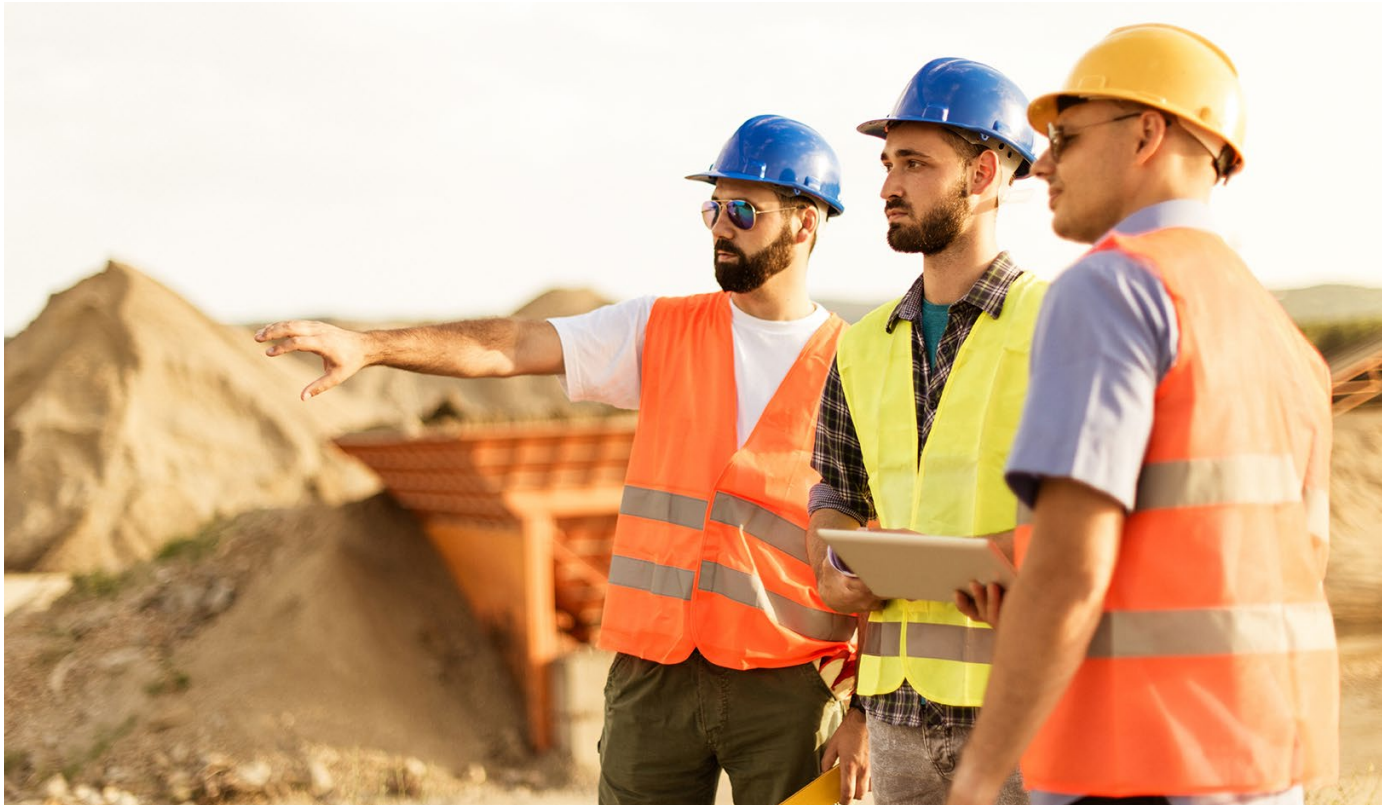
A glossary of offsite construction/ modular construction terms

by Kenny Ingram, Global Industry Director, IFS



Engineering and construction companies are striving for the type of productivity gains realized in recent decades by their counterparts in manufacturing. And they are fast realizing that the most significant gains come from moving activity that had been completed on site into a shop environment–becoming more like manufacturers themselves.

This is not an entirely new phenomenon. Companies in precast construction, modular home builders and many mechanical contractors already perform work in a shop environment and then transport assemblies or subassemblies to the job site to be placed in situ, erected, assembled. But as more construction organizations in more disciplines move their operations in this direction, they will need to learn and implement new concepts and methods. Richard Feynman taught us that there is a difference between knowing the name of something and knowing something, but knowing that name is a start.

