A Summary of Speaking Topics, Asia 2008

Japan, China, Taiwan, Korea

Edmund W. Schuster

Field Intelligence Lab & Data Center Program
Laboratory for Manufacturing and Productivity
Massachusetts Institute of Technology

Edmund_w@mit.edu
www.ed-w.info

Japan, China, Korea, Taiwan (3 hours)

General Topic Area: Manufacturing Systems

The Open System for Master Production Scheduling (OSMPS):

Information Technology for Semantic Connections between Data and Mathematical Models

based on the Modified Dixon-Silver Heuristic

powered by the M Language developed at MIT

Overview

OSMPS is a research program at the MIT Data Center with the goal of offering sophisticated modeling capabilities for manufacturing systems. Specifically, the M Language in conjunction with other web standards enable the Modified Dixon-Silver Heuristic (MODS), developed by Stuart Allen and Ed Schuster, to be delivered to users with a new method called Software as a Service (SaaS). This approach allows anyone access to the MODS algorithm located on a remote server using only a Microsoft Excel spreadsheet. There is no implementation of MODS on local computing systems and access is immediate. Essentially, the algorithm serves as a calculator and does not store any data from the spreadsheet on the server.

This technique fulfills one of the original goals of the MIT Data Center Program, established in 2003, to standardize and speed the process of applying mathematical models in practice using the Internet. The M Language dictionary provides machine-understandable semantics for describing data fields that are inputs to MODS. In this way, there can be no misunderstanding regarding the type of data needed to run the model or the meaning of various calculations required for input data. The M Language is also the standard for XML data transfers between the spreadsheet and the algorithm or any other target. This makes the data interoperable. Overall, the SaaS approach, combined with the M Language, quickly puts state-of-the-art modeling in the hands of many users with no local computer implementation other than downloading an Excel spreadsheet.

The MODS model is a powerful way to calculate a master production schedule for situations relating to make-to-stock manufacturing, commonly experienced in the food, consumer goods, and repetitive manufacturing industries. Tested for over ten years, MODS consistently finds feasible solutions involving the trade-off between choice of products to

produce and capacity, inventory carrying cost, set-up cost, and set-up time. Solve times for large planning problems involving 50 products and 52 weeks are less than ten seconds. MODS is robust enough to become the standard for make-to-stock manufacturing worldwide. One of the goals is to give small and medium sized companies access to sophisticated models. Large companies will also benefit from OSMPS. The reach of OSMPS is international with a particular emphasis on manufacturing in Asia.

In addition to models for manufacturing systems, the technology can enable other types of models to be delivered in such industries as agriculture, defense, and finance.

Getting Started

To download the spreadsheet and connect to MODS, click on the following link (we recommend that you save the file to disk, and then re-open to execute MODS):

http://web.mit.edu/lmp/news/news_03_07_08.html

Please note that this is Alpha software and there might be a few adjustments needed to operate the model.

Publications

Schuster, Edmund W., Hyoung-Gon Lee, Stuart J. Allen, Pinaki Kar, and Ping Wang, **"The Open System for Master Production Scheduling: Information Technology for Semantic Connections between Data and Mathematical Models,"** under review for the *Supply Chain Management Educators' Conference:* Denver, CO (October 2008).

http://www.ed-w.info/SCMEC2008V7%20_2_.pdf

Schuster, E.W., C. Unahabhokha, and S.J. Allen, **"Master production schedule stability under conditions of finite capacity,"** Paper accepted for the poster session of *The Proceedings of the 34th Annual Logistics Educators Conference*: San Diego, CA (2005).

http://www.ed-w.info/LEC20054-14-05R1.pdf

Schuster, E.W., H.G. Lee, and Stuart J. Allen, **"The Open System for Master Production Scheduling: Information Technology for Semantic Connections Between Data and Mathematical models,"** *Seminar1*: Boston (April 29, 2008).

http://www.ed-w.info/Seminar12008Schuster(2).pdf

Japan, China, Korea, Taiwan (30 minutes)

General Topic Area: Interdisciplinary Engineering, Spatial Analysis

Introduction to the MIT Field Intelligence Laboratory (FIL)

Under the leadership of Prof. Sanjay Sarma of the Laboratory for Manufacturing and Productivity and the Dept. of Mechanical Engineering, the MIT Field Intelligence Lab focuses on four areas, agricultural system productivity, environmental sampling, the megalopolis program, and marketing spatial diffusion. The common thread involves various aspects of spatial analysis.

