PennState College of Engineering | ARCHITECTURAL ENGINEERING

A Case Study in Lean Construction: Parsons Electric Company

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

Case Study No. 06
December 2022

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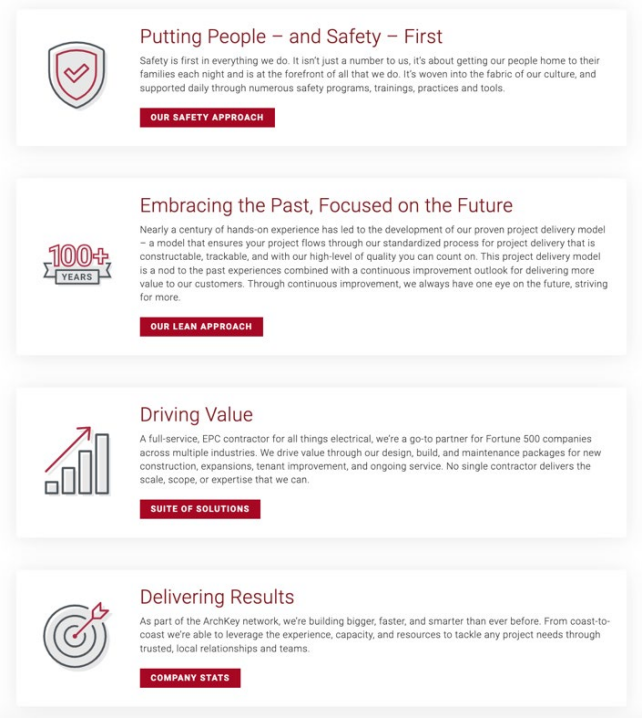
Summary

The adoption of lean at Parsons is strongly apparent. Parsons has developed a mentoring and coaching approach to building continuous improvement into the company's culture. Building upon a strong core of training developed in-house, the principles are embedded in a way that makes them apparent and strongly emphasized, while keeping them simple and clear to those that use them. Everyone within the company is expected to be able to explain why they are doing their work and how it relates to value for their customers. Those values are translated into setting practical goals and checking each week, or at the appropriate interval, to assess if you are meeting your goal and fulfilling your duties to your customer and your team. The culture is further enhanced by the high value placed on the craft workforce Parsons engages in their projects. Building relationships with craft, internal teams, and external partners allows Parsons to build trust. Still, that trust is complemented by strong technical planning and execution that justifies the trust they create. The training and mentoring are further embodied in the ongoing pursuit of excellence in the continuous improvement processes. Training everyone in methods from process planning and 5S to takt time provides a rich and consistent toolset that people are empowered and encouraged to use throughout the company.

Company Overview

Parsons is a large electrical contractor based out of Minneapolis, MN. Parsons was founded in 1927 and has slowly grown from a regional contractor to one with a national presence. The recent acquisition by ArchKey Solutions has expanded the footprint and scope of services that make the overall corporation $1.4 Billion. While Parsons focuses on electrical construction, they also perform low voltage and controls and automation installation, electrical service and maintenance, utility, line, and substation work, along with a unique panel shop that can produce UL-rated panels.



Parsons receives a substantial portion of its work through preconstruction and negotiation of work. They are seasoned as a signatory partner on integrated project delivery (IPD) projects, mainly in the healthcare market. They also have national relationships, particularly in their service sector.

Parsons excels at technical projects but performs electrical work on projects of all types. Both have a robust regional emphasis in the Midwest, radiating from the Minneapolis headquarters. However, they will travel where needed to work with their long-term partners, or as one of the company leaders phrased it, "we go wherever our friends take us."