So, to that end, IFS offers this quick glossary of important terms for those embarking on or advancing on a journey towards offsite, modular construction.

Offsite Construction Glossary

Multiple terms for the same thing

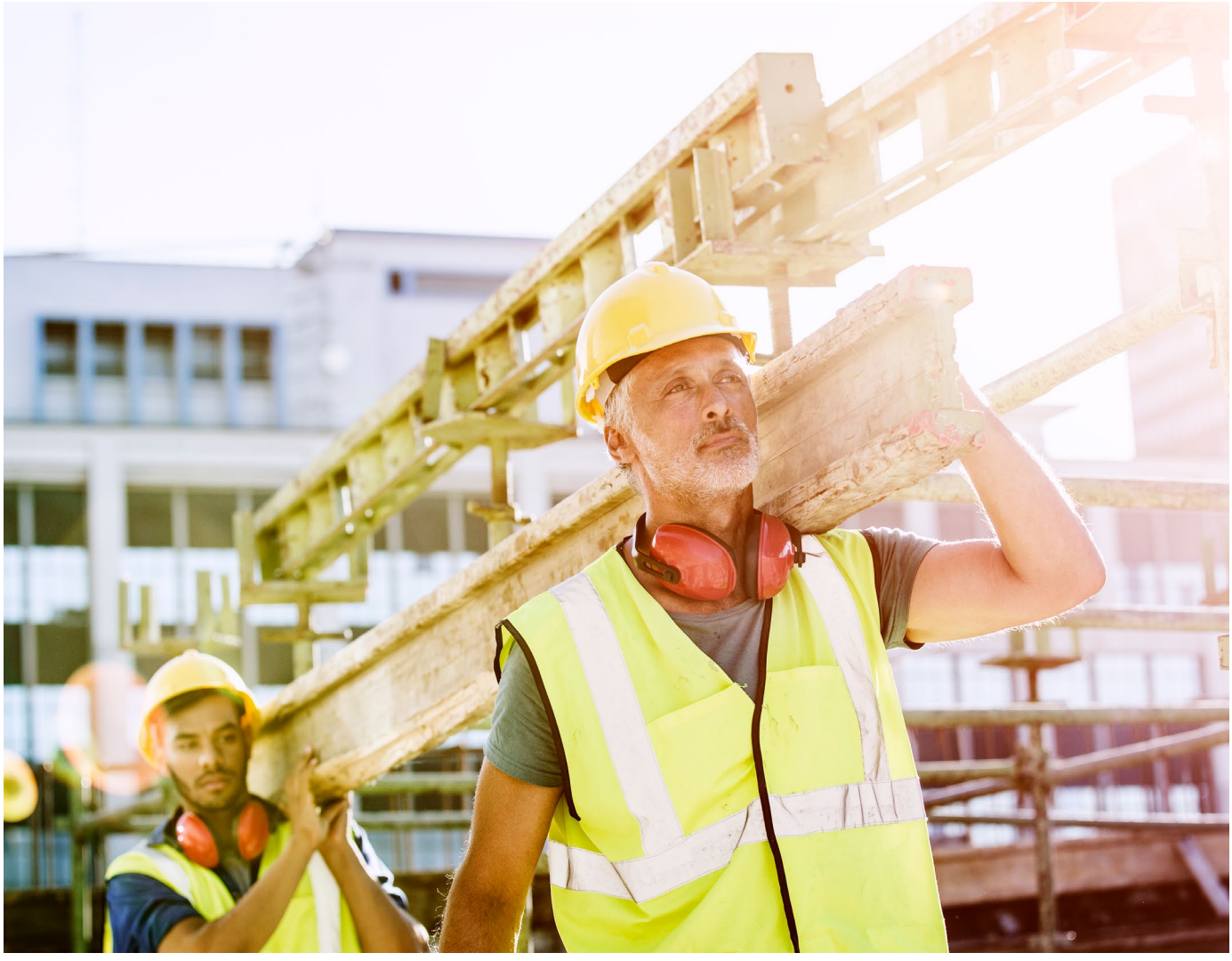
Offsite construction. Modular construction. Construction integrated manufacturing. Prefabrication. Panelized construction. Designed for manufacturing and assembly (DFMA).

