INEIGHT

ADVANCED WORK PACKAGING: IMPROVING CONSTRUCTION PERFORMANCE THROUGH PROCESS AND TECHNOLOGY

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OVERVIEW

The objective of this white paper is to provide insight into the rapidly accelerating world of Advanced Work Packaging (AWP). This paper covers the origin of this execution philosophy and the specific needs this process addresses. The paper discusses the shortcomings of project management solutions to date, how AWP aims to address these and how InEight's unique approach to AWP accelerates and extends the AWP value proposition.

AWP continues gaining traction with owners and contractors, with many of them reaching AWP maturity levels. Globally, project management is long overdue for an overhaul, and most indications are that AWP is a pivot in the right direction. Over recent years, AWP advocates are already suggesting hard ROI metrics reflecting up to 10% cost reduction and 25% execution productivity improvements. Those types of numbers are hard to ignore.

THE PROBLEM WITH TRADITIONAL PROJECT MANAGEMENT

For 70 years, ever since DuPont formalized into a science what had previously been an ad-hoc approach to "taming" projects, capital expenditure (CAPEX) projects have been managed under the *"plan the work, then work the plan"* philosophy.

This has led to the evolution of two not-always-fully-aligned management approaches — project planning and project control. The former *predicts* what *will* be done during execution and the latter *tracks* what *was actually achieved* during execution. When the two models inevitably diverge, projects either revert to adjusting the plan or adjusting the execution strategy (e.g., "throw more people at the project"). That's pretty much project management in a nutshell.

So, does this approach work? Unfortunately, not often enough — CAPEX projects have a terrible reputation for being late and over budget. But why? Is the all-too-common "late/over budget" syndrome a result of overly optimistic planning or simply poor execution? Frankly it's both, but the root cause is even more elemental — *context*, or rather, lack thereof.

Planning techniques such as Critical Path Method (CPM) forecast from left to right. You stick a stake in the ground representing your project start date; you then break down your work into activities, assign durations, represent sequence using logic and let the CPM calculation figure out the project finish date. Easy, yes, but perhaps CPM has literally got it backwards! Wouldn't it be better to think about the date we want our project to finish by and then work back from this date?

By establishing our desired completion date, we should be able to determine the sequence of engineering or design and subsequent procurement needed in order to satisfy an on-time and achievable construction completion date.

At the end of the day, planning is little more than our best attempt to forecast the future given a number of uncertainties and unknowns. Surely, then, the best way to think about project planning is to tie down the most important factor (project completion) and let the other variables be driven by this rather than letting them be the drivers.

Execution is often marred by less-than-planned productivity. *"If we could just increase our productivity, then we'd be on track."* Looking at isolated productivity data, this is a common and fair assessment. Unfortunately, that assessment is blind to the root cause, and resulting decisions informed by it will not meaningfully alter outcomes.

Poor productivity is a symptom of being constrained, it is not the root cause of poor execution. The key is to understand the constraint that is triggering the symptom.

Constraints such as not having sufficient resources are an easy fix — simply throw more people at the job. What is much harder to overcome and more common, are constraints such as *"the material needed to execute a given task isn't where the crew needs it for install, and the costly equipment required to move it isn't available again for two days."* Likewise, if the materials were available and the crew are ready, but the installation workface isn't accessible because of a physical clash with another crew working in the same place, lost productivity results. The symptoms will persist, as does margin erosion, because the cause goes unaddressed.

The subtle and specific nuances of each mission-critical constraint scenario that plays out over a project cannot be sufficiently accounted for using traditional planning and control techniques. How can they be? Traditional methods don't have a clear line of sight across construction, procurement and engineering, as they lack a full and shared context across disciplines — the context that only hindsight made clear. To get us past symptoms and drive at systemic relief, something better is needed.

That "something better" is today being touted as Advanced Work Packaging, or AWP. In reality, AWP is really an evolution of, and improvement on, existing planning and control techniques rather than a complete U-turn in thinking and approach to project management. AWP builds on accepted approaches such as CPM, WBS and Cost Breakdown Structures by adding both formality and contextual information in the planning and control process. It's a highly intentional method of managing for future constraints before you start.

INTRODUCTION TO ADVANCED WORK PACKAGING (AWP)

WHAT IS AWP?

AWP is highly focused on enabling the execution or construction phase of a project. AWP should be viewed as a way of ensuring that upstream engineering and procurement scope aligns with downstream construction, and that these construction activities provide an effective means to work toward a better-controlled closeout and turnover. AWP is a completion-to-start project planning and execution process.

Construction Industry Institute (CII) defines AWP as *"the overall process flow of all the detailed work packages (construction, engineering and installation work packages). AWP is a planned, executable process that encompasses the work on an EPC project, beginning with initial planning and continuing through detailed design and construction execution. AWP provides the framework for productive and progressive construction, and presumes the existence of a construction."* That's a lot of words for what is essentially "plan with the end in mind."

Why not take the AWP acronym more literally? "Advanced" aptly describes the improvement in decision making the benefit of AWP provides. "Work" reflects the fact AWP is more execution-focused than traditional planning. "Packaging" perfectly describes the fact we are bundling up work into manageable chunks.

I like the fact that AWP is challenging the sequential nature of *"plan the work, then work the plan"* and shifting towards an iterative approach of *"continuously better plan the plan so as to continuously better work the work."*

Perhaps, then, the definition of AWP should be, *"a context-driven planning and control approach for*

removing constraints and adding predictability to project outcomes," or an even simpler version: " eyes-open execution."

