

sdm pulse



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SDM Alum Designs and Promotes Ford Liftgate

A self-described “car guy,” Vince Mahé, SDM '06, is a lead design engineer at Ford Motor Company. He refers to himself as a “crossover” who has traversed many disparate terrains: growing up as a child in France and relocating to the United States at age 10 where he went “from 0 to 60 mph” to learn a new language and culture; transitioning from volunteering as a firefighter in his late teens to working as an engineer in his late 20s; leading the design of innovative features for the 2013 Ford Escape crossover SUV; and starring in a series of ads in Ford’s “Go Further” campaign in recognition of his contributions designing its innovative liftgate technology.

The challenge: Lead a design team that would help reinvent the Escape by identifying and incorporating new features that would “wow” customers.



Photo courtesy of Ford Motor Company



Hands-free liftgate technology automatically opens after detecting kicking motion under the bumper.

Applying SDM learnings:

- Leadership: “In SDM’s monthlong January session, we worked in teams specially chosen to represent diversity of thought, expertise, and culture. Members of my SDM group included high-achieving professionals from NASA, Boeing, Ford, and others. We learned that in order to build a strong team, it’s important for all members to slow down and take time to express their feelings openly so that we could all understand each other and work together more effectively. We also learned how to share leadership, follow others, and follow in order to lead.” Mahé applied these techniques when leading his global design team.
- Innovation: The liftgate’s innovative design consists of two sensors and a control module. The sensors detect the presence of a foot and a shin—as well as the presence of the key—and as soon as the user comes within a meter of the car, it sends a signal to the power liftgate, which opens automatically.

continued on page 11

Welcome

This edition showcases how systems thinking can be applied in a wide range of domains, including:

- designing an innovative product feature for the Ford Escape;
- developing a new framework for transforming a complex, multilevel healthcare enterprise for the US Department of Defense;
- calculating technical debt when determining how to move forward in designing a new generation of product features; and
- using big data analytics in professional sports to gain a competitive edge.

We hope these articles spark ideas for how you can apply systems thinking in your organization.

We also hope that you will join us on October 10, 2013, for the annual MIT SDM Conference on Systems Thinking for Contemporary Challenges. This year's one-day event will be specially designed as a back-to-the-classroom experiential program where you will have the opportunity to practice applying systems thinking. More details are available at sdm.mit.edu/systemsthinkingconference/2013/.

Lastly, please join me in welcoming Jonathan Pratt, SDM's new director of career development and recruiting and learn about him below. We are thrilled to have him on board!

Sincerely,



Joan S. Rubin
Industry Codirector
MIT System Design and Management
jsrubin@mit.edu

Pratt Joins SDM for Recruiting and Career Development

The MIT System Design and Management (SDM) program is pleased to announce that Jonathan Pratt recently joined SDM as director of career development and recruiting.

Pat Hale, director of the SDM Fellows Program said, "Jon's expertise and superb track record in career development and recruiting for the MIT Supply Chain Management program; his industry background and knowledge; and his knowledge of MIT and the Engineering Systems Division will enable him to make significant contributions to the SDM program and the community it serves."

Companies interested in learning about recruiting SDM fellows may contact Pratt at sdm_careers@mit.edu.



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MIT's SDM program is jointly offered by the MIT Sloan School of Management and the MIT School of Engineering. SDM resides within the MIT Engineering Systems Division.

For further information on MIT's System Design and Management program, visit sdm.mit.edu.



Learn more about
Pratt:

sdm.mit.edu

http://



Big Data, Sports Analytics, and an SDM Fellow

SDM '12 Ben Levitt, a senior systems engineer at Raytheon Corporation, was a key player in the 2013 MIT Sloan Sports Analytics Conference held in March. Now in its seventh year and called the “Super Bowl of Sports Analytics” by Forbes Magazine, the student-run conference attracted more than 2,700 attendees.