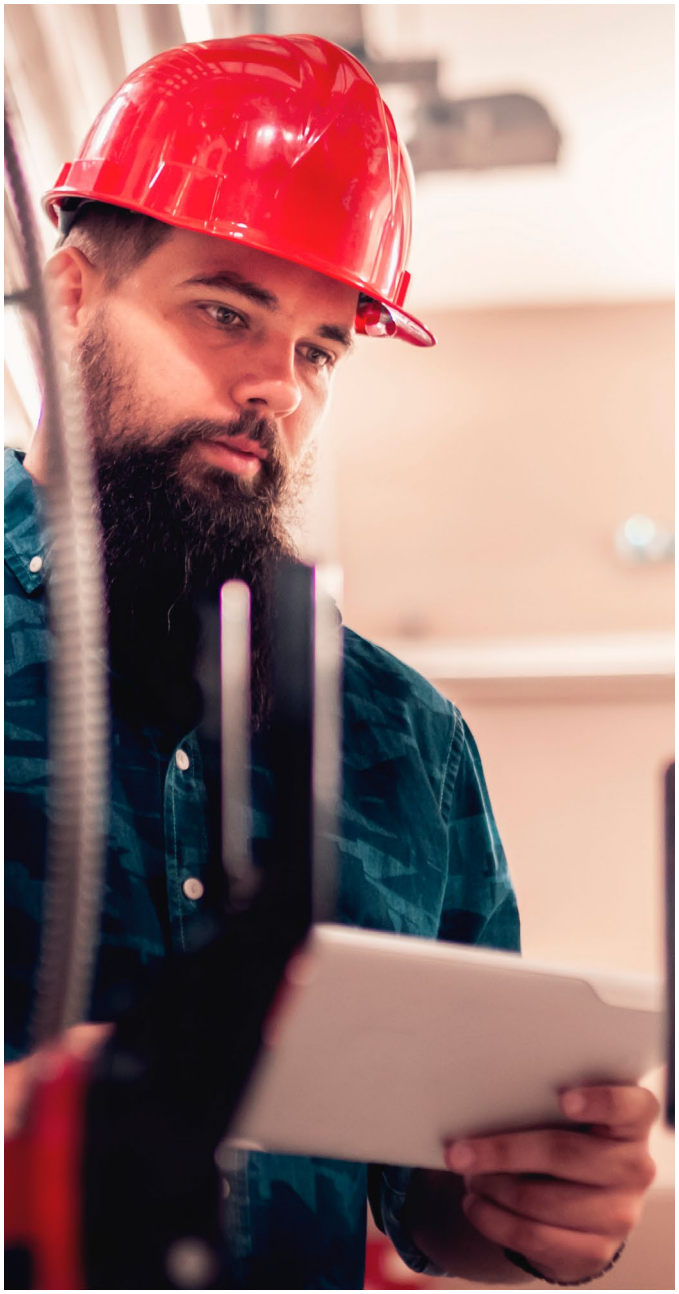
All these terms refer to essentially the same thing, although some may be used more in certain sub-industries or countries than others. Regardless of which specific term we use, the definition is the same. It is a technique, whereby standardized modules or components are manufactured, fabricated or assembled in a factory or offsite location, transported to, and assembled or installed on the construction site.

Manufacturing terms to know

Simply moving some work offsite can bring measurable benefits as you can be more efficient in how you use labor and prevent weather-related delays and inconveniences. But manufacturers have also adopted lean principles that, compounded over time, has for instance let US manufacturers increase output by 80 percent over 30 years while employing fewer workers.

A contractor simply moving some activities to a shop environment will not automatically see that type of productivity gain. The exponential gains in productivity will come by adopting some of the best practices taken for granted in the manufacturing space over the last few decades.





