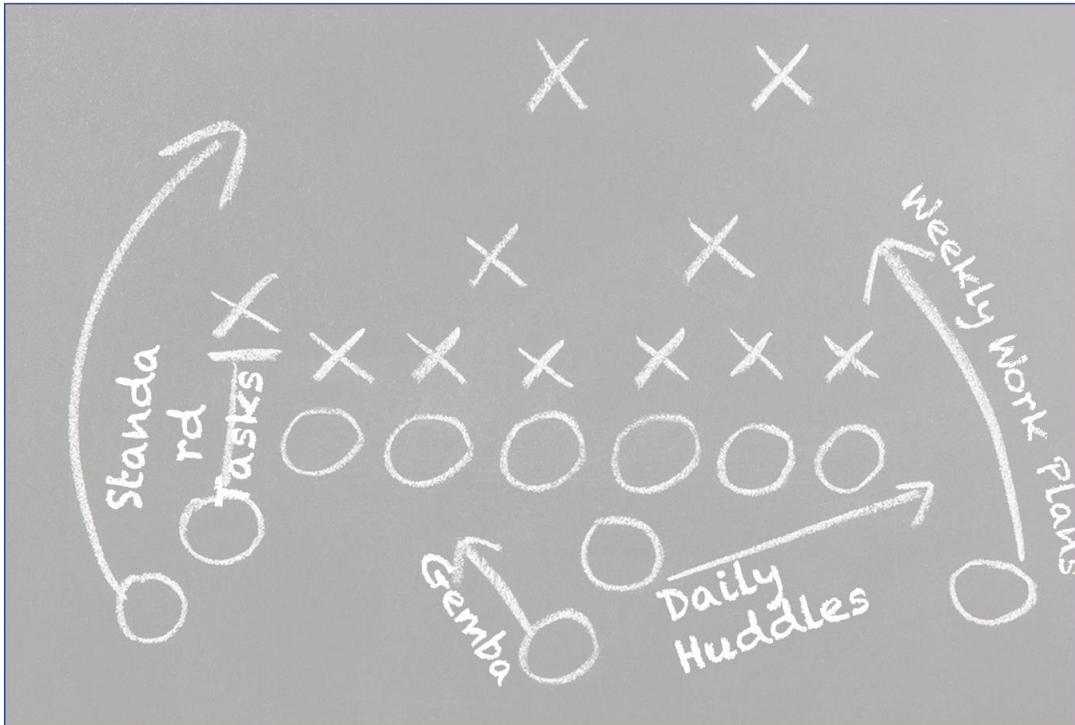


# Handbook of Production Improvement Methods



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For further information and video examples of trade contractor use of methods, please visit:

<https://fieldcrewhuddle.leanconstruction.org/>

or scan the QR code.



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## **Executive Summary**

Trades are the linchpin between the vision of the facility in the design phase to its actual assembly through the many systems, equipment, components, and finishes. Trades, or specialty contractors, add value to a project through the assembly or installation of these systems, components, or fixtures that allow the occupants and owners to use and enjoy their completed facility.

This handbook was developed as a resource. The content is intended as a user guide with practical resources, lessons learned by others, examples, and guidance to allow trade contractors and specialty construction firms operating to adopt lean principles and reap the workforce and business benefits that follow more readily. To enable their adoption, the emphasis is on identifying and using methods to enable your craft workforce and colleagues across the firm to support the key tasks where your firm adds value to your projects.

The handbook focuses on identifying and linking those methods and techniques from the lean community with the common tasks and waste trade contractors regularly encounter on projects.

### **Audience**

The intended audience for the handbook is trade contractors interested in or new to the use of lean. While that is the target, many related stakeholders in the construction community may find value in the process and resources provided, from general contractors who have self-perform crafts to vendors that commonly engage or support on-site construction activities.

## 1. Introduction

The adoption of lean into a specialty trade contractor requires both the understanding of the principles of lean along with the methods that allow the principles to be used. This handbook aims to introduce a core set of lean methods that provide immediate value in the operations undertaken by the specialty contractor community, emphasizing methods that will add value and remove waste in field construction activities.

In interviews with lean experts, the most cited benefit from lean methods for trade contractors is happier people, with collaboration and empowerment amongst the top five reasons. The use of lean empowers workers, notably the craft workforce, in the ownership and improvement of their daily work. Further, using lean enhances safety, productivity, and successfully completing projects on time [1]. Despite these many benefits, much of the emphasis of lean research and training focuses on project-level or General Contractor (GC)-led methods rather than methods that the trade community should implement. Moreover, several barriers hinder trade contractors from adopting these methods [2]. Previous studies, such as *“Key Planning Steps Enabling Systematic Lean Implementation on Construction Projects”* [3], provide useful insights on how to implement lean methods at a project level; however, this handbook seeks to introduce methods focused on the scopes performed by trades and methods they can readily adopt to improve.

### Using lean methods within your sphere of influence

One of the key concepts when identifying the appropriate methods is understanding your sphere of influence. While we strongly encourage sharing ideas and suggestions with your colleague or other contractors within your project or other departments within your firm, we suggest you focus first on adopting the methods that relate directly to your work and your tasks. First, improving your workflow and processes provides an immediate reward to you both through the satisfaction that comes with improving the quality and effectiveness of your work and those that work with you. Second, the effectiveness of your message when you share will drastically improve if others come to you and ask how you were able to make the improvements they have seen or heard about.

One of the keys to adopting lean methods is fitting the technique to your specific work, scope, and processes. In the following sections, a set of lean methods are introduced along with the principles, extracted from [4], they support. Examples from a series of case studies are presented to further support their adoption. These cases were taken from successful trade contractors with extensive experience in using the methods for the planning, management, and continuous improvement of their processes for construction.

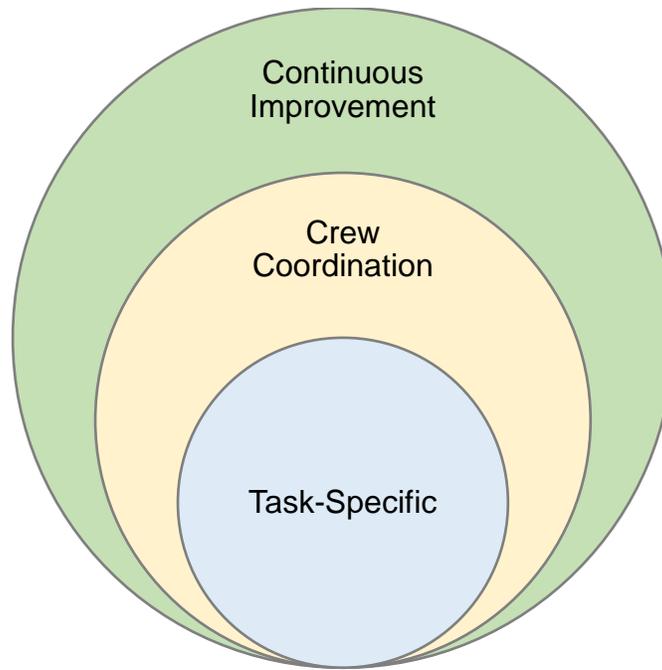


Figure 1: Relative spheres of influence

To capture how the lean methods align with the level of influence that you may want to consider, Figure 1 shows the changing spheres of influence under the overall umbrella of continuous improvement.

### Task-specific Methods



Task-specific methods are those that one person can use to improve their own work processes, such as organizing methods for materials and tools, standard work to improve the speed and efficiency of execution, or the 8 Wastes as a lens for recognizing inefficiencies or misused resources.

### Crew Coordination Methods



Crew Coordination methods support the improvement across a group or crew of workers. Methods such as visual management or daily huddles allow quick but effective communication that allows a whole team to get on the same page.

### Continuous Improvement Methods



Continuous improvement methods capture broader concepts that can help recognize and systematically solve problems at many levels, from individual tasks or crew coordination to projects-level or processes within a company.

## 2. Lean Methods Classification by Task

 <b>Task-specific</b>	 <b>Crew Coordination</b>	 <b>Continuous Improvement</b>
<b>8 Wastes</b> <i>A simple method to introduce the idea of recognizing waste effort and resources that detract from producing value in work that is performed.</i>	<b>Weekly Work Plans</b> <i>Method within the Last Planner System that supports collaborative and commitment-based planning and control that helps develop a reliable workflow.</i>	<b>A3 Thinking</b> <i>Documentation approach for problem-solving and reporting on project-related critical decisions using the Plan - Do - Check - Adjust. (PDCA) method for continuous improvement.</i>
<b>Standard Work</b> <i>Creating consistent processes and techniques for how work is performed based upon best practices.</i>	<b>Daily Huddle</b> <i>A structured daily check-in for briefly highlight key plans, emerging constraints or safety concerns, changes, and team accomplishments.</i>	<b>Value Stream Mapping</b> <i>Mapping the process by including value and non-value add work activities to identify areas of improvement in the delivery process.</i>
<b>5S</b> <i>An approach for workplace organization and maintaining visual control. The “S” stands for: Sort, Set-in-order, Standardize, Shine, and Sustain.</i>	<b>Visual Management</b> <i>A way to manage information visually such that it enables collaboration, open communication, helps track progress and notice disruptions quickly.</i>	<b>Gemba Walk</b> <i>Means “Going to the work” or walking the job site where the actual work is done to identify waste elimination opportunities.</i>
<b>Kitting</b> <i>Sorting, grouping and packaging separate but related items together to reduce packaging and waste at the workface.</i>	<b>Prefabrication</b> <i>Strategies employed in production to develop assemblies or components off-site to streamline work on-site.</i>	<b>5 Whys</b> <i>Problem solving technique to determine root cause by diving deeper into the “why” five times.</i>

## 2.1. Task-specific Methods

 <b>Lean Method</b>	 <b>Lean Principle</b>	 <b>Trade Context</b>
<b>8 Wastes</b> A simple method to introduce the idea of recognizing waste effort and resources that detract from producing value in work that is performed.	<i>Build a culture of stopping to fix a problem and get quality right the first time.</i>	Training and empowering craft to identify wasted movements, resources, or efforts to improve the process, and increase productivity and workspace utilization.
<b>Standard Work</b> Creating consistent processes and techniques for how work is performed based upon best practices.	<i>Standardized tasks and processes are the foundation for continuous improvement</i>	Create stability and repeatability for tasks and processes to reduce errors, waste and risks, while increasing quality, productivity, and employee morale.
<b>5S</b> An approach for workplace organization and maintaining visual control. The “S” stands for: Sort, Set-in-order, Standardize, Shine, and Sustain.	<i>Use visual control so no problems are hidden</i>	Organize tools, job boxes, materials, and storage through maintaining an orderly workplace and using simple visuals to reduce the time craft spend searching for resources.
<b>Kitting</b> Sorting, grouping and packaging separate but related items together to reduce packaging and waste at the workface.	<i>Level out the workload</i>	Organize materials and components based upon how they will be installed, with all the necessary pieces for each worker to improve assembly efficiency.