AWP is all about driving alignment between:

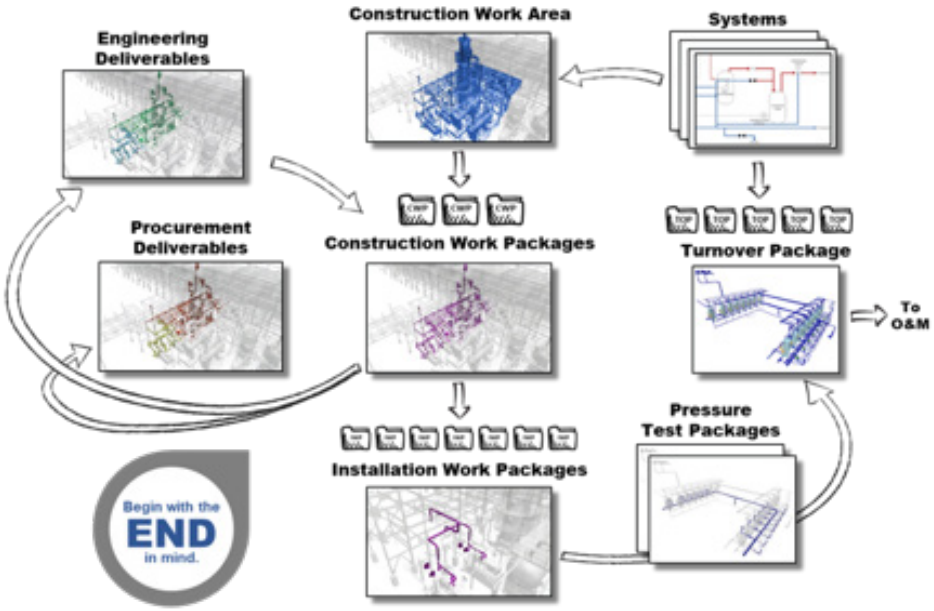
- The triple constraint of time, money and quality
- Outcome prediction (the plan) and outcome reality (the execution)
- Engineering, procurement and construction
- Materials, people, tools and location during execution

Another alignment benefit exists between the people planning the project and those executing it. Project planners and cost estimators are far removed from those doing the work, and so, removed from the work context. AWP bridges this gap by introducing workface planners and formalizing superintendents and general foreman execution plans. Formalizing plans for those closest to the work's execution plans enhances overall communication and improves responsiveness to dynamic constraints and context.

Further, AWP also breeds alignment between the owner and the contractor. The collaborative approach to defining work areas, work packages and so forth is something that previously has been more nearly a firewalled effort specific to the contractor. Breaking down barriers for more visibility improves understanding and the greater risk profile.

AWP overcomes the age-old disconnect between plan and execution packaging of scope and work:

> Projects are planned by packaging up multiple deliverables (e.g., Piperack A, B, C) versus execution that often involves multiple disciplines having to work in synchronization across multiple pipe racks. AWP contemplates the needs and constraints as well as the full context across disciplines to ensure execution as per the plan.



AWP Institute

WHERE DID AWP COME FROM?

Credit to the origination of AWP goes to a collaborative effort between the Construction Owners Association of Alberta (COAA) and Construction Industry Institute (CII). Developed in the mid-2000s, the advent of AWP is really the culmination of *Front-End Planning (FEP)* with what is called *WorkFace Planning*, along with next-generation *Information Management.*

- FEP is typically driven by an owner organization. It is a top-down approach used to establish project scope and associated high-level timelines and cost estimates for a project. CII defines FEP as *"the process of developing sufficient strategic information with which owners can address risk and decide to commit resources to maximize the chance for a successful project."*

  Traditional project planning starts with FEP. With FEP being largely owner-oriented though, challenges have arisen when handing over this plan to a contractor, as a contractor thinks about the project from an execution perspective rather than the owner's deliverable perspective — hence the need for WorkFace Planning.

- WorkFace Planning is very different to traditional project planning. Traditional planning groups work by package or deliverable, and rely largely on historical performance for forecasting (e.g., "*last time it took eight days to install the piping*"). WorkFace Planning still accounts for historical performance, but also takes into account the reality of the project in question (e.g., "*for this project, we know there are specific installation requirements that will drive out our duration*").

  Establishing a longer duration based on reality is great. What is not fine is establishing a duration that is not achievable. In addition, WorkFace Planning groups work by execution workface rather than by multi-discipline packages. Who better to determine this than the field execution teams themselves? WorkFace Planning is contractor-oriented.

- Information Management Systems enable the acquisition, custodianship and subsequent distribution of information. Next-generation project management, and specifically AWP, is possible due to knowledge-driven information management systems. Historically, project management has been catered to through software originating from multiple point solutions from multiple vendors. With accumulating stores of specific types of project data (e.g., cost, schedule, drawings and so forth), such disparate and largely disconnected point solutions have been plagued by data cleanliness, standardization and ease-of-access issues.

  With the rapid move towards truly integrated systems, the ability for a single source of truth to be centrally housed within a common platform and tracked over time through what is called a Digital Thread, and intelligently interrogated through the likes of AI, is now available. Think of this as an evolution from data-driven project management to knowledge-driven project management. Platforms are finally becoming smarter and, as such, more useful to the point of actually being intelligent systems. The biggest differentiators across providers are actual effort required to establish a Digital Thread and the effective richness of it.

Having walked through the top-level components and now stepping back, AWP ultimately boils down to "everything pivoting towards construction" — end of story.

WHO IS ADOPTING AWP?

Today, AWP is being embraced by a growing number of adopters, with more coming online daily. Companies spanning both owners and contractors (e.g., super-majors and top contractors) are all

exploring how best to adopt and incorporate AWP into their existing project management best practices.

Interestingly outside of North America, some high-profile commercial organizations and government entities are adopting many AWP concepts (such as WorkFace Planning and "plan backwards from project completion") without necessarily acknowledging the nomenclature of "AWP." To this point, there are other emerging project management techniques that follow similar approaches and thinking to AWP:

- **Lean Scheduling:** A way to design processes and procedures to minimize waste in the workplace to maximize value.
- **Pull Planning:** A lean construction practice involving all project stakeholders thinking about the project in reverse timeframe, starting with an end goal and working backwards.
- **Last Planner System:** A collaborative and iterative approach to planning involving field execution personnel to detail out work as it becomes time to execute that work.
- **Agile Planning:** An iterative approach to planning. A rolling wave of self-contained work units.
- **Backwards Pass CPM Scheduling:** Starting at the project's scheduled end date and working backwards through the schedule network logic.

