

# Advanced Work Packaging (AWP) and Lean Construction: Optimizing Project Workflow

*SR22-01d • Optimizing Workflow and Increasing Project Throughput:  
Comparing Conventional Project Delivery Methodologies with a Flow-based Thinking Approach*



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Revision Date: August 23, 2023

# Why is Flow so important?

Descriptions of “good projects” typically include terms like “smooth” or “great teamwork” to describe situations where things flowed smoothly. Conversely, “lousy projects” will likely generate memories of rework, conflict, stress, and frustration where *nothing* seemed to flow smoothly. Every project participant shares an intuitive appreciation for Flow, but Lean advocates seem obsessed with it. We believe that creating and continuously improving Flow is a highly underappreciated and misunderstood strategy for consistently creating great projects. Flow isn’t just a pleasant *characteristic* of good projects, but rather the *strategy* for creating them.

Flow is the common denominator linking many aspects of improved project experience, including:

- Faster response and greater flexibility
- Better throughput
- Better use of capacity
- Better cash flow
- Better quality
- More predictable outcomes
- Less frustration, wasted effort, and rework
- Better and safer work experience

It seems clear that understanding and improving Flow is well worth the attention of the industry.

For questions or comments, please contact:

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*Thank you to the CII AWP + Lean Joint Working Group*

# What is “Flow”?

The term “Flow,” as used herein, describes the movement of work effort through a production or decision-making system to create transitions from ideas to a useful physical asset. For capital projects, this is manifested by changes in the state of work, or transformation of work from one state to another.

For projects, effectively managing Flow encompasses and integrates the changes or movement of resources, materials, information, and decisions to drive improved project outcomes.

# Flow Can Be “Engineered” to Deliver Consistently Better Projects

Engineers and scientists study and design systems to improve flow (e.g., fluids through pipe, electricity through conductors, air over wings, laminar versus turbulent), increasing or restricting flow. Well-developed and understood models and equations are available to improve or optimize physical flows through our physical installations. A similar set of models and equations is available to help us improve Flow through our project delivery systems, but they are neither well understood nor commonly applied to projects. Like engineers and scientists, we have the ability to influence workflows on projects to get desired outcomes.

There is a distinct human element involved in creating Flow. The complexity and high rates of change associated with the modern project are growing at an exponential rate, outrunning the ability of any individual or team of specialists to plan the project and keep it on track. We will be much more effective if we can find a way to engage everybody in the value stream, to understand and improve their work and how it affects downstream users. **In other words, we need teamwork to create Flow.** The reciprocal relationship also holds – creating smooth-flowing work enhances teamwork and creates a better project experience for the participants. Creating Flow benefits everybody.



# Integration and Flow Are Mutually Dependent

Economic value is generated by satisfying the need of downstream customers. Satisfying those needs with minimal diversions or extra work is the essence of Flow, characterized by reliable and predictable handoffs delivered without delay or rework. High degrees of integration and relatedness within the value delivery chain are necessary to create effective flow.

Correspondingly, creating flow improves relatedness and integration, and leads to a much better project experience for the participants. Flow is critical across all dimensions and aspects of the project, not only in physical flows but in information flows as well. Optimal flow of resources, materials, information, and decisions drives improved project outcomes.

This document will provide a high-level comparison of Flow-based thinking with a simplified summary of conventional project delivery in order to illustrate (and perhaps exaggerate) the differences to stimulate constructive dialog. Creating Flow will be critical for advancing our industry. More time, understanding, and creating flow will uncover opportunities to create value and improve the experience of project work.

# Lean + AWP or “Next Gen” AWP

Lean Construction and Advanced Work Packaging (AWP) are two project delivery approaches with different origins but similar goals:

- **Lean Construction** emerged in the 1990s with the formation of the Lean Construction Institute (LCI) and an early focus on improving the reliability of weekly field commitments via the Last Planner System®. The concepts of optimizing workflows, collaborative planning, and Target Value Delivery (TVD) emerged from the LCI community not long after the Institute was formed. The LCI community embraces the concept of Integrated Project Delivery, which involves engaging trade contractors as “partners” to develop the project scope and design in contracting arrangements and project operating systems that are highly relational and collaborative.
- **AWP** found its origins in industrial construction and was focused on effectively delivering projects on schedule and budget by making sure that field crews were provided with everything they needed to complete their work efficiently, including information, tools, and materials. AWP is most commonly associated with project procurement approaches in which trade contractors are selected based on complete bidding from issued for construction (IFC) drawings.

