Business cycle tracking method spots downturns

By Felipe Bustos, SDM ’11

**Problem statement:** Although manufacturing represents 12% of the US economy and the Obama administration is emphasizing manufacturing as a way to stimulate the creation of high-quality jobs, most data related to manufacturing are expensive and suffer from inherent biases.

**A new metric:** For their thesis project, Bustos and co-author Fernando Barraza, SDM ’10, developed a metric that characterizes US manufacturing using a simple, yet meaningful, mathematical representation derived from public data.

The metric, Manufacturing Composite Index of Leading Indicators (MCI), taps data from the US Census Bureau and the US Bureau of Labor Statistics that includes:

- time series for new orders
- shipments
- total inventory
- capacity utilization
- average weekly hours of manufacturing

**Initial findings:** After several months of intensive data mining, Bustos and Barraza compiled graphs plotting the MCI against GDP for several subsectors. When they benchmarked the Primary Metals subsector MCI against the US Manufacturing Gross Domestic Product (GDP), they found that this MCI anticipates fluctuations in the GDP by 5 to 9 months. They had found a metric capable of signaling recessions.
SDM 2010-2011 Employment Report

Each year SDM produces an employment report for self-funded students designed to provide an overview of the most recent SDM graduating class and the world-class corporations that hired them. SDM Fellows continue to be hired into top-level technical and managerial leadership positions across a wide range of industries. Employers recognize that the 10 year average prior work experience of SDM Fellows, combined with SDM’s academic rigor, and the diversity of thought among SDM Fellows equips them to communicate and lead across organizations helping to solve complex problems throughout business and technical domains.

Highlights of the 2010-2011 SDM Employment Report include:

1. 100% of SDM graduates responding to the 2011 survey are employed.
2. 83% accepted offers before graduation; 17% after graduation.
3. Job functions include consulting/strategy, project management, general management/leadership development programs, IT/software, and engineering.
4. Among the hiring employers were McKinsey & Company, Boston Consulting Group, Altman Villandrie & Company, Casco, Google, Microsoft, Prudent Energy, Sears Holdings, Topcon Positioning Systems, and TSMC.

For details on salaries, bonuses and more, visit: sdm.mit.edu/employmentreport
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The MCI would have indicated the recessions of 2001 and 2007/2008 well before the official government declarations. For example, the 2001 recession began in March and ended in November of that year. The official declaration was not issued until November 28. The MCI would have given its first warning of the recession in March.

The MCI correlates with GDP on 18 of 20 manufacturing subsectors defined by the North American Industrial Classification System. In looking at industry subsectors, Bustos and Barraza found that some lead their respective GDP’s more than others. Food products, petroleum and coal products, primary metals, and fabricated metals turn out to be prime movers in manufacturing.

Using the MCI

Businesses can use the method as a management tool in several ways:

- delaying expansion or acquisition plans to wait for better prices
- renegotiating contracts for raw materials
- adjusting hiring plans
- decreasing capacity utilization to reduce inventory
- shifting sales strategies

In addition, investors can use the MCI method to adjust their valuations of companies. Businesses can also create Inventory Coverage indexes for each subsector. These allow businesses to identify safe inventory levels for their sectors, track how their sectors perform against this benchmark, and react accordingly.

The research work that Bustos and Barraza conducted demonstrates how a systematic approach to data analysis can offer significant understanding of fluctuations in the complex US manufacturing economy.

To read Felipe Bustos’s entire article, visit: http://sdm.mit.edu/news/business-cycle-tracking

WiSDM Update

By Melissa Rosen, SDM ’11

Women in SDM (WiSDM): A student-focused organization, conceived and led by women in MIT’s System Design and Management (SDM) Program.

Mission: To empower female leaders and to enhance the ongoing learning experience for SDM students and alums.

Goal: To reach out to mid-career women interested in engineering and management in order to achieve a balanced SDM cohort by 2017.

Initiatives:

- Invited women from industry who could be prospective SDM applicants to the MIT SDM Conference on Systems Thinking for Contemporary Challenges and hosted them at a pre-conference “Breakfast with Engineering Leaders” that highlighted the role of women in engineering leadership. Professor Deborah Nightingale presented a keynote (see sidebar).
- Collaborated with other MIT women’s groups at MIT such as the Society of Women Engineers (MIT SWE) and the Graduate Women at MIT (GWAMIT) to co-host a mentoring panel for female undergraduates.
- Supported the GWAMIT Fall Leadership Conference and Spring Empowerment Conferences in 2011 as well as the 2012 Sloan Women in Management (SWIM) Conference.
- Welcomed nine new members from the 2012 SDM cohort. Several have already assumed leadership roles in the SDM and MIT communities. They include Katy O’Brien, co-chair of the SDM Leadership Committee; Elizabeth Cilley Southern, SDM Social co-chair; and Leena Ratnam, co-chair of the SDM Tech Trek and an organizer for the SWIM Conference’s sponsorship team.