## Reducing variability through Standard work and Kitting at Rosendin Electric

### Background

Due to the specific nature of electrical construction, large-scale or large modular assemblies are sometimes impractical to implement for building construction. Rosendin has found that the project GC's approach to managing the schedule directly affects the scale and specific scope of prefabrication. High levels of uncertainty in the flow of work reduce the benefit of using prefabrication and often lead to either rework of the materials or increased inventory at the project, which slows down production.



Figure 2: Prefabricated parts

Rosendin has slowly evolved its approach to prefabrication to support the field electricians as their internal clients. Regardless of the specifics, common elements can usually be prefabricated, reducing the number of pieces an electrician needs to handle for each task, grouping and carting the assemblies or parts to reduce a worker's time moving or finding the necessary pieces, and focusing on the enabling tasks to streamline field install (Figure 2).

### Standard Work

To simplify the core value-adding tasks for the electrical installation, Rosendin's shop often puts together small assemblies, such as wall boxes (Figure 3). If field installed, a worker would need the junction box, mud ring, strap(s) to attach to the adjacent studs, screws to connect them, conduit coupling(s), the conduit, or MC cable for the raceway, and possibly other pieces depending on the wall assembly. By assembling these in the shop, the field installation requires one component and the screws to connect that assembly. The worker is thus better able to focus on the quality and location needs of that project when setting the box. This also removes waste simply by reducing the number of pieces and tools the worker needs to manage while completing the task, as well as eliminating scenarios where one of these pieces is missing that would require the worker to return to the material laydown area to collect the necessary item(s). These assemblies also reduce the amount of trash generated at the project site – saving field labor valuable time.



Figure 3: Standard Assemblies

One critical effort to enable this approach is standardization as a solution to reduce variation. Rosendin standardized these assemblies and components, so the boxes, materials, and connection locations are consistent across projects. Their prefabrication shop prepares components in kitting packages for their field personnel. However, they usually need to balance the components and kits for each specific project based on the project circumstances.

## 5S

Rosendin was thorough in the organization of job boxes. Different parts are sorted under categories, making finding a specific item much easier for the installer (Figure 4).

Combining this organization with visual management techniques makes it easy to recognize which materials or items are being used to maintain a ‘minimum’ stock needed for tasks between deliveries of materials.



Figure 4: Organized materials

## Kitting

When sending the assemblies out to projects, the shop groups assemblies by area and puts the assemblies onto wheeled carts or cages (Figure 5). By grouping the assemblies or supporting pieces or materials, workers can quickly gather the items they need to work continuously in a room or section of a building without frequently pausing to get more materials. It also saves them time and effort by keeping their materials for current, and future tasks close at hand.



Figure 5: Grouping parts and assemblies

Using wheeled carts provides ergonomic benefits; workers reduce their need to handle and carry heavy materials. The carts can be easily shifted between areas to keep them close at hand, and they are wheeled and easily movable – so if they happen to be in the way of another trade or group, it does not take much time or effort to move them.

They also established “Grab and Go” kits on some projects to install certain systems. Under this strategy, all necessary small pieces, and parts for a specific electrical task, such as running a ¾” conduit, will be sorted in a kit so that workers on a given task can grab that kit and quickly take them to the location of work as they move along a run of conduit or circuiting and terminations. The kit has all the necessary items, which could be sent back to the materials space or shop to be re-stocked on an as-needed basis.

## Conclusion

In Rosendin’s case, the successful adoption of Lean Methods into their operations appears to stem from unbundling the often-complex methods and techniques to simple and easily understood concepts. For instance, when there is often uncertainty in a project schedule or it has frequent changes, it can be challenging to scale up their prefabrication procedure. To mitigate this, Rosendin seeks to prefabricate into smaller standard work or kit as much as possible in their shop facility. By unbundling the pieces, conversations can focus on specific techniques that apply to a very specific task or area of waste.

Moreover, Rosendin’s approach successfully creates constructive interactions between Lean Methods. For instance, they combine standardization and prefabrication with visual management techniques. They can manage the day-to-day production using Trello as a virtual Kanban board. The prefab shop receives orders through email and posts them to the Trello board so that the people engaged in the process can see what parts have been done and are currently assembled with specific dates. They also include pictures, drawings, and any other data related to each prefabricated piece in the Trello platform to have complete info on each part. The board further serves as institutional memory with past prefab requests, examples, and scopes.

## 2.2. Crew Coordination Methods

 <b>Lean Method</b>	 <b>Lean Principle</b>	 <b>Trade Context</b>
<b>Weekly Work Plans</b> Method within the Last Planner System that supports collaborative and commitment-based planning and control that helps develop a reliable workflow.	<i>Level Workflow</i>	A task management tool for crew-level planning, including material delivery and placement, crew assignments and locations, billing codes, and daily schedules to keep track of activities for the week.
<b>Daily Huddle</b> A structured daily check-in for briefly highlight key plans, emerging constraints or safety concerns, changes, and team accomplishments.	<i>Train and develop exceptional individuals and teams to achieve exceptional results.</i>	Communication & field leader empowerment, including daily updates on project progress, safety training, and constraints identification to drive employee engagement.
<b>Visual Management</b> A way to manage information visually such that it enables collaboration, open communication, helps track progress and notice disruptions quickly.	<i>Use simple visual indicators to help people determine immediately whether they are in a standard condition.</i>	Use visual indicators for materials & tools, huddle boards, schedules, and production status to provide transparent information, which allows everyone to see how the team is performing.
<b>Prefabrication</b> Strategies employed in production to develop assemblies or components off-site to streamline work on-site.	<i>Reducing variability</i>	Assembly of building components at a location other than the job site, allowing to work in a controlled environment, utilizing standardized processes, and cutting down on waste.

## Crew Coordination at KHS&S Contractors

### Background

KHS&S uses a standard process for coordinating the work across crews. The focus of trade work occurs in weekly cycles, breaking large milestones into manageable scopes of work to hand out to crews or individual workers. Balancing and leveling this work, along with the necessary equipment, tools, and materials, requires detailed weekly work plans to define these activities and match them to the project plan and budget.

### Weekly Work Plans (WWP)

Beyond the training and understanding of all elements, KHS&S took the weekly work plan as a critical element for engagement with field personnel. The planning builds from standard Last Planner<sup>®</sup> System (LPS<sup>®</sup>) activities. Still, it is used to align budget information to field activities, plan detailed crew and location assignments, map work areas and material deliveries.



Figure 6. Weekly work plan and color-coding of daily tasks within WWP Map

The tasks for each crew member are laid out for the week, including the areas of work and day, using color coding as a visual management strategy (Figure 6). The tasks are broken down to match the budget, so the tracked hours are easily linked to progress, productivity, and billing. Color-coding the daily functions within the weekly work plan created a quick visual link between the crew, task, area, and materials across the different visuals used to plan and coordinate work. Each morning, the plan is discussed as part of each crew's daily huddle (Figure 7).

## Daily Huddles

Daily huddles or stand-up meetings are conducted each morning before work begins to track the progress and activity of each worker or crew. In addition, using a standard work agenda, there is time spent discussing each group's production goal, identifying any current or expected constraints, and critical safety planning for their activities (Figure 7). Before wrapping up, a 3-minute lean topic is used each day to maintain the emphasis on continuous improvement, and there is a daily stretch and flex, as well as a safety discussion.

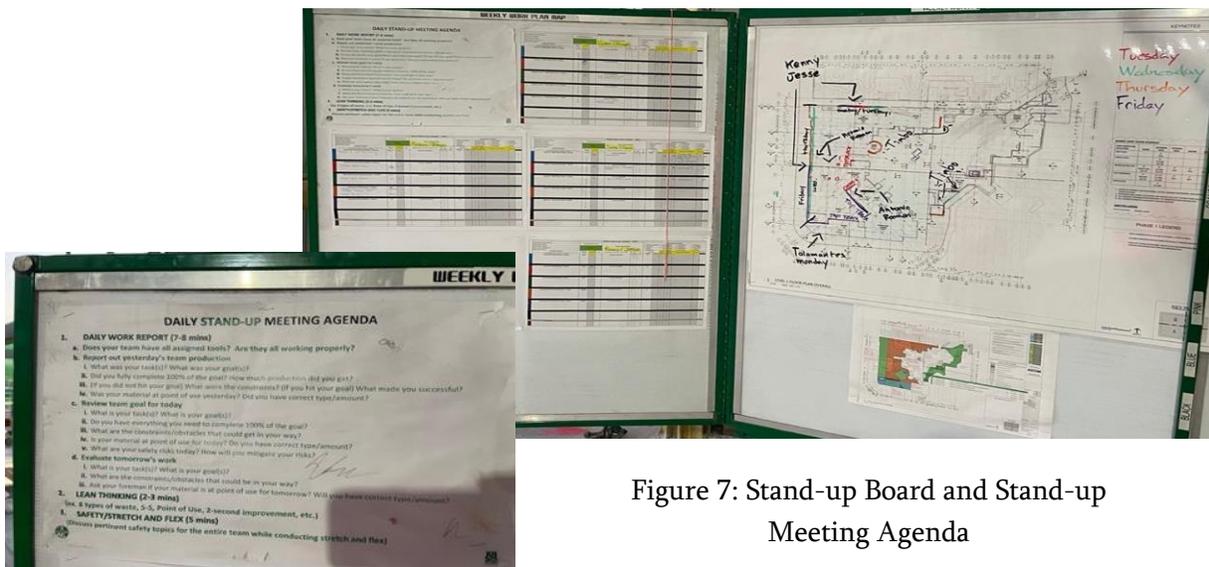


Figure 7: Stand-up Board and Stand-up Meeting Agenda

## Visual Management

Job boxes were marked and codified with standard tools or equipment to make them easy to find or note if they were missing (Figure 8). Custom safety stickers were created to convey which foreman or craft had completed set training quickly (e.g., Certified to drive a forklift). All served to shorten the time needed to take in and process the information required for effective planning or communication.



