POMS PRODUCTION AND OPERATIONS MANAGEMENT

Laudatio for Larry Wein

Lawrence M. Wein, known to all as Larry, is by any measure one of the foremost scholars in production and operations management. He has contributed to both theory and applications, and has been widely recognized for both. Larry has brought the operations mindset and attendant methods to bear on numerous problems that others would not recognize as operational. More importantly, his work has had tremendous impact upon many of the most pressing issues of the day. Larry is one of the very few researchers in our field who has testified before congressional committees on numerous occasions, and has had his research viewpoint adopted to the point where government-sponsored meetings are given over to discussing the consequences and extensions of "the Wein model." Larry has also served an invaluable role in educating the public by bringing his research to the masses via Op Ed pieces in major media (including seven in the *New York Times* alone!). So let's review Larry's illustrious career with an eye towards connecting the dots that have made him so influential while celebrating his accomplishments.

Larry's adventures in operations began as an undergraduate student in operations research and industrial engineering at Cornell, where he received his bachelor's degree in 1979. Bitten by the operations bug, Larry continued to graduate study at Stanford where he received two masters degrees – in operations research in 1980, and statistics in 1985, before completing his operations research PhD in 1988 under the guidance of Mike Harrison. Along the way, Larry gained industry experience by working at Bell Labs from June 1979 through May 1981, and as an operations analyst at W. R. Grace and Company from May 1981 through the end of 1982.

Larry's PhD thesis was about scheduling a two-station multiclass queueing network, and resulted in his most-cited paper, Scheduling Semiconductor Wafer Fabrication (*IEEE Transactions on Semiconductor Manufacturing*, 1987), which led to widespread use of his workload regulating release policy within the semiconductor industry, in addition to a flurry of related articles in *Operations Research*, *Mathematics of Operations Research*, *Management Science*, and *Queueing Systems*. These early articles illustrate traits which Larry would exhibit throughout his career: careful problem formulation, elegant and incisive mathematical analysis, and clever approximations meant to pull key features/relationships out of otherwise more complicated models.

Larry joined the faculty of the Sloan School of Management at MIT as an assistant professor in January of 1988. He spent the next 14 years at MIT where he established himself as a star in the operations realm, rising through the ranks to tenure in 1993, full professor in 1994, and the Digital Equipment Corporation Leaders for Manufacturing Professor in 1997. While at MIT, Larry continued to extend his queueing analyses of manufacturing systems, with scheduling and screening important areas of concern. However, in the mid 1990's, Larry began his forays into non-standard applications of operations management. Initially he focused on problems in public health and medicine. Working with his doctoral students, he developed contributions to HIV prevention and treatment with papers on pooled testing for HIV screening, and dynamic management of antiretroviral therapy for HIV. He next tackled problems in kidney allocation systems, in cancer therapy where he modeled the optimal sequencing of surgery, radiation treatment and chemotherapy among other applications, and in Alzheimer's disease.

In 2002, after a sabbatical in New Zealand, Larry joined the faculty of the Stanford Graduate School of Business as a full professor. The following year he was awarded the Paul E. Holden chair in Management Science there, and in 2010 he became the Jeffrey S. Skoll Professor of Management Science at Stanford. The year 2002 also saw the results of the first of a series of projects in the broad area of homeland security that firmly established Larry as *the* expert in this important operations domain. Following the terror attacks of 9/11/2001, Larry worked with his MIT student David Craft and Yale's Ed Kaplan to develop models for evaluating alternative responses to smallpox and anthrax attacks. These first-of-their-kind analyses modeled the logistics of emergency response operations to bioterror attacks, and in doing so embedded common operations frameworks such as queueing and inventory analysis into epidemiological disease propagation models. Both of these analyses were published in the *Proceedings of the National Academy of Sciences*, and rank among Larry's most cited papers. But more important than publication in a prestigious journal was the impact these studies had on US government response planning for smallpox and anthrax outbreaks.

Larry continued working on homeland security problems such as how to remediate contaminated buildings in the aftermath of an anthrax attack; how to protect the nation's milk supply against an attack with botulinum toxin (an exercise that required detailing the entire milk supply chain from cows to customers); border protection issues such as

optimizing fingerprinting within the US Visit Program to improve its ability to detect terrorists, and optimizing the protection of the US-Mexico border; preventing catastrophic chemical attacks; optimal deployment of radiation monitors to detect and interdict nuclear terrorists, both in cities and in ports; and evaluating evacuation versus shelter-in-place in the event of a nuclear attack. Not content with simply studying these problems and writing up his results in a plethora of journal articles, Larry learned the Washington ropes, and consequently was called upon by government agencies and congress to discuss and in some cases act upon his recommendations.

More recently, Larry has focused his energy on a series of seemingly unrelated high-impact public sector problems such as optimal strategies for blood transfusion, assessing the long-term risks of space debris, predicting the prevalence of PTSD among veterans, food security and the optimal allocation of food supplements to save lives, childhood screening for obesity, ballistic imaging to help solve crimes, biometric policies for societal inclusion applied to India's national identification system, assessing pre-trial release and split-sentencing, and optimal screening and management of a stool bank for use in preventing certain diseases. Furthermore, Larry has involved his graduate students in all of these projects, many of whom are now professors at leading universities.

While the many topics Larry has studied testify to his tremendous breadth of interest and ability to learn, there are common links across these projects in problem identification, formulation, execution and implementation. Larry first focuses on problems that are recognized by (typically) government decision-makers as very important. He puts an enormous amount of energy into understanding the operations of whatever system is involved, and with that understanding is able to characterize whatever present policies are in place, be they for food allocation, blood transfusion, matching fingerprints, or vaccination. Via a data-informed model of these operations, he is then able to deduce and evaluate alternative policies that improve system performance, and surface trade-offs among the critical components of the problem. Often he resorts to clever mathematical approximations that, while less accurate numerically, highlight the most important issues. He then publishes his results in both highly technical forms to exhibit the analysis itself, and more widely-read Op Ed or other articles that reference the technical work to make his arguments. No scholar in our field has done more to see his analyses through from formulation to implementation than Larry Wein.

It should therefore come as no surprise that Larry has been widely recognized as a leader in the field of production and operations management. He was elected to the National Academy of Engineering in 2009, named a fellow of the Institute for Operations Research and Management Sciences (INFORMS) in 2005, and was inducted into the Omega Rho honor society (2012). Larry has received many of the top awards in his field including the Lanchester Prize (2008), INFORMS President's Award (2007), INFORMS Expository Writing Award (2005), Koopman Prize for Military Operations Research (2002), Philip McCord Morse Lectureship (2007), and the Kimball Medal (2010).

Finally, Larry shows no signs of slowing down. He understands operations in such a deep manner that he is able to see the operational components in almost anything. Larry will continue to inspire students of production and operations management for many years to come.