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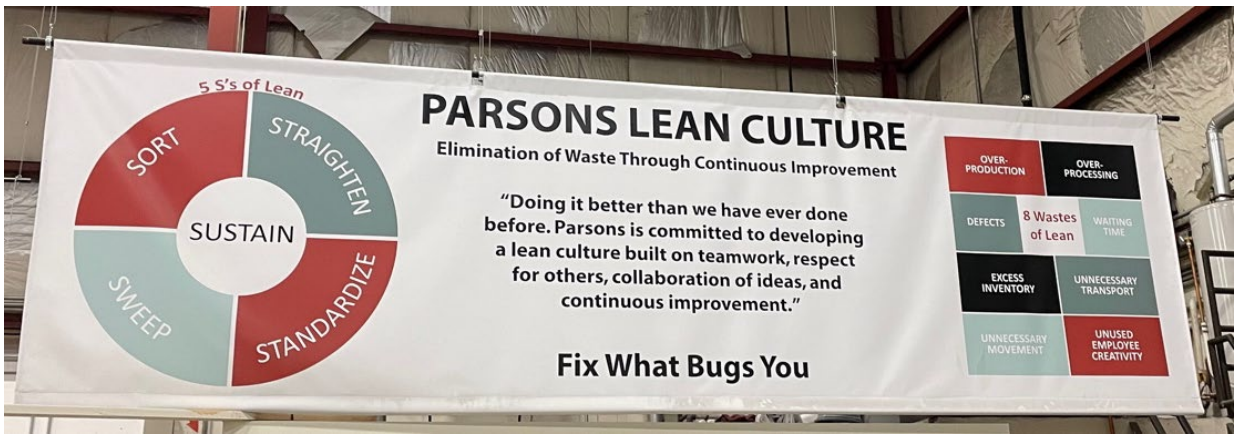
Case Study Process

In late June 2022, the Penn State Research Team investigators conducted a site visit and interviews and observed the operations at a construction project for Parson Electric's office in Minneapolis, MN. The notes from the interviews and observations were reviewed to identify themes and align observed practices with lean principles. Following the visit, the case study was documented and shared with personnel at Parsons for validation. The case study document describes how the behaviors and approaches to lean are implemented at Parsons to support their construction operations.

Overview of Lean Construction Implementation

Parson's approach to lean emphasizes three key elements – mentoring and training, embedding continuous improvement into the mentality and culture of the company and the P4 planning process for project success. The pursuit of continuous improvement has encouraged several methods to be embedded into the processes Parsons has standardized around, but with the goal of improvement. The standard methods serve as a benchmark to build upon and improve upon throughout the journey. As one person framed it, they have 'built-in' continuous improvement into the culture and mindset of the company personnel.



Training and Mentoring

It is hard to capture in words how comprehensive and pervasive the lean mindset was across Parsons. The basis for this extensive adoption and understanding is tied to the structured training regiment Parsons employees undertake. The emphasis within Parsons was not simply on providing training but on creating an active culture of coaching and mentoring. They began their lean journey by hiring lean coaches to train the company's personnel in the fundamentals of lean. They conducted several lean boot camps in the first and second years of their lean journey. By the end of the second year, most personnel were trained in lean fundamentals, from the warehouse workers to the CEO. To help encourage and recognize the training and advancement, Parsons works from the belt program through the Global Leadership Institute. They developed a yellow and green belt program which comprised a deeper dive into lean principles and tools and how to apply them to construction projects. Everyone at Parsons undertakes twenty hours of training to earn their yellow belts, with the content for the modules described in Table 1. New management

employees and emerging field leaders are taken through the yellow belt, typically within their first year, as well as across the different support units of the company. Those moving toward higher leadership, or upon request, take an additional twenty hours of training and practical application to develop as lean leaders and mentors, earning their green belt, if they are passionate or have an impetus for coaching, with a few getting their black belt.