Learn more: http://sdm.mit.edu/voices/wisdm.html
Integrating radiology into electronic health records promises cost and care benefits

By Palani Perumal, SDM '11

Case for action

Spending in the US for diagnostic imaging is growing at twice the rate of total healthcare costs. This comes at a time when there are number of issues facing radiology:

- Lack of communication between physicians and radiologists
- Lack of awareness of American College of Radiology (ACR) guidelines among ordering physicians
- Absence of clinical decision support systems
- IT issues (data standards, interoperability)
- Higher costs from the fee-for-service reimbursement model

Under the Health Information Technology for Economic and Clinical Health (HITECH) Act, healthcare providers have incentives for the "meaningful use" of electronic health record technologies. However, the Stage 1 meaningful use regulations do not explicitly include radiologists or medical imaging information, and radiologists are in the dark about what the regulations offer and require.

The approach

For his SDM thesis project, Palani Perumal, SDM '11, worked with Beth Israel Deaconess Medical Center in Boston to assess the impact of integrating radiology into electronic health records (EHRs).

Palani used system dynamics modeling to analyze the technology, business, and policy forces that shape the radiology field, and answer the question of whether radiologists should be considered part of the care team.

Figure 1. This chart shows the radiology-ordering cycle. The green arrow is the missing feedback loop. The radiology system is less efficient without communication between physician and radiologist.

Figure 2. This chart shows the impact of including radiology in the HITECH meaningful use requirements. The red text describes the changes the meaningful use requirements would introduce in the radiology system. The green text describes the resulting changes in the image ordering process.

The radiology system is composed of the following:

- Radiologists
- Image capturing devices
- Picture Archiving and Communication Systems (PACS)
- Digital Imaging and Communications in Medicine (DICOM) standards
- Billing systems

The radiology system interfaces with several other systems, notably ordering physicians, hospital information systems (HIS), and payers.

Benefits and impacts

Acknowledging and fostering radiology’s role in core care has important benefits:

- Physicians can leverage the value of radiologists in ordering the right study at the right time.
- Radiologists can continually learn from the impact their diagnostic findings have on patient health records and population data.
- Improved physician ordering behavior as awareness of clinical guidelines and on-demand access to data improve.

Conclusion

Radiologists should be included in the meaningful use requirements as part of the care team. This modification will allow for the addition of standardized imaging data to EHRs and use of Clinical Decision Support systems in the radiology ordering workflow.

About the Author

Palani Perumal is a Senior Program Manager at Microsoft who recently earned an MS in Engineering and Management through MIT’s System Design and Management (SDM) Program.

Palani Perumal was advised on his thesis by Dr. John D. Halamka, MD, MS, professor and CIO, Harvard Medical School, CIO, Beth Israel Deaconess Medical Center, and Dr. Max P. Rosen, MD, MPH, associate professor of radiology, Harvard Medical School, vice chairman of radiology, Beth Israel Deaconess Medical Center.
SDM Tech Trek Report

By Joan Rubin, SDM Industry Co-director

What do you get when 23 SDM fellows travel 5,400 miles to visit eight companies in four days? The SDM Tech Trek — a soon-to-be annual trip to Silicon Valley to learn how top technical companies operate. This trip highlighted best practices from industry and built upon the students’ classroom learning with real world examples.

Goals:
- Expand students’ knowledge of complex challenges in different industries
- Strengthen relationships between the SDM program and companies

Organized by a group of fellows and led by Co-Chairs Leena Ratnam, SDM ’12, and Neil Gadhok, SDM ’11, the Tech Trek provided SDM students an opportunity to engage with leading companies to discuss strategic, operational, and tactical challenges from both business and technical perspectives. Silicon Valley, a hub for software and computer technology giants, as well as clean-tech startups, was selected to expose the fellows (who have an average of 8-10 years of experience in a single industry), to a variety of industries in a short amount of time. At the various companies, discussions with senior management, product demonstrations, and tours highlighted the individual approaches adopted by these businesses to manage the complex issues they face.

Companies visited:
- Cisco (Network and Communication Devices)
- Silver Springs Networks (Smart Grid Utility Networks)
- TIBCO (Infrastructure Software for Businesses)
- Yammer (Social Media)
- Tesla (Automotive)
- Google (Internet Information Providers)
- First Solar (Solar Energy)
- Intel (Semiconductor)

Sampling of trip insights:
- The visit to Cisco, hosted by Carol Ann McDevitt, SDM ’02, and Rafael Marañón, SDM ’10, included discussions with executives in the Network Operating System Technology Group. One of the key insights was that Cisco has a “no technology” religion. They do not tie themselves to or define themselves by any single technology. They look to constantly evolve.
- TIBCO senior management engaged the fellows in a spirited give and take that demonstrated the need for companies to better utilize data analytics for competitive advantage. The SDM group was joined by Murat Sonmez, EVP, Global Field Operations, Tom Laffey, EVP Products and Technology, and Vivek Ranadive, chairman and CTO (MIT BS and MS).
- At the Tesla plant in Palo Alto, CA, Milo Werner, manager of New Product Introduction, (MIT MS and MBA ’07) and Jim Dunley, VP of Powertrain Engineering and Production (MIT BS, EECS and Economics, ’79), gave presentations in which they emphasized that development of great products includes making mistakes, learning, and improving the product while always focusing on customer needs and product experience.
- Intel employee Heidi Pan (Sloan) and current student and Intel intern Rutu Manchiganti, SDM ’10, brought together a panel from Intel to highlight how innovation can be encouraged and fostered in larger companies.