Figure 8: Coded Job Boxes

In addition to educating their employees on eight types of waste in their training curriculum, KHS&S emphasized enhancing the field personnel's awareness of the waste and how to identify and eliminate it. They leveraged visualization techniques to demonstrate these non-value-adding activities on the job site by giving short explanations of waste on stand-up boards, job boxes, and other locations (Figure 9).



Figure 9: Visual Management Triangle and Visualization of Waste Types

As a result, workers are constantly exposed to this concept and try to implement their training knowledge to eliminate waste. They also have daily waste walks performed by field supervision to focus on the eight types of waste and help them identify safety and areas of quality.

## Conclusion

*“Spreading out the lean principles and initiatives as much as possible throughout their entire organization”* is one of the critical features of KHS&S's lean journey. They employ a thoughtful array of Lean Methods, combining them into daily routines and ongoing training. For example, they have embedded several practical concepts, such as material mapping and color-coded weekly work plans, into daily huddle routines to make planning consistent, visual, and easy to understand - thus empowering employees to focus on planning and seeing waste in their activities.

In summary, it is apparent that they do not limit Lean Methods and concepts to their construction processes; instead, the training and lean concepts are merged with the daily activities and routines to make them part of the culture. In other words, while the pursuit of lean emphasizes the support of field operations and construction tasks for improving production, the processes and culture of lean permeated the office, departments, and processes at KHS&S.

## 2.3. Continuous Improvement Methods

 <b>Lean Method</b>	 <b>Lean Principle</b>	 <b>Trade Context</b>
<p><b>A3 Thinking</b></p> <p>Documentation approach for problem-solving and reporting on project-related critical decisions using the Plan - Do - Check - Adjust. (PDCA) method for continuous improvement.</p>	<p><i>Make decisions slowly by consensus, thoroughly considering all options</i></p>	<p>A way to fully grasp the issue, visualize the whole process, gain alignment with others, and sustain improvement by facilitating communication and building consensus.</p>
<p><b>Value Stream Mapping</b></p> <p>Mapping the process by including value and non-value add work activities to identify areas of improvement in the delivery process.</p>	<p><i>Right process for right results</i></p>	<p>Understand and document the entirety of a process flow of how materials and resources are purchased, transported and used/installed at the project to optimize efforts.</p>
<p><b>Gemba Walk</b></p> <p>Means “Going to the work” or walking the job site where the actual work is done to identify waste elimination opportunities.</p>	<p><i>Go and see for yourself to thoroughly understand the situation</i></p>	<p>Solve problems and improve processes by going to the source and personally observing and verifying data to continuously improve operations.</p>
<p><b>5 Whys</b></p> <p>Problem solving technique to determine root cause by diving deeper into the “why” five times.</p>	<p><i>Bring problems to the surface</i></p>	<p>Determine the root cause of a problem, such as delays in the schedule, to support continuous improvement.</p>

## Continuous Improvement at Baker Concrete

### Background

Considering lean implementation as an “ongoing” process, which requires buy-in and attention from all employees rather than viewing it as a one-time adoption, results in putting high emphasis on the “*Continuous Improvement*” nature at the heart of lean adoption. This aspect was highlighted by different personnel of Baker Concrete, demonstrating that continuous improvement is embedded in their mindset and culture. This allows continuous improvement to be quickly grounded in how Baker does business, treats people, analyzes its operations, and achieves the company goals.

### PDCA Method (A3 Thinking)

Baker Concrete employs metrics to track and analyze its performance in different areas, including quality control, safety, schedule, and efficiency of craft. The massive use of data analysis is one of the remarkable aspects of Baker’s lean journey, indicating that they focus on the entire circle of PDCA by constantly checking and adjusting their processes and seeking continuous improvement. As an illustration, Baker has initiated an Opportunity for Improvement (OFI) program (Figure 10). Each employee is asked to report an issue through an app all employees have on their phones. It allows Baker to surface their problems, evaluate, and provide solutions for everyday issues, quality concerns, or inefficiencies. They find this method helpful for proactively identifying changing needs across the entire company operations for avoiding problems or developing new best practices.

Region	2021 YTD thru June, by region					
	All YTD OFI's Submitted	YTD "Compulsory" OFI's Submitted	YTD "Compulsory" OFI's/Week	YTD OFI's / PM/Super / Week	Only PM/Super OFI's	# of PM's & Supers
Baker DC	1,189	340	12.59	1.42	241	31
Central Florida Operations	37			0.11		12
Dugan & Meyers	421			1.42		11
Greater Atlanta Region	6			0.04		5
Northern Operations	160			0.74		8
Rocky Mountain Operations	107			0.10		40
South Florida Operations	145			0.08		65
Southeast Industrial	65			1.20		2
Southern Operations	0			0.00		47
Southwest Operations	67			0.11		22
<b>Totals:</b>	<b>2,197 OFIs</b>			<b>0.24 OFIs/User</b>		<b>339 Users</b>
					No Gen. Supers or Sr. PM's	

Figure 10: OFI (Opportunity for Improvement) Dashboard

Baker’s efforts to improve build upon a well-defined standard of work that defines consistent approaches, resources, agendas, or other processes that could be easily ported across projects. They have standard agendas for their start-up meetings and checklists for their core procedures to ensure all key topics are touched on related to daily planning, constraints, lean thinking, and safety. Weekly work planning documents were standardized to keep them simple but structured to align with budget and material planning needs. Even the visuals used to track Last Planner, material needs, and production tracking are standard across projects, so any new personnel can walk in and quickly assess the project status. In conclusion, they apply standardization in many aspects of their planning to control their production more effectively. At the same time, they emphasize finding ways to improve their current standardized work continuously.

## Value Stream Mapping

After some years of standardizing their operation and seeking continuous improvement, Baker developed the upgraded version of their operational model, “Baker 3.0” (Figure 11). This model, developed through continuous iterative reviews and consensus building using the PDCA process, helped them refine and document standard operating procedures to ensure each process step is conducted in the “best way.”

In addition to creating the ‘instruction manual,’ the model includes an evaluation stage to audit their operation to ensure their processes and core values are being implemented properly through re-visiting, checking, analyzing, and implementing it (PDCA). This model is reviewed and updated continuously, ranging from once a quarter to once a year, depending on the process.

Baker crafted this model to define and communicate their approach for their operations. The ability to continuously improve must build upon a well-defined baseline or standard procedure. The model captured the core principles, methods, and processes they have found to be consistently valuable in their lean implementation. Based on the PDCA process of continuous improvement through the lifecycle of a project, the operations are approached

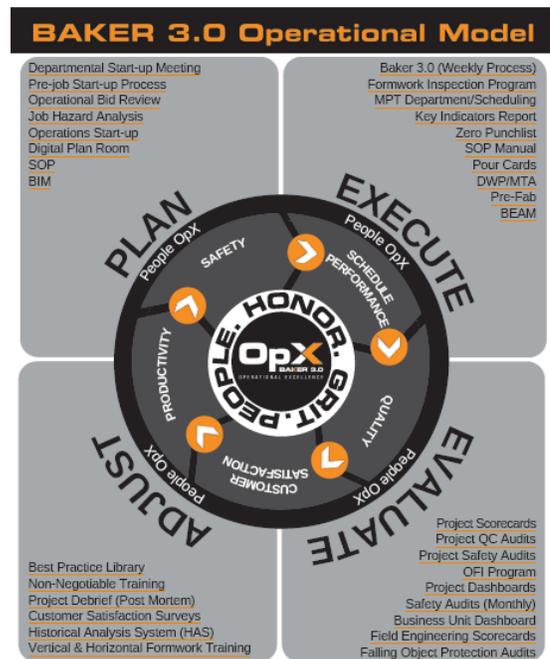


Figure 11: Baker 3.0 Operational Model

through four phases: Plan, Execute, Evaluate, and Adjust. The Plan phase characterizes and establishes the standards that support their operations. In the Execution phase, the model highlights the standard procedures for performing each process or procedure, such as the weekly planning process to provide an overview of the project in the next two weeks. Using visuals, they simplify the standard methods to overcome any confusion or misunderstanding regarding daily activities. In addition to bringing consistency and connection between teams through standardization, the documented processes help them turn their best practices into the company's standard practice.

They measure each department's performance against the plan or targets through the evaluation phase. Ultimately, in the Adjust phase, they document their after-action reports on performance, metrics such as labor per CY, among others, to develop a database for their future analysis of bids and planning. It includes financial, schedule-related, quality, and safety data for historical analysis. They also document the output of OFI as the "*Best Practice Library*" to accept and adopt them as new standards across the country.

## Conclusion

By defining critical processes in their Baker 3.0 Operational Model, Baker has established a platform to spread their best practices as the standard operations. Through this standardization, they can embody their core values in their standards and processes. However, while using traditional boards and methods acts as a company-wide guideline, their main goal is to balance autonomy and standardization, not limiting the employee's innovation and creativity but making the work procedures routine. To ensure the guidelines are correctly aligned with their tasks and values, they review them based on the feedback from users and add their insights to apply adjustments as needed, which can be considered an indication of the "*respect for people*" principle to move towards continuous improvement.

Another exciting feature of Baker's lean journey is that the lean operations within Baker Concrete are not led by a specific lean department or lean director but rather by having a lean mindset and related principles in their company, which are embedded in every aspect of their job. Under this mindset, it can be argued that Baker tries to educate and mentor all employees as a lean champion: "*everyone is empowered to pursue continuous improvement.*"

### 3. Tips and lessons learned

Throughout the study of trade partner lean method use and the case studies, several tips and lessons were captured from the many lean enthusiasts.