Table 1 – Summary of topics for each of the Yellow-Belt modules

Yellow-Belt Module	Topics
Introduction to Lean Construction	• Intro to Lean Principles • Lean Principles in Construction • Lean Culture • Lean Leadership • *Exercise* – Culture • *Exercise* – Lean Leadership
The 8 Wastes – DOWNTIME	• Lean Thinking • Each of the 8 Wastes (Defects, Overproduction, Waiting, Non-utilized resources, Transportation, Inventory, Motion, and Extra-processing) • *Exercise* – Pick three wastes
5S for Workplace Organization and Standardization	• Intro to 5S System • Each S (Sort, Straighten, Shine, Standardize, Sustain) • *Exercise* – Number game • *Exercise* – 5S a workplace
The Last Planner System®	• Planning to achieve milestones • Introduction to Takt • Sequencing • LPS in 3 parts • *Exercise* - Milestones
The P4 System for Pre-Planning	• Intro to P4 • Each P (Process, Pace, Prepare, Perform) • *Exercise* – perfect cup of coffee • *Exercise* – P4 of an electrical lighting plan • *Exercise* – P4 for Process Improvement • *Exercise* – Preparing Energize Ready Plan

In the fourth year of their lean journey, Parsons customized a process of preparing for phase pull planning that they coined *P4 Planning*. This four-step process helps them to view their current processes and look for ways to improve what they have done on past projects. P4 Planning is now part of their core process document for all project teams. The focus, particularly for field operations, is to bring order to chaos. Field leaders should be as prepared as possible and able to adapt to change, but also be able to plan and create flow in the construction of their scope. The coaching process focuses on embedding the value system into all personnel as they join Parsons, creating the mindset and expectations to plan effectively and support their team. The leaders should have initiative, focusing on what team members should expect of each other, how the project team will approach the work, and how the project team will execute the work. Foundational to that value system is the recognition of the value of skilled trades as people and team

members. In addition to the integrity and accountability that it incorporates, the value extends to getting outside of the traditional comfort zones to create opportunity, as well as injecting a 'lean mentality' of mutual respect, collaboration, reliable commitments, and the continuous elimination of waste.

Each field leader is expected to be able to speak to the value proposition of their work and plan. Everyone makes decisions based on their values, the why or why not. While a firm cannot control that value system, it can influence it. To support the coaching, the process defines the expected behaviors – creating clear conditions of satisfaction for customers, being accountable to the team, and having humble confidence. Someone with humble confidence is confident in their ability and resulting plans but can listen and accept constructive feedback to improve the plan or their process.

Coaching begins during the hiring process. It then manifests through the verbal commitment process of each crew member to the values and plans of a project. Each apprentice is given two 'gut check' questions to assess their performance – did I make my foreman's day easier or harder? And am I delivering to expectations? If apprentices understand and can work to answer yes to these questions, it allows the foreman to focus on delivering to the customer's needs. Similarly, leaders are expected to be able to answer whether their team did *'more than my customer expected'* to deliver value and if their team made their job easier or harder. Reflecting on these questions and improving at answering yes is huge for the company's success. Over the years, it manifests in how work is executed and how team members behave toward one another. That naturally evolves into a pyramid of servant leadership at escalating levels.

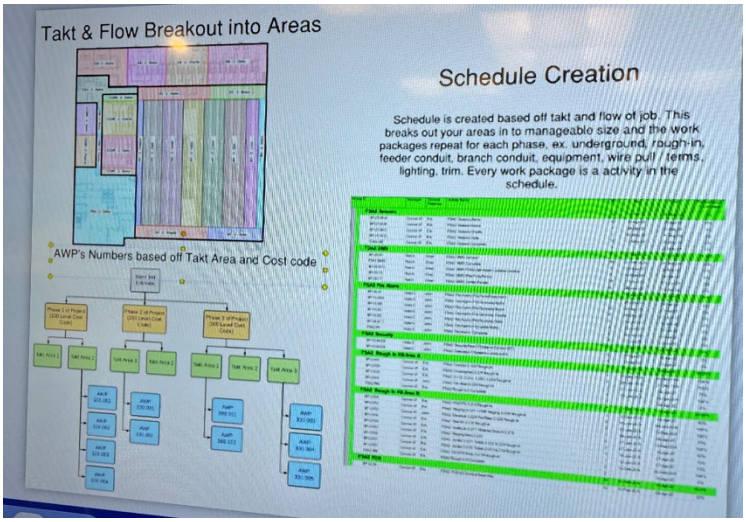
The culture is embedded but kept to simple concepts – as easy as *"fix what bugs you."* Employees throughout, from accounting to field to shop, are encouraged to identify the little problems that slow things down or cause nuisance issues and remedy them. The empowerment of everyone was clear; everyone was comfortable and knowledgeable to speak to lean principles, but in lay terms, related to how they go about their daily activities, support their team members, and meet or exceed client expectations. As one executive put it, it starts with concepts and language, then becomes a process, but the ultimate transformation is when it becomes a way of life – built-in continuous improvement. Having a field worker recognize a problem with a prefabricated assembly and kitted parts, and rather than fixing it and 'making do' with what they have in the field, that worker instead calls in the foreman and back to the shop to fix the problem across the dozens, or potentially hundreds, of parts – that is the key to building a self-improving organization.