Levitt’s contributions: With the support of MIT M.B.A. and now Houston Rockets General Manager Daryl Morey, Levitt created two panels—an in-game coaching session titled “Monday Morning Quarterback: Coaching and In-Game Decisions” and another called “Big Data: Lessons for Sports.” He developed the content framework for each and lined up participants from the sports, business, media, and technology sectors.

> **Monday Morning Quarterback:** The in-game coaching panel used video and audience interactivity to encourage the panelists and the audience to explore the use of analytics in all aspects of play calling. The panelists, a collection of the NFL’s best coaches and managers, included:

- Jack Del Rio, defensive coordinator, Denver Broncos
- Herm Edwards, NFL analyst, ESPN, and former NFL head coach
- Thomas Dimitroff, general manager, Atlanta Falcons
- Brian Burke, founder, Advanced NFL Stats website

Tony Reali, host, Around the Horn and Pardon the Interruption “Stat Boy”, ESPN, moderated the panel.

> **Big Data-Lessons for Sports:** Composed of the world’s best data experts, this panel discussed how “nexgen” data scientists can supersede today’s “stats geeks.” Panelists also explored best practices from industries outside of sports and the insights they offer into how to turn petabytes of “motion capture” and multispectral data into competitive advantage. Panelists included:

- Chris Selland, vice president, marketing, HP Vertica Analytics platform
- Jeff Hammerbacher, co-founder, Cloudera, and former leader of Facebook’s data team
- Claudia Perlich, chief scientist, m6d
- Joe Doyle, Erwin H. Schell Professor of Management and associate professor of applied economics, MIT Sloan School of Management.

Michael Schrage, research fellow, MIT Sloan School of Management Center for Digital Business and the Imperial College [London] Business School, served as moderator.

> Watch the videos:

www.sloansportsconference.com/?p=10038

www.sloansportsconference.com/?page_id=460

> Learn more about Levitt:

sdm.mit.edu

http://



The Monday Morning Quarterback: In-Game Coaching panel included (left to right) Jack Del Rio, Denver Broncos; Tony Reali, ESPN’s ‘Around the Horn’; Thomas Dimitroff, Atlanta Falcons; Brian Burke, Advanced NFL Stats; Ben Levitt, panel producer/developer and SDM '12; and Herm Edwards, ESPN.
Photo by SLY Photography

The SDM tools: Southerlan used matrix-based techniques learned in her SDM classes (see Figures 1 and 2) to transform the information she gathered into objective data. She then combined this data with information on how levels of the DoD MPHE interact to suggest a framework for modeling potential future states of the enterprise.

The findings: The descriptive application of Southerlan’s suggested framework supported both the design and selection of a transformation plan for the overall enterprise. Nightingale and Southerlan believe that the insight gained from combining enterprise architecting tools with multilevel analysis techniques could be used to support the transformation of a complex, multilevel enterprise.

Southerlan then worked closely with research colleague Jaya Plmanabhan, SDM ’11, to explore potential approaches that could be derived from her work to support an extension to the current enterprise architecting assessment technique.

The results: In her thesis, Southerlan outlined the way in which the subjective information received during the as-is analysis was transformed into objective data. In her thesis investigation, the interactions between resources of the Camp Lejeune MPHE were quantified and analyzed to provide visibility to how changes made at higher levels of the complex, multilevel enterprise (the DoD MPHE) would impact the Camp Lejeune MPHE. While Southerlan used behavioral health (BH) resources and subsequent BH tasks as the quantifiable data in this application, she stated that there is potential to use different types of information as quantifiable data. For example, the metrics used by enterprises to measure performance could be considered objective data and could potentially be used to model impacts of changes made at different levels of a complex, multilevel enterprise. Southerlan recommended that when applying the framework outlined in her thesis, the dominant views of the enterprise—as determined during the enterprise architecting as-is analysis—should be used as reference to abstract objective data from the analysis. This will ensure that the data being used to model the as-is and potential future states of the enterprise have a strong presence throughout the enterprise.