- **Fundamentals** – all methods come down to providing processes that help people or teams execute their work. Plan your work, organize your tools/materials
- **Discipline** - Improvement relies upon using the methods in a disciplined manner, with valuable tools and resources to ensure - embed lean thinking into routines and habits
- **Training** – the construction workforce is constantly changing. There will always be an ongoing need to provide training and engagement around the essential planning, organization, material procurement, and logistics tasks.
- **Start small** – you don't need to solve every problem right now; focus on minor improvements where crews lose time – moving materials, collecting tools, looking for equipment. A few minutes a day add up quickly across crews and projects.
- **Empowering craft** – more improvements can be found from empowering a large workforce than waiting for one boss or manager to recognize a problem and try to fix it.
- **Risk is in the field** – the most significant source of risk and cost from any work is the field labor. This should be the focus for improving tasks; it should be everyone's focus – helping craft deliver value.
- **Incentives** – acknowledgment goes a long way. Find ways to share improvements and recognize those that helped develop them.
- **Color outside the lines** – many people are quickly discouraged by complicated forms or templates they are not comfortable using. Make the process and tools as simple and easy as possible. And remember that forms, even simple forms, are only there to help provide guidance and make the process easier. Do it if you need to draw outside the lines or move off the template to capture your idea.
- **Share and keep sharing** – continuous improvement is not developed by one person working alone through constant sharing and communication about challenges and opportunities that can be tackled.

#### **4. Building a Lean culture**

Even though the primary focus of Lean Construction is on eliminating waste and delivering the best product to customers, the principles of customer orientation, culture/people, and teamwork have become increasingly prominent over the past few years. In this regard, one of the main concepts is to continually cultivate and sustain a thriving Lean Culture within your organization or project to provide the foundation to ease and support the implementation process. Observing how successful lean adopters apply their Lean Methods led to the conclusion that implementing these methods without adopting a Lean Culture would not be successful. All these cases operate based on their company's core values and guiding principles, which closely align with lean principles. This similarity allows continuous improvement to be quickly grounded in how they treat people and achieve the company goals. As a result, these fundamental principles guide all the company personnel to adopt the right behaviors and procedures.

While we acknowledge lean construction as a management philosophy, the soft area of knowledge, helping to support applying the hard concepts associated with the value generation process and waste reduction, should not be neglected. Therefore, it is necessary to recognize the role of people working in a lean organization or project. To implement lean successfully, it is fundamental for managers to go beyond lean technicalities by adopting soft practices and nurturing the development of an appropriate organizational culture profile [5,6].

##### **Respect for people**

The lean principle, “Respect for People,” is embodied directly in Rosendin’s core value, “We Care,” which Rosendin defines as balancing integrity with empowering people to be their best, be safe, and respect one another. Rosendin’s recognition of the importance of people has been fundamental to their success. They invest heavily in their people but balance the need for technical training with the personal development and support of the individuals. Several examples of this were observed during the visit and raised by the Rosendin personnel regularly during interviews. It was evident that Rosendin strongly emphasized the value of training, mentoring, and team building. This pattern was both observed in field visits and office tours and identified through interviews. For example, it was noted that they prefer to hire ‘team players’ first, understanding that they can train and develop technical skills for the role or position.

## Core Clarity

Rosendin invested heavily in a program titled ‘Core Clarity’ to support all their full-time employees' personal and team development (Figure 12). There are many approaches, tools, consultants, and resources available to support personal and professional development initiatives – the intent is not to focus on the specific benefits of the Core Clarity model. Instead, the key observation was how Rosendin implemented the use of Core Clarity, its development into a sustainable program, and its continued service to support and empower project teams.

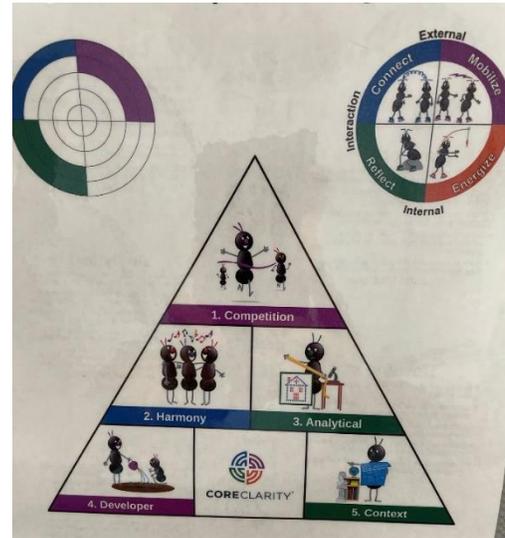


Figure 12: Core Clarity

Core Clarity is used to help Rosendin personnel better understand themselves, both personally and professionally. While first piloted with a consultant, the initial success was used to move the pilot into a standard initiative for all full-time personnel. In addition to scaling the initiative, Rosendin invested in having multiple internal staff trained in the assessment and coaching for the Core Clarity program. These coaches then deployed the program company-wide over an approximately two-year period and continue to engage with project teams, new personnel, and other efforts on an as-needed basis.

One of the primary benefits and uses that supported Rosendin’s resounding success was the program’s value in helping team members better understand how to engage with others from across Rosendin. The profiles for personnel are posted in offices and provide a quick, visual, and insightful glance into the ‘why’ and ‘how’ when understanding the behaviors of co-workers. These insights appear to reduce common misunderstandings and encourage all of Rosendin’s team to consider how their team members will perceive the information or message they are trying to communicate. As communication requires both the effective sending and receiving of the message, this awareness is critical to the success of any team.

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- [6] Bortolotti, T., Boscari, S., & Danese, P. (2015). Successful lean implementation: Organizational culture and soft lean practices. *International Journal of Production Economics*, 160, 182–201. <https://doi.org/10.1016/j.ijpe.2014.10.013>



# Task-specific Methods

# 8 Wastes

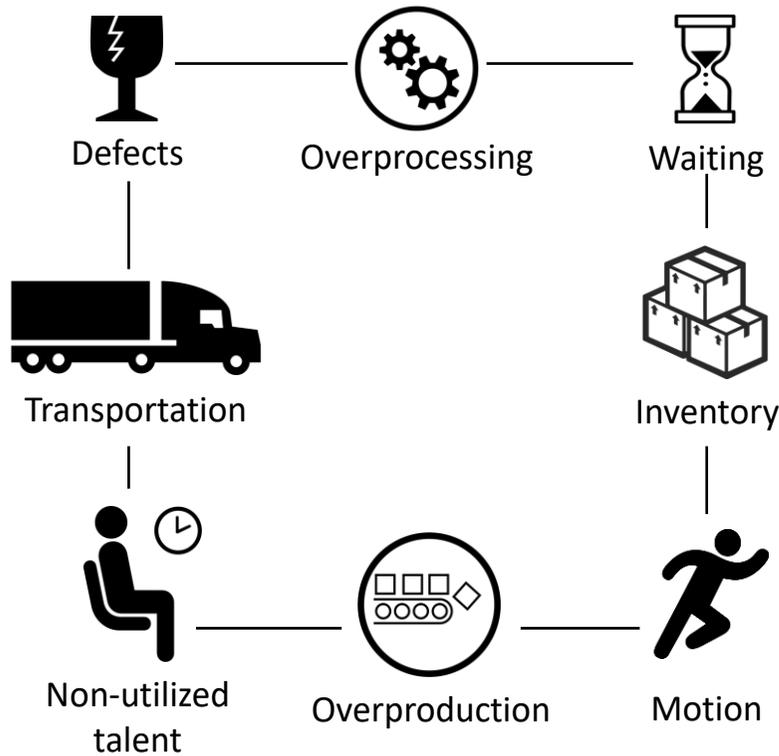
In Lean, waste is defined as activities or entities that can be removed from the workflow stream without impacting its productivity negatively.

Identifying and eliminating waste is the starting point for continuous improvement. Once the types of waste are understood clearly, the company can focus on optimizing their processes by eliminating waste from these processes.

## Application

The goal of process improvement is to identify and remove all forms of waste from a process in order to increase efficiency, reduce cost and optimize stakeholder value. Waste is any step in a process that is not required to complete a process (Non-Value-Adding) successfully. When waste is removed, only the steps that are required (Value-Adding) to deliver a satisfactory product or service to the customer remain in the process.

## 8 Types of Waste



## Process

*"If your customer wouldn't pay for it, it's waste."*

The overall process for identifying and removing waste is to eliminate any process, activity, or practice that does not result in more value for the customer, both internal and ultimate customers. To identify wastes, use Value Stream Mapping (VSM) to document instances of the waste in the processes, then develop a plan for eliminating or reducing them. By streamlining the entire process, the production flow can proceed without interruption.

## Complementary Methods

- Value Stream Mapping (VSM)
- 5S
- Gemba Walk
- Ohno Circle
- Spaghetti Diagrams

## Best Practices

- Clarify operating procedures and specifications to ensure waste-free processes.
- Reduce large batches.
- Use value stream mapping and process mapping to identify and eliminate waste.

## Do

- Ensure that employees are actively involved in their processes by encouraging them to take ownership.
- Identify what is needed and why, then remove extra steps, efforts and processes that add no value.

## Don't

- Consider the process for identifying and eliminating waste as a one-time action.
- Exclude your frontline workers and their input for process improvement.

## Resources

- Book: Lean Thinking: Banish Waste and Create Wealth in Your Corporation, by Womack and Jones.
- Book: Transforming Design and Construction: Chapter on Waste

## Business Drivers

- Reducing the amount of work required to perform tasks.
- More efficient business processes.
- Increasing value for customers.
- Improve competitiveness within the industry.

## Benefits

- Increase productivity and efficiency.
- Improved operational performance.
- Reduce cost and increase profits.
- More satisfied customers.
- Inventory reductions.
- Increase workspace utilization.
- Reduced lead time for orders.

## Attributes

	Low	High
Ease of Use	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Investment	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Training	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Value	<input type="checkbox"/>	<input checked="" type="checkbox"/>

# Standard Work

Standard work is the identification of repetitive processes and activities to structure a baseline process for how to perform the identified task.

The standard should optimize the defined task, to ensure a smooth handoff to reduce variability.



## Application

To reduce variability and increase transparency work standardization provides a detailed process, inputs, tools and resources, and expected output.

By explaining each procedure's steps and requirements, all involved workers can understand the process, remove unneeded waste, and can set a consistent baseline for performance.



## Standard Work Overview



1. Collect data and analyze your current operations



2. Ask for input from multiple sources



3. Establish/find the current best practices



4. Document everything in a visual manner



5. Provide training



## Process

Identify your work sequence and Takt time as the first step. Then you can identify the most efficient method for performing the task.

To find the most efficient way to run your operations, lean tools such as Value Stream Mapping (VSM) can be used to optimize work sequence and procedures. By recognizing these procedures, you can ensure that operators follow each step, according to the best practice outlined by your standardized work.