Developing Flow through Work Packaging and Takt Planning

At the heart of the approach taught at Parsons to allow field leaders to bring order to chaos is the focus on developing the flow of work. Two critical elements the field leaders learn to enable them to develop a flow for their work are how to break down the full scope of their system and construction tasks into manageable work packages and understanding the takt time approach to enable the crews to 'flow' at a consistent pace in performance of their work.

Work Packaging

A work package, in simple terms, is a group of related tasks within a project. A logical, manageable scope of construction work should define it. As a subset of the work breakdown structure, it is the smallest level or lowest unit – defining the system components or materials needed, the expected task outcomes, the location of the work, the nature or method of work, and the time to be complete. It is larger in scope than a worker task; as defined, it is the level to be managed and thus is organized by how a crew, even if only one or two workers, should undertake it.



When considering why and how to break down work packages, the point should be to define them in both a way that is necessary to complete a project but also to ensure the integration of work within and across the packages. They allow the foreman or field leader to divide work into simultaneous activities that different crews can perform. They offer defined units for materials, prefabrication, and logistical planning. They should also align in a way to easily manage to project outcomes through alignment with budgets, schedule milestones, and system or facility targets.

Takt Planning

The breakdown of work into packages is common for any construction company. The introduction of takt planning in conjunction with the work packaging helps translate the breakdown of work or systems into a manageable plan. Takt, a German word that translates to beat or pulse, introduces the idea of building to a rhythm. In manufacturing, the rhythm is driven by the pace of customer demand or purchasing of the product. In construction, with the client typically wanting a complete facility or in large phases, the takt rhythm is driven by setting the pace for internal clients – those downstream of you in the production sequence or within your scope. By integrating the idea of breaking down work into manageable packages and then trying to put a rhythm or cadence to the build, field leaders are trained to think not of the pieces but the whole. Rather than focusing on how to fit one round peg into one round hole and then move to the square peg, the mindset is re-oriented around how to get a whole crew of rowers to follow the same drummer's beat. The field leader's role, thus, is to serve as the drummer and determine the beat that the whole crew needs to match to move the ship forward at a consistent and certain speed.

Another unique aspect of introducing this into construction, over manufacturing, is that the widgets made do not come to the worker on an assembly line. The craft workforce needs to go to the work or space where the work will take place. Thus, takt planning has to incorporate an element of location and movement of the workers. The rhythm has to consider how the building is constructed ahead of the crews to build the structure and shell of the spaces to come, as well as to break the spaces down in a manner that allows for a consistent pace for the work packages that occur in each space. In highly repetitive designs, this is often simpler; however, it can be applied across all projects with some creativity in the breakdown.