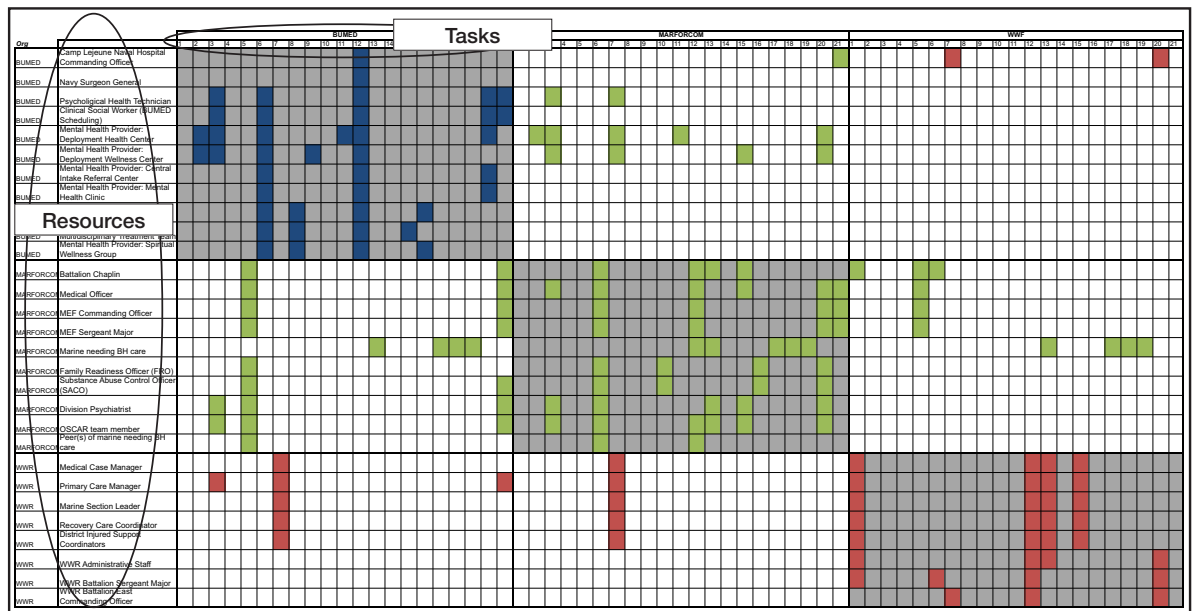


Figure 2. Matrix of resources and tasks, organized by strategic group.

For a copy of Southerlan’s thesis, please contact SDM Industry Codirector Joan S. Rubin at jsrubin@mit.edu.

T I M E L I N E

WiSDM

Women in System Design and Management

2009

- WiSDM formed.
- First events organized with women from earlier SDM cohorts.

2011

- Melissa Rosen Ceruolo named WiSDM chair.
- Workshop conducted with SDM staff to define mission and goals.
- Launch of WiSDM page on SDM website.
- Joan Rubin, SDM industry codirector, named WiSDM advisor.
- WiSDM “Breakfast with Engineering Leaders.”

2012

- Welcome event for women in SDM '12 cohort.
- Networking breakfasts with Sloan Women in Management (SWIM).
- WiSDM hosts “Introduction to Engineering Leaders” at Pratt & Whitney to discuss collaboration opportunities.

SDM Fellow, Student Group Win Excellence Awards

Courtesy of News@MITSloan

Melissa Rosen Ceruolo, SDM '11, and the Women in System Design and Management (WiSDM) student group were honored as Graduate Women of Excellence at a reception hosted by MIT's Office of the Dean for Graduate Education on April 23, 2013, at the Microsoft New England Research and Development Center in Cambridge.

Ceruolo won for her leadership role in revitalizing WiSDM—a student-led organization started in 2009 by female students in MIT's System Design and Management (SDM) program. WiSDM's mission is to empower female leaders and to enhance the ongoing learning experience for SDM students and alumnae.

