Operations Management Education Review 15: 117-150.

Lead-Time Manager: Design, Implementation and Use Cases of an Operations Management Simulation Game

Jordi Weiss
University of Lausanne, Switzerland

Abstract. Recent research in Operations Management has shown that local manufacturing can be competitive against offshoring when lead-time's impact on supply and demand mismatch is correctly valued. However, these research outputs are counterintuitive, and it is challenging to change the deeply rooted and myopic focus on unit costs minimization of students and practitioners alike. This article presents the Lead-Time Manager, a simulation-game developed at the University of Lausanne to leverage the teaching and communication benefits of this booming type of active learning tools, and help transmit research insights. The paper describes the features of the simulation-game, its different use cases, target audiences, expected learning benefits and its integration in our Operations Management course. As the tool is freely available, we also provide a template to help any interested faculty member integrate it into their own courses.

Keywords: serious games, simulation games, learning sciences, lead-time.

1. Introduction to the Lead-Time Manager

This chapter defines the context around the Lead-Time Manager. The first part provides a brief introduction of the simulation-game setting, the second part exposes its pedagogical purpose, and the third part describes its different use cases in terms of context and target audiences.

1.1. Description

In recent years, there is increasing awareness of how manufacturing can benefit local economy, but managers remain hesitant to take the leap to reshoring production. To bridge the gap between research outcomes that demonstrate the potential for local production competitivity, and people's perception, we created a software-based simulation-game called the Lead-

Time Manager. The player – student, manager, policymaker, or anyone with an interest in the topic – is faced with a strategic choice between local production and offshoring, and will experience the consequences of this decision, put to the test of demand risk and supply-chain uncertainties. The aim is to transmit research insights that show how local manufacturing can be competitive, in a way that gives meaning and real-life relevance to the theoretical content we teach, so that participants feel empowered to apply it.

The player takes the role of the top operations manager of a skiwear shop in the mountains of Europe that sells two kinds of products. The Fashion ski jacket has a comfortable financial margin, but a volatile demand, and overstocked products cannot be stored. The Standard ski jacket has a considerably smaller financial margin, but also a more stable demand, and potential overstock can be stored, at a reasonable cost, to be sold the following year at full price: the residual value of the standard jacket is the acquisition cost less the holding cost. The rationale behind these storage rules is that Fashion jackets belong to a collection specific to the current sales period, will be out of fashion next season and will need to make room for the new collection, while Standard jackets are basic – plain black or white – items that do not follow fashion cycles.

The main goal is to maximize the company's profit. To reach this goal, the player controls sourcing and production decisions, for a predefined number of in-game years, and must choose between ordering the jackets from a low-cost offshore supplier or building local capacity to produce on-site and on-demand, at a cost premium. The player is given full information about the selling price and the costs of each product for each sourcing option – local or offshore – as well as limited statistical data about the demand for each product: its mean and median. Without knowing the demand for the current year, the player is prompted to make three decisions: the offshore order quantity for Fashion jackets, the offshore order quantity for Standard jackets, and the local capacity to build. Then, the demand for the current year is revealed, and the player is prompted to make two more decisions: the local production of Fashion jackets, and the local production of Standard jackets, the sum of which is limited by the local capacity previously chosen.

Ordering offshore decreases unit costs but exposes to discrepancies between supply and demand – mismatch – that arise from demand uncertainty. Producing locally increases unit costs but allows to delay production until after demand is known. The main fighting issue, assuming the player wants to maximize profit, is the tradeoff between minimizing unit costs and minimizing mismatch costs. The game's mechanics and its interface will be discussed in-depth in Section 3.

1.2. Purpose

At the Undergraduate level, the pedagogical point is to familiarize students with demand volatility, production optimization under uncertain demand, and the value of minimizing mismatch costs via decision lead-time reduction. At the Master level, we want students to build a sustainable operations strategy by creating a portfolio of products with different volatility and leverage responsiveness.

A usual gap – and common student concern – in university learning process is a lack of application, hands-on experience, which in the sense of the Experiential Learning theory, makes it incomplete. University knowledge sometimes feels like lyophilized food, waiting for the water of professional experience. Simulation-games provide students with some experience, some edible food, instead of just loading them with powder. Through both levels, our course learning objectives, from the most basic to the most high-level, can be described as follows:

- Give students a solid theoretical background on demand randomness, Newsvendor model, Fill rate and the link between Lead-time and Mismatch costs, and make sure, as we tell them, that: "If we wake you up by surprise at 4AM, you are able to do the calculations as a reflex."

- Add meaning to the course content: have students experience how the theoretical content of the course is a toolbox for real data analysis and decision making.

- Prepare students technically and mentally: make them capable and make them feel capable to apply university knowledge in an internship or employment.

- Have an impact on students overall organizational thinking, give them a transformational learning opportunity that goes beyond loading them with knowledge and onto inspiring them to use this important knowledge to change the world, one lead-time reduction at a time.

Switching from a classic ex-cathedra course format to a participative format articulated around the Lead-Time Manager has helped us achieve more of these objectives in the past years, as confirmed by the positive students' feedback presented in the Appendix.

As one of the main learning benefits we expect from the simulation-game is the development of practical job skills and knowledge that will be relevant

for students during their internship and future jobs, we have also been attentive to feedback from operations management practitioners, and we want to share two comments that capture the purpose of the Lead-Time Manager.

Two guest speakers in our course, working as demand forecasters in fast-moving consumer goods companies – one focused on toiletries, the other on alimentation – were positive that our simulation-game captures the core dilemma of their job in balancing unit costs minimization with risks driven by lead-time increase. Interestingly, they both initially expressed concerns that the simulation-game was oversimplified and lacked elements of complexity that represent a large part of their work, such as communication issues and market monitoring. However, after attending the class session and seeing students play the simulation-game, they grew convinced that many of their daily hurdles fundamentally arise from supply-chain over-complexification that comes as a consequence of offshoring to pursue the myopic hunt for lowest unit costs, and that the data we present is accurate and helpful in exposing the problem in a meaningful way.

Another professional, with decades of experience in airport services, approached us at the occasion of an Executive Education course. She had been trying for years to change the mindset in her company from obsessive forecasting of demand – on which they spent a lot of money, but obtained disappointing results – to capacity management, and praised our simulation-game for its ability to help change the thinking frame in that direction.

1.3. Usage

We started using the Lead-Time Manager as a teaching tool. First, it was an experimental accessory, and as it improved through iterations, we developed accompanying content and activities, and made it more central to the teaching plan. The basic idea behind our courses is that students receive theoretical content as a toolbox to reduce lead-time and solve real-life mismatch issues. We use the Lead-Time Manager simulation-game as the link between theory and practice, and before the theory comes as a solution-inducing tool, we want the students to feel the true struggle of the problem and start a trial and error type of exploration.

At both Undergraduate and Masters levels, we start by making a basic version of the game available to students before teaching the material in class. In the spirit of the Experiential Learning theory (Kolb 2014), we let students discover by themselves, giving them sufficient time to learn the ropes of the simulation-game; trial and error is at the heart of the learning experience with this kind of tool. In the following weeks, students learn the relevant theory, and are encouraged to play the simulation-game in teams to come up with more sophisticated solutions. Surprising events are added to the game, which, we