



Optimization of Planning & Scheduling for Aerospace Manufacturing

Despite their claims over the years, ERP vendors have not delivered robust and practical shop optimizers for aerospace manufacturing. During the latter half of 2021 we conducted 60 interviews with SME manufactures in the aerospace supply chain, as well as with various industry experts and software professionals. A clear opportunity for a practical factory optimizer is observed to improve shop planning & scheduling.

Our proprietary solution – OptimizerAero™ - fulfills this unmet market need.

Q3 / Q4 2021

Study partially funded by:



National
Science
Foundation

Study conducted by:

**ADVISORY
AEROSPACE**

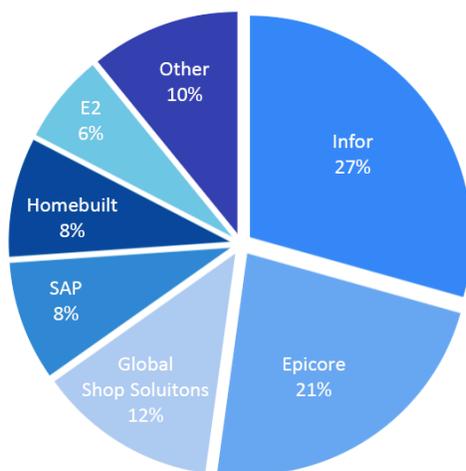
We interviewed 60 aerospace SMEs (small and medium enterprises) to understand their data systems' ability for planning and scheduling – both short term and long term. More importantly, we wanted to understand if those functionalities are used routinely and whether they actually help factories improve operations.

The long lead times, long set up times for some operations, and the “low volume – high mix” nature of aerospace manufacturing manifests itself in making many of the standard planning and scheduling tools unusable or extremely difficult to use. The main pain points from the manufactures' perspective are listed below along with our plug-in solution – OptimizerAero™ - to address these pain points.

What data systems are SMEs using?

Enterprise Resource Planning systems manage the flow of data between business processes and are vital during manufacturing as they are used for many tasks including creating schedules and issuing Requisitions and Work Orders. There are a multitude of ERP systems marketed to aerospace manufacturers. These systems are generic in the sense they do not specifically account for the process or data peculiarities in aerospace industry. For the purpose of this report, we will be focusing on the planning and scheduling tools of products commonly used by aerospace SMEs.

Our focus is on SMEs since they constitute thousands of factories in the aerospace supply chain and have limited resources, both in terms of in-house IT / engineering professionals and funds to implement highly sophisticated but expensive data solutions from the large software vendors.



Aerospace SME ERP System Use

Various versions of the same product / vendor have been combined in this pie chart.

What are the short comings of ERP systems for Planning & Scheduling?

There are two overarching concepts which determine the efficacy of planning and scheduling:

1. **Integration & Seamless Connectivity of Long-Term and Short-Term Planning** and
2. **Optimization Capabilities.**

ERP scheduling tools are typically created to be a one-size-fits-all manufacturing solution so they can be marketed to many industries. They continue to use legacy algorithms, rather than the latest in Operations Research, that were developed when computing power was a millionth of today's power.



We consider three important time horizons for operations planning.

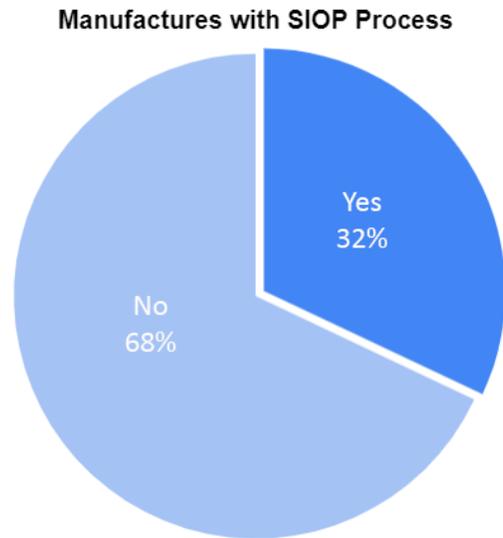
Long-term planning processes are those which build part-family level data sets based on backlog and sales, often the main part of Sales Inventory Operations Planning (SIOP or S&OP). The time horizon for long term planning tends to be at least 12 months. Mid-term planning is the Master Schedule and MRP, which contains specific information for all confirmed orders for the next few weeks to months. Finally, Short term planning is day-to-day scheduling of orders currently in production.