The awards

More than 140 students were nominated for awards from among the greater MIT community; 47 women were named winners along with nine women's groups. Nominees were evaluated based on leadership, activities, interactions with colleagues and professors, service to the MIT community, and being a catalyst for change.

Tina P. Srivastava, SDM '11, accepted the award on behalf of WiSDM. Other members of the group at the ceremony were Elizabeth Cilley Southerlan, SDM '12, Kathleen Voelbel, SDM '12, Leena Ratnam, SDM '11, Marianna Novellino, SDM '13, and SDM staff member Melissa Parrillo.

“We are ecstatic and grateful to have received this recognition and to be given the opportunity to shed a brighter light on both WiSDM and SDM,” said Phatty Arbuckle, SDM '13, media relations officer for the group. “In the next year, we hope to carry the torch passed on to us by Melissa and prior members to both continue our traditions and to also further our recognition. We have large shoes to fill, but we are definitely up to the challenge.”

SDM and WiSDM

Ceruolo noted that she was initially drawn to SDM by the program's flexibility and its focus on both management and engineering. After an intensive search for the right graduate program, she said she found SDM fit best with her goals and interests. Under SDM's commuter option, she could continue working at her full-time job at Helbling Precision Engineering, Inc., in Kendall Square, where she develops medical technology.

“When we broke into teams in the January ‘boot camp,’ I noticed that there were very few of us [women],” Ceruolo said. “I wanted to get to know the other women in the program. I was working in a predominately male field, and there were these amazing women in SDM that I wanted to connect with. I started to think of ways that we could get to know each other and enhance our network.”

Ceruolo had heard about WiSDM and decided to bring it back to life after a brief period of inactivity. She soon began to organize events for the group. WiSDM's goal is to increase the number of female students in the program, inspire women to become engineering and technical leaders, and to promote the SDM program as a whole.

T I M E L I N E



From left to right: Marianna Novellino, SDM '13, Melissa Rosen Ceruolo, SDM '11, Melissa Parrillo, SDM staff, Tina P. Srivastava, SDM '11, Kathleen Voelbel, SDM '12, Elizabeth Cilley Southerlan, SDM '12, Leena Ratnam, SDM '11.

WiSDM has helped organize the MIT Systems Thinking Conference—securing women engineering leaders as keynote speakers. WiSDM also collaborates and networks with SWIM (Sloan Women in Management) and GWAMIT (Graduate Women at MIT) and coordinates other activities such as group yoga, mentoring, and speaker events. WiSDM even created a marketing video for SDM (sdm.mit.edu/voices/wisdm.html).

"I'm so happy that I did this," Ceruolo said of her work with WiSDM. "The relationships I've made and the women that I have met are awesome. We've bonded ... I've made lifelong friends and I know we will stay in touch after we graduate."



Learn more about WiSDM:

sdm.mit.edu/voices/wisdm.html

http://

- WiSDM marketing video produced for SDM website.
- Women in Technology Management event held with keynote speaker Bettina Hein, Pixability.
- WiSDM symposium "Creating Value in Your Organization Using Systems Engineering" held at MIT. Speakers—including Zoe Finch Totten, The Full Yield; Heidi Grenek, Xerox Corporation; and Ellen Ferraro, Raytheon—discuss the application of systems thinking and systems engineering in their organizations.

2013

- Welcome event for women in SDM '13 cohort.
- WiSDM and Melissa Rosen Ceruolo honored as Graduate Women of Excellence by MIT's Office of the Dean for Graduate Education.

WiSDM would like to express sincere appreciation to the entire SDM staff, headed by Pat Hale, for their support of, and dedication to, WiSDM.

