SDM Evolution in Its 19th Year

By Pat Hale, Executive Director, MIT SDM Fellows Program

As MIT System Design and Management (SDM) marks its 19th year, all of us involved in the program are proud to announce several important milestones. These include:

- SDM’s first fall start date, designed to enable master’s and certificate students to matriculate together in August of each year.
- A robust number of students in each program—the MIT S.M. in engineering and management and the SDM Graduate Certificate Program in Systems and Product Development.
- The inaugural offering of SDM’s three-semester core course, which will provide an integrated view of architecting, engineering, and managing the development of complex systems (see page 6 for details). Because students in each program will attend these together, the opportunities for mutual learning and enrichment from classmates (who are experienced professionals—a hallmark of SDM) will deepen significantly.
- Additional flexible master’s options that will enable self-sponsored students to choose program length and coursework based on their professional obligations, goals, and interests—while enabling company-sponsored students to make choices that also meet their employer’s needs.
- Development of a new specialization track called Integrated Design & Management, which is scheduled to begin in August 2015 spearheaded by Matthew S. Kressy, director and senior lecturer. (See page 3 for more information.) Program details will be formally announced this fall.
- More women enrolled than ever before.

We are extremely grateful for the efforts of the SDM family—faculty, company partners, alumni, students, and staff—in designing this new core and supporting us in achieving all of the above. We want to express special thanks to Professor Olivier de Weck, who led the core and curriculum development team.

Please visit pages 6-7 to explore the new SDM options—and do let us know your thoughts and suggestions!
Welcome

This edition of the SDM Pulse is a prime example of systems thinking at work within MIT, across industry, at all organizational levels, and around the world.

In these pages you will find:

- An overview of SDM’s new core curriculum and examples of how it can be customized to suit individual students’ interests and industry’s evolving needs;
- A brief announcement of the recent appointment of Matthew S. Kressy as director and senior lecturer of SDM’s Integrated Design & Management track. Matt will develop, manage, and teach the new track, which will launch in August 2015. Check the SDM website (sdm.mit.edu) for updates or contact sdm@mit.edu;
- Detailed overviews of how systems thinking has been employed by a startup specializing in solar energy product design and by the US Coast Guard to help understand what caused a fatal accident at sea;
- A report on the spring 2014 SDM Tech Trek that demonstrates the mutual value received by participating companies and students, as well as information on how your company can get involved in future treks;
- An introduction to the 2015 SDM cohort, the first SDM class to matriculate in the fall semester and to participate in the inaugural offering of the new SDM core;
- Highlights of the most recent SDM Employment Report, along with a link to the full report on the SDM website;
- A list of upcoming SDM events, such as this year’s SDM conference and back-to-the-classroom sessions; an alumni-student networking evening; live and virtual information events for prospective applicants; webinars on applying systems thinking to various complex challenges; and more.

We hope you enjoy this edition of the Pulse. As always, we welcome your feedback and suggestions.

Sincerely,

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

Kressy Joins SDM to Create New Product Design Track

By Lois Slavin, MIT SDM Communications Director

The MIT System Design and Management (SDM) program is pleased to announce that Matthew S. Kressy has been named director and senior lecturer of Integrated Design & Management to develop, manage, and teach in SDM’s new master’s track.

Kressy, founder of Designturn, brings to SDM extensive experience in globally distributed, interdisciplinary product development, from research and concept generation to prototype iteration, risk reduction, and volume manufacturing. His firm has developed and manufactured numerous successful products for a wide range of industries, among them high-tech, healthcare, and sporting goods. His experience in academia includes co-teaching Product Design and Development (both 15.783 and 6.33D.40) at MIT since 1999. He has also taught at the Harvard Business School, Babson College, and the Rhode Island School of Design (from which he holds a BFA in industrial design).

Pat Hale, executive director of the SDM Fellows Program, said, “Matt is a thought leader in industrial design and interdisciplinary product development and a widely acclaimed hands-on industrial designer. He receives accolades for his teaching from SDM students and faculty and we are thrilled that he has joined SDM.”