1. **Integration of Long- and Short-term Planning** describes a system's ability to adapt to both long- and short-term production goals. This functionality is vital to improving cashflow and maintaining high OTD (on time deliveries). A system which performs well in this area can effectively adapt to day-to-day production changes without sacrificing future delivery dates. Currently, not all systems available offer SIOP modules for long-term planning, and most systems are not capable of utilizing this sort of data for planning and scheduling. Using these criteria, we can sort the common aerospace ERP solutions into 3 categories which describe their functionality.

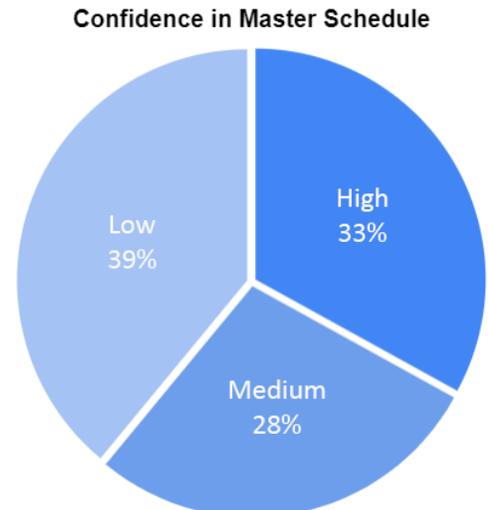
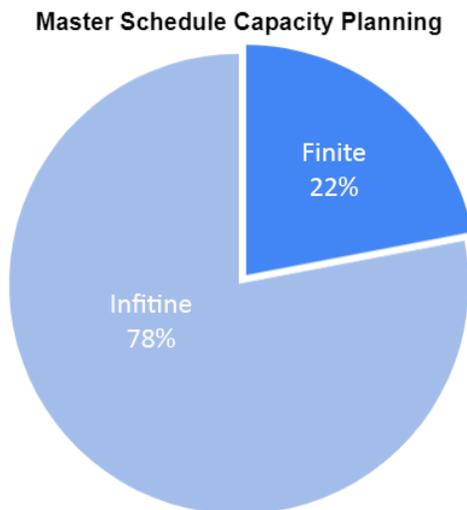
	CATEGORY 1	CATEGORY 2	CATEGORY 3
SIOP MODULE AVAILABLE	No	Yes	Yes
LONG & SHORT-TERM PLANNING	No integration with day-to-day scheduling	Little to no integration with day-to-day scheduling, lack of trust in long term operations planning	Connected, but not used for long term planning, lack of trust in long term operations planning
EXAMPLES	JobBOSS, E2	Infor, Epicor	SAP

Not all aerospace manufacturers have access to long term planning modules and even fewer of them actually use them. Only about one third of the companies interviewed had a well-defined SIOP process. Even in companies that do have a SIOP process, it is generally managed offline in Excel sheets. SIOP tools are barely mentioned by ERP vendors.

***“We do not have a single aerospace customer that uses Syteplan—the SIOP module in Syteline ERP system”
—Authorized ERP Reseller***



2. Optimization Capabilities are the algorithmic and executive toolbox of a planning and scheduling module. However, in the name of optimization, commercial ERP systems today only allow limited scenario analysis and, that too, in the most non-intuitive and difficult to use functionalities. Most systems on the market have both finite capacity and infinite capacity scheduling options. With infinite capacity scheduling the system schedules all production steps assuming no material, labor, or machine constraints. Finite capacity scheduling takes the resource constraints into consideration and attempts to create a practical schedule and flag production bottlenecks ahead of time. Each of these options should be used for both long-term planning and day-to-day production scheduling.



