Lean Enterprise Value (LEV) Simulation

OVERVIEW

The Lean Enterprise Value (LEV) simulation is a unique tool for demonstrating the value, and challenges, of implementing lean principles and practices at the enterprise level. It currently comprises four modular simulations developed on a foundation of insights gained through more than 11 years of intensive research and Lean Aerospace Initiative consortium real-world experience. It is a complete, flexible simulation of a complex enterprise, which allows hands-on lessons in lean improvement.

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.

A manufacturing table in action

A supplier network table at rest

MULTIPLE LEARNING OPTIONS

The LEV simulation is, intrinsically, a tool for teaching enterprise-level lean thinking. It includes manufacturing, a supplier network, engineering, and service and support areas that must work together to achieve enterprise performance. Even within the individual modules of the simulation, the participants must identify not only how to improve the mechanical aspects of their processes, but also the more complex challenge of how to interact with elements of the enterprise outside their control, on mechanical, financial, and human levels.

The LEV simulation is designed around teaching a few high-level lessons. The details of a simulation-based training experience can be modified to further emphasize these lessons as desired. Examples include (but are not limited to)

- Change management processes
- Economics of lean transformation
- Communication and teamwork during both operations and transformations
- Enterprise Value Stream Mapping and Analysis (EVSMA)

All of these subjects are at least touched on intrinsically in the simulation. This learning can be greatly accentuated by formal teaching and exercises integrated into a training experience.

The LEV simulation has demonstrated that it provides a very effective *practice field* for a variety of lean skills and tools. Addition of formal teaching and exercises, and in some cases minor modifications to the simulation itself, can greatly increase the value of this hands-on practice in areas such as:

5S	Value Stream Mapping	Project accounting
Kanban	Product Development VSM	Paperless business systems
Level Loading	Lean Engineering	Statistical Process Control (SPC)
Takt time	Supplier network design	Other quality tools
Visual control	Just in time delivery	Change planning
Pull	Make/Buy and outsourcing	Knowledge sharing/management

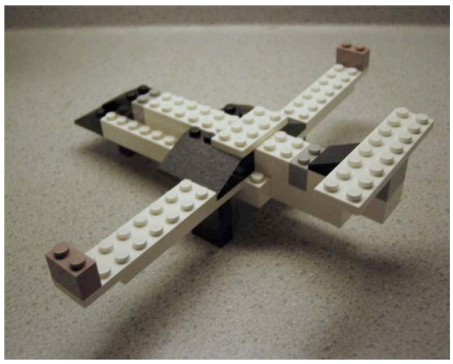
The LEV simulation can be used in a variety of configurations, or "scenarios." These are often selected to achieve the maximum credibility with the target audience: the goal is to have the participants accept that the simulation looks like their daily life. Scenario design choices include:

- Which and how many of the basic modules to include—many enterprise configurations are possible
- Sequence—improvements can start local and then spread through the enterprise
- Product—the default is an aircraft, but other Lego objects can be built, or pre-built objects can be torn down and rebuilt
- Initial state—anywhere from dysfunctional to fairly lean
- Goals—may include increased production, redesigned product, slashed costs, better financial performance, lean on a budget, etc.
- Challenges—may include costs of change, bureaucratic barriers, parts shortages, shifting customer needs, resource shortages…

APPLICATIONS

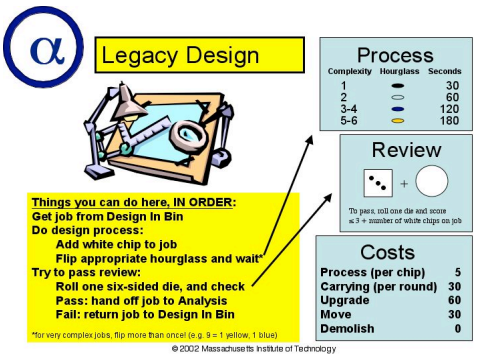
Based on these design options, the LEV simulation has successfully been used in the following applications:

- The manufacturing module and an abbreviated supply chain are used as the focal point of a week-long basic lean course. It provides a tactile experience in basic lean concepts to students with limited applied lean experience. Phased improvements are facilitated, with the goal of increased production and a return to financial health for a failing organization. VSM exercises along with basic tools such as 5S are used in the improvements.
- The product development module is used as the focal point for a day-long Lean Engineering course. The simulation is used to illustrate the applicability of lean to engineering processes, and practice basic lean tools in an engineering context.
- The full enterprise simulation is used, reinforced by exercises and lectures, as part of a 2.5 day Lean Enterprise Value seminar. The focus is on lean enterprise concepts and on the big lessons of change management, economics of lean, teamwork, and enterprise-level VSM. Basic lean tools (5S, Kanban, etc.) are also taught and used.
- The full enterprise simulation is used in 2-3 day corporate training. The focus is similar to LEV short course, but with additional emphasis on enterprise level goals and choices. Through constraints on resources and time, the needs of OEM and support organizations must be weighted and prioritized at an enterprise level.
- The full enterprise simulation is used to provide an active learning environment for a two-week corporate training in Lean and 6-Sigma tools. In addition to intrinsic enterprise lessons, the simulation is used as a practice field for basic lean tools, SPC and other quality tools, change planning and justification on ROIC grounds, formal presentation and approval of change plans, and supply chain design.
- 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, problems uncovered during incoming inspection and tear-down require engineering intervention before the aircraft can be reassembled.
- Appropriate modules are used as part of program enterprise improvement events. The simulation is customized to closely resemble both the product created and the challenges faced by the participants in the actual program. Mapping and improving the simulation provides two realistic opportunities to practice value stream mapping and process change (once local, and once enterprise-wide) before creating the enterprise value stream map for the real program enterprise. This avoids the slow start that is typical of high-level VSM events; participants begin real VSM work at the conclusion of the 1.5-2 day simulation experience.
- The full enterprise simulation is used as a practice field for learning and using the EVSMA process and methods. This is similar to program enterprise improvement efforts in that it accelerates the enterprise teams' understanding of the enterprise and how to apply the EVSMA methods and tools in a manageable setting before proceeding with the EVSMA of their own enterprise.



USING THE LEV SIMULATION

The LEV simulation and associated training materials were developed by the LAI consortium for use by its members. Their principal designers are Dr. Hugh McManus and Dr. Eric Rebentisch. LAI consortium members may adopt the simulation and training for their own use in training and improvement activities or may participate in short courses offered by LAI on a periodic basis (see http://lean.mit.edu for details about the next short course offering.)



The LEV simulation is currently in version 2.0. Adoption of the LEV Simulation requires development of local facilitation expertise. LAI has developed a certification program for facilitators which has been used successfully at several large aerospace enterprises. The designers train local facilitators on the use of the LEV simulation. Often, this includes modifications to the simulation to meet the adopter's particular learning objectives. Typically, it takes three levels of involvement for first-time facilitators to become effective LEV simulation facilitators themselves: first, experiencing the LEV simulation; second, facilitating a portion or portions of it; and third, facilitating the entire LEV simulation with mentoring.

For more information about adopting and using the LEV simulation, contact Hugh McManus (hmcmanus@metisdesign.com) or Eric Rebentisch (erebenti@mit.edu) or see http://lean.mit.edu.