With the population of the Earth projected to double in the next 30 years, the agricultural systems productivity program of FIL concentrates on food production, water, energy, data, and mathematical modeling. Understanding the relationships between these areas is very important to the future of the world in terms of innovation and sustainability.
Other areas of concentration for FIL include Drop Sensing, a new approach to sensor networks; the Megalopolis Program, which examines increasing population densities in Asia along with land use; and marketing spatial diffusion for consumer products in advanced economies.

In total, there are 8 faculty, research staff, and graduate students associated with FIL. For more information about FIL please see the following report that examines in detail the area of agriculture systems productivity and the contribution MIT can make in terms of data, computer science, engineering, and mathematical modeling.

Publications

The MIT Field Intelligence Lab by E.W. Schuster

http://www.ed-w.info/AgriculturePlan_11-05-07_.pdf

Schuster, E.W., **"Data Sensing: The Path to Precision Agriculture,"** E-Mail Advisor *(June 2007).* Published by the Cutter Consortium: Arlington, MA).

http://www.ed-w.info/CutterE-advisorSpecialtyCropsAgricultureFINAL.pdf

Schuster, E.W., **"EPCglobal Network and RFID: Harvesting the Possibilities,"** E-Mail Advisor (May 2007). (Published by the Cutter Consortium: Arlington, MA).

http://www.ed-w.info/CutterE-advisorAgriculture.pdf

Japan, China, Korea, Taiwan

General Topic Area: Engineering, Systems, Sensing

Drop Sensing

Principal Investigator - Prof. Sanjay Sarma; Edmund W. Schuster assisting

Research Definition: The initial applications of sensors in agriculture commonly involve two deployment approaches 1) fixed where the sensor is mounted in the field and 2) moving where the sensor is attached to a piece of farm machinery such as a harvester. However, a third approach exists where sensors are dropped into areas of interest. This method is a way to optimize the deployment of sensors. To determine drop locations, remote sensing of various types serves an important role in narrowing down the area of interest. Once in place, the sensors can provide detailed information including real-time observations.

Immediate Outcome: This research is in an initial phase with several theses completed. The short-term goal is to apply the technology for an aspect of agricultural sensing with the expectation of understanding the range of uses for this type of technology. A near term objective might be to use dropped sensors to measure pollen concentration at critical times during the development of corn or other crops. In addition, there are plans to use drop sensing for ecological issues such as environmental pollution, chemical spills, or monitoring water quality.

Eventual Outcome: A methodology for deploying sensors in the most economical manner and a firm understanding of the uses of data obtained from the sensor. Data might be used to assess vegetable or fruit quality in the field, “hot spots” of pest or microbiological activity, or conditions of maturity in preparation for the harvest. The identification of hot spots is essential to combating outbreaks of citrus canker and greening, and other diseases that might infect US crops in the field like soybean leaf rust.

From an ecological standpoint, drop sensing will be a low cost way to gather data across large areas for the purpose of environmental decision-making, planning, and regulation. We anticipate that the approach used to develop the EPCglobal Network will also apply to developing the technology for drop sensing. Besides the technology, approaches are needed to determine the optimal deployment of sensors in a network and new ways of data management to form a big picture of what is happening over large spaces.

Long-term, there are three areas of research:

a. Development of an environmentally friendly sensor that has the required functionality and can be dropped into place using various means such as unmanned aircraft. Such a sensor could analyze crop quality. the concentration of pests or environmental quality.

b. Develop a method to identify “hot spots” using sampling theory and a threshold approach where deployment of sensors takes place after reaching some threshold. This also involves the resolution needed for sensing.

c. Visualization of the data gathered by the sensor involving Google maps.

Japan, China, Korea, Taiwan

General Topic Area: Business, Spatial Analysis, Planning, Urban Studies

The Asian Megalopolis

Given the dramatic impact the city has had on American and European society, the world economy is on the verge of an even greater development in urbanization. Advances in information technology and globalization of the supply chain have created three massive Megalopolises in China. These in turn will create altogether new opportunities for the information technology needed by public administrators and those in business who must run the city. This is also true for other Asian cities.