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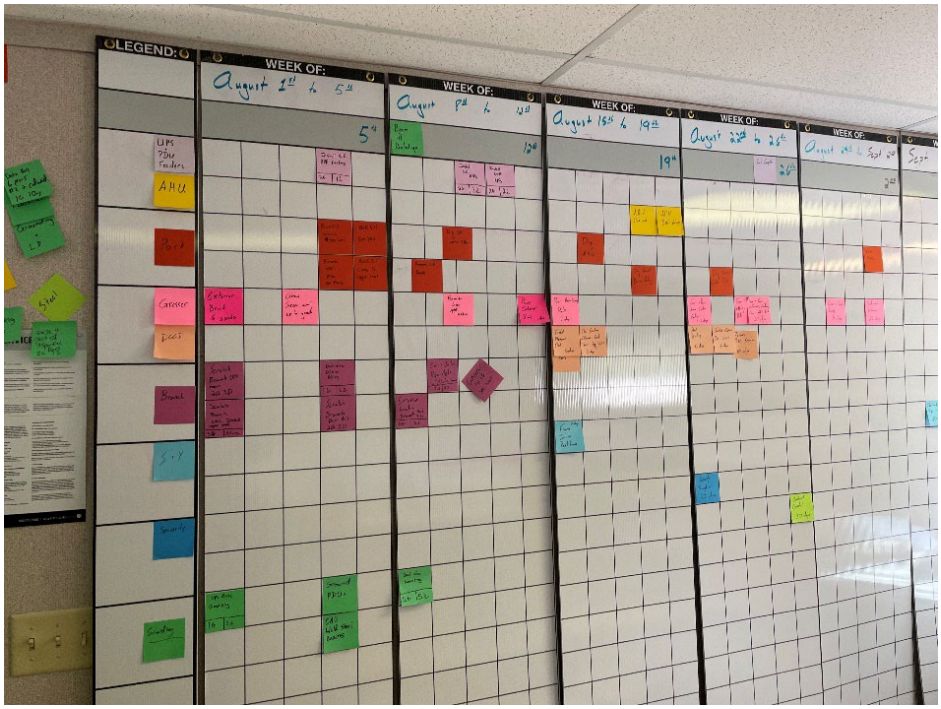
With the definition of work packages and a takt plan for how the work packages, or more accurately, the crews delivering the work packages, flow through the space, field leaders are equipped with a reliable plan for building a project, and the takt train can leave the station.

Last Planner System®

Using takt planning and work packaging to develop the project flow does not negate the need to apply the Last Planner System (LPS). The use of LPS engages the project team and crews in the collaboration of transforming a plan into a network of commitments, as well as breaking work packages down into detailed tasks and potential constraints that need to be removed to execute the work in the field. Further, the use of learning directly ties to the importance of mentoring and coaching up-and-coming field leaders in the planning, forecasting, and learning needed to execute a plan and how to communicate it to and negotiate with colleagues leading other crews or trades. Further, as leaders are expected to practice having humble confidence, the team may identify options or alternatives to the original plan to address emerging problems on a project that were not expected or to identify improvements to be more successful.



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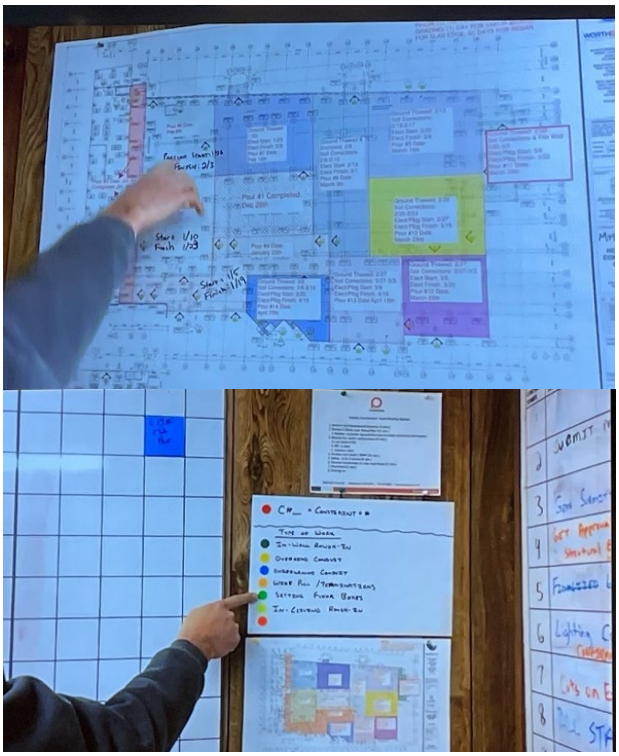
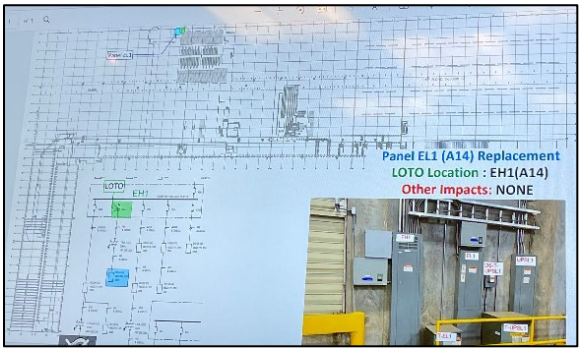
Visual Management