2013 SDM Tech Trek Report



The annual MIT SDM Tech Trek provides an opportunity for SDM fellows to engage with leading companies to discuss strategic, operational, and tactical challenges from both business and technical perspectives. The 2013 visit to Silicon Valley exposed fellows (who have an average of 8-10 years of experience in a single field) to a wide variety of industries in a short amount of time. Fellows met with senior managers at best-in-class companies to learn about their complex technical and business challenges and how they address them. Designed to build upon the students' coursework at MIT, the trek enabled students to tour facilities, view product demonstrations, and engage in lively and informative question and answer sessions with industry leaders. This year's trek was led by cochairs Alvaro Madero and Michael Seelhoff, both SDM '13s, and organized by several SDM fellows.

Goals:

- Expand students' knowledge of complex challenges across several industries
- Strengthen relationships between the companies and SDM

Companies visited:

- Cisco (network and communications devices)
- Google (Internet information provider)
- Amazon Lab126 (consumer products)
- E.&J. Gallo Winery (food and beverages)
- Intuitive Surgical (medical devices)
- Twitter (Internet communications)
- Mission Motors (automotive)

Trip highlights:

- At Intuitive Surgical, Catherine Mohr, M.D., the director of medical research, discussed the DaVinci robotic surgical system, including the specific product's history and the history of laparoscopic surgery in general. Mohr demonstrated how the device worked, explained many of the decisions that went into its final design, and offered each tech trek visitor a chance to try the multimillion-dollar device. Fellows also toured the manufacturing facilities to see how the device's surgical arms and body were constructed. Students found it extremely informative to investigate the end-to-end processes used to create such a precise technological device, including the challenges the company encountered and the techniques used to overcome them. Mohr, who holds a S.B. and an S.M. from MIT, also discussed her decision to pursue an M.D. at Stanford, as well as her career path. Many SDMs came away inspired by the versatility of their MIT education, which can be applied to many industries.



- SDM alumnus Juan Spiniak hosted the visit to Google. He presented an overview of the company and its products, plus a close-up of Google Fiber, the Internet service provider that he manages. Jim Miller, Google's vice president of worldwide operations, discussed the company's infrastructure and global operations. He emphasized that the company is interested in professionals who want to engage in "intrapreneurship" (behaving like an entrepreneur within a large company) and making a difference. Miller said he wants to use Google's computing power to help analyze the human genome.
- At Cisco, SDM fellows met with several SDM alumni, including Carol Ann McDevitt and Rafael Marañón. They were treated to a hands-on demonstration of Cisco's current telepresence technology, then heard a presentation by Susie Wee, vice president and CTO of networked experiences, who provided some insight into the product's future path. She also shared lessons she has learned along the way, from earning her degree at MIT to becoming a VP at Cisco.
- At Mission Motors, Vice President for Finance and Administration Mike Rosenzweig gave a tour of the company's operations, which included the workshop where electric motorcycle models are built, the battery charging and component design/fabrication facilities, and the software development area. CEO Jit Bhattacharya described the history of the electric vehicle industry, challenges experienced in this still-maturing market, and areas in which a system thinker could provide value. The visit demonstrated that creative ideas and emerging markets are not enough to build a company. External market development—in this case, evolution of battery technology and infrastructure—plays a critical role in supporting innovation. Mission Motors demonstrated that flexibility in the business plan was essential to keeping the company moving forward while the critical elements of the external market developed.



Key takeaways:

- Face-to-face meetings with senior executives gave companies an opportunity to learn more about SDM and understand the competitive advantage that developing or enhancing a systems capability in their organizations can bring.
- Meeting and engaging with SDM fellows offered opportunities for companies to experience first-hand the unique perspective and skills SDMs acquire at MIT and to identify future graduates to recruit.
- SDM fellows returned to MIT with an expanded understanding of how versatile and applicable their SDM education is, no matter what the industry.

2014 SDM Tech Trek

Each year, MIT SDM fellows, faculty, and staff visit best-in-class companies to discuss global business challenges and to learn directly from executives about how to address them. If your company would like to participate in the 2014 SDM Tech Trek, please contact Joan Rubin, SDM industry codirector, at jsrubin@mit.edu or 617.253.2081.

sdm alumni profiles



About the Author

SDM alumnus **Rudy Smaling** is executive director of systems engineering at Cummins Inc. He holds a Ph.D. in engineering systems from MIT and an S.M., engineering and management, both earned at MIT. His Ph.D. dissertation was entitled System Architecture Analysis and Selection under Uncertainty.