Part number/catalog number

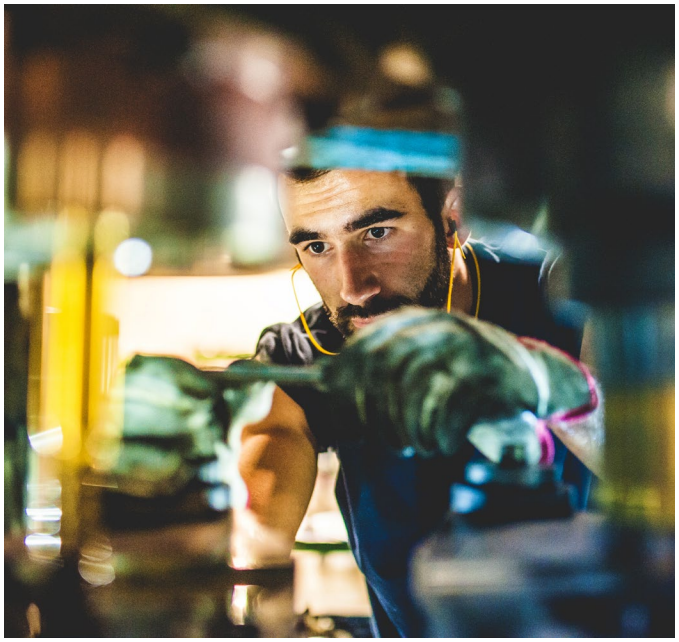
This is a very simple term for a simple idea, but it will be revolutionary to many engineering and construction firms. Project designers and construction companies often start any project from a blank slate with no common elements from one project to the next. While each owner and set of project requirements is unique, contractors adopting standardization, including standard parts, will see significant cost savings and productivity improvements over those who do not.

A part number or catalog number is a unique identifier used to define each standard part along with its form and function. This is assuming a construction or engineering operation has adopted design elements that are used consistently. Right now, this is typically not the case as any manufactured or fabricated part is just considered work in progress (WIP). But once an engineering or construction organization makes that leap to standard parts, they offer several benefits:

- The design process can be compressed by re-using common elements in the form of standard parts or assemblies
- You can take advantage of inventory control efficiencies by tracking standard part availability, location balancing that against demand in the project plan
- You can also move inventory around between projects
- While the benefit of implementing part numbers is the ability to re-use them across multiple projects, you can also still have parts unique to a project, so you are not giving up any flexibility

The other concepts and definitions we review here are also vital, but none overall can impact the construction industry to the degree of standardization. The repeatability that comes from standardization is why manufacturing is more productive than construction–repeatability. After all, you cannot produce 1,000 cars a day, with an assortment of option packages and features, if you must design every single one from the ground up. Even with configured options, you are still working from a standard design. And even across different models, there are often shared inventory parts or even shared platforms.

We have some standard products in construction already, but we need exponentially more. Think of the steel beams for a structure and how the consistent structural qualities and dimensions influence and improve construction. Precast concrete panels are another example–manufactured to tight tolerances and easy to design projects around. Driving more of this type of consistency and high quality into the construction discipline will make all projects more predictable, efficient and profitable. Designs may also be proprietary, which means your company's approach and technology may become sought after, allowing you even higher margin by de-commoditizing and increasing demand.



Subassemblies

While some parts are simply cast, die cut, rolled, welded, stamped or molded items, multiple parts can be assembled into a more complex part and kept in inventory. This intermediate stage in a build process is called a subassembly. These subassemblies are parts could also be configured and assembled into modules. A construction or engineering company could have standard subassemblies as well, each of which are assembled as needed into a module for deployment on the job site.

Based on anticipated demand and current project plans, it might make sense to manufacture and keep in inventory be three types and two sizes. Or standardize at even a lower level of a structure. Can build to stock to cut down lead time.

Bill of materials/product structure

A bill of materials (BOM)--a parts list or assembly/installation kit–is the final accounting of what you send to a job site. It enumerates the items and quantities, and in a construction environment is attached not just to a shop order used at a manufacturing facility but to a project. All the raw materials, labor and other resources that go into the items on a BOM can then be broken down and analyzed for cost, and the data used later for serial traceability. The term work face planning has started to be used in some segments of the industry to describe a structured work package management approach. These work packages are used on the construction site to execute site-based work and are in principal the same as shop orders in a manufacturing plant. Each work package will describe the materials, labor and equipment required to do the work.

In a construction and engineering environment, a lot of work must go into planning this BOM because of the advanced logistical challenges. This is also true in many industrial equipment settings, and construction companies can probably learn a lot from how machinery manufacturers plan a BOM given the large dimensions of the equipment, its weight, dimensions and oftentimes the capacities of public rights of way.