Companies interested in learning about SDM’s new product development track may contact Kressy at mkressy@mit.edu.
Applying Systems Theory to Analyze Failed Coast Guard Rescue

The challenge: In 1997, a sailing vessel sank outside Charleston Harbor, SC, killing all four passengers aboard. An investigation by the National Transportation Safety Board (NTSB) identified two probable causes:

- the operator’s inability to adequately assess, prepare for, and respond to the known risks; and
- the substandard performance of US Coast Guard (USCG) Group Charleston in initiating a search and rescue (SAR) response.

The NTSB also provided recommendations subsequently implemented by the USCG, including a major upgrade to the National Distress Response System (NDRS) developed and deployed through the Rescue 21 project.

For four years I was responsible for deploying this system to USCG Sector Command Centers. Though I believe that Rescue 21 was a success in terms of delivering value, I am equally interested in determining what can be done to further improve policies and capabilities. To do this, I applied System Theoretic Accident Model and Processes (STAMP), developed by MIT Professor Nancy Leveson, along with its causal analysis based on STAMP (CAST) investigation component.

Using STAMP and CAST enabled:

- a comprehensive comparison of NTSB-generated recommendations to new findings and insights, enabling us to assess actual implemented solutions; and
- a way to take contextual and environmental factors into account.

This analysis of system safety constraints and hazards against controls in the system’s hierarchical control structure made it possible to identify weaknesses and recommend solutions to the full range of causal and systemic factors, including humans.

The approach: When using system theory to assess accidents, a clear definition of system hazards relative to the accident is essential. In this case, the relevant hazard was the USCG’s failure to respond to a distressed mariner. Figure 1 shows that what was needed was a safety requirement designed to ensure that the USCG would respond.

HAZARD | SAFETY DESIGN CONSTRAINTS/REQUIREMENTS
--- | ---
The USCG does not respond to a mariner who is in distress. |
| a. The USCG shall have the ability to receive/hear distress notifications within the system boundary; |
| b. The USCG shall have the ability to understand/interpret distress notifications received within the system boundary; |
| c. The USCG shall have the ability to respond to distress notifications received within the system boundary; and |
| d. The USCG shall have the capability to communicate and coordinate with other first responders within the system boundary. |

The tools: To understand how system interfaces interact with control elements, a safety control structure was drawn to model the hierarchy of organization levels within the system. This allows the system to be evaluated as a whole rather than by its individual parts.

The control structure starts at the physical or operating process level where the hazardous process or activity occurs and where human controllers are typically involved. Figure 2 shows the operating process safety control structure at the controller level. Figure 2 also displays how the operating process level is linked to the hierarchical safety control structure, including the applicable control action and feedback loops.

Moving up the safety control structure enables us to see the whole system boundary with the key entities involved.

To view the complete thesis, please contact Joan S. Rubin, SDM industry codirector, jsrubin@mit.edu or 617.253.2081.

Steven (Sid) F. Osgood, is a captain in the US Coast Guard. This article is an excerpt from his thesis, System Theoretic Value Analysis of the United States Coast Guard Search and Rescue Communication System, which was a finalist in SDM’s Best Thesis Competition.

Thesis advisor: Qi Van Eikema Hommes, PhD, lecturer, Engineering Systems Division, MIT.

To view the complete thesis, please contact Joan S. Rubin, SDM industry codirector, jsrubin@mit.edu or 617.253.2081.

Figure 1: Safety constraints and design requirements necessary to address system safety hazards.
SDM Unveils New Program Options, Core Curriculum

Overview for All Options

- Intense two-week orientation begins in mid-August, prior to the start of fall classes
- 38-unit unified systems core curriculum is spread evenly throughout the fall semester (16 units), January Independent Activities Period (6 units), and spring semester (16 units)

Full-Time On-Campus Option 12-Month Program

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SDM’s intensive 12-month option minimizes students’ time away from the workforce. Core, required, and elective courses are concentrated in the fall, January, and spring terms. In the spring and fall, students carry a minimum of 43 credit units split between the Sloan School and the School of Engineering. Thesis work is scoped out and begun in parallel with coursework during the academic year and finished during the summer. The SDM degree is awarded upon completion of thesis work in September.