## Complementary Methods

- A3 Thinking
- Value Stream Mapping (VSM)
- Visual Management
- Mistake-proofing (Poke Yoke)



## Best Practices

- Highly repetitive tasks such as assembly procedures are good candidates for standardization.
- Standards should reflect the current best-known method for completing a process.



## Do

- Adopt a culture of continuous improvement.
- Visualize the benefits of Standard Work to encourage employees to participate in the process.
- Enable employees to provide feedback and take charge in process improvement.



## Don't

- Underestimate the importance of support from leadership.
- Neglect to continuously improve standards
- Overcomplicate revision processes and change request forms.



## Resources

- eBook: The Modern Guide to Standard Work, by Dr. Rebecca Morlando.
- Book: Transforming Design and Construction: Chapter on Work Structuring.



## Business Drivers

- Streamline problem-solving and process improvement.
- Ensure uniformity to certain practices.
- Simplify the training procedures for new employees.
- Lower operational costs.



## Benefits

- Faster production.
- Higher quality of work.
- Happier employees.
- Increased customer satisfaction.
- Reduced variability and more predictable processes to ensure outcomes are near identical every time.
- Improve processes leading to better outcomes.



## Attributes

	Low	High
Ease of Use	<input type="checkbox"/>	<input type="checkbox"/>
Investment	<input type="checkbox"/>	<input type="checkbox"/>
Training	<input type="checkbox"/>	<input type="checkbox"/>
Value	<input type="checkbox"/>	<input type="checkbox"/>

# 5S

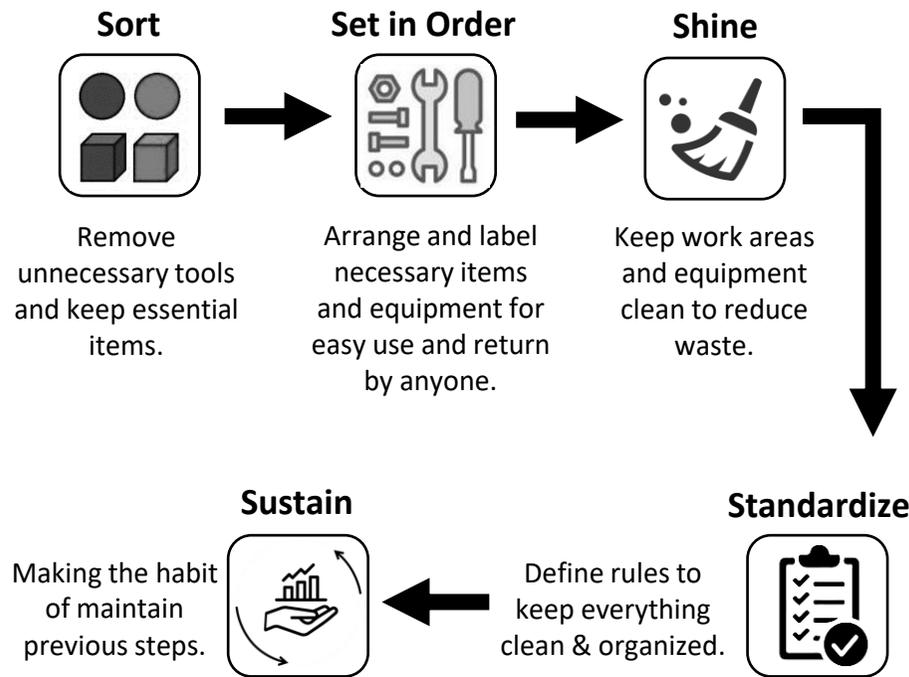
5 S is an abbreviation for Sort, Set-in-order, Shine, Standardize, and Sustain (or in the original Japanese - Seiri, Seiso, Seiton, Seiketsu and Shitsuke).

This is a process for waste removal from the workplace through the use of visual controls.

## Application

5S is a process that guides people through improving efficiency and making tasks repeatable through defining and organizing the supporting space or resources. This method emphasizes organizing the workspace in a clean, efficient and safe manner in order to achieve a productive work environment. 5S is used to differentiate required items from undesirable items and to remove unwanted materials and tools that should be stored in an organized fashion.

## 5S Overview



## Process

Sort is the first step in 5S implementation. This step emphasizes organizing materials and tools so needless items, redundancies, and hazards can be removed from the work area. Set-in-order is the task of setting out the precise, formal components or tools in the order they are used. Shine refers to the cleaning and basic maintenance duties workers incorporate into their daily routines. Standardize focuses on adding formal elements to make the system easy to maintain. Sustain is the process of continuing and constantly improving upon the system.

## Complementary Methods

- 8 Waste
- Visual Management
- Work Standardization
- Gemba Walk

## Best Practices

- Store items based on their function and label them to simplify retrieval.
- Use an organized workspace to reduce waste
- Reduce search time for tool and equipment.
- Place visual signs through the work area.

## Do

- Determine the frequency with which items or equipment are used.
- Implement the tagging technique.
- Store items in the accessible and controllable spots such as toolboxes, Conexus, lay down areas and storage yards.

## Don't

- Neglect to regularly check oil spills, leaks, and equipment damage
- Forget to meet regularly with workers to review the 5S System.

## Resources

- Book: 5s: A Visual Control System for the Workplace, by Edward Moulding.
- Book: Lean Construction Leaders: A Trade Partner's Guide to Lean, Chapter 3, The 5S System for Workplace Organization.

## Business Drivers

- Cost and time savings.
- Increase employees' satisfaction and morale.
- Provide discipline and structure for the organization.
- Identify and eliminate waste to generate smooth and efficient flow.

## Benefits

- Establish and maintain a clean and productive environment.
- Improve work quality and workplace safety.
- Increase process efficiency.
- Reduce production and set-up times.
- Decrease underutilized floor space.

## Attributes

	Low	High
Ease of Use	<input type="checkbox"/>	<input type="checkbox"/>
Investment	<input type="checkbox"/>	<input type="checkbox"/>
Training	<input type="checkbox"/>	<input type="checkbox"/>
Value	<input type="checkbox"/>	<input type="checkbox"/>

# Kitting

Kitting is the process of sorting, grouping, and packaging separate but related items together.

Kitting allows all of the miscellaneous pieces, parts, and components to be provided to craft workers in an organized fashion, allowing them to focus on assembly. This process reduces the amount of time spent looking for lost parts on the job.



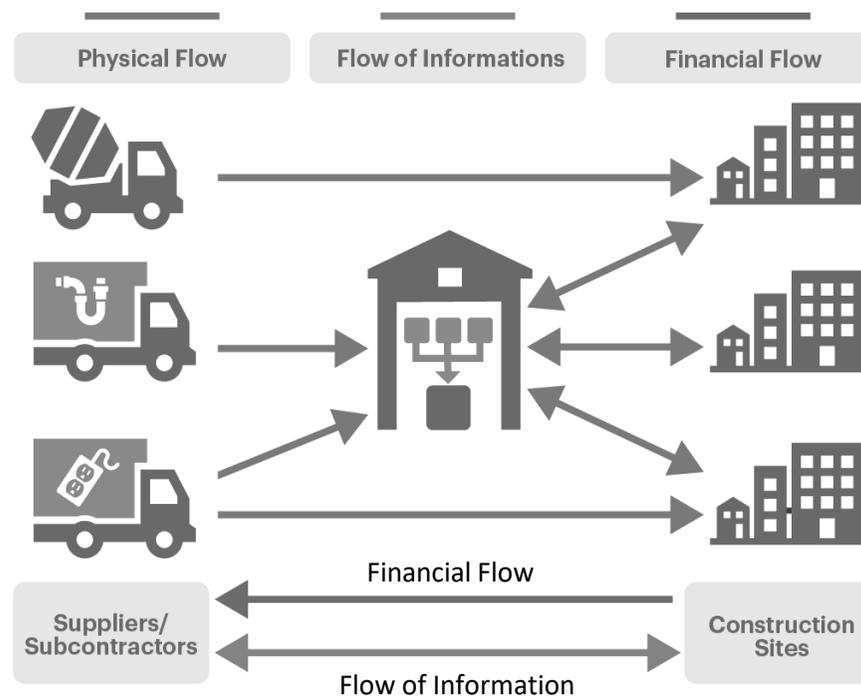
## Application

The application of kitting should focus on finding common tasks and standard sets of components that can be pre-sorted into convenient containers or packaging.

The kits are assembled off site or in an onsite yard to reduce unnecessary items from going to the field.



## Kitting Overview



## Process

Kitting is the process by which related groups of items are combined to comprise one single package. This combination is assembled into a customized kit and prepared for sending to craft workers in a job site as a one unit. The kit is a carrier, such as a box or trolley, containing the parts and consumables for a single assembly task. These kits can be placed close to the location at which they will be consumed. Thus, assemblies can be performed more efficiently through the use of kitting.



## Complementary Methods

- Standardized Work
- 8 Waste
- Value Stream Mapping (VSM)
- Just-In-Time (JIT) deliveries



## Best Practices

- It requires smooth information flow between operations.
- It requires centralized material logistics.
- Adopt kitting when implementing takt production.
- Look for ways to consolidate parts.



## Do

- Use the JIT (Just-in-Time) principle to send kits to job sites to avoid material piles, which can limit worker mobility and cause delays.
- While maintaining the standard format, customize each kit based on the project-specific requirements.



## Don't

- Neglect to identify the right components for the kitting combination.



## Resources

- Article: Tetik, M., Peltokorpi, A., Seppänen, O., Leväniemi, M., & Holmström, J. (2021). Kitting Logistics Solution for Improving On-Site Work Performance in Construction Projects. *Journal of Construction Engineering and Management*, 147(1).



## Business Drivers

- Streamline the onsite assembly process.
- Less track and packaging on site.
- Increase workflow reliability and on-site labor productivity.
- Improve the workers' workplace utilization rate.
- Planning and controlling material deliveries.



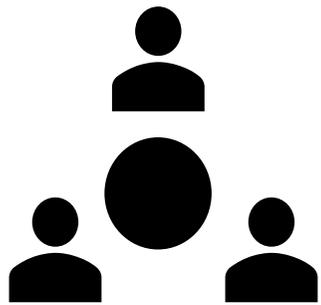
## Benefits

- Time savings during construction.
- Cost savings organizing materials and managing packaging.
- Increased efficiency and on-site labor productivity.
- Reduces waste and rework.
- Stabilize assembly work and increase workplace utilization.