# Lean + AWP or “Next Gen” AWP *(continued)*

Some proponents of AWP and Lean Construction have been critical and dismissive of each other’s work. Other practitioners, however, noted important common themes, especially in the areas of constraint management and maintaining a positive project culture.

Supported by the Construction Industry Institute (CII) and the Lean Construction Institute (LCI), the latter group of practitioners formed a Joint Working Group to explore how aspects of AWP and Lean Construction could be combined to be “stronger together.” This report is the second in a series of publications comparing AWP with Lean Construction.

Flow is integral to Lean thinking, but it generally does not receive the same focus within the AWP community. Flow is central to the mission of the Project Production Institute (PPI) and the authors gratefully acknowledge the influence of the founders of that organization. PPI is now supporting the Joint Working Group and its representatives will be adding their Operations Science expertise to the collective effort to create the Next Gen project delivery model.

For questions or comments, please contact:

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Topics List

## Conventional Project Delivery

- Flow is great when it happens, but there is little specific understanding of underlying factors that create or inhibit it.
- Project managers believe flow is reflected in well-developed Master Schedules, and it can be achieved if field supervisors implement the plan.
- CM/GC generally expect subcontractors to subordinate their crew flows to support the Master Schedule.

## 1. How Do We Think about Flow?



## How Do We Create It?

## Flow-based Thinking

- Creating Flow creates great projects.
- Flow is a fundamental delivery strategy, not a happy by-product.
- Flow on projects is governed by relationships, which can be managed rather than left to chance.
- Flow on project works best by enabling efficient Flow for trade contractors and other supply chain participants.

### Key Insights:

Every experienced project participant has an appreciation for smooth-flowing work – it makes everything seem easier, predictable, less stressful, and ultimately less expensive. What has been missing, however, is an understanding of how Flow is created and maintained. Using a hydraulic analogy, we can apply scientific principles to predictably shift from chaotic and “turbulent” Flow to smooth “laminar” Flow – and deliver far more value with far less effort. Go with Flow!

## Conventional Project Delivery

- Does not specifically address the impact of Work in Process (WIP) on cycle times, throughput, and defects.
- Does not fully recognize or consider the need to control and limit WIP when setting up or troubleshooting projects.
- Views WIP as an asset (earned value) rather than a common problem and considers ideas about controlling WIP as esoteric, ethereal or impractical.

## 2. Work In Process (WIP)



**Work has been started but not finished and cannot be used**

## Flow-based Thinking

- Considers Work in Process (WIP) to be a key production factor that should be carefully measured and controlled.
- Says excess WIP commonly and unnecessarily increases cycle time (or response time).
- Believes excess WIP allows defects to be repeated before they are detected, resulting in more rework.
- Sees little “earned” value in partially completed work. Value is earned when work product can be used.

### Key Insights:

Understanding the nature of WIP and how to control it is integral to creating Flow and maximizing the amount of work getting through the production system. Avoiding excess WIP is also critical to minimizing the damage caused by defects. Perhaps unintentionally, traditional project management approaches tend to create excessive WIP in an effort to “make progress” or maximize earned value. One cannot, and should not, eliminate WIP (both “too much” and “too little” can create problems). We need measures that support improved project delivery objectives, to help us “right size” WIP.



## Conventional Project Delivery

- Generally recognizes “beginning with the end in mind” and understanding the “backward pass” of a CPM schedule.
- Creates a detailed CPM prepared by specialists at the beginning of the project, then drives the project to follow the plan:  
**Plan the Work, then Work the Plan**
- Its default is to get work done by making decisions as soon as possible – get it behind you.
- The responsibility and means for achieving schedule are mainly in the domain of the contractors – a “means and method” issue.

