Production engineering | Aerospace and defense | Improved process performance | Systems-Theoretic Accident Model and Processes

Application of System-Theoretic Analysis to Work Movement in Production Systems

BUSINESS PROBLEM

In the aerospace industry, long product lifecycles, life extension programs, and highly specialized manufacturing capabilities combine to produce a challenge for OEMs in providing aftermarket support for fielded products. These factors drive the need for a work movement capability, where production of a product is physically relocated from one facility to another. The dynamics of work movement efforts are especially challenging when external suppliers are involved in support of long-lived defense products.

APPROACH

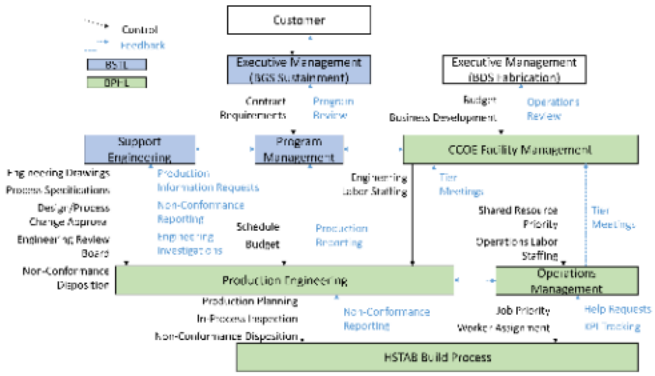
The principal investigation is a CAST (Causal Analysis based on Systems Theory) analysis of the fabrication and assembly of composite aircraft flight control surfaces at Boeing's Ridley Park, PA site, based on internship experience working with the operations and the engineering support teams. Additional background information was obtained through interviews, site visits and document review.

DATA SOURCES

The data gathered for this thesis can be grouped into three categories: interviews, documents, and observation. Due to the structure of the CAST analysis performed as the core of this research, the data-gathering process was necessarily iterative, with new information leading to questions, which then guided the search for further information.

Data Types and Format

26 interviews were conducted with a total of 23 individuals, ranging from 30 to 90 minutes. Documents included technical documents, correspondence, and executive briefing materials.



Author: John Barstow

IMPACT

The long lifecycle of many aerospace products means that aircraft with decades-old design still require support in the form of spare parts, leaving the manufacturer without a viable alternative to absorbing work if a supplier ceases operations. The recommendations generated by the CAST Analysis can be used to inform future decisions on work transfers, and provide a framework for establishing a production control structure when a transfer is required. Unlike more traditional analyses, CAST focuses on the control structure surrounding a production system, i.e. the structural, social, and communication relationships between stakeholders such as mechanics, managers, engineers, and other support personnel. Due to this emphasis on systemic causes of production failures, the recommendations are principally organizational in nature, and provide a effective countermeasure to the cost and schedule overruns and hidden factory effects that have been observed in past work transfers, despite previous efforts to mitigate these effects.

DRIVERS	**The recommendations generated by the CAST analysis are strongly constrained by the business need to provide aftermarket support for fielded aircraft. Coupled with the complexity of defense products and a low production volume, the best solution available is to "do it right the first time" and thus avoid the cost and schedule risks that arise from shortcuts and mistaken assumptions.**
BARRIERS	**Geographic distribution, business unit relationships, and cultural differences all impacted the project significantly. Recommendations addressing these factors were developed in the analysis, but they remain a challenge for a large organization with a distributed international footprint.**
ENABLERS	**The close integration of Boeing and the LGO program was a great asset to the project. The availability of LGO alumni was very helpful in sourcing several interviews that made a significant impact on the project and thesis.**
ACTIONS	**The recommendations generated by the CAST analysis were briefed to leaders within Boeing. Due to the details of the program being analyzed and the nature of the recommendations, their implementation is a long-run prospect that will take time to yield results.**
INNOVATION	**The least intuitive aspect of the results is that OEMs should not expect or even attempt to exert complete control over supplier production processes. Instead, supplier relationships should be managed to maximize visibility, but in the event a work movement is required the OEM must carefully assess and test any assumptions made about supplier processes that were not fully visible.**
IMPROVEMENT	**The recommendations suggested by this project provide a framework for structuring an organization responsible for production restart after a work movement. If they are implemented, future work movement efforts may be able to avoid the creeping cost and schedule impacts that result from the mistaken assumptions uncovered in this project.**
BEST PRACTICES	**The CAST process that generated the recommendations is dependent on a detailed understanding of the system and the entities that operate within it. Any attempt to implement these recommendations as a solution must take into account the specific attributes of the product, process and organization(s) that are involved.**
OTHER APPLICATIONS	**The recommendations generated by this analysis were developed in the context of work movement and defense aerospace support programs, but the broader conclusions about configuration control and process model divergence have application in any production system. Designers and operators of such systems must be incentivized to share information whenever possible in order to avoid the worst effects observed during this project.**