Key take-aways:
- Face-to-face meetings with key stakeholders strengthen relationships between SDM and industry, opening up opportunities for further collaboration.
- Meeting and engaging with SDM Fellows creates opportunities for companies to identify and recruit graduates.
- Fellows have a better understanding of the corporate environment in both startup and established companies and can tailor their remaining time at SDM to focus on skills needed by industry today.

Tech Trek 2013

The SDM ’12s are already planning for next year’s Tech Trek. If your company would like to participate, please contact Joan Rubin, SDM industry co-director at jsrubin@mit.edu or 617-253-2081.
Applying visualization to classroom seating habits
By Ali Almossawi, SDM ’11

Overview
It can be difficult to extract patterns with complex sets of data. Visualization tools can be used to identify relationships that would not be otherwise evident.

Hypothesis
Students seem to always sit in the same seats in the class. Data visualization provided an opportunity to examine the seating habits of students in the author’s financial accounting class throughout the semester. This involved:

- gathering data
- transforming the data into the right types of data sets
- loading the data into the visualization tool
- running the tool and observing the results

Experiment
Where every student sat for each lecture was recorded in a spreadsheet. The data were transformed into two representations:

- a static set that listed each student, the seats he or she sat in and how frequently the student sat in each seat
- a dynamic set that showed a time-series for where students sat throughout the semester

The data sets were loaded into Data-Driven Documents (D3), a powerful visualization toolkit developed by Stanford’s Visualization Group. The visualization renders a circle for each student-seat pair. Hence, a student who sat in a total of four seats during the semester would have four circles rendered on screen, each at the coordinate corresponding to the seat’s location. Each circle’s diameter is determined by the number of times the student sat in the seat — bigger circles for more frequent use.

Results and observations
The visualization revealed that there are three groups of students, in the following order from most to least:

- those who preferred to sit in the same zone, or set of seats
- those who moved seats, showing no preference
- those who chose to sit in the same seat

For the SDM ’11 cohort in this one class, most students didn’t sit in the same seats but rather in the same zones.

Suggestions for extending this project include having a clustering algorithm to investigate correlations between where people sit and the following:

- relationships between students
- gender
- what time they arrive to class
- personality type
- whether or not they have a class immediately before
- final grade

Conclusion
Ultimately, this experiment showed that transforming data via analysis and visualization is a great way of seeing patterns that would otherwise not be apparent.

Figure 1. The visualization can show a time-series animation of a particular student’s seating behavior. This shows a static view of one student’s behavior throughout the semester.

Figure 2. This is the default view of the visualization. The disks represent specific students sitting in specific seats. The colors represent three different types of seating behavior: staying in the same general area, moving around, and sitting in the same seat.

To read Ali Almossawi’s entire article visit: sdm.mit.edu/news/applying-visualization-classroom
MIT SDM Systems Thinking Webinar Series

This series features research conducted by members of the SDM community. All webinars are held on Mondays, from noon to 1 pm, and are free and open to all. Details and registration are at sdm.mit.edu.

**June 11**

**The Transformation of the Datacenter**

*Kurt Keville, SDM ‘09*

**July 23**

**SE: A Smart Energy Box**

*Jon Hickey, US Coast Guard, SDM ‘11*

**August 6**

**Negotiation**

*Nirmalya Bannerjee, SDM ‘11*

**August 20**

**Smart Grid Modernization**

*Brad Rogers, MIT SM ‘09, MBA ‘09*

Event information includes all details available at press time. For more current event information, go to sdm.mit.edu and esd.mit.edu.

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Pre-recorded **webinars** are available on demand at sdm.mit.edu/voices/webinars.html

**Videos**: 2011 MIT SDM Conference on Systems Thinking for Contemporary Challenges

Videos of presentations from the 2011 MIT SDM Conference on Systems Thinking for Contemporary Challenges are available online and provide a sample of the type of content that will be included in this year’s conference. Topics include the impact of systems thinking on the future of engineering design, personalized medicine, product development, and education. Keynote speakers include SDM Co-Founder Professor Edward F. Crawley and Institute Professor Thomas L. Magnanti, as well as Julian M. Goldman, MD, medical director of biomedical engineering for Partners HealthCare System.