## 3. Pull-based Delivery



**Performing work at the “pull” (or request) of the downstream customer**

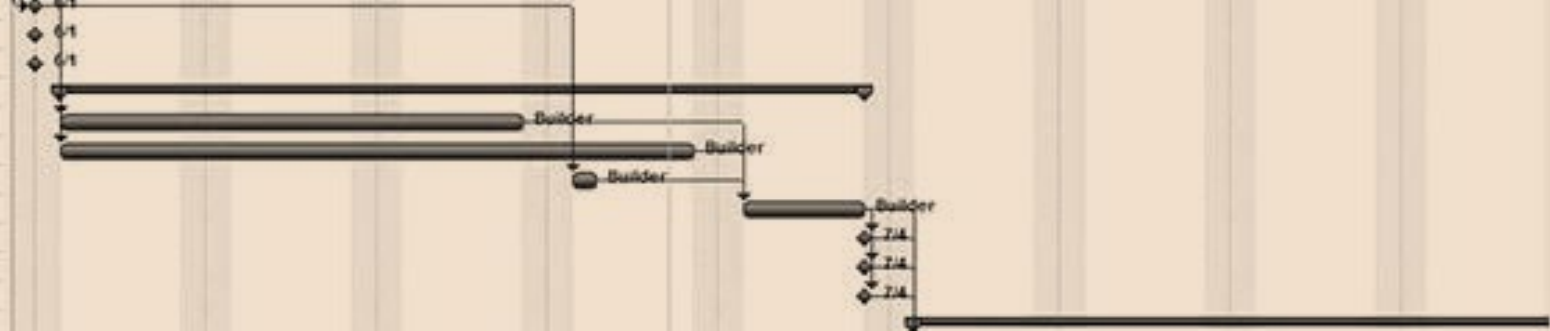
## Flow-based Thinking

- Perform at the pull of the downstream work to the greatest degree feasible and practical:
  - *Produce only what is needed.*
  - *Precisely how it should be delivered.*
  - *Only when it is needed.*
- Distribute planning and coordination to those closest to the work.
- Adapt to the needs of the downstream customer, often the next performer.
- Once work is defined and ready for execution, ensure handoff requirements are understood.
- Avoid high levels of detail in the master schedule – supplement with information and details as the work gets closer.

## Key Insights:

Pull-based thinking operates on the idea of every performer making the work of the downstream user a little easier. It also involves producing only what is needed, and when it is needed. That is best done by creating a "network of commitments" which focuses on transparently defining work scopes and integrating those work scopes across stakeholders by focusing on the hand-offs.

7	Secure Financing	0 days	Sun 6/1/08	Sun 6/1/08	3	Builder
8	Construction Loan Settlement	0 days	Sun 6/1/08	Sun 6/1/08		Client
9	Document Review & Revision	25 days	Mon 6/2/08	Fri 7/4/08		
10	Review & Finalize Plans	15 days	Mon 6/2/08	Fri 6/20/08	4	Builder
11	Specifications	20 days	Mon 6/2/08	Fri 6/27/08	5	Builder
12	Site Plan	1 day	Mon 6/23/08	Mon 6/23/08	6,10	Builder
13	Final construction drawings	5 days	Mon 6/30/08	Fri 7/4/08	10,11,12	Builder
14	Approve Revised Plans	0 days	Fri 7/4/08	Fri 7/4/08	13	Client
15	Approve Revised Specifications	0 days	Fri 7/4/08	Fri 7/4/08	13	Client
16	Approve Revised Site Plan	0 days	Fri 7/4/08	Fri 7/4/08	13	Client
17	Bids & Contracts	24 days	Mon 7/7/08	Thu 8/7/08		



Topics List

## Conventional Project Delivery

- Create detailed plans for events far in the future and then apply discipline to follow the plan.
- Professional planners cannot be bothered with the detailed nuances of every participants' work or take variability into account. Rely on assumptions instead.
- Resist change and chastise whoever introduces it. It is disruptive by its nature.
- Shift exposure and risk to another entity and include allowances (buffers) to deal with uncertainty.