The LPS board, along with the visual elements of the takt plan, such as the breakdown of work areas, and the constraints log, offer anyone walking into a project trailer the capability to assess the work status on the project. The LPS notes are expected to be defined clearly, such that anyone within the company should be able to reasonably decipher the task. The area breakdown on the takt plan should be used in the notes to link the scheduled tasks to the visual areas of the project. The constraints log should be clearly labeled and linked to the tasks so it is apparent what constraint needs to be removed to allow the specific task to be completed. In simple terms – "do I know what is happening without anyone telling me."
Similarly, at the end of each week, the foreman can clearly tell if they 'won' that week. The post-its should include where the scope, the area, the workforce, and the duration. The verbiage on the post-its should match the pre-planning cards for crews to ensure the plan addresses material handling, prefab, the right installation drawings, other constraints, and the needed tools.

The visuals allow everyone to get on the same page for understanding the plan; it also takes away the 'assumption' often built into communication that whether we two people are talking about the same space, scope, or task. For smaller projects with one crew of 2-3 electricians, Parsons developed a small template board that can be attached to break carts that functions the same as the full pull planning board.



One unique instance of visual management was presented by the ECS group that manages national facilities and maintenance contracts. Their group oversees subcontracted work to other MEP firms across the country for MEP, low voltage, fire alarm, sprinkler, and similar scopes on facilities that are in operation for preventative service, maintenance, repair, and small capital improvements. In addition to the LPS use in a microcosm that breaks tasks down in intricate detail, to support the on-site team and communication with owners, placemats with system images are used to communicate visual scopes, impacted areas for system outages, floor plans for key logistical planning, elevation for where work will be installed or repaired, single line diagrams related to lockout/tag-out procedures, as well as schedule information.

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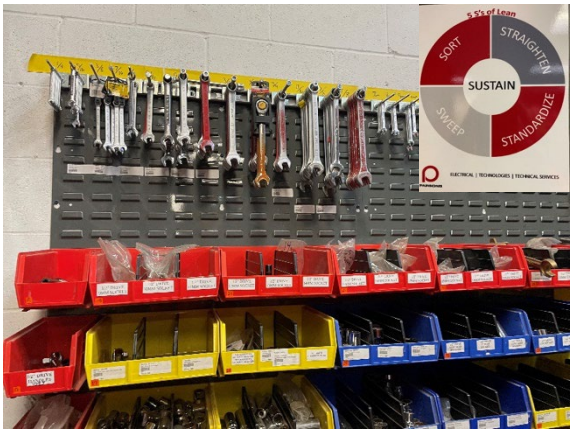
Manufacturing (Prefabrication)

Prefabrication started with focusing on repeatable items, such as a series of offices with consistent elements and dimensions for device locations. Moved to a *'do what makes sense'* approach of working with a foreman on each job to identify what the shop is good at and where it creates savings or field efficiency. The initial approach included an element of 'we'll prefabricate if we have time." As one leader framed it, "you won't have time if you don't create time." More recently, it has moved to a collaborative plan, with the shop coming to kickoff meetings with their plan and the general foreman coming with their own. The shop has developed a catalog of basic elements that can be easily prefabricated. It is organized by work breakdown, starting with the underground and continuing to finish work. The shop published newsletters to let all company personnel know about recent or new assemblies, as well as simple information such as the recent purchase of an offset bender.