What is worth noting is the fact that these five alternate planning approaches all align with AWP in terms of their focus on enriched context:

- Plan collaboratively – sharing context across stakeholders
- Work backwards – leverage the context of what comes next as you plan for it
- Forecast iteratively – fully embrace the dynamic nature of construction

IS AWP MORE FOR OWNERS OR CONTRACTORS?

If the purpose of AWP is to drive more achievable, predicable project completions, then it goes without saying that AWP is relevant to both owner and contractor organizations.

Let's start with owners. Owners invest in a project so as to establish a capital asset. The project phase of the asset life cycle can be the riskiest in terms of commercial exposure. Get the CAPEX spend and timing wrong and the economics regarding the total asset life cycle can change dramatically, not only from a spend perspective but, more importantly, from a lost revenue perspective. Owner organizations engage a contractor to do the actual building of the project. However, the owner owns the scope and requirements of the project. As such, they have a keen interest in the overall timing and cost of the project, but less so with regards to detailed WorkFace Planning.

That isn't to say AWP isn't relevant to an owner. In fact, quite the opposite. Above and beyond the overarching *"AWP supposedly improves execution performance by 25%,"* one of the key benefits of AWP to an owner organization is the ability to link owner-defined requirements to engineering/contractor 2D drawings and 3D models. Having big-picture insight backed up by defendable contractor detail is a big deal. Being able to track project performance from a deliverable perspective is also big leap forward for an owner.

As a homeowner having a garden shed built by a contractor, I am more interested in knowing when my shed is going to be finished rather than the somewhat irrelevant details as to the sequence of construction and type of tools and crafts needed to build the shed. But at the same time, knowing that the contractor is aligned with, and being managed by, my expectations is a huge plus.

For the contractor, the biggest benefit of AWP is the change in planning philosophy by truly pivoting towards what happens in the field (i.e., the construction workface). By executing against a plan that is construction-oriented, and absent of constraints, the contractor has a higher probability of as-planned performance. As-planned performance leads to on-time, on-budget completion which, in turn, reduces the back-end risk exposure of claims and litigation.

AWP is applicable to multiple project types. The most obvious use case is probably process-type assets such as refineries, where the Path of Construction (PoC) is driven by the startup and commissioning sequence. However, AWP is also just as applicable to linear and vertical build type projects where the likes of intersecting infrastructure or existing brownfield assets drive the PoC. In short, all projects have constraints, and these constraints drive the sequence of the PoC. In fact, forcing a project to pay more attention to these constraints actually helps reveal otherwise hidden or less understood critical paths on a project.

One of the big benefits of adopting AWP is the highly collaborative approach to managing the project because it brings owners and contractors together. Having insight into not just craft performance, but performance in context of a given area or a given scope of work or deliverable is a big benefit. This linking of owner-focused deliverables and contractor-focused work is a massive step forward for project management. To date, work and project scope have been very loosely linked at best. With AWP, that linkage and resulting insight between the two is now possible. At last, the ability to truly understand "*how we are doing with regards to what are we building*" is now a reality. This helps form a collaborative context.

Visualization through AWP is also a big deal. While 2D drawings and 3D models of projects are certainly not new constructs, what is new is decorating and enriching these models with supporting metadata such as activities, durations, costs, risks, constraints, sequence of work, and even the components required to construct. One of the most beneficial aspects of this visualization is connecting the 3D Model with the document repository to bridge the 2D and 3D worlds. As the project life cycle progresses, this timeline of information about the asset (called a Digital Thread) continually grows as it gets fed by contributing data sources such as schedule, cost estimate, component registers, etc. Where the real value then comes in is the ability to use the Virtual Design and Construction (VDC) model to highlight not only completed work (the good) but, more importantly, the bottlenecks, issues, and overruns (the bad!). With the weaving and enriching of Digital Threads, you can form a visual context. This bold new trend of contributing all sorts of metadata into the VDC model presents the entry point into the world of AWP.

4D project planning, or BIM, was in many ways the precursor to the now almost infinite-dimensional insight that AWP brings to the table. Persisting this Digital Thread of multidimensional project data through the operational phase of a project, in the form of what is known as a Digital Twin, further adds value and efficiency to the operational asset itself, as well as providing more insight for the next round on subsequent projects.

DOES AWP MEAN THE END OF TRADITIONAL PROJECT MANAGEMENT?

So, does AWP mean "the end is nigh" for traditional project management? Highly unlikely. Actually, let's be clear — it is NOT the end. Instead, it should be seen as the beginning of the next generation, and it's about time. Project management software has arguably gotten shinier in recent years, but little has changed about actual function. The industry needs better, whatever that better ultimately becomes.

More than a fad, but indeed short of a revolution, AWP is a significant enhancement to what we have

already learned in the last half-century in regard to managing projects. Whether AWP remains as the next-generation approach, whether lean or pull or agile or some combination of all of these become the de facto standard, is yet to be seen.

An attribute supporting the lasting power of the chosen framework will be technology-enabled breadth of value. Technology undoubtedly fosters efficient innovation and a range of value about the asset supply chain's depth, realizing value from the fully enriched digital context. As a leading project management software vendor with deep roots in construction, InEight has distinguished itself in the marketplace with a unique context-oriented perspective that leverages and further extends the potential of AWP.

INEIGHT'S AWP SOLUTION

From a field execution perspective, the overarching objective of AWP is, on a weekly basis, to give a foreman a ready-to-execute chunk of work that is fully defined in terms of who is needed, what tools are required, the materials necessary and one that is generally free of constraints. This is achieved through the following top-down, rolling-wave technique formally known as AWP.