## 4. Uncertainty, Variation, and Change



**How can we deal with what we do not know and cannot anticipate?**

## Flow-based Thinking

- Expect and proactively address uncertainty, variation, and change to eliminate or alleviate project impacts.
- Plan the work, then keep adapting the plan as you work.
- *All plans are forecasts. The further into the future they look and the more detailed they are, the more likely they will be in error.*  
– Glenn Ballard
- Leverage constraint management to detect and address potential issues earlier.
- Align contracts to proactively anticipate and manage change early and often.

## Key Insights:

Uncertainty and change are inevitable as projects become larger and market conditions change faster. Dealing with complexity is hard. Rather than simply relying on assumptions or allowances, create a plan to manage complexity better. Better serve customers and improve experience for project participants by creating operating procedures, systems, and commercial agreements that rapidly detect and adapt to change – in a controlled manner. Efforts to prevent changes may be futile, but reducing their impact and high transaction cost can be within our control.

*“Plans are worthless, but planning is everything.” – Dwight Eisenhower*

## Conventional Project Delivery

- Generally, prefers large batches and bulk purchases to optimize economy of scale and market competition to get “the best price.”
- Creates comprehensive and complete design packages whose details must be nailed down prior to soliciting bids.
- Makes everything available as soon as possible – “I’d rather look at it than later look for it.”
- Considers the costs to be necessary and expected to manage, protect, and store excess materials.

## 5. Batch Size



**How many shall we do (or buy) at one time?**

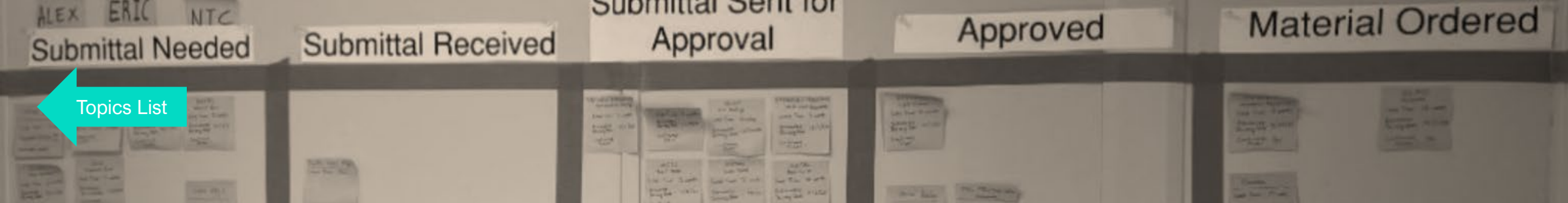
## Flow-based Thinking

- Generally, prefers small batches of work scope and material inventory to be able to execute work more efficiently, release follow-on work more quickly, and adapt to change more flexibly.
- Small batches enable quicker detection of problems or errors; improving quality, reducing friction, and reducing rework.
- Small batches leveraging integrated materials management techniques enable more efficiencies in warehousing, staging, marshalling, and searching, reducing loss or over-purchasing.

## Key Insights:

In general, small chunks of work can get through a complicated workflow system more easily than big chunks. Getting the right batch size involves many trade-offs and can be proactively “engineered.” The economies of scale associated with large batch sizes are appropriate in some cases, but remain aware of the unintended consequences of excess Work In Process (WIP) created by large batch sizes, such as slow response time and late detection of defects. Also be aware of the extra handling, warehousing, protection and replacement costs that are added as batch size increases.





## Conventional Project Delivery

- Does not understand or address throughput well.
- Managers are obsessed with utilization, giving little regard to the impact on throughput.
- Improvement efforts focus on improving the productivity of each activity and “time on tools.”
- The key focus is on improving the efficiency of each workstation, usually considered in isolation.

## 6. Utilization vs. Throughput



**Does keeping everyone busy maximize work through the system?**

## Flow-based Thinking

- Leaders are obsessed with improving throughput, which will then lead to higher overall utilization.
- Improvement efforts focus on the transitions between work activities.
- The key relationships between utilization, cycle time, and throughput that must be well understood and managed.