The bread and butter of fabrication are still common and repetitive items, such as device junction boxes with MC whips, conduit racks, 20' underground duct banks with spacers, and some panels and transformers. All of the work is still dependent on the conditions or constraints of a project and shipping distances. When large projects are too far or if constrained by union agreements, Parsons has set up short-term shops near project locations. They train a local lead, set up a subset of shop equipment based on the project needs, or in some instances, partner with a local firm to utilize their shop. In addition, they have learned the value of having a 'last mile' warehouse to reduce variability on site when prefabricating significant scopes or assemblies.

5S

The use of the 5S process was apparent throughout the shop, as well as in areas such as the electrician's carts. 5S was used as a baseline to ensure organization and cleanliness and reinforce the need to be organized in your work. It was supplemented in the field with simple tips, like the 10-foot rule. Everything you need for your work, including the cart, should be within 10' to reduce walking and waste in finding materials.



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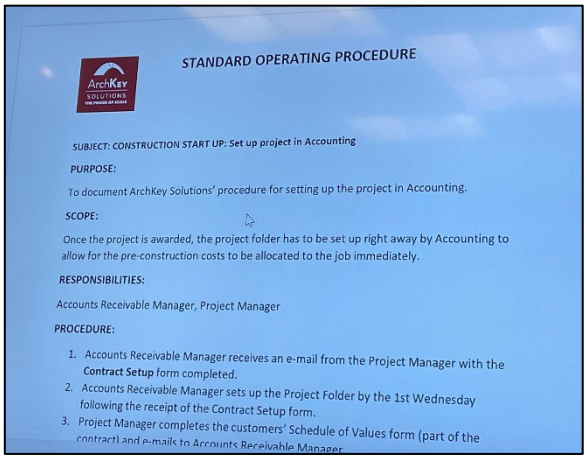
Standardization

The company has mapped out core processes, and these directly align with role-based training (e.g., PM training). Each process has standard procedures defined. When a new project starts, template documents can be quickly pre-populated with the necessary forms. In an effort to advance the work packaging, the cost coding is being refined to create a method to match takt areas. Having the defined worker hours for that area linked to the budget code simplifies the forecasting, tracking, reporting, and analysis of project outcomes.



STANDARD OPERATING PROCEDURE

SUBJECT: CONSTRUCTION START UP: Set up project in Accounting

PURPOSE:

To document ArchKey Solutions' procedure for setting up the project in Accounting.

SCOPE:

Once the project is awarded, the project folder has to be set up right away by Accounting to allow for the pre-construction costs to be allocated to the job immediately.

RESPONSIBILITIES:

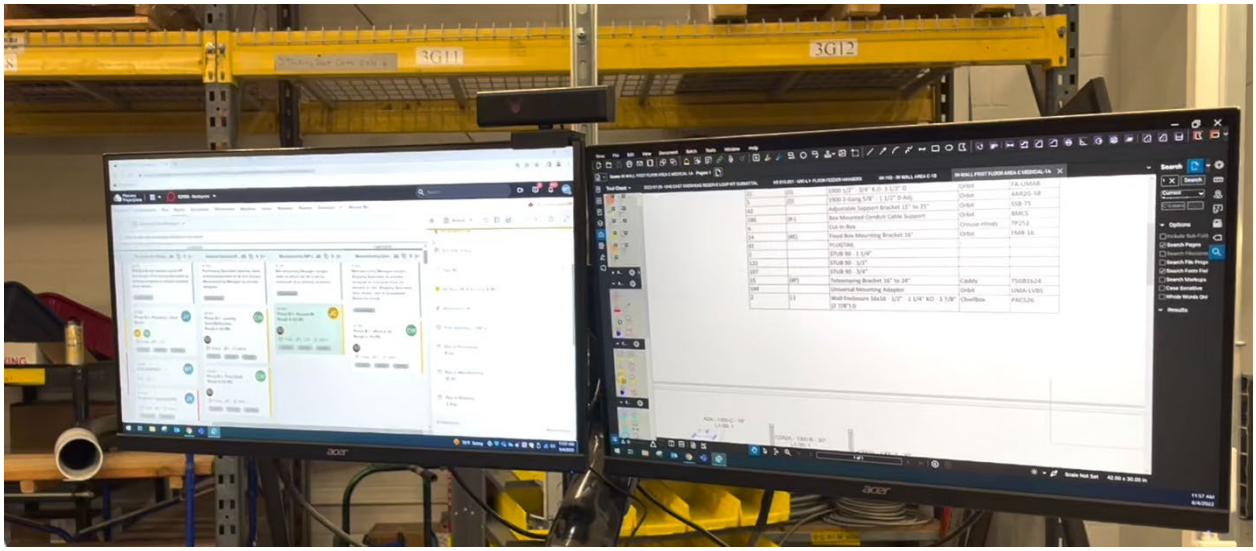
Accounts Receivable Manager, Project Manager