InEight's Top-Down Hierarchical Approach to AWP

InEight's approach to the AWP framework is a composite of two complementary, but distinct approaches that, when woven together, helps deliver more predictable outcomes. The first concept sets up in Front-End Planning and builds a plan backwards across disciplines from a desired set of goals.

Planning backwards inherently and intentionally exposes constraints across disciplines that must be accounted for in crafting the plan. Because this approach considers and shares constraints across engineering, procurement and construction, we are improving context. This approach intuitively makes sense and is hard to challenge.

The second piece of AWP sets up in WorkFace Planning and drives at iteratively forward planning at the workface, where productivity, environmental and situational realities pose as fluid constraints that require active management, planning and re-planning. The face of work is where the impact of decisions is realized. Here, AWP pushes this planning away from traditional settings and moves it out to the field, providing literal proximity to reality, or improving context. This context inherently supports the creation of more realistic and achievable plans for execution.

Agreeing that context is key, and AWP offers it in troves, the challenge the industry faces is what's the best angle of approach to AWP? Such a studied, methodical approach risks stifling continuous improvement, optimization and innovation, or runs the risk of simply remaining too daunting or inaccessible for most to engage. We'll get through all of these pieces within this paper, but let's first do some groundwork.

THE PROJECT

Establishing the formative context for a shared end goal, project stakeholders need to firstly agree on the deliverables that make up the overarching scope of the project. Right from the get-go, this forces the initial top-down nature of AWP planning to be deliverable-oriented. This is quite a change of course from traditional planning, which drove planners straight into the weeds of the work itself.

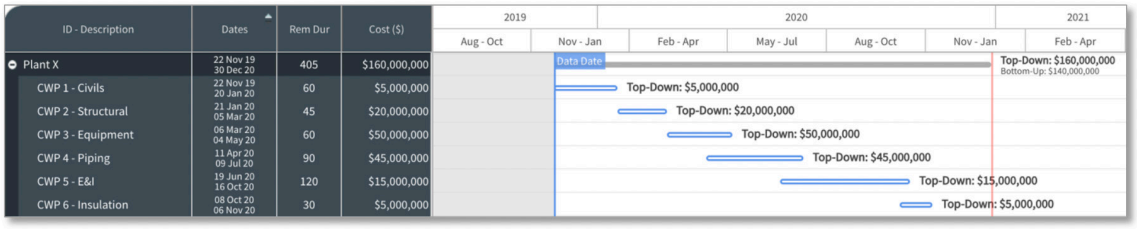
THE PATH OF CONSTRUCTION (PoC)

With a common end goal and deliverables scoped, the Path of Construction (PoC) begins the AWP planning step. The PoC is a high-level sequence and logical scope of Construction Work Packages (CWPs) flowing across Construction Work Areas (CWAs) that are established during Interactive Planning Sessions (IPS). The outcome of IPS is your "march-to" plan for the optimal building sequence.

Think of IPS as the collaborative work process that formally brings together vital project stakeholders from operations, construction, engineering, procurement and project controls to collectively provide input into the PoC. Having the "right people in the room," IPS aligns stakeholders in attaining optimal solutions and addressing trade-offs necessary for project execution. Interactive planning directly supports the team to define, refine, and finalize the PoC. Through successive iterations of the IPS, the project team lays out the structure and sequence of contracts, CWAs, CWPs, Engineering Work Packages (EWPs), Procurement Work Packages (PWPs) and turnover sequence.

The PoC develops the framework and target for the rest of the project (engineering and procurement). In other words, as you begin to define your engineering and procurement work packages, you are inherently driven to accommodate the "need-by" dates of the CWPs in your Path of Construction. Again, having a construction-led plan with engineering and procurement successive is a dramatic philosophical departure from traditional planning.

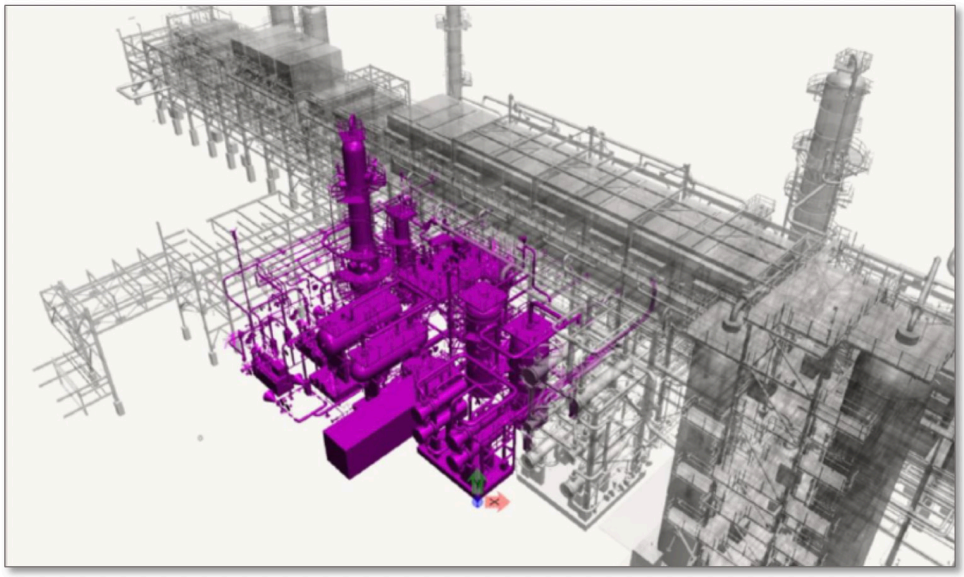
The project's PoC should be defined, refined and finalized iteratively during the early project definition phase and encoded explicitly into the project schedule. The PoC is collaboratively developed with all key stakeholders through the IPS and is "owned" by the construction team. Given it is a top-down sequence of work, it can make sense to define the PoC not only in the schedule, but also in your top-down cost estimate or graphically from your 2D drawing or 3D model.