### Key Insights:

Pursuing high utilization at each individual workstation can have serious unintended consequences on how much beneficial work the system produces (throughput). Optimizing work in isolation often creates misalignment of production rates, has a whipsaw effect on the production system, and increase the overall duration of the system. This also leads to the frustration of “futile hurrying” and “hurry up and wait.” Reducing queue times is often the most effective – and least costly – way to shorten overall duration.

## Conventional Project Delivery

- Make decisions as quickly and as early as possible based on whatever limited information is available.
- Any decision is better than no decision.
- Resist changes to decisions – do not revisit decisions that have been made.
- Making decisions and then not sticking to them is viewed as a character flaw.

## 7. Decision Timing



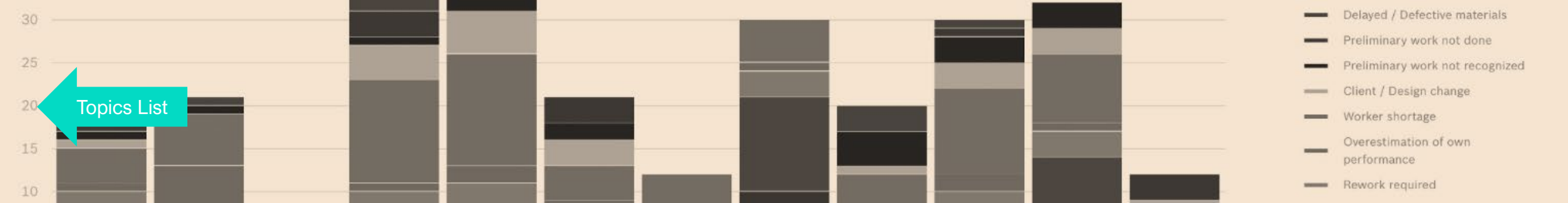
### When should key decisions be made?

## Flow-based Thinking

- Clear, early decisions may come at the expense of rework and flexibility.
- Request and release information and decisions as they are needed.
- Decisions made too soon are a leading cause of disruptive change.
- Recognize which decisions should be left open until the “last responsible moment,” possibly by breaking them into smaller decisions.

### Key Insights:

Uncertainty and variability are inevitable and humans do not always develop new ideas or concerns in a predictable way. It may not be possible to make sound decisions that do not need to be revised later. Understanding which decisions to make and when to make them may be as important as the decisions themselves. Breaking the decisions down into smaller chunks can help the team respond to urgent decisions while keeping its options open.



## Conventional Project Delivery

- Buffers, especially system buffers, are not well understood or specifically addressed.
- Most participants intuitively take actions and positions to preserve buffers that are important to their own interests.
- Lots – and lots – of time, inventory, and/or Work-In-Process (WIP) buffers are needed to make sure crews do not run out of work or finish “late.”
- Tendency to “block out more time” than is really needed, “just in case.”
- Tendency to “reduce” capacity because increasing capacity would “add” cost.

## 8. Buffers



Time, Capacity,  
or Inventory to  
Absorb Variation

## Flow-based Thinking

- Buffers occur in any system that combines dependence and variation.
- Buffers can be strategically engineered into the production flow to protect the system – or be allowed to form randomly on their own.
- Three types of buffers (inventory, capacity, time) interact with one another in ways that warrant special attention – you cannot look at them in isolation.

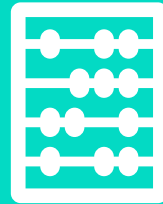
## Key Insights:

Buffers are inevitable whenever variation (or uncertainty) combines with dependency – a condition found on all construction projects. Much of the waste, cost, and duration of a project is hidden or disguised as buffers. Conventional project delivery encourages each participant to create and protect wasteful buffers (time and inventory) to protect personal interests without much regard for the effect on the overall system or somebody else’s buffer. Well-designed system buffers can be much smaller and offer more protection than trying to protect each task or participant individually.