During the past twenty-five years, China has achieved an average annual GDP growth rate of over 9%, and has become a leading world economic power. China's continued high-speed growth has been led by megalopolises that have begun to form in three regions: Pearl River Delta (including Hong Kong, Macau, and Guangdong province), Yangtze Delta (including Shanghai, Jiangsu, Zhejiang), and Beijing-Tianjin-Hebei region (Beijing, Tianjin, and Hebei province). In 2005, domestic share of the three major megalopolises accounted for 42.4% in GDP and 77% in export value.

Changes in Chinese urbanization policy now support the continued formation of the three megalopolises. This means that twenty to thirty years of continued economic growth will cause the Hong Kong, Shanghai, and Beijing areas to become population centers that could reach as many as 200 - 300 million people each, The current precedent for high population metropolitan areas is Tokyo with 30 million inhabitants located in 23 districts. Given much greater land resources, metropolitan areas in the US seldom surpass 10 million people.

Beyond total metropolitan population, the projected densities that China will experience offer an additional perspective on emerging business opportunities. With massive population shifts occurring as nearly 20 million workers per year move from rural areas to megalopolises, the densities of the three major Chinese cities are rising rapidly. The population shift, unprecedented in world history, is the result of Chinese workers seeking higher paying manufacturing and construction jobs. At current growth rates, population densities double or triple of Tokyo exist in isolated locations and will likely be widespread in the Chinese Megalopolises of the future. This means up to 38,000 people might live per square kilometer of land.

Issues such as controlling land use, the application of information technology to operate the megalopolis, developing transport and other infrastructure, preserving water resources and energy, environment conservation, and the role of agriculture outside of major population centers will play an important future role in the lives of Chinese people and the world

economy. For this reason, megalopolis policies are an extremely important topic that presents a unique opportunity for multi-disciplinary research in addition to opportunities for businesses involved in information technology.

In summary, the two most important issues relating to the megalopolis are 1) the various constraints that could limit urban growth or actually be harmful to inhabitants, such as the prospect of hyper-epidemics involving highly contagious diseases like SARS and 2) existing and future computer and other technologies that will enable huge population centers to function efficiently.

Of all developed countries, Japan has the most experience in dealing with the megalopolis. However, with urban areas projected to reach several hundred million people in China, it is safe to assume that innovations must happen to avoid complete economic collapse that often occurs during periods of rapid growth and population concentration.

This presentation will focus on innovations that must happen to have livable and efficient cities of the future in Asia.

Publications

Schuster, E.W., **"The Asian Megalopolis: Opportunities for Information Technology Growth (Part II),"** E-Mail Advisor (forthcoming). (Published by the Cutter Consortium: Arlington, MA).

http://www.ed-w.info/Cutter-TheAsianMegalopolisV2.pdf

Schuster, E.W., **"The Asian Megalopolis: Opportunities for Information Technology Growth,"** E-Mail Advisor *(forthcoming).* (Published by the Cutter Consortium: Arlington, MA).

http://www.ed-w.info/CutterE-AdvisorMegaII_R_.pdf

Book Prospectus

http://www.ed-w.info/MuzhiBook.pdf

Taiwan (Other Countries as Appropriate, 1 hour)

General Topic Area: Supply Chain Management, Risk Pooling, M Language, Interoperable Data

The Asian Inventory Hub

When traveling in Asia, it becomes clear that many of the smaller countries in the region have highly specialized economies. If anything, the degree of specialization within Asia appears to be increasing, fueled by the impressive economic growth for nearly all nations in the region. Sometimes called the "Swiss Model," many small countries have directed the majority of public funds and development efforts toward several promising industries, as has been the case in Switzerland (banking and pharmaceutical). This policy provides the best chance to maximize wealth for citizens.

Because of the level of specialization within Asian economies, business relations take a much different path as compared to common practice within the United States. For example, Taiwan has emerged as a center for contract manufacturing. In total, five producers supply a steady stream of notebook computers to the rest of the world. It is often the case that several Taiwanese producers supply a single company such as Dell, and use the same parts for assembly such as power sources or circuit boards. Going a step further, essentially all of the contract manufacturers in Taiwan source from the identical set of suppliers located in China. This presents an interesting opportunity for collaboration between competing Taiwanese contract manufacturers and a chance to apply some innovative information technology approaches.

Representing an important aspect of supply chain management, the idea of risk pooling has been a topic of study for many years. Made famous by Prof. David Simchi-Levi in his book *Designing and Managing the Supply Chain* (2000 – 1st edition), and as part of public lectures addressed to industry, risk pooling is an effective way to reduce safety stock and increase customer service.