Example Level 1 PoC

CONSTRUCTION WORK AREAS (CWAs)

Construction Work Areas are geographical locations within the construction site segmented through the division of work defined by construction. CWAs are multi-discipline and are typically represented in a project schedule as Level 2 entities and will subsequently be further divided into multiple CWPs. CWA will normally align with a design area on a one-to-one basis, but in some circumstances, the basis may be several design areas to one CWA.



Example of a Model Highlighting a Specific Construction Work Area (CWA) - AWP Institute

One of the most effective ways to develop CWAs is to adopt a graphical perspective through a VDC tool. Early adopters of AWP principles are dissecting the VDC into CWAs through tagging. This visualization aids in defining the construction sequence logically by providing the visual confirmation of work scopes.

Each designated CWA should include:

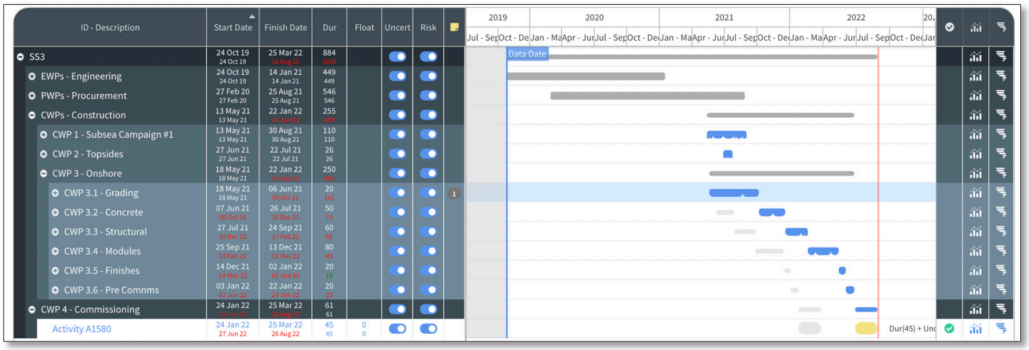
- Scope of work, represented in a 3D model or 2D plot plan.
- CPM schedule
- Associated Path of Construction
- List of associated EWPs and PWPs
- CWPs
- Equipment list

- Material list
- Work-hours

CWAs essentially become more manageable sub-projects within the overarching project. CWAs are modeled down to a Level 2 in a WBS structure.

CONSTRUCTION WORK PACKAGES (CWPs)

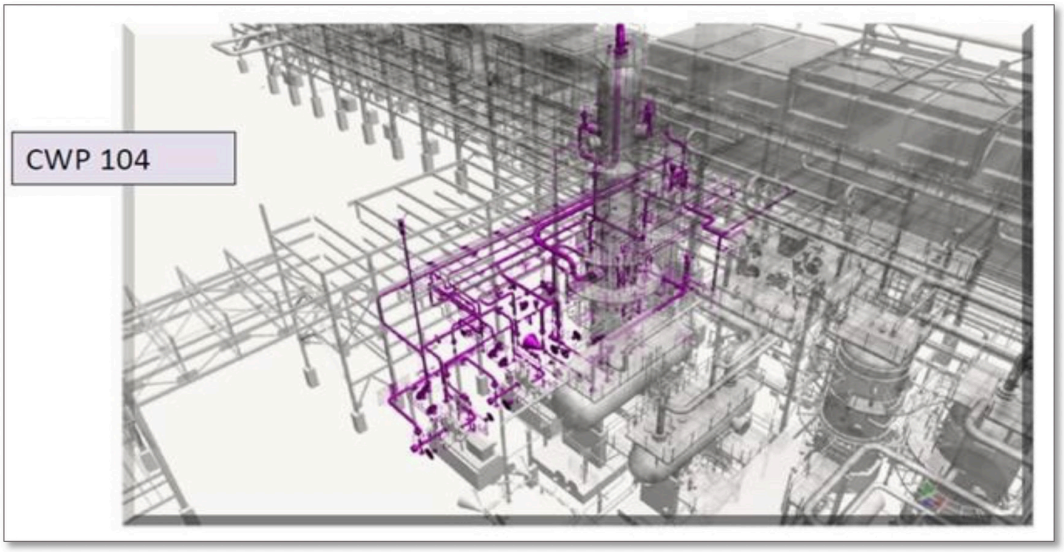
Construction Work Packages (CWPs) are indeed the meat and potatoes of AWP. A CWP is an instruction of work. It defines the scope and includes: all drawings, models, and plot plans; all of the supportive services needed to execute the work; the people, tools and materials required; and an estimate of the work-hours and duration cost of the work. Definition of work-hours, duration, and cost allows for comparisons of planned to actual performance. Typically, a CWP is defined down to a Level 3 in the schedule.



Example of CWPs in a CPM Schedule

CWPs are discipline-specific and do not overlap. A VDC representation of a CWP is the perfect environment for visualizing work, time, cost and scope. Time phased VDC representation of CWPs allows execution to expose constraints across disciplines, support crafts, and eliminate potential work face execution impediments.

During CWP, scoping visually, the definition of applicable drawings, specifications and quality requirements is critical to accurately define the context of the CWPs and subsequent Installation Work Packages (IWPs). Utilizing your tools to leverage metadata and allow for these data connections to travel through the various phases of the project is crucial in optimizing package definition.



Example of a Construction Work Package (CWP) Highlighted in the Model - AWP Institute

CWPs should adhere to the Level 1 Path of Construction (the overarching framework for construction). As you detail out your Level 3 CWPs, understanding whether or not this detail adheres to or breaches the PoC is a further check and balance as to whether your refined workface plan aligns with overall project expectations or not.