## Attributes

	Low	High
Ease of Use	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Investment	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Training	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Value	<input type="checkbox"/>	<input checked="" type="checkbox"/>



# Task / Crew Coordination Methods

# Weekly Work Planning

The Weekly Work Plan (WWP) is a collaborative agreement on the production tasks for the next week. The WWP is based on lookahead planning and should include only quality assignments (those that are well defined, sound, in the proper sequence, and sized to capacity).

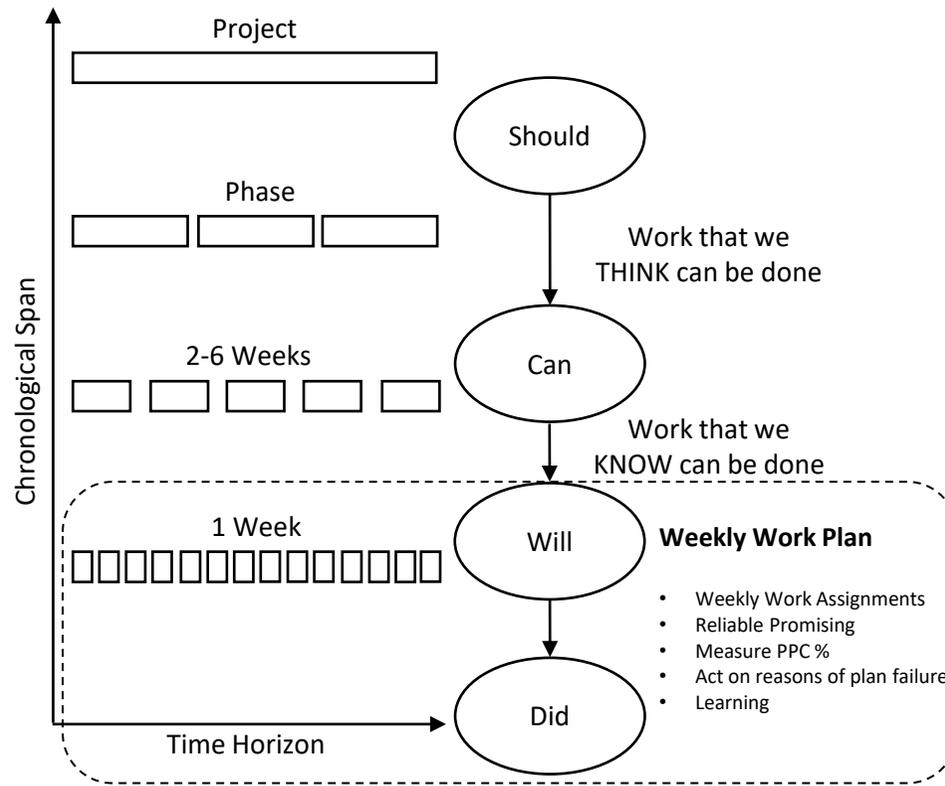


## Application

The WWP is formed based on the mechanism of Last Planner System® (LPS), which aims to transform what SHOULD be done into what CAN be done, thus forming an inventory of ready work. The WWP meeting covers weekly plans, safety, quality issues, resources, construction methods and any problems that occur in the field. It promotes two-way communication to share information on the project efficiently and accurately.



## Weekly Work Plan Overview



Adjusted from Ballard, 2000



## Process

The WWP process starts with listing big-picture goals. Afterwards, decide what is needed to meet those goals. WWP generally consists of three main parts:

- Overview of jobs/tasks that have been completed in the past week.
- Overview of jobs/tasks that need to be completed in the coming week.
- Analysis of the root causes for schedule delay and associated countermeasures.



## Complementary Methods

- Last Planner System (LPS)
- Visual Management
- Root Cause Analysis



## Best Practices

- Establishes the work that will be performed based on the promises of specific individuals.
- Connect and visualize the big picture.
- Helps set priorities.
- Plan and track time spent on each task.
- Use color-coding to aid visualization.



## Do

- Choose a regular day and time to conduct it (Friday afternoon is a good day for this – you can review your weekly accomplishments and plan ahead for the next).
- Stick to the plan, reschedule the tasks that weren't completed.
- Review and optimize the plan when the priorities change.



## Don't

- Over-schedule your time.
- Forget to include buffers (build in time for the unexpected).



## Resources

- Book: Lean Deployment Planning Guide (LCI)
- Book: Transforming Design and Construction: Chapter on Last Planner System of Production Control.



## Business Drivers

- Communicate progress.
- Plan the following week and make ready for the future.
- Explore and identify any interdependencies between resources, access and equipment.
- Maximize use of resources.



## Benefits

- Increase productivity.
- Prioritize work more effectively through visualization.
- Build a commitment to the program and reduce the overall program period.
- Enable teams to test options to improve workflow, buildability, and program reduction.



## Attributes

	Low	High
Ease of Use	<input type="checkbox"/>	<input type="checkbox"/>
Investment	<input type="checkbox"/>	<input type="checkbox"/>
Training	<input type="checkbox"/>	<input type="checkbox"/>
Value	<input type="checkbox"/>	<input type="checkbox"/>

# Daily Huddle

The Daily Huddle is a structured meeting with the goal of coordinating tasks and communicating information with the project team in a near-term scope. The meeting is usually brief, informal, but frequent – often daily. This technique is used for communicating and for the project team’s everyday meeting process to accomplish workers’ involvement.



## Application

The daily huddle is a short, daily meeting to convey information updates, confirm or coordinate daily tasks, and to identify and resolve issues.

Due to the short target durations, meetings are often held as ‘stand-up’ meetings to ensure quick updates. During these meetings, key information such as safety concerns, important deliveries, or last-minute changes can be quickly shared with the team.



## Rules for Great Daily Huddle



## Process

To effectively conduct the meeting, encourage everyone to attend the daily huddle. Make this activity a daily practice to instill a sense of commitment among all employees. Use ice-breaking strategies by beginning the discussion with good news that brings a positive vibe, or a light topic that allows everyone to have a good laugh. Then you can continue with topics related to safety, project progress, deliveries, inventories etc.



## Complementary Methods

- Onboarding
- Last Planner System (LPS)
- Visual Management



## Best Practices

- Use a dedicated facilitator for an effective and productive meeting.
- Focus on the How, not the Why. Try to produce solutions-based discussions instead of status-based presentations.
- Engage everyone who attends.



## Do

- Keep it short and solution-oriented.
- Stick to the agenda.
- Start on time and end on time.
- Ask questions that will encourage your employees to be proactive.
- Make sure participants aren’t interrupting each other.



## Don’t

- Forget that the details matter.
- Use daily huddles as a venue to scold employees.
- Try to use daily huddles for problem-solving, which requires discussion and a thorough review of all options. If problems are brought up, quickly determine a different time and place to dive into those topics further.



## Resources

- Book: Beyond the Morning Huddle: HR Management for a Successful Dental Practice, by Dr. Ann Marie Gorczyca



## Business Drivers

- Improve the performance and engagement of employees.
- Improve internal communication among team members to address issues on a regular basis.



## Benefits

- Keeps the team connected and maintains healthy team dynamics.
- Streamlines communication to ensure messages are easily understood.
- Provides an open exchange of thoughts.
- Reduces interruptions and rework.



## Attributes

	Low	High
Ease of Use	<input type="checkbox"/>	<input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
Investment	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input checked="" type="checkbox"/> <input type="checkbox"/>	
Training	<input type="checkbox"/> <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	
Value	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input checked="" type="checkbox"/>	

# Visual Management

Visual Management (VM) refers to the presentation of information in a way that enables everyone to recognize current status within 30 seconds.

Visual management may capture information on productivity, status of deliveries, timing of events, or quality standards. The main purpose of VM is sharing information.

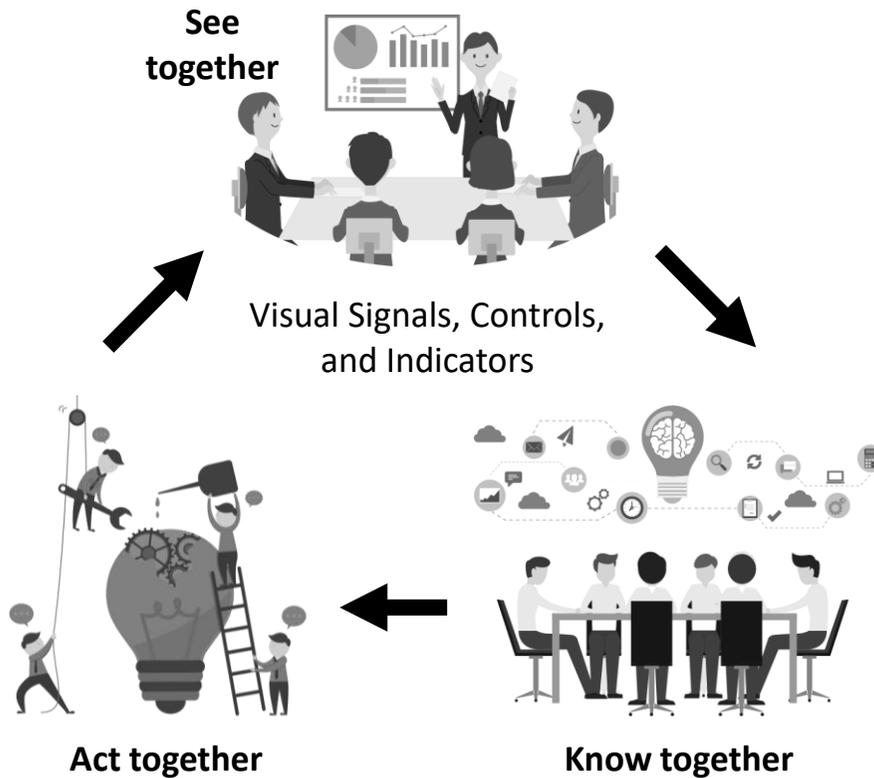


## Application

The use of visual management supports quick assessment of tasks, tools, and resources to allow workers to save time. Common examples include organization systems to ensure all tools are accounted for and stored properly, colors to convey systems (e.g., red is hot water and blue is cold water) or providing markings to show walking paths and material flow.



## How Visual Management Works



## Process

*"A picture is worth a thousand words."*

Visual management can take several forms or topics. It uses processes, charts, or diagrams to capture and share information. Focus on the key areas for ensuring work is progressing – production, materials, and schedule. Keep the visuals simple and take suggestions for improving them as they are used.



