



# Lean Enterprise Solutions

## Lean Applied to the Aerospace Industry

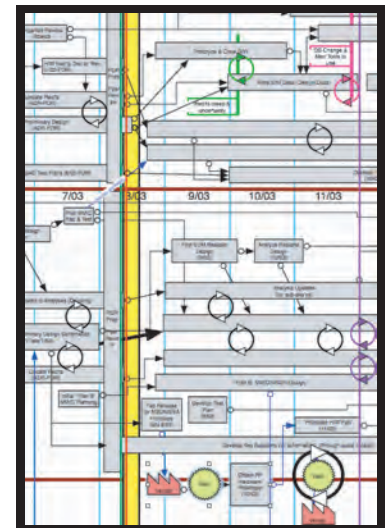
Metis Design has been at the forefront of applying lean business improvement techniques to the U.S. Aerospace Enterprise. Much of this work has been done in collaboration with the MIT Lean Aerospace Initiative (LAI). The unique challenges facing aerospace enterprises require a tailored application of lean principles, and greater focus on product development and integrated enterprise issues. New knowledge generated by the initiative's research has been synthesized by Metis personnel into a set of products useful for deploying lean in commercial and government aerospace organizations, and transforming such organizations into leaner, more efficient entities



Metis training products are in use in the Lean and Six-Sigma training programs at several large aerospace companies. Metis personnel have also planned and facilitated major lean improvement events, in both government and industry organizations, at both the facility and enterprise levels.

## Product Development Value Stream Mapping

MDC is pushing the use of Value Stream Mapping (VSM) beyond its traditional home in manufacturing. In cooperation with the LAI, MDC has created the Product Development Value Stream Mapping (PDVSM) manual and the Lean Enterprise Product Development (LEPD) short course. Based on years of research in lean product development, they translate, adapt, and expand lean concepts to the unique needs of product development processes. The result is the identification and elimination of unique wastes (such as long review cycles and excessive multitasking) and, more importantly, the creation of new value through slashed cycle times, more resources applied to the customers' real problems, and increased process quality.



## Enterprise Value Stream Analysis

MDC is also pushing the state of the art in Enterprise Value Stream Mapping and Analysis (EVSMA) in cooperation with the LAI. Complex enterprises cannot be captured with simple maps; a multi-pronged approach with external and internal assessments; process and organizational mapping; financial, quality, and performance metrics; and the creation of a coherent, aggressive future vision is needed. These allow enterprise-wide improvements to be targeted and prioritized for the achievement of that vision and its associated enterprise goals. Metis gets things started with facilitated events that train enterprise leaders in Lean Enterprise principles, and put these to immediate use in an EVSMA event. The results: efficient use of valuable leadership time, enterprise-wide lean vision, and concrete plans for deploying lean throughout the enterprise.

## Customized Lean Training

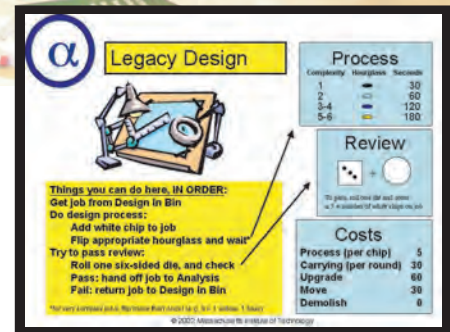
Metis offers lean training customized to the specific needs of a variety of customers. We have found that a one-sized-fits-all approach to lean is not applicable to the aerospace industry, and training with roots in manufacturing and the auto industry can be counterproductive. Metis training is customized to the specific needs and problems of our customers. Product development and enterprise lean are mentioned above; we also customize training for specific program enterprises, including factory, supply change, and engineering groups, focusing on the unique characteristics and needs of the program. The training is made relevant to the participants, which results in greater acceptance of the need for, and desirability of, lean improvements, and quicker transitions from the learning-and-planning stage to actual lean implementation.



