				Action Plan	Action	Responsible
	3. Why did the employee not secure their hardhat visor all the way down? The employee assumed that just utilizing the visor would be enough protection. 4. Why did the employee not utilize a full-face shield or goggles? The employee did not follow proper procedure. Any activity that produces debris while drilling should be worn with a full-face shield and/or goggles with a seal. Participants:					<ol> <li>Stand down with crew members to utilize face shields when drilling.</li> <li>Order full face shield attachment for Kask hardhat.</li> </ol>	1. Foremai
Author:							
A3 No.: Document Date: Caracteria Control Cont							

#### Photos



Root Cause Analysis: The root cause of this incident was improper procedure. The employee should nave been wearing a face shield and/or goggles with seal to protect their eye.

Responsible Party	When			
1. Foreman/Safety	<ol> <li>Pre-Task Morning meeting. 6.14.2023</li> </ol>			
2. Safety	2. Ordered. 6.14.23			