PROCEDURE:

1. Accounts Receivable Manager receives an e-mail from the Project Manager with the **Contract Setup** form completed.
2. Accounts Receivable Manager sets up the Project Folder by the 1st Wednesday following the receipt of the Contract Setup form.
3. Project Manager completes the customers' Schedule of Values form (part of the contract) and e-mails to Accounts Receivable Manager.

Kanban Board (Project Place)

Parsons uses Project Place software as an electronic Kanban board as work packages are defined, detailed, fabricated, and installed on-site. As part of the standard process, the packages are pre-built in the software at the start of the project with personnel across all locations (office, shop, site) that can see, use, and manage the cards to maintain a visual market of work scopes. The cards on the boards can be used to set dates, recognize the status of scopes of work, and communicate changes while bringing simple visual recognition to the status of progress or who is responsible for certain tasks.



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Concluding Thoughts

Throughout the visit, I was impressed with how thoroughly the lean culture was embedded into all the processes and practices witnessed. While embedded, they were inculcated through a focus on understanding the principles and a simple focus on implementation – fix what bugs you.

Practices that support lean

- The emphasis on training and building a continuous improvement mindset for everyone with Parsons stood out. As Peter Drucker stated, "Culture eats strategy for breakfast."
- People are not only able to make changes but they are also empowered and encouraged to do so.
- Building relationships – it was apparent through multiple interviews that company leaders and field leadership focus on building relationships both internally with their teams as well as with their colleague trade leaders on a project and GCs. To work well together, you have to have trust, and to develop trust, you need to build a relationship at a personal level.

Common challenges and barriers

- Growth, challenges with finding good personnel, and having to train or onboard much new personnel is difficult in any organization.
- Certainty and reliability of construction schedules – there were several examples of firms well known in Lean circles whose project teams did not embody those principles in managing their projects.

Other Observations

Time to Shine – (5S) It was apparent that recent events, specifically recent disruptions that the entire industry felt, appeared to have disrupted some of the consistency of Parsons' operations in small ways. This was noticeable in items such as the retirements of personnel, some of the natural disconnects that came through working remotely during the COVID-19 pandemic, and reductions in in-person training to more remote sharing that may not have been as rich as in-person engagement and coaching. For example, one of the projects visited had a foreman trying to implement Last Planner and takt planning, but he had not been formally trained. While he was doing an excellent job given his available resources, some coaching and more formal training would push his efforts from good to great. A brief revisiting of training status should help, along with identifying priority areas to audit and minimize potential backsliding in areas that may have key personnel changes or a greater influx of new personnel.

Production dashboards – The use of extensive visuals for the plan was well-defined and trained. Adding production/ productivity tracking on key measures in a consistent format could be incorporated into the consistent planning visuals. This would allow the team to consider not just the work needs but how to improve their production in the field against the baseline plan on a consistent and ongoing basis, which could help with goal setting and performance transparency.

Acknowledgments

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