## Conventional Project Delivery

- Planning is so important and complicated that it needs to be done by specialists.
- Plans flow from the top down. Management does the “thinking.” workers do the “doing.”
- Front-line personnel should focus on “time on tools” and leave the planning and coordination to specialists, or senior leadership.

## 9. Responsibility for Planning and Coordination



**Who is best able to plan and coordinate the work?**

## Flow-based Thinking

- Projects are far too complex, interdependent, and prone to disruptive variation to allow highly centralized planning.
- Engage performers to do most of the planning and monitoring via simple visual indicators maintained in real time.
- Avoid separating “planning” from “doing.”
- Attempts to solely maximize “time on tools” without considering integrated processes usually create unintended consequences.

### Key Insights:

Flow and teamwork depend upon each other. Projects are so complex that we need the help of everybody on the team – especially those closest to the work – to help us recognize issues and adapt to them. Engaging the front-line workers, and everybody else, in developing and improving the process is one of the best ways to demonstrate Respect for People.

### Conventional Project Delivery

- Front-line workers are the “muscle” required to execute the work planned by others.
- Information should be tightly controlled and issued on a “need to know” basis.
- Front-line workers are not usually capable of, and should not be bothered with, the details of planning and coordination.

## 10. Underlying Respect for the Participants



**How do we view those who do the work?**

### Flow-based Thinking

- Respect for People (as in “respect for mankind”) is central to Lean thinking.
- Listening with the willingness to be influenced is among the best ways to show respect.
- Each body is equipped with a powerful mind – free of charge.
- Everybody needs to know.

### Key Insights:

Lean-based thinking is based on “asking,” which is intrinsically more respectful than “telling.” Although there has been improvement in the past few decades, the construction industry retains high degrees of “command and control” thinking. Lean thinking embraces “Respect for People” as a core value. It is not naïve altruism, but rather a recognition that we need the help and imagination of the entire team to create Flow. View the project environment from the perspective of a new-hire craft employee on a major project – would you feel respected?





Fixtures & Furniture

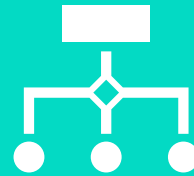


Landscape & Hardscape

## Conventional Project Delivery

- Each entity manages its supply chain with a new and unique supply chain for every project.
- Transactional arrangements specifically prohibit the integration often required by customer organizations.
- A fragmented system is often recognized as dysfunctional, yet considered to be unavoidable.

## 11. Supply Chain Management Approach



**How do goods and information flow to and from the customer?**

## Flow-based Thinking

- Offers a distinct integrated effort to improve a highly chaotic network.
- Relational contracts enable high performance.
- Aligned commercial interests focus on win-win arrangements.
- Alignment of resource and material flows into the project.
- Has a collective appreciation for system buffers.

### Key Insights:

The flows of materials and information required to create a major construction project are incredibly complex, and often much more chaotic than they need to be. Streamlining these flows may represent the greatest opportunity to improve project outcomes. Conventional delivery recognizes much of the chaotic nature but fails to recognize the obstacles this chaos creates. Flow-based thinking is far from perfect, but it makes a critical attempt to shift to a more effective and efficient mindset and set of sound underlying principles.



## Conventional Project Delivery

- Teamwork is important, but not the focus of the organizational and commercial structures, which are based on a hierarchal command and control system that follows contract lines.
- There is no specific focus on team dynamics or interactions. Mutual commitment to the success of other participants is *ad hoc* at best.
- Social sciences are largely dismissed as “not really science.”

## 12. Team Structuring



**How do we create high-performance teams?**

## Flow-based Thinking

- Intentionally organizes the project is as a network of teams.
- Forms cross-functional teams to enable common understanding of flow of work.
- Focuses on team performance rather than individual entities.
- Consciously develops behavioral factors.
- Collectively addresses success and issues.
- Has a high sense of mutual commitment.

### Key Insights:

Each project represents an extremely complex, temporary social structure. All project participants have an appreciation for teamwork, but Flow-based thinking elevates Flow to be a fundamental part of the project delivery strategy. The “network of teams” approach involves starkly different types of organizational structures and communications systems, and it draws heavily upon the social sciences.