Smaling will be delivering a webinar on systems thinking and organizational change on November 18, 2013.

Details/registration after November 4:

sdm.mit.edu

http://

Rudy Smaling, Ph.D.

I first heard of the MIT System Design and Management (SDM) program in the spring of 2000. I worked for ArvinMeritor at the time and was attending a meeting at our facility in Gifhorn, Germany. The vice president of technology told me about SDM and that he was going to send some people to attend the program. That man was Jack Grace. Many of you no doubt know Jack as the former codirector of the SDM program, a role he took on after retiring from ArvinMeritor.

I was immediately drawn to the premise of the SDM program: a bridge between the worlds of engineering and business. I had considered an MBA before, but was not really interested in the career path traditionally represented by that degree.

I was fortunate enough to be one of three people ArvinMeritor sponsored for the SDM '01 class, which I entered as a distance learning student. It was an assignment in Professor Edward F. Crawley's January class in system architecture that really changed my path at MIT—and my career in general. The assignment was something like this: "Go find some technology in the MIT labs, propose to your sponsoring company to invest in it, and write a report about it." Well, I did just that, and by the fall of 2001 found myself and my family moving to the Boston area where I would represent ArvinMeritor as the lead of a joint research and development (R&D) program with MIT. (I will never forget the time of the kick-off meeting at the Plasma Science and Fusion Center: It was 9 a.m. on September 11, 2001.)

Five incredible years at MIT ensued, first in the SDM program, then pursuing a Ph.D. in the Engineering Systems Division. The ArvinMeritor-MIT technology development program afforded me the opportunity to directly apply, and learn from, the lessons taught in SDM and ESD. These lessons extended beyond the classroom to the many interactions with fellow students and MIT faculty and staff. I learned to think more holistically and came to appreciate the different viewpoints of the many stakeholders in technology development. Working with the many students who received research assistantships from the ArvinMeritor-MIT program, I came to value the impact industry can have in shaping the skills and knowledge of students, our future engineers and scientists.

Currently, I serve as the executive director of systems engineering at Cummins, the largest independent diesel engine manufacturer in the world. What attracted me to Cummins is its spirit of innovation, the focus on organic growth, and—most of all—the people. With all the success Cummins has enjoyed over the past few years, much potential for growth remains. Systems engineering and, more broadly, systems thinking, is poised to make significant contributions to that growth. Especially given that Cummins until recently did not formally recognize systems engineering as a job classification, I am energized by the prospects.



About the Author

Daniel J. Sturtevant

holds a Ph.D. from the MIT Engineering Systems Division and an S.M. in engineering and management as an SDM alumnus. This article and his webinar are based on his dissertation research.



Sturtevant's webinar available on demand:

sdm.mit.edu/news/news_articles/webinar_050613/sturtevant-webinar-technical-debt.html

http://

Daniel J. Sturtevant, Ph.D.

Designing around features that already exist is a challenge common to almost all complex systems. Here is a high-level outline of a solution based on research conducted by Daniel J. Sturtevant, an SDM alumnus and Ph.D. graduate of MIT. While the focus is on software, the approach can be adapted to virtually any industry.

The challenge: Many companies that choose to keep existing features and design around them discover that they have incurred “technical debt.” This is often a result of not systematically determining the costs—financial and otherwise—of overhauling a complex system versus simply maintaining and adapting to it over the long term, conducting repairs as needed.

The strategy: Ask specific questions. Managers and engineers must explore the following issues when developing new features for an existing platform:

- Can we reliably and repeatedly measure technical debt in different parts of the complex system?
- Can the cost of servicing that debt be measured?
- What kind of product-related complexity metrics correlate with significant maintenance costs, and can we use them to measure and track our technical debt?