Material requirements planning (MRP) and Capacity Requirements Planning (CRP)

WIn a manufacturing environment, MRP is an approach to using the sales forecast to pull through raw materials and schedule labor. In a construction and engineering environment, this can be driven not only by the project plan but by projects in the pipeline. In engineering and construction companies traditional MRP and CRP are not appropriate, but some modern project centric ERP solutions can drive procurement and resource plans from the project plan, so the principals are broadly similar. In addition, in an offsite model project MRP and project inventory are also critical processes.

The ability to include potential projects that you are bidding for in the plan is also a very useful simulation option which is available is a small number of ERP solutions.

This means you will have a head start on completing the work even before you win the business. And it means you can purchase materials and hire workers and plan for the equipment needs based on your anticipated needs, reducing cost and lead times even further.

Work centers

Work center is a term used to refer to an individual machine or set of machines that do the same thing, or assembly areas where workers do similar or identical work.

Routings

Routings are the specific steps that must be executed in a shop environment to create a part, assembly or subassembly. It includes a sequence of production operations and identifies which work center completes each operation and the expected time to perform the operation. In ERP software, it is important for a company in the construction and engineering industry to have very agile routing processes, as new routing will be required regularly depending on individual project requirements. Some manufacturing software products require extensive systems integration work to create a new routing–an important thing to keep in mind.

Product Cost Rollup

This is an account and management procedure that will help you get a handle on the cost the assemblies you deliver and put in place on the job site. Think of a BOM as a nested table of all the constituent parts, subassemblies and the final assembly. In construction ERP with manufacturing capabilities, it will be simple enough to roll up cost of all the component parts of a BOM, including the labor, machine and overhead costs so you can get actual costing on the assembly.

Make-To-Stock

In this model, products are manufactured and placed into inventory for later consumption. In some manufacturing environments, these products may be used to fulfill orders, but in an offsite manufacturing setting they will often be commonly-used parts that can be consumed by multiple projects.

Configure-To-Order

Made-to-stock parts are configured into pre-defined assemblies according to an order or project requirement.

Make-To-Order

This model typically involves standard parts, unlike job shop manufacturing. But the manufacturing process is still triggered by an order or more specifically, in an offsite construction environment, a defined project requirement.

Manufacturing modes

Modes of manufacturing are terms used by APICS and other operations educational organizations to refer to specific manufacturing business models. An optimal offsite construction operation will want to use multiple of these modes at different times and for different reasons. And ERP for offsite construction should have capabilities in all these areas.