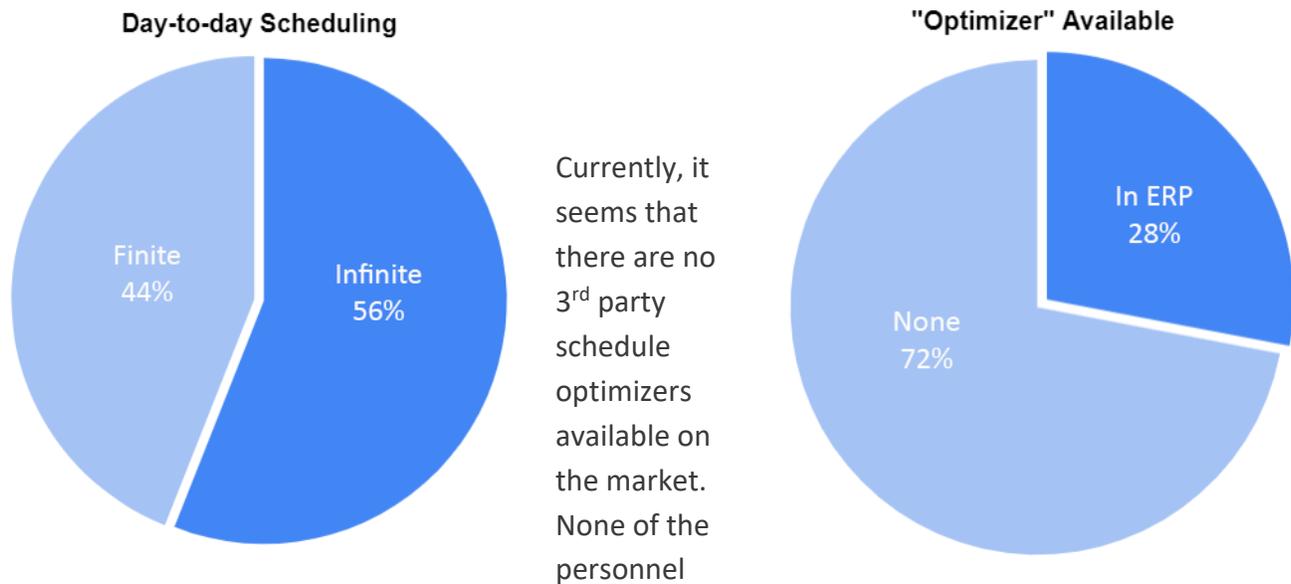
Less than 25% of planning personnel in Aerospace use Finite Capacity Planning in their ERP.

For the most part, the only shops that seem to be able to effectively utilize finite capacity master scheduling are those with small and simple operations.

The consensus among interviewees seems to be that the finite capacity setting in their ERP systems is not reliable enough for aerospace manufacturing.

There were a wide range of responses regarding operations personnel’s confidence in their master schedule as shown above.

In day-to-day scheduling, the usage of finite capacity tools is much higher, but still less than half of operations personnel choose to finite capacity scheduling day-to-day. They tend to use manpower-heavy brute-force scheduling strategies instead. These usually involve tedious production oversight to ensure plans are followed and parts are released on time.

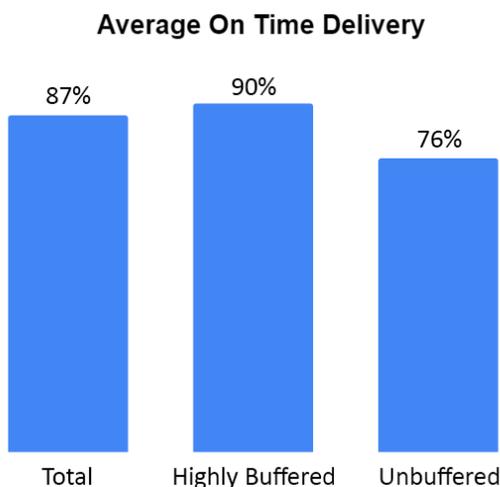


interviewed indicated any knowledge of a 3rd party optimization tool. Certain ERP systems such as Epicor and some Infor options offer a built-in “Optimizer”. Less than one third of those interviewed had access to such a tool, and none had any knowledge of its use. ERP experts confirmed to us that the so called “optimizers” in these systems are not true optimizers.

Unfortunately, even these ERP systems which claim to have “Optimizer” tools do very little to improve upon typical finite scheduling techniques. The ERP industry seems to be distant from the modern operations research, as they have not yet incorporated true optimization software, which is achievable now that efficient computing techniques, faster algorithms and improved data fidelity are possible.

Then, how do some aerospace manufacturers achieve high On-Time Delivery (OTD)?