Sample coursework could include:

SDM Core:
- Foundations of Systems Design and Management (38 units)

Management Foundations:
- Management Accounting and Control (9 units)
- Strategic Management of Innovation and Entrepreneurship (6 units)

Management Electives:
- Operations Strategy (9 units)
- Manufacturing System and Supply Chain Design (6 units)

Engineering Foundations:
- Engineering Systems Analysis for Design (12 units)

Engineering Electives:
- Product Design and Development (12 units)
- Integrating the Lean Enterprise (12 units)

Distance Option 21-Month Program

Distance students join the cohort for the initial two-week August orientation, then return to their full-time jobs. During the first year, this group attends the core course at a distance using MIT’s state-of-the-art web technology to participate remotely in live classes. In January the cohort continues the core course sequence primarily at a distance, but returns to campus for one intensive week of classes and workshops. All distance students are required to spend one semester in residence at MIT and may choose either the fall or spring of their second year to finish their required and elective courses. The other semester of the second year is spent at a distance, working on and completing the thesis. The degree is granted in June of the second year.

Commuter, RA/TA, or Full-Time on Campus with Internship 21-Month Program

Students who are working locally, participating in a research or teaching assistantship (RA or TA) on campus, or including an internship with their course of study may spread out the course load evenly over their 21 months at MIT. All students in this category attend the mandatory two-week August orientation, then typically add one additional course to the required core in both the spring and fall of their first year. The summer between terms is generally reserved for work, either an internship or a continuation of the student’s regular, full-time position. In the second year this group completes required and elective courses while allocating time during both semesters to thesis work. Students receive their degrees in June of the second year.

Full-Time on Campus with Internship 16-Month Program

While some students join SDM planning to minimize time outside of work, many want to incorporate an internship into their education. Internships offer students the chance to apply the theory they have learned to the workplace and potentially test and explore new career directions. The 16-month option allows integration of coursework with an internship in a compressed time period. Using this option, students complete all course requirements in their first year, similar to the full-time on-campus students. During the summer they undertake an internship, returning to complete the thesis in the fall. Students in this group finish in the fall and receive their degrees in February.
SDMs Launch Solar Energy Startup

The challenge: Enabling middle-class homeowners to affordably and cost-effectively participate in the solar energy revolution.

The approach: Conversations with potential purchasers helped AE identify three key deterrents to “going solar”:

• significant upfront costs, approximately $20,000 to acquire and install a solar system that can generate and store enough energy for daily use;
• long payback periods for return on investment; and
• the need for large arrays of solar panels, which can mar a home’s aesthetics.

The team created a detailed profile of target customers for solar power that focused on incentives, expectations, and frustrations with existing products. AE sought to develop a modular solution that would address each key point and chose California as an initial test market because the state provides significant incentives for purchasing and installing solar energy systems.

The tools: SDM’s emphasis on systems thinking and systems engineering provided an excellent foundation for creating the final product, a patent-pending solar hot water collector. The team’s overall vision is based on real-world requirements analysis, and the group used problem decomposition to further refine their product and create a working prototype.

System engineering: The team performed a series of analyses that included design structure matrices, quality function deployment, and a problem-solving methodology called TRIZ. The result was a sound architectural framework (see Figure 1).

The results: AE team members used the information from their SDM coursework over six months to design a patent-pending double reflector solar thermal collector that:

• is roughly twice the size of a satellite dish;
• provides the equivalent of 7 kilowatt-hours of energy per day in the southwestern United States;
• reduces roof-mounted weight through the use of two reflectors instead of the traditional single-reflector system; and
• simplifies the installation process by utilizing the homeowners’ existing hot water tank.

The team is now manufacturing a second-generation, full-scale prototype. Functionality testing of the alpha prototype of their low-profile solar thermal collector was completed during January 2014 at a home in San Jose, CA.