PROCUREMENT AND ENGINEERING WORK PACKAGES (PWPs AND EWPs)

Once the project CWPs are defined, your CWP Release Plan is ready for backfilling with supporting engineering and procurement steps. Defining the engineering and procurements scopes that feed CWPs results in the clear demarcation of Engineering and Procurement Work Packages (EWPs and PWPs). The build-out of EWPs and PWPs is backward from the required date of the construction work packages.

At a minimum, EWPs should include:

- Scope description
- Attributed 3D model
- Drawings / drawing list
- Procurement deliverables
- Specifications and vendor support
- Bill of Materials (BOMs)

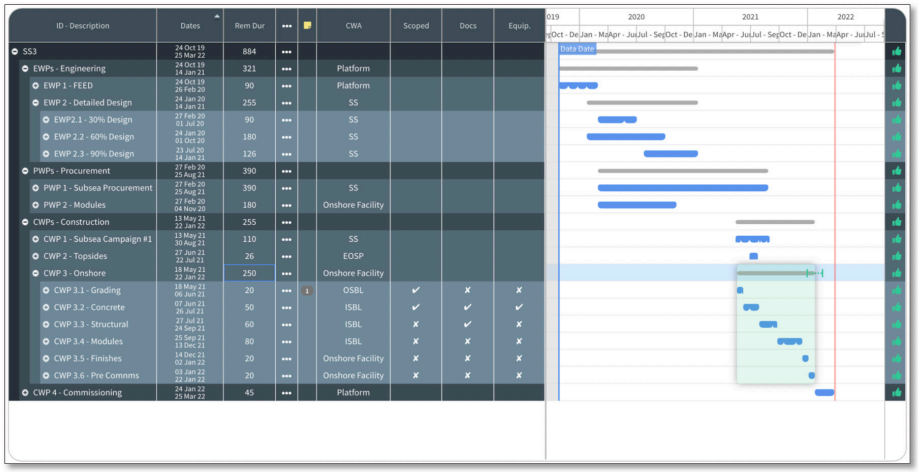
EWPs are typically defined within the context of the intersection of a given CWP and a CWA. EWP boundary definitions should refine the engineering into workable packages that can be engineered separately or can be scheduled to support engineering workflows.

Procurement work packages define a work scope to support construction in procurement deliverables, specifications, and vendor support. PWPs aggregate all of the material requirements related to a CWP. PWPs and CWPs have a one-to-one relationship. However, practically speaking, for most procurement strategies, there is typically a several PWP to one CWP relationship. Materials are usually procured by

commodity types, sometimes involving multiple participants. By leveraging InEight's solution and its data integrations, material association by CWP is maintained as an add-on step on the procurement life cycle.

At a minimum, PWPs should define the following:

- Materials required
- Responsible procurement organization
- Vendor data and drawings
- Supplier
- "Need-by" or Required at Site (RAS) dates



Aligned Engineering, Procurement and Construction Work Package Sequence

The development of a sequenced and supporting network of EWPs feeding into PWPs and then feeding into CWPs and the Path of Construction is a key structure of AWP. Establishing a natural flow that accounts for sufficient scope definition during design in order to support efficient procurement to fabricate and deliver items on time to support construction is vital. Historically, because projects have planned from left to right (engineering to procurement to construction), all of the risk exposure has also compounded from left to right, resulting in inevitable construction delay. This is overcome by the "right-to-left" construction-led nature of AWP.

INSTALLATION WORK PACKAGE (IWP)

Following the project-defined CWP release window, weekly IWP plans are developed. This process is widely known as WorkFace Planning (WFP) or quite literally planning at the face of work. WFP is very different from the Work Package Planning steps described above. WorkFace Planning is designed to be consumed by those executing the work, whereas Work Package Planning ensures everything is optimized to support constraint-free field execution.

IWPs form the basis for actual in-field workface execution. Unlike CWPs, EWPs and PWPs, IWPs are not constrained by sequential logic. Think of IWPs as more of a duration-based checklist from which your daily plans originate. IWPs include everything needed for a foreman to execute their work freely.

IWPs should consist of, at a minimum, the following:

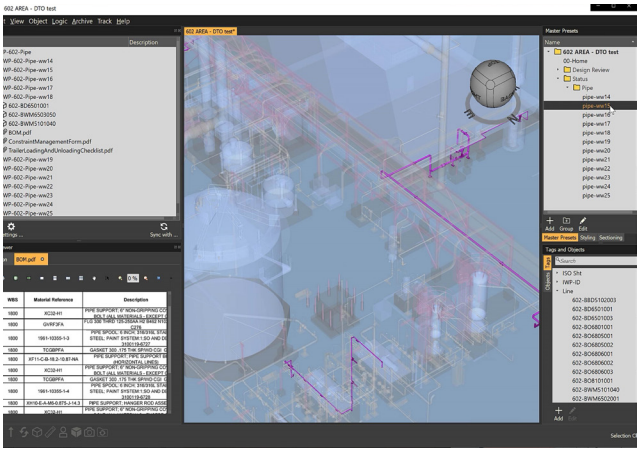
- Plot plans
- Drawings
- Scope of work

- Safety/quality/environmental considerations
- Risks and assumptions
- Progress/status
- Constraints listing
- Equipment
- Components lists

IWPs should ONLY be released to the field (foreman) for execution once they are in a state known as "constraint-free." Such constraints are managed in a Constraint Register. Projects can define exceptions to this rule and releasing IWPs with minor constraints should be evaluated on a case-by-case basis.

IWPs ultimately carry the enriched data (the Digital Thread concept) generated through the AWP workflow. IWPs are where all the supporting entities (listed above) come together, providing a full context. Every IWP should be as highly enriched and tagged as possible with this meta-data. Being able to visualize, highlight by exception, and monitor these attributes' status in the model over time (the Digital Thread) is a large part of the magic and benefit of AWP. Looking toward the future of AWP, individuals at the work face will be provided a mobile device where every bit of project data, including the IWPs, models, and documents, are available in real time to offer contextual updates actively to the work scope.