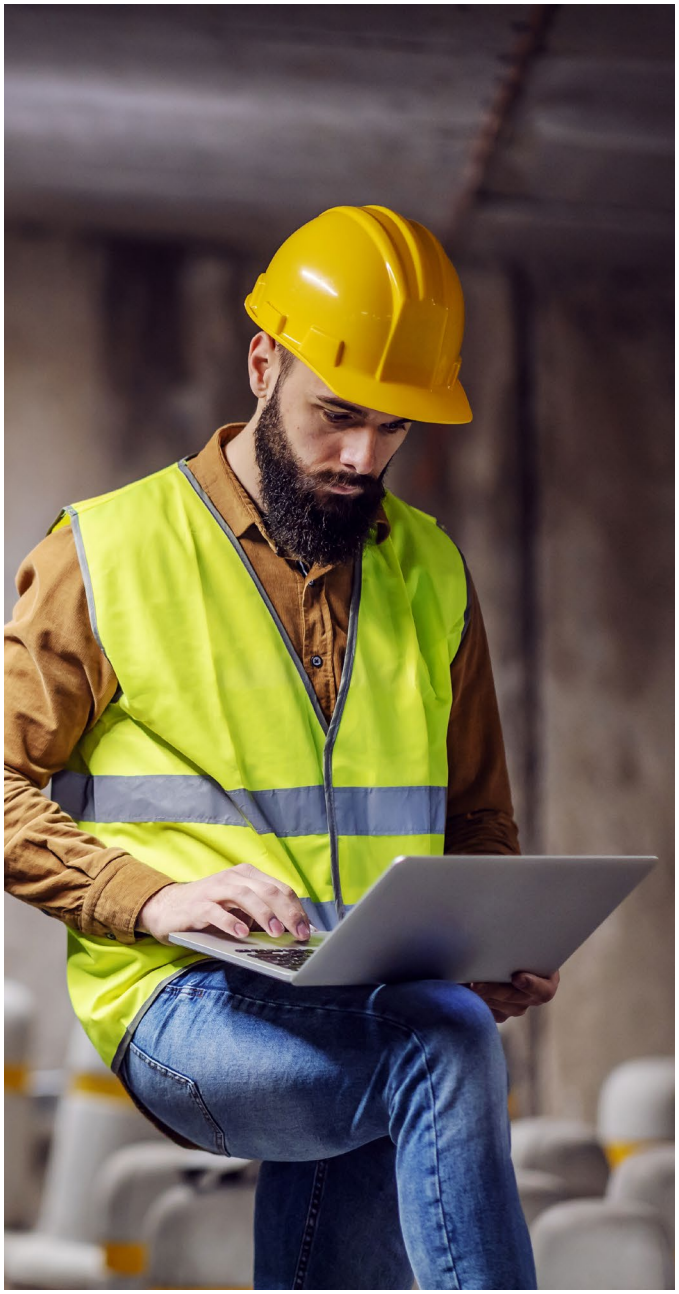
Job shop manufacturing

In this style of manufacturing, a shop simply takes an order to fabricate specific items of a design supplied by the customer. This is a rudimentary approach with no standard parts. A mechanical contractor taking an order for duct work for a fast food chain according to supplied plans is operating in a job shop environment. Inventory management for raw materials and capacity planning for labor are still important in job shop manufacturing though.

Engineer-to-order or Project-driven manufacturing

This model is perhaps most easily compared to design-build construction, where you receive functional requirements from a customer and collaborate with them to create a finished unique design. Oftentimes there is overlap between the engineering/design processes and subsequent processes like purchasing of long lead time items and in many cases, actual work on site.

Again, there are many lessons an offsite construction organization can learn from manufacturers of complex industrial equipment, including how to use technology to create a shared platform to communicate as engineering, purchasing and site professionals collaborate in real time. Industrial manufacturers will also repurpose perhaps 90 percent of their project content, using existing standard designs and standard subassemblies to meet their customers' requirements.



Traceability

Some materials providers like structural steel and concrete manufacturers already rely on lot and batch traceability to identify and mitigate against quality issues. A concrete sample may be collected and submitted to a structural engineering firm or project owner according to American Concrete Institute (ACI) or American Society for Testing and Materials (ASTM) international standards.

The contract may require lot traceability, which means that the materials testing report (MTR) corresponds to a quality control index number assigned to that batch of materials. In some cases, the chain of custody of that material sample is required through a process like a certificate of compliance and traceability.

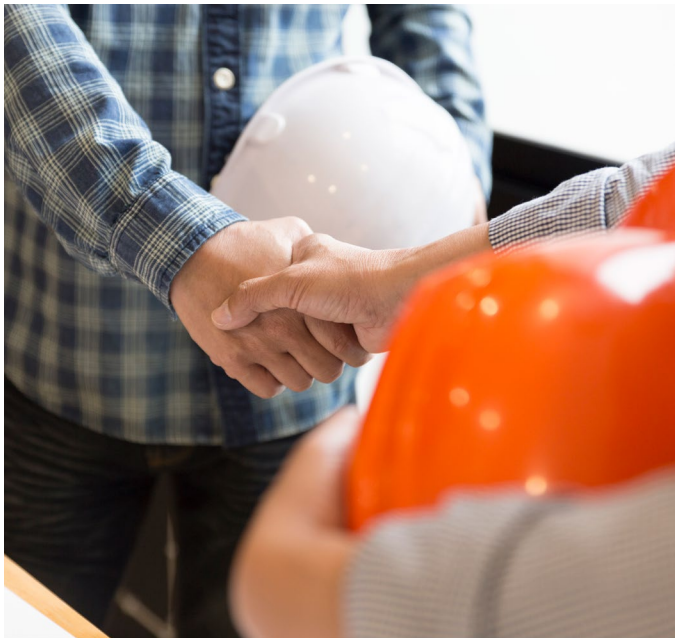
When it comes to discrete items fabricated in a shop, you may be required to provide serial traceability. Particularly with a more complex electrical or mechanical assembly, or those consisting of other serialized parts provided by your vendors, you could need to issue each piece a serial number, oftentimes with a nested table of serialized component parts. This might come in handy either in the event of a recall or quality issue but in documenting a warranty or aftermarket service contract that covers serialized components.