The concept is simple; a centralized approach for holding inventory decreases the need for safety stock. In the case of Taiwanese contract manufacturers, each currently places an order to the same supplier for the identical component. Given that orders depend on a forecast generated independently by each contract manufacturer, and that forecast error always exists, the variances between forecast and actual are additive. This means the supplier will experience a great deal of uncertainty concerning the level of production needed to satisfy future demand.

However, by pooling inventory of identical parts at a single location for all suppliers, the variance is much less, and a greater chance exists that demand can be satisfied with reduced safety stock. This is because forecast errors from different contract manufacturers

tend to offset each other when pooled. Demand for the identical circuit board might be over the forecast for a specific contract manufacturer, while a different contract manufacturer might undersell the same component. Aggregation of inventory is nearly always better when considering the investment in safety stock and the level of customer service (percentage of time in stock).

The trade-off is that centralized inventory means increased transportation cost and longer response time. However, for smaller countries, these impacts are minimal. In the computer manufacturing industry, the cost of the product is high and life cycles short. Centralized inventory has many benefits in reducing the amount of obsolescence that overshadow increases in transportation cost.

In the case of Taiwan, a single location, or inventory hub, would exist in the country where all five of the contract manufacturers share the inventory of identical components originating from China. Establishing this form of inventory management organization is possible through industry and governmental cooperation that is unique as compared to the United States, where price signals are often the primary mechanism to manage inventory between suppliers and manufacturers. For example, to reduce the risk of obsolete inventory, Intel has historically cut the price of existing microprocessors as part of a transition to a new product.

To enable a risk pooling system for Taiwanese notebook manufacturers requires the proper analytical approaches along with a means of achieving computer-to-computer communication between suppliers and contract manufacturers. This presentation will examine the research and application needed to make inventory hubs a reality in the Taiwan contract manufacturing industry.

Publication

Schuster, E.W., **"The Inventory Hub,"** E-Mail Advisor *(forthcoming).* (Published by the Cutter Consortium: Arlington, MA)

http://www.ed-w.info/Cutter-TheInventoryHub.pdf

Japan, China, Korea, Taiwan (4 hours)

General Topic Area: Computer Science and Information Technology

The Data-Driven Economy

Fundamentals of the M Language for Practitioners and Programmers

Formal research on building an interoperable data and modeling network began in March 2003. By the fall of the same year, a comprehensive framework for the M Language was put forth in a paper that became the base for another paper submitted to the 2004 Educators Conference sponsored by the Council of Supply Chain Management Professionals. This work won the Plowman Award given each year for best paper. In December 2004, SmartWorld was sponsored by the MIT Industrial Liaison Program to discuss the M Language. Several hundred people attended the event.

Since 2004, the M Language has undergone a number of different iterations. In February 2008, a prototype version of M was released (mlanguage.mit.edu). The web site includes the dictionary, web services links to the dictionary, examples of web machines along with several applications.

Though the M Language web site is not a beta version, it does represent an effort to demonstrate the ideas associated with interoperable data and modeling networks. Programmers can use the web site in various ways by attaching via web services. Of particular interest is the M Dictionary that currently has about 210,000 English words along with semantic relationships.

Most of the applications of the M Language have been in various U.S. Government agencies. This presentation will highlight current and future applications of the M Language. Most of the talk will be technical in nature and deal with the following specific topics.

1. Interoperable Data and the M Converter Factory
2. Geospatial
3. Natural Language Processing
4. Finding weak associations in text
5. Internet Search
6. Interoperable Modeling

It is inevitable that the next generation of the Internet will involve improved connections between data and mathematical models, and a robust treatment of semantics in machine-understandable way. The M Language forms the base for these connections.