A desire to make impactful decisions at this stage is rewarded with access to the full context of surrounding previous work and its implications across all disciplines. Enabled by this integral Digital Thread, project decisions have never been more informed.



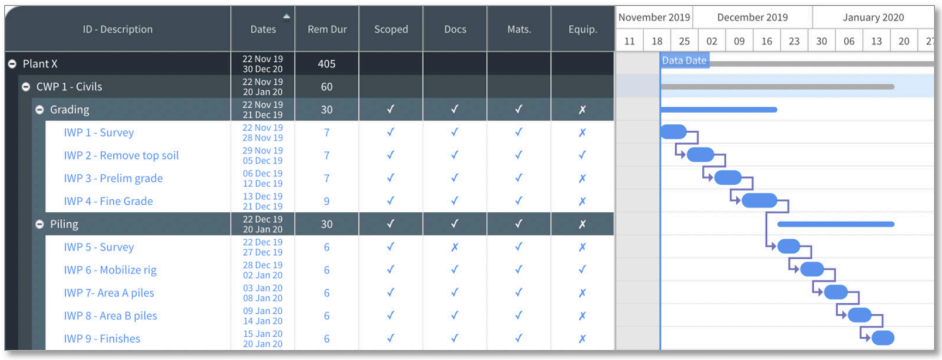
Highlighting a Data-Enriched IWP

CONSTRAINT REGISTER

The constraint register is the AWP control mechanism that ensures that work released to the field is truly ready. An IWP should not be released into the field until it is constraint-free.

Constraint Registers are typically defined at the IWP level. They contain checklists that need to be satisfied before the work is released for execution. The multiple attributes and tags that were defined during the CWP, PWP and EPW development process form the basis for the Constraint Register. One of the challenges of using a Constraint Register is the sheer volume of data generated. With each IWP carrying approximately 10 constraints, the total number of constraints to track quickly becomes large.

Constraint ownership and accountability is the key to successfully dissolving constraints in time for IWP release to the field. Being able to flag and highlight areas of a project that repeatedly have constraint bottlenecks is the first step in optimizing the release of work to the field as per the project plan.



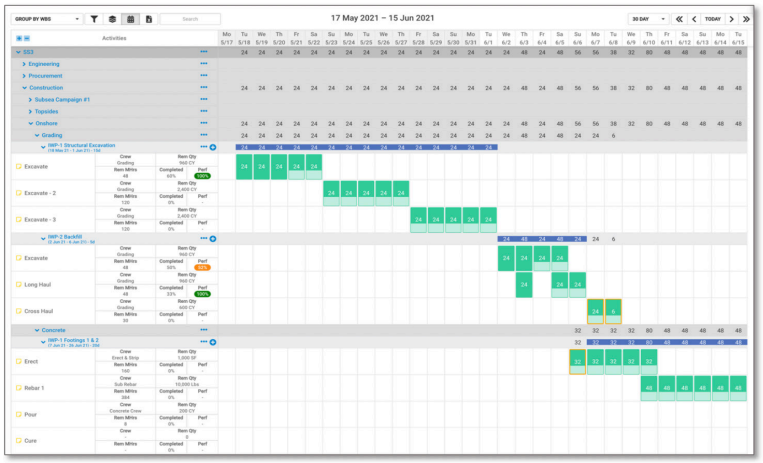
Example of a Constraint Register

DOCUMENT INTEGRATION

Hinted throughout this paper is the notion of relevant documents, specifications, 2D drawings, vendor data, etc., being readily available to support the scoping and packaging efforts during all phases. All pertinent drawings and documents available to all stakeholders at all times is a critical information flow. As such, robust integration with your document management system is imperative to ensure the entire project team manages a single source of controlled project truth. All future projects should aim to operate with a reduced use of a paper environment implementing work processes and systems to expedite communication among the project team, third parties, contractors, and suppliers contributing to the project. Leaving behind your on-premise software platform and transitioning to a cloud-based document management system is adopted similarly to AWP.

DAILY PLANS/SHORT-INTERVAL PLANNING (SIP)

Daily plans (often in the form of what is called a short-interval plan) are typically defined at Level 5 in the schedule. These granular plans are highly fluid and should be flexible enough to respond to unforeseen field or site changes. For this reason, daily plan IWPs shouldn't have a lookahead of more than three weeks.



Example of Daily Planning Using Level 5 Short Term Interval Schedule

TYING IT ALL TOGETHER WITH A DIGITAL THREAD AND DIGITAL TWIN

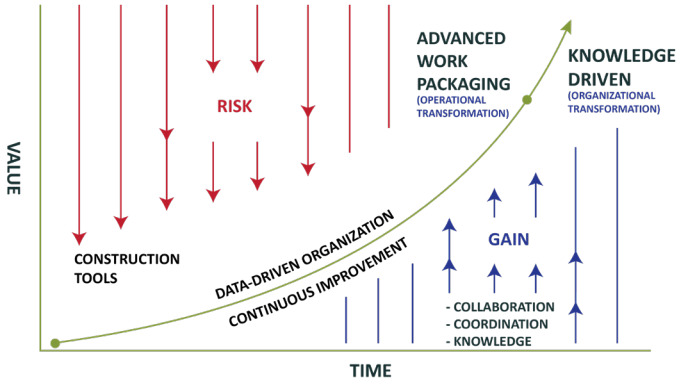
One of the additional benefits of AWP is the residual digital footprint that is generated. This footprint exists not only during the project itself, but long after once the asset becomes operational. It can be segmented into two sub-elements: the Digital Twin and the Digital Thread.