The simple answer is – they achieve high OTD in the most inefficient manner, by sacrificing cash flow and / or profitability. As would be expected, companies located in the Boeing corridor reported higher OTD, most likely due to Boeing’s proximity and relentless pressure. Does the higher OTD of these companies demonstrate superior manufacturing and planning processes, or rather that they are using other strategies to inflate OTD percentage? We found that over 50% of companies interviewed significantly buffer their quoted lead times to allow extra flexibility for meeting delivery dates. This buffer is frequently greater than 30% of the actual time required to produce the part (given no unexpected delays). Every company which reported OTD above 90% said that they had to buffer their lead times and material in WIP (work-in-process) to maintain these numbers.



A \$350M revenue manufacturer of complex aerospace fabrications confided that they have about 10 people in their staff just reporting their shop floor status to the customers and communicating daily prioritization to the shop. They heavily buffered their material WIP and, as a result, their inventory turns were close to 1.0. This inefficient situation is not unique in the aerospace supply chain.

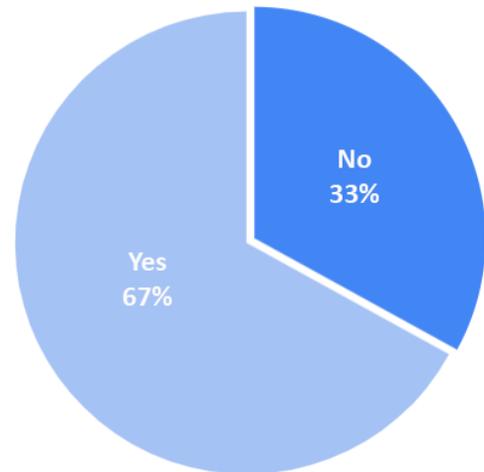
Nearly 60% of manufacturers reported that they generally buffer their lead times & material inventory significantly in order to maintain acceptable On-Time Delivery.

“What if?” scheduling tools are either unavailable or unused when available:

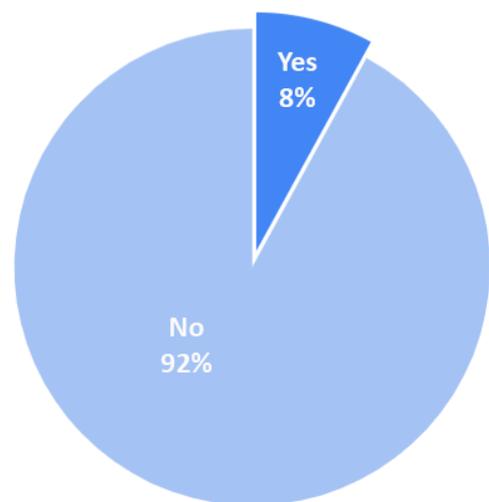
“What if?” scheduling tools are a sub-optimal but inexpensive alternatives to a true optimizer. They allow production planners to run simulations of different production scenarios and constraints. These tools can be extremely useful for navigating production bottlenecks and capacity issues. Nearly 70% of the companies interviewed had ERP systems with built-in “What if?” functionality. However, only a few companies reported using this functionality in day-to-day production planning.

Additionally, most personnel interviewed did not have any experience using this functionality. This phenomenon is related to general distrust in ERP finite schedulers, since “What if?” functionality is only reliable and usable if the system is already capable of generating reliable finite capacity schedules. “What if?” simulations could be a valuable tool in aerospace if schedulers were better suited to complex aerospace workflows.

“What if?” Available in System



“What if?” Scheduling Used



Summary of SME’s Pain Points:

- ERP systems expensive and disruptive to upgrade
- Non intuitive user interface, hours of training, few experts
- Multiple unconnected spreadsheets for data analysis; no ‘single source of truth’
- Poor OTD is common, high OTD comes primarily through brute force (expensive buffers)
- Inefficient use of resources
- Long term planning tools non-existent or not used
- ERP scheduling often diverts from shop reality
- Manufacturers not aware of any software solutions for their pain points

The solution is here - OTD Improvements with OptimizerAero™

- We routinely find double digit (up to 20-point) improvements in % OTD with our Optimizer.
- More complex the factory & BOM and longer the lead times; higher the improvement.
- ERP / MES system agnostic solution – plugs into any data system/s.
- The example below compares achievable OTD from a standard ERP scheduler vs. that using an OptimizerAero™ schedule -



Our suite of productivity tools for aerospace SMEs also includes –

VisualAero™ for factory visualization

CapacityAero™ for capacity management

SIOPAero™ for long term planning.

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