Recent Publications

Brock,D.L., R.A. Bryant, B. Jacokes, H-G Lee, A.J. Lisy, P. P. Nichols, H.S.Paskov, E. W. Schuster, **"An Update for the M Language,"** *The MIT Data Center*, Cambridge, MA: MIT-DATACENTER-WH-11 (November 2007).

http://www.ed-w.info/MIT-DATACENTER-WH-011_v3_.pdf

Lee, H-G and E.W. Schuster, **"MRP as a Service: An Alternative Way to Execute Models for Business Processes."** E-Mail Advisor (forthcoming). (Published by the Cutter Consortium: Arlington, MA).

http://www.ed-w.info/MRP%20as%20a%20Service-v6.pdf

Schuster, E.W., **"News and Semantic Technologies,"** E-Mail Advisor *(forthcoming),* (Published by the Cutter Consortium: Arlington, MA).

http://www.ed-w.info/Cutter-NewsandSemanticTechnologies.pdf

Brock, D.L., Schuster, E.W., and Thumrattranapruk, C., **"Multi-Lingual Display of Business Documents,"** *The MIT Data Center*, Cambridge, MA: MIT-DATACENTER-WH-10 (May 2006).

http://www.ed-w.info/MIT-DATACENTER-WH-010.pdf

Brock, D.L., Schuster, E.W., and Kutz, Sr., T.J., **"An Overview of the M Language,"** *The MIT Data Center*, Cambridge, MA: MIT-DATACENTER-WH-09 (January 2006).

http://www.ed-w.info/MIT-DATACENTER-WH-009.pdf

Japan, China

General Topic Area: Business, Spatial Analysis, Planning, Urban Studies, Supply Chain Management

Global Supply Chain Management and the Asian Megalopolis

China is a vast country with abundant human resources. Today, China is undergoing a rapid amount of change as its people build a modern, high performance economy. Given continued rapid economic growth along with population concentration, China is moving into an age unprecedented in human history, the age of the Megalopolis.

This presentation will deal with ways that improved supply chain management and design can make China and other Asian countries more efficient in the following areas:

- Reduce requirements for petroleum
- Improve space planning and utilization
- Increase the flow of consumer goods to the Chinese people
- Improved product safety

Publications

Schuster, E.W., **"Global Supply Chain Management and the Chinese Megalopolis,"** Japan-China Organization for Business, Academic & Government Partnership: Nanjing, China, August 22, 2007.

http://www.ed-w.info/ChineseMegalopolisAug2007(V2).pdf

Schuster, E.W., **"Global Supply Chain Management and the Chinese Megalopolis,"** *Japan-China Organization for Business, Academic & Government Partnership* (August 2007).

http://www.ed-w.info/NotesChinaMega07.pdf

Japan, Korea, Taiwan

General Topic Area: Marketing

Improved New Product Forecasting though Visualization of Spatial Diffusion

ABSTRACT

Forecasting demand for a new product is a particularly difficult task. Part of the reason that new product forecasting is such a challenging problem involves the way consumers adopt a product within a defined space. Early studies have noted customer adoption is not spatially uniform. Clusters of adopters tend to form and grow or contract with time. This presentation discusses the spatial diffusion process in the context of introducing new consumer products into markets. Advances in technology including visualization, along with innovative digital mapping technology and new ways of interoperating mathematical models give improved ways to track spatial diffusion resulting in better forecasting and supply chain coordination.

Publication

Schuster, E.W., S.J. Allen, and D.L. Brock, **"Marketing Science and Technology"** *Executive Update* (March 2007).

http://www.ed-w.info/CutterSpatialDiffusion.pdf

Schuster, E.W., Stuart J. Allen, and H.G. Lee, **"Improved New Product Forecasting Through Visualization of Spatial Diffusion,"** *Seminar1*: Boston (April 28, 2008).

http://www.ed-w.info/Seminar12008Schuster.pdf

Japan, Korea, Taiwan

General Topic Area: Business, Customer Service

Supply Chain Management and Related Trends

Summary: a future trend in business is the integration of marketing science, engineering technology, and supply chain management.

The goal of every firm is to increase revenue in a profitable way. Marketing science is playing an increasing role in helping firms to grow revenue through the application of various analytics. Recent developments in several areas of engineering, including computer science, civil engineering, wireless technology, and geodetic science hold the promise of enhancing the work of marketing science through better ways of capturing and handling data, new methods to link models and data together utilizing the Internet, and improved methods of visualization.

In the context of rapid changes taking place in online advertising, and the development of new technologies such as Internet search, Auto-ID, and the EPCGlobal Network, the future role of marketing will take on a greater focus concerning the quantitative and technical aspects of reaching customers, coordinating supply chains, and corporate strategy. Though product management, creative product design, print and media advertising, and promotion will always be important aspects of marketing, the advent of various technological developments are driving changes to traditional sales and marketing approaches, especially in the area of field operations and new product introductions.
This presentation will revisit the original topics that I presented in Taiwan during spring 2002. The goal will be to provide a summary of trends in supply chain management of importance to any company shipping goods to consumers.