Digital Thread

The formal definition of a Digital Thread is *"the record of a product or project timeline, from creation to its completion."* Perhaps more meaningfully, think of a Digital Thread as an information trail that becomes a permanent record of the work executed by an EPC or contractor as part of the path towards project completion. A Digital Thread is the intersection of information about work expended and can include schedules, cost estimates, daily execution plans, materials installed and so forth.

The AWP process supports a Digital Thread's continuous enrichment from very early concept select phase all the way through detailed design through execution and handover. Such a permanent record can then be used as needed for the project in question (e.g., claims and delay analysis) and as a benchmark for subsequent projects when forecasting future delivery and productivity rates. This can have immense value in challenging installation environments such as offshore installation campaigns.

For the first time, such previously disparate information stemming from multiple sources in multiple formats can now be both captured through AWP and intelligently mined using AI and machine learning.



Project Maturity From Data to Knowledge Through a Digital Thread

Digital Twin

If a Digital Thread reflects the work executed by the EPC or contractor, then a Digital Twin can be viewed as a permanent digital record of the delivered asset. A Digital Twin is defined as *"the current representation of a product or asset mimicking a company's machines, controls, workflows and systems."* A Digital Twin pertains to the asset rather than the work expended to deliver the asset. It is a snapshot of the deliverables being handed over by the EPC or contractor to the owner.

Digital Twin data includes specs, 3D models and 2D plans. The real value of a Digital Twin is its ability to optimize a physical asset or system's operation and maintenance after project completion. Digital Twins provide previously hard-to-determine insight for both planned and unplanned maintenance and shutdown for operating assets.

SUMMARY OF THE AWP PROCESS

What is described above is 100% geared towards per-plan project execution. To achieve this, AWP ties together owner-oriented Front-End Planning (focus on deliverables) with contractor-oriented WorkFace Planning (focus on work).

Prior to AWP, such harmony and alignment between scope and work was not possible using traditional planning techniques — you either planned through deliverables or work, not both.

This collaborative integration and alignment of scope and work has been made possible by next-generation information systems that not only enable the linking of vast volumes of project data and metrics, but actually provide meaningful context, reasoning and insight. The concept of continuously enriching a Digital Thread to then benefit from predictive analytics and 3D visualization is one of the many benefits of AWP.

AWP is not a magic bullet by any means, but one of its impressive strengths is the enforcement of the hierarchical and rolling-wave nature of the development of a construction-led plan. This is achieved by establishing the Path of Construction, Construction Work Areas and Construction Work Packages, along with their supporting Engineering and Procurement Work Packages, ultimately leading to workface plans in the form of Installation Work Packages and daily plans. All of this is supported through the management of constraints, ensuring free-flowing, constraint-free, per-plan execution with more predictable outcomes and lower risk profiles.

HOW IS INEIGHT PUSHING THE BOUNDARIES OF AWP?

As discussed, AWP is the culmination of traditional Front-End Planning with WorkFace Planning, along with next-generation information management. InEight has long recognized the value of aligning these two and is now extending its planning and field execution platform to support the AWP process. The depth, integrated nature and next generation innovations native to the InEight platform ensure that the AWP promise is realized and so much more. Following are some of the available scenarios InEight brings to life.

NEXT-GENERATION INTEGRATED FRONT-END AND WORKFACE PLANNING

InEight's field execution tools are second to none. One of the driving forces behind this is that they have been designed and stress tested by one of the biggest and most successful contractor organizations in North America: Kiewit.

A unique capability that InEight offers is to directly tie together CAPEX plans (schedules and cost estimates) with daily workface plans. Think *"Top-down meets bottom-up."* For the first time, short-term execution can align with the bigger-picture outlook. And not only that, but the bigger-picture outlook can now be updated to reflect field execution reality. Relate this back to where InEight is driving AWP. Imagine being able to:

- Automatically generate your three-week daily plan look-ahead with required components automatically associated.
- Light up the project 3D model with IWPs that have outstanding constraints that need to be resolved.
- Execute your daily plans knowing the required people, materials, equipment and supporting information are all readily available.

- Flag areas of the schedule that are being breached with regards to timing and cost.
- Fully integrate InEight Document Management that drives platform communication, collaboration and data integrity.
- Have the InEight software automatically update your schedule/cost forecast based on real-time productivity feedback from the field.

NEXT-GENERATION INFORMATION MANAGEMENT

InEight has adopted a knowledge-driven approach to project management. This is very different from traditional project management software that analyzes data. Knowledge-driven project management drives organizations from capturing data to capturing knowledge that can be interrogated, from which inferences can be drawn to assist in decision making. Again, relating this to AWP, imagine:

- A toolset being able to guide you through the definition of your Level 1 Path of Construction (think "AWP assistant").
- Software highlighting common risks and issues that arose along analogous PoCs on prior projects.
- Being able to establish standard subnets detailing out the sequence and logic between your CWPs.
- Software suggesting standard rules of thumb (e.g., 80% of procurement needs to be on-site before construction can start").
- Being able to share relevant information between the owner and contractor in a controlled yet collaborative environment.

Imagine all of this data and knowledge being captured as a digital entity that then becomes part of the operational asset itself.

As an early adopter of InEight's AWP solution, Kiewit is seeing several demonstrable benefits, most clearly through their use on a multibillion-dollar petrochemical project in Texas, including:

- Efficiencies realized through the complete supply chain in the project, specifically in the field, due to material and equipment alignment and timing.
- The Path of Construction, as a result of the integrated planning session, receives full buy-in from multiple stakeholders, including procurement and engineering.
- The visualization and insight into constraints through the 3D model is proving to be hugely valuable during the development of daily plans.

As a result of this powerful interplay of advanced planning expertise, next generation WorkFace Planning and truly integrated information management, InEight is positioned to take the lead in the arena of AWP, push the boundaries and effect a step-change in construction project management.

To learn more about how InEight can help you achieve project certainty, visit InEight.com.