The benefits of addressing technical debt: Sturtevant conducted a research study at a large, commercially successful software firm and calculated multiple types of complexity scores for hundreds of thousands of software source-code files. He also measured a number of significant costs—including increased defect density, lower developer productivity, and higher staff turnover—related to complexity. He found that:

- Because system architecture significantly impacts financial performance, projects that address architectural problems have the potential to eliminate technical debt, thereby freeing up money for more productive use.
- Companies that use tooling and databases similar to those developed during this research should find it possible to begin estimating financial cost complexity by assigning a monetary value to cost drivers (such as productivity, defect density, and turnover).
- Firms could use such a system to plan, manage, and estimate the value of architectural improvement in large complex systems.

Contact SDM Industry Codirector Joan S. Rubin at jrubin@mit.edu for a copy of Dr. Sturtevant's thesis.

continued from page 1

Mahé Designs, Promotes Ford Liftgate



Video frame courtesy of Ford Motor Company

- Systems thinking: “Coursework in system architecture, systems engineering, and systems design gave me a set of methodologies for dealing with the technical and managerial complexities of requirements analysis, prioritization, design specs, concurrent engineering, testing, safety, and other important elements needed to produce the ‘wow.’ This, in turn, enabled us to troubleshoot any potential problems.”

The results: The Ford Escape was named No. 1 in the affordable compact and affordable crossover SUV categories by *US News* on its Best Cars website and received numerous other accolades. As lead design engineer, Mahé starred in several commercials for the Ford Escape.

See Mahé at:

www.youtube.com/watch?v=zLi9qHkaogM
www.youtube.com/watch?v=FyusEDHY_WQ
www.youtube.com/watch?v=wIZhowLQ0fQ



Learn more about Vince Mahé and the Ford foot-activated liftgate:

sdm.mit.edu/vince.mahe

http://

summer

2013

sdmcalendar

2013 MIT SDM Conference on Systems Thinking for Contemporary Challenges

Thursday,
October 10, 2013

This annual event focuses on addressing complexity and innovation in industry, academia, government, and the world at large. Speakers from multiple disciplines will provide practical information on how to apply systems thinking to address complex challenges in any domain.

Details/registration:

sdm.mit.edu/systemsthinkingconference/2013/

AVAILABLE

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Prerecorded webinars:

sdm.mit.edu/voices/webinars.html

Videos:

SDM program offerings and conferences

sdm.mit.edu/voices/videos.html

Women in SDM (WiSDM)

sdm.mit.edu/voices/wisdm.html

MIT SDM Information Evenings

Learn about MIT's Master of Science in Engineering and Management, discuss career opportunities, and network with SDM alumni, faculty, students, and staff.

Details/registration: sdm.mit.edu.

August 7

Boston Marriot Cambridge

October 10

Bush Room, MIT

MIT SDM Systems Thinking Webinar Series

This series features research conducted by members of the SDM community.

Webinars are held on Mondays, from noon to 1 p.m., and are free and open to all.

Details/registration: sdm.mit.edu.

July 29

Safety of Management

[John Helferich](#), former senior vice president of R&D, Mars Inc., SDM alumnus, and Ph.D. candidate in MIT's Engineering Systems Division

August 12

Re-engineering Cybersecurity Systems for the 21st Century Economy

[Charles Iheagwara](#), Ph.D., director of cybersecurity practice, Unatek, and SDM alumnus

September 9

Airport Systems Planning

[Richard de Neufville](#), professor of engineering systems and civil and environmental engineering, MIT

September 23

Strategies for Introducing Alternative Fuel Vehicles in India

[Abhijith Neekaje](#), SDM '12, and Tata Fellow

October 7

Strategy, Simulation, and Analytics for the Complex World of Education

[Daniel Sturtevant](#), Ph.D., co-founder of Emtect Solutions, and SDM alumnus

October 21

Extreme Learning Process

[Ben Koo](#), associate professor, Tsinghua University, and SDM alumnus

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