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## Modular Training Simulation

The Lean Enterprise Value (LEV) simulation is a unique tool for demonstrating the value, and challenges, of implementing lean principles and practices. It comprises four modular simulations developed on a foundation of insights gained through more than 11 years of intensive research and real-world experience. Participants fabricate parts, process engineering design jobs, assemble, and support a fleet of Lego™ aircraft, to satisfy customer and corporate demands. Each participant is in charge of a facility: an assembly plant, subcontractor fabricating plant, product development department, or service and support depot. A sophisticated economic system allows participants to track their performance and justify their decisions as they progress on their lean enterprise journey. During the course of the simulation, participants learn advanced lessons in applying lean at the enterprise level, quantifying the value of lean improvements, and managing change in a complex, interdependent enterprise.



The LEV simulation has successfully been used in applications such as:

- A 2.5 day Lean Enterprise Value seminar. The full simulation illustrates lean enterprise concepts, and provides a practice field for lean tools (VSM, 5S, Kanban, etc.), change management, the economics of lean, the importance of organization and teamwork, and lean implementation. The simulation is reinforced by exercises and lectures.
- An integrating event of a week-long basic lean course. The manufacturing module and an abbreviated supply chain provide a tactile experience in basic lean concepts to students with limited real-world experience.
- The focal point for a day-long Lean Engineering course. The product development module is used to illustrate the applicability of lean to engineering processes, and practice basic lean tools in an engineering context.
- An active learning environment for a two-week corporate training in Lean and 6-Sigma tools. In addition to teaching intrinsic lean enterprise lessons, the simulation is used as a practice field for basic lean tools, SPC and other quality tools, change planning and justification, formal presentation and approval of change plans, and supply chain design.
- Program improvement events. Customized modules, designed to mimic a program's real features and problems, are created. Mapping and improving the simulation provides realistic opportunities to practice value stream mapping and process change before creating the value stream map for the real program. This avoids the slow start that is typical of high-level VSM events; participants begin real VSM work immediately at the conclusion of the 1.5-2 day simulation experience.
- An example of the above: a "Depot" variant of the manufacturing simulation requires existing aircraft to be torn down and rebuilt in a programmed depot maintenance cycle. In addition to programmed upgrades, random problems are uncovered during this process that require engineering intervention before the aircraft can be reassembled.
- Training and a practice experience in EVSMA before high-level EVSMA events. This application can dramatically "jump-start" the often confusing and frustrating process of EVSMA; it provides participants with a vision of how the process works from the start.
- The focus of the LEPD training. A modified and extended version of the product development module used to create a multi-organization coupled product development enterprise to teach lean applied to PD, organizational design, and coordination across interdependent PD entities.

## Complex Systems Analysis & Tradespace Exploration

Complex modern systems and systems-of-systems must perform multiple tasks, satisfy multiple stakeholders, and operate in constantly shifting economic, political and threat environments. Traditional methods for designing the architecture of such systems, which concentrate on defining "fixed" requirements up front and developing a single "point design" in detail, are inadequate. MDC is working on advanced methods for tradespace analysis that explore a wide space of possible solutions, evaluate them based on analyses of user needs, and present the possibilities for failure risk, program tradeoffs, and possible opportunities for future growth before requirements are set and expensive-to-change decisions have been made. The methods have been used to analyze a number of complex systems in or proposed for development. They have revealed technical and cost risks, poorly-posed requirements, and unanticipated opportunities for superior value - all before even preliminary design has been done! Tradespace analysis is also good a good "front end" for advanced product design techniques such as those practiced at MDC, or lean PD organizations created through MDC training; the combined methods have the potential to slash the total cycle time from perceived user need or technology potential to complete product design.

\*Many of the products mentioned here were created in cooperation with MIT's Lean Aerospace Initiative for the use of member companies; these products are available for member use. In these cases, Metis Design provides training, facilitation, and customization services that enable the application of these often complex tools to your situation.