Shipping plan

This is how you synchronize delivery of materials, assemblies and subassemblies to a construction site so you are not sending materials before you have a safe place to put them or you may not have enough space to store them. You want to ensure that the site labor resource plan is in synch with the shipping plan so that maximum efficiency is achieved and project plan dates are met.

Just-in-time (JIT) delivery schedule

This is another concept that originated with the Toyota Production System. The idea is to integrate the delivery schedule of materials directly with the production schedule or in the case of an engineering and construction environment, with scheduled activities on a job site. In your offsite construction journey, you can certainly explore whether you want to use this method on your shop floor because it reduces the dollars you have tied up in inventory. What makes obvious sense though is using JIT to schedule the delivery of assemblies and subassemblies to the site, so the transport timeline corresponds precisely with when crews and equipment are available to erect or install them. This JIT approach can protect assemblies from the elements and from theft, make efficient use of crews and equipment on site and preserve valuable space on site–a crucial factor when space is constrained or you have multiple trades working at once.



Lean construction

This is a term coined by the International Group for Lean Construction[1] in 1993. It is hard to define, because like lean manufacturing, it is a collection of disciplines and concepts that are applied at different points to construction processes.

While the methods and approaches to bring lean improvements are many, the consistently exciting thing is to see a disciplined and measurable approach to reducing waste and increasing efficiency in the construction industry. One well-documented case study[2] of a heating, ventilation and air conditioning (HVAC) contractor found that offsite construction results in a 44 percent cost savings.

Supply hub

While you may have warehousing space or a marshalling yard at your shop location, sometimes it makes sense to locate assemblies, subassemblies and other material at a different site, perhaps one closer to one or more project sites. You or your suppliers can deliver material into these hubs and material moved to the job site as needed. This is common in sites in densely developed urban areas. But a single supply hub can also support multiple project sites, making you more competitive on projects further away from a central shop environment.

Supply chain management

To manage a supply chain, it helps if we first define exactly what a supply chain consists of. In construction it is about managing all the internal and external resources required to deliver a project. That includes materials, labor, sub-contractors and equipment. In involves the flow of materials into an offsite manufacturing facility or supply chain hub and the subsequent shipping of materials and modules to the construction site where they are then installed into the asset. In an Offsite model the construction site becomes more like a final assembly operation.

As is the case with lean, supply chain management is a deep discipline and there is no shortage of resources to help you turn it into a competitive advantage. Perhaps the most reputable are the certification programs offered by APICS[3].

[1]International Group for Lean Construction: www.iglc.net
[2]Proceedings IGLC-10, Christina L. Pasquire, Gary E. Connolly, Aug 2002
[3]APICS: www.apics.org

A whole new world

Moving some construction offsite, into a shop environment, can lead to some very attractive efficiencies. But even bigger gains can be made by engineering and construction companies by adopting standardization of parts and design content, along with the other business efficiency disciplines manufacturers have come to take for granted.

This represents a real sea change–and engineering and construction companies need to understand how a product-centric business works. But more than this, they need to figure out how a product-centric business fits into their project-centric business. When you are ready to make this transition, IFS is your trusted and proven partner to allow you to transition to a hybrid business model where you can evolve to become a work class manufacturer and construction business. We look forward to defining the future of your engineering or construction business together.

About Kenny Ingram

Kenny is the Global Industry Director for the construction industry at IFS, Kenny's main responsibilities are to promote the IFS solution to the external marketplace and to educate the IFS workforce on the business issues and challenges these industries face. He is also a key member of the IFS Product Direction Board who are responsible for making decisions on the IFS product strategy. Kenny has been with IFS for 21 years and has worked in the business systems marketplace for over 25 years. He is now regarded as one of the top specialists in Project Based Solutions and construction software worldwide and has been heavily involved in driving the IFS strategy. Prior to joining IFS, Kenny worked in Industry in various management, supply chain, logistics and project accounting positions.

About IFS

IFS develops and delivers enterprise software for companies around the world who manufacture and distribute goods, build and maintain assets, and manage service-focused operations. Within our single platform, our industry specific products are innately connected to a single data model and use embedded digital innovation so that our customers can be their best when it really matters to their customers–at the Moment of Service.

The industry expertise of our people and of our growing ecosystem, together with a commitment to deliver value at every single step, has made IFS a recognized leader and the most recommended supplier in our sector. Our team of 4,000 employees every day live our values of agility, trustworthiness and collaboration in how we support our 10,000+ customers.

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