## Complementary Methods

- 5S
- Standardized Work
- Supportive of many Lean methods



## Best Practices

- Develop standard visuals across projects, so team members can easily adapt.
- Use daily huddles to update visuals.
- Use colors for consistent info (such as days of the week or which crew is responsible for specific tasks)



## Do

- Visualize targets on a large screen to ensure that everyone knows what's important.
- Bring clarity to the team through visualization, creating a shared path towards business goals.



## Don't

- Use too many words to transfer the data.



## Resources

- Book: 5 Pillars of the Visual Workplace: The Sourcebook for 5S Implementation, by Hiroyuki Hirano.
- Book: Visual Workplace/Visual Thinking, by Gwendolyn D. Galsworth.
- Book: Transforming Design and Construction: Chapter on Visual Management.



## Business Drivers

- Enhance the flow of information.
- Increase transparency, resulting in self-control.
- Broaden employees' participation and create shared ownership.
- Increase effective communication.
- Adopt a mindset of continuous improvement.



## Benefits

- Build common understanding
- Save time
- Recognize where help is needed
- Improve accountability
- Improved performance
- Provide real-time updates



## Attributes

	Low	High
Ease of Use	<input type="checkbox"/>	<input type="checkbox"/>
Investment	<input type="checkbox"/>	<input type="checkbox"/>
Training	<input type="checkbox"/>	<input type="checkbox"/>
Value	<input type="checkbox"/>	<input type="checkbox"/>

# Prefabrication

Prefabrication, or “prefab,” is a lean method that uses components made off-site in a factory, which are then transported and put together on-site to create a building component.



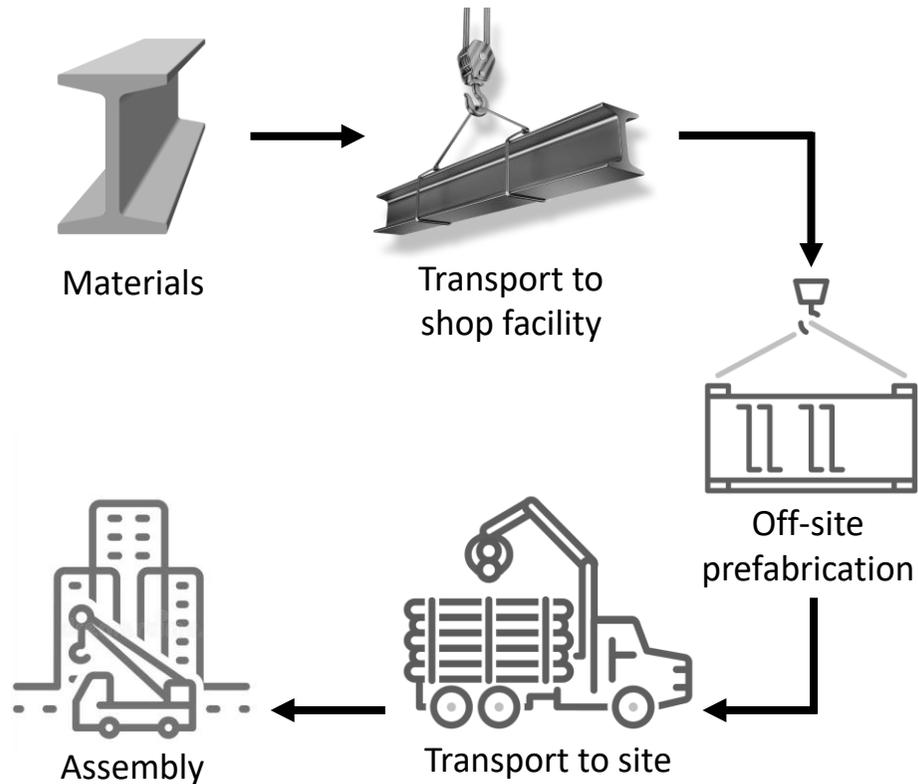
## Application

Construction companies will transport the completed unit to the final site, where they will also complete the setup and handover buildings.

This process eliminates the need for traditionally sourced construction materials because parts assembled off-site result in less waste. As the raw materials are built off-site and shipped partially assembled, prefabrication reduces the cost of labor and materials.



## Prefabrication Overview



## Process

Prefabrication supports field workers as internal clients. Each project has unique constraints and needs, the specific approach to prefabricating systems, components, and assemblies need to be custom-tailored. This includes reducing the number of pieces a worker needs to handle for each task, grouping parts to reduce worker time, and focusing on the enabling tasks to streamline field installation.



## Complementary Methods

- Modularization
- JIT
- BIM
- Kitting
- Standard Work



## Best Practices

- It requires an increased level of communication and coordination in preplanning.
- It requires information to be shared in a timely manner by other trade partners.
- Use Juts-In-Time (JIT) deliveries for prefabricated units to reduce the storage space.
- Poor quality designs or last-minute changes would complicate prefabrication, leading to reworks.
- It is more cost-effective for large projects with many repetitive units.



## Do

- Use BIM to facilitate prefabrication by providing more details and reducing the chance for reworks.



## Don't

- Underestimate the importance of preplanning.
- Get involved in projects late, which reduces preplanning time for prefabrication.



## Resources

- Book: Prefabricated Systems: Principles of Construction, by Ulrich Knaack, Sharon Chung-Klatte, Reinhard Hasselbach



## Business Drivers

- Cost-effectiveness.
- Consistency & quality control.
- Reduced lead time and accelerate construction process.
- Reduced effects of uncontrolled factors.
- Optimized work sequences.



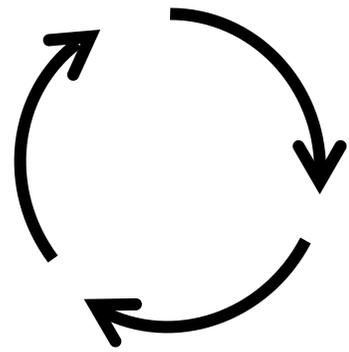
## Benefits

- Increase efficiency and work speed due to better working ergonomics.
- Improve quality and safety.
- Reduce impact of poor weather.
- Reduced site disruption.
- Decrease jobsite congestion.
- Reduce waste.



## Attributes

	Low	High
Ease of Use	<input type="checkbox"/>	<input type="checkbox"/>
Investment	<input type="checkbox"/>	<input type="checkbox"/>
Training	<input type="checkbox"/>	<input type="checkbox"/>
Value	<input type="checkbox"/>	<input type="checkbox"/>



# Continuous Improvement Methods

# A3 Thinking

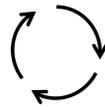
A3 thinking is a documentation approach for problem solving and reporting on project-related critical decisions using the PDCA method of continuous improvement.

PDCA stands for Plan, Do, Check, Adjust. It is a method for continuous improvement that focus on a cyclic process of planning, execution, monitoring, and learning.



## Application

Teams use A3s for problem-solving. This is done by establishing a single 11 x 17-inch sheet of paper to allow the problem solver (author) to fully grasp the issue. The author includes relevant business background information, explores the current situation, and sets goals. By using other sections such as countermeasures, root-cause analysis, and an action plan, the author is able to visualize the whole process, gain alignment with others, and sustain improvement.



## A3 Template Structure

Background	Proposed approach
Why do we need to work on this? Context & Importance	What actions will you take? What does the improved process look like? How do you measure it?
Current Condition	Plan
Problem statement Document "as-is" state and capture the scale of the problem	Tracking of results Trend visual?
Goals / Target	Follow-up
Define the target performance or desire outcome	Actions still required Learning points to share
Root Cause Analysis	
Fishbone diagram, 5Whys, or Cause/effect diagrams (among others)	



## Process

The A3 process follows the structure of the template to document the problem or opportunity, identify the reasons why it needs to be addressed, and present information to justify the root cause to be fixed (left side). On the right side of the document, the implementation of the change is captured and tracked to show if the proposed improvement makes an impact, using data to convey the change from the original state.



## Complementary Methods

- 5 Whys Analysis
- Fishbone Diagram
- PCDA: Plan-Do-Check-Adjust
- DCAP: Detect-Correct-Analyze-Prevent
- Ohno Circle
- Quality Circle



## Best Practices

- Apply A3 thinking in situations that are hard to define clearly.
- Use this method for chronic or repetitive challenges.
- Use this method for problems that are costly or require significant attention to solve.
- Make information visual.



## Do

- Use the PDCA process to ask questions.
- Be patient with yourself and others.
- Start with a pencil and paper or a whiteboard.
- Engage with others
- go and observe the current state for yourself.



## Don't

- Fill out a template without following the PDCA process.
- Do not rush the process or assume that others will be able to follow a template.
- Assume you understand the situation based on secondhand information.



## Resources

- Book: Lean Deployment Planning Guide (LCI)
- Book: Transforming Design and Construction - chapter on A3 Thinking



## Business Drivers

- Communicate ideas in a simple way.
- Identify and track problems.
- Expose/analyze value to eliminate waste.
- Enhance collaboration.



## Benefits

- Creates clear & concise reporting .
- Develops problem solvers.
- Is easy to understand.
- Supports a mindset of continuous improvement.
- Provides information for others with similar problems



## Attributes

	Low	High
Ease of Use	<input type="checkbox"/>	<input type="checkbox"/>
Investment	<input type="checkbox"/>	<input type="checkbox"/>
Training	<input type="checkbox"/>	<input type="checkbox"/>
Value	<input type="checkbox"/>	<input type="checkbox"/>

# Value Stream Mapping (VSM)

Value Stream Mapping (VSM) is the act of producing a picture (map) of an entire working process. A VSM includes both material (product/ service) and information flows and includes both value-added and non-value-added activities. It is a tool used to identify waste and potential areas of improvement within a process. A VSM shows values (information like the timing of steps) and numbers to objectively display where improvements can be made.