Publications

Schuster, Edmund W., 2002. **"Supply Chain Management: Innovations and Trends."** Given as part of a 1.5 day seminar sponsored by the Epoch Foundation in Taiwan.

http://www.ed-w.info/EWSwebpagePRESENTATIONS.htm

Introduction

Overview of Logistics and Supply Chain Management

Logistics and Supply Chain Courses at MIT (Excel File)

Overview of Logistics and Supply Chain Management (continued)

Managing Production and Inventory (1)

Managing Production and Inventory (2)

Managing Production and Inventory (3)

Managing Logistical Systems (1)

Managing Logistical Systems (2)

eCommerce and eLogistics

The Value of Customer Service

Supply Chain Risk

Global Logistics Systems

The Future

Japan, China, Korea, Taiwan

General Topic Area: Agriculture

Agricultural Supply Chains: Track and Trace for Improved Food Safety

Safety has emerged as an issue for the fresh fruit and vegetable industry with reports of several recent food poisoning outbreaks traced to E. Coli. Although these outbreaks generate a great deal of attention, probably many more fresh food contamination instances go undetected. By one account, 76 million illnesses and 5,000 deaths occur each year in the United States from food contaminated with various pathogens.

While the agricultural supply chain is complex, new technologies are available that hold the promise of better track and trace for fresh foods. This presentation will examine the trends and applications of RFID and related information technologies as a means of improving the safety for fresh foods in addition to being a platform for other innovations in agriculture. Part of the talk will focus on fundamental research already conducted to address the track and trace problem in other businesses such as the pharmaceutical industry. Another area of emphasis will be the application of computer science in agriculture to form an information backbone similar to the Internet. The overall theme for the talk is that data and information technologies will gain increasing importance in agriculture, affecting diverse areas such as food safety, logistics, and marketing.

Publications

Schuster, E.W., **"Agricultural Supply Chains: Track and Trace for Improved Food Safety,"** *Application of Precision Agriculture for Fruits and Vegetables*, International Society for Horticultural Science: Orlando, FL, January 7, 2008.

http://www.ed-w.info/PrecisionAg2008-EWSchusterU.pdf

and

http://www.ed-w.info/PrecisionAg2008Schuster.pdf

Japan, China, Korea, Taiwan

General Topic Area: Agriculture

Agricultural Systems Productivity - Information Technology Frameworks for Precision Farming

This presentation will focus on a comprehensive framework for managing data relating to precision agriculture. The following four points will be discussed:

1. Drop Sensing - Prof. Sanjay Sarma and his graduate students are working on a new way to deploy sensors. Rather than placing sensors on moving pieces of machinery, such as a yield monitor, or fix placement (a weather station), a third way is to drop sensors into place. This will require new types of technology and a way to determine exactly where to place sensors in a field.

2. Information Technology Backbone - as a way to gather and analyze the large amounts of data expected from efforts in precision agriculture, there will need to be new types of infrastructure. A way is needed to inter operate data and mathematical models. The M Language is a candidate.

3. Web 2.0 - The rate of scientific advancement is thought to depend on the ability to collaborate and share data, information, and insights. A move to "open science" in agriculture can be facilitated through the application of Web 2.0 methods.

4. Semantic Analysis - The overwhelming amount of information available within journal articles makes it difficult to find associations between related technologies. Many believe that it is the weak associations between various technologies that leads to technological advancement. Some capabilities of the M Language might provide the capability to perform semantic analysis on journal articles, looking for various types of associations. This can be as specific as associations between paragraphs in two different articles.

Japan, China, Korea, Taiwan

General Topic Area: Agriculture

Harvest Risk: An Introduction to Quantitative Modeling and Optimization in Agriculture

Since the dawn of agriculture about 12,000 years ago, farmers have dealt with several categories of risk in producing the food needed to sustain their lives and to build urban centers of industry and learning. In this presentation, we examine quantitative methods for modeling the risk associated with the harvest of Concord grapes. The technique involves a real-world problem in capacity planning and was implemented at a large agricultural cooperative.

Publication

Schuster, E.W., **"Harvest Risk: An Introduction to Quantitative Modeling and Optimization in Agriculture,"** INFORMS annual Meeting: Seattle, WA, November 6, 2007.

http://www.ed-w.info/INFORMSseattleFINAL.pdf