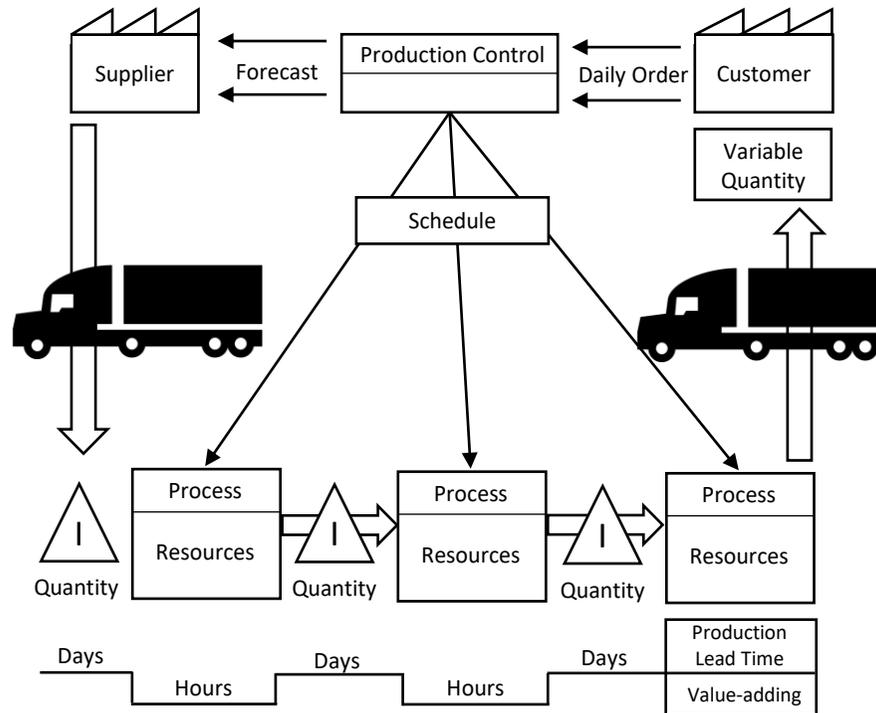
## Application

A VSM is useful for defining and understanding the process for how materials and resources are purchased, transported, stored, used in prefabrication processes, then prepared and shipped to the site to be used at the project.

Understanding and documenting the full process enables teams to identify waste, opportunities for value enhancement, and areas where the production and efficiency can be improved as whole.



## Value Stream Mapping Template



## Process

The VSM discussion starts by mapping the current state of the process from beginning to end. This allows the team to find areas that do not add value to the process.

Afterwards, the team is left with what's called the future state map – the map of the ideal process that is free of waste. The visualization of the future state map allows the team to analyze and implement actions to achieve it.



## Complementary Methods

- 8 Waste
- Ohno Circle
- 5 Whys Analysis
- Gemba Walk
- A3 Thinking



## Best Practices

- Use VSM to handle simple and repetitive projects or processes.
- Help decision makers to formulate and optimize project processes.
- Use VSM for cases involving multiple functional areas or departments.



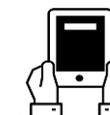
## Do

- Collect data while observing the process.
- Keep a record of the time it takes to complete each step and identify any areas of inefficiency.
- Define the current state of the process so that any issues can be identified.



## Don't

- Rush into an improvement plan without fully understanding the current process and identifying pinch points.



## Resources

- Book: Lean Deployment Planning Guide (LCI)
- Book: Learning to See: Value Stream Mapping to Add Value and Eliminate MUDA, by Mike Rother and John Shook.
- Book: Transforming Design and Construction: Chapter on Value Stream Mapping.



## Business Drivers

- Identify and remove waste to have a consistent flow (Level workflow).
- Process efficiency and improvement.
- Identify 'pinch points'
- Support continuous improvement.



## Benefits

- Provide effective communication and collaboration.
- Provide a clear visualization of the current state of the process and clearly see where waste is occurring.
- Highlight problem areas.
- Identify opportunities for process improvement.



## Attributes

	Low	High
Ease of Use	<input type="checkbox"/>	<input type="checkbox"/>
Investment	<input type="checkbox"/>	<input type="checkbox"/>
Training	<input type="checkbox"/>	<input type="checkbox"/>
Value	<input type="checkbox"/>	<input type="checkbox"/>

# Gemba Walks

Lean experts encourage partaking in Gemba walks (also known as “going to the gemba”) to see how the work is done, allowing for opportunities to identify and eliminate waste.

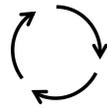
This usually involves a close physical or personal observation of the work. The Japanese term, Gemba, refers to the location where the work takes place.



## Application

A Gemba walk is more than just an observation. Gemba walks focus on observation, gaining an understanding of how work is being performed, engaging with workers to understand the what and why for the methods being employed, the challenges being faced, and potential areas where waste is occurring.

This engagement is intended to enable an understanding of the tasks and workplace needs with the direct context of the tasks being performed.



## Gemba Walk in 7 Steps



## Process

Gemba walks help the participant understand the process in a more comprehensive way. When you perform a Gemba walk, you need to look for any potential area for improvement within an established process of your work. By recognizing the root cause of the waste in the process (and by applying Lean tools such as 5 Whys or PDCA), you can identify and remove it.



## Complementary Methods

- Visual Management
- First Run Studies
- 8 Waste
- Value Stream Mapping
- 5 Whys Analysis
- PDCA



## Best Practices

- Use Gemba walks to identify wasteful practices.
- Focus on specific parts of your value-creation process and assess it from start to finish.
- Observe and seek to gain understanding while leaving all assumptions at the office.



## Do

- Prepare a list of questions you are going to ask.
- Focus on the process, not people.
- Explain the purpose of the Gemba walk to your team so that they feel more comfortable and are willing to collaborate.



## Don't

- Make suggestions during the walk.
- Forget to share with the team what you have learned or seen (after you have left and analyzed your notes). Inform them about the upcoming changes and why they are necessary.



## Resources

- Book: How to Do a Gemba Walk: Coaching Gemba Walkers, by Michael Bremer



## Business Drivers

- Improve communication
- Streamline problem-solving.
- Identify waste in the workplace and processes
- Cost and time savings



## Benefits

- Build stable relationships with those who do the work and create value.
- Identify problems and take actions for achieving continuous improvement.
- Clearly communicate goals and objectives leading to increased employee engagement.



## Attributes

	Low	High
Ease of Use	<input type="checkbox"/>	<input type="checkbox"/>
Investment	<input type="checkbox"/>	<input type="checkbox"/>
Training	<input type="checkbox"/>	<input type="checkbox"/>
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# 5 Whys

The 5 Whys problem-solving technique is used to dig for the root cause of a condition by asking “why?” at least five consecutive times.

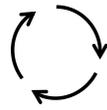
As the answer to each “why” question is provided, the next “why” is asked in a continuous cycle until the base problem is found.



## Application

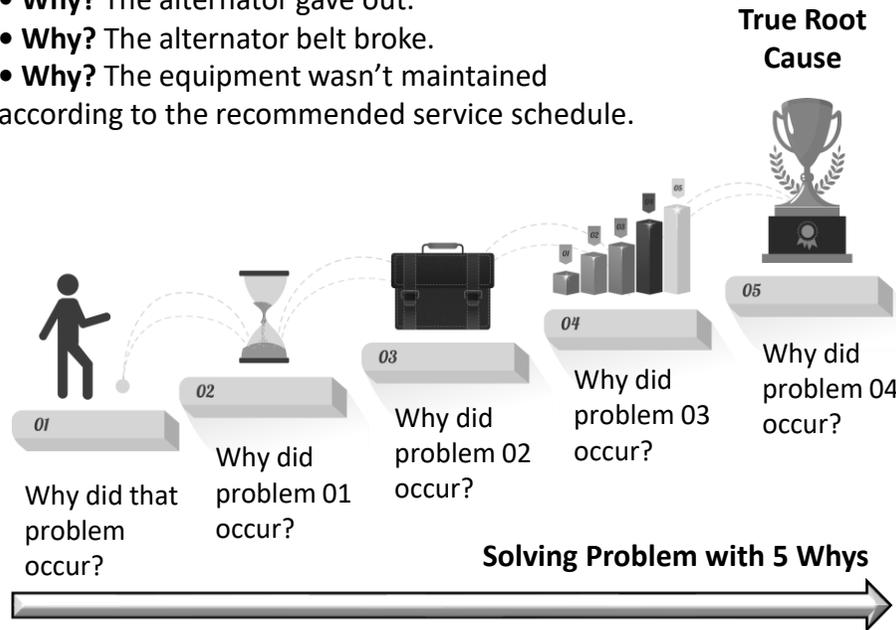
The 5 Whys technique helps to determine the root cause of a problem, such as delays in the schedule. To support continuous improvement, problems should not simply be resolved, but the reason(s) for the problem should be addressed so the error does not happen again.

By understanding the root cause of an issue, the team can uncover processes that are not working correctly, discern where planning was insufficient, or determine if different resources or tools are needed to perform a task more effectively.



## 5 Whys Problem-solving

- **Why we are behind schedule?** The excavator broke down.
- **Why?** The battery was dead.
- **Why?** The alternator gave out.
- **Why?** The alternator belt broke.
- **Why?** The equipment wasn't maintained according to the recommended service schedule.



## Process

The 5 Whys method follows a very simple process. First, invite people who are familiar with the issue to the meeting. Select a facilitator to lead the discussion, ask the 5 Whys, and keep the team focused on the issue at hand. Develop a clear and concise problem statement after discussing the problem with your team. Ask “why” as many times as needed until the team identifies the root cause of the initial problem. By identifying one true root cause, discuss what countermeasures can be taken to prevent the issue from happening again.



## Complementary Methods

- Supportive of many lean methods, such as:
- Gemba Walk
  - Ohno Circle
  - A3 Thinking



## Best Practices

- It is most effective when used to solve simple to moderately challenging issues.
- For complex problems, it is best to use 5 Whys in conjunction with other problem-solving methods since there are often multiple causes.
- The success of the method relies on the skill of the facilitator and the people involved.



## Do

- Include people with practical experience on the issue.
- Use paper or whiteboard instead of computers.
- Write down the problem and make sure that all people understand it.
- Pay attention to the logic of cause-and-effect relationship.



## Don't

- Forget that not all problems have a single root cause. If you want to uncover multiple root causes, the method must be repeated asking a different sequence of questions each time.



## Resources

- Book: 5 WHYS: one of the simplest and fastest problem-solving ways to get to the root of the problem, by Majed F Rajeh.



## Business Drivers

- Help detect and eliminate organizational issues.
- Identify the underlying cause of a problem.
- Help to identify a sustainable, incremental solution to resolve the issue.



## Benefits

- Enhance team morale among employees.
- Help avoid iteration of failures.
- Encourages team members to share ideas for continuous improvement.



## Attributes

	Low	High
Ease of Use	<input checked="" type="checkbox"/>	<input type="checkbox"/>
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