System architecture: Use of diagramming techniques from the object process methodology helped determine the system’s architecture. This was employed as the basis for an alpha prototype design.

Figure 2. This object process methodology diagram shows a residential solar thermal water heating system, demonstrating the function of each system component.

The authors

Alex Piña ’13 and Sean Gilliland ’13 cofounded Avalanche Energy (AE), which is dedicated to the vision that solar energy should be accessible to everyone, everywhere. The company won first prize in the 2013 Boston Lean Startup Challenge, was a semifinalist in both the MIT $100K Pitch and Accelerate contests, and is currently a semifinalist in the 2014 Cleantech Open Accelerator.

Figure 1. This design structure matrix represents the general architecture AE used for its solar hot water and electricity generation system.
Although the course has ended, we are now looking into a patent for our design. Other comforters are now in the process of submitting a provisional patent application. We intend to submit a full patent in the coming months.

- a seamless fit into a duvet cover, ensuring an aesthetic consistent with
- applications
- user and observer feedback has been overwhelmingly positive and we are
- comforters laterally
- each with its own heat retention capacity;
- the capability for electric heaters to be added if desired;
- panels that can be attached to customize comforter warmth laterally
- allow the use of an ordinary bicycle with little or no modification.
- the ability to transport up to 50 pounds of cargo, such as groceries;
- enable riders to easily transport up to 50 pounds of cargo, such as groceries;
- preserve the normal feel—and enjoyment—of bike riding;
- improve their health and minimize their carbon footprint—particularly in traffic-heavy urban areas. However, an ordinary bike’s design can present many challenges and, with them, opportunities for designing and developing new products.

Bike riding has become increasingly popular among those who want to improve their health and minimize their carbon footprint—particularly in traffic-heavy urban areas. However, an ordinary bike’s design can present many challenges and, with them, opportunities for designing and developing new products.

We first studied the range of problems in depth. Our process included:

- conducting extensive surveys and in-depth user interviews;
- applying system architecture principles and concepts to our ideation-generation process for one major bike shortcoming—the difficulty of transporting bundles;
- choosing one architecture to pursue; and
- focusing relentlessly on user needs.

We developed two variants, then built a prototype for each potential model. We ultimately developed a prototype quite close to meeting our goals for functionality and aesthetics. However, we feel a few more iterations will need to be completed before we go to market.

Our team was asked to tackle “terrible vacation photos.” Practicing the methods learned in PDD, such as user-centric product development, we:

- conducted interviews to discover how users define a “good photo”;
- identified a latent user need—organized storage that enables rapid image retrieval;
- brainstormed on the above, finding inspiration from Facebook’s use of a plain English search function, existing tags, and data to return results;
- applied this to smartphone photos, using existing metadata, location, color, origin/medium, etc., to aid the organization and search process;
- refined this process by making tagging as simple as possible through learning user behaviors, integrating existing smartphone functionality, and designing a simple, intuitive user interface; and
- sketched a variety of initial concepts, diagramming functionality, composing screenshots for each unique feature, and attempting to tell the story of what the product should do.

We also learned a lot about what individual traits are important to creating a successful team. These include:

- patience;
- openness to critical feedback;
- willingness to learn from others’ unique backgrounds and skill sets; and
- receptivity to learning about new fields, such as industrial design, application building, databases, and photography.

We ultimately developed a prototype quite close to meeting our goals for functionality and aesthetics. However, we feel a few more iterations will need to be completed before we go to market.

The students work together in multidisciplinary teams to practice best-in-class methodologies to conceive, design, and prototype new products while honing their skills in leadership and teamwork. All teams are charged with:

- identifying customer needs;
- generating and selecting concepts; and
- developing product architectures, industrial designs, concept designs, and designs for manufacturing.

At semester’s end, each team participates in the annual PDD competition, presenting design concepts and prototypes to a panel of judges comprising MIT faculty and industry experts. The following profiles highlight this year’s winners and some of the tools they applied.
Snapshot: SDM Class of AY15

On August 18, 61 early to mid-career technical professionals became the first SDM cohort to matriculate in the fall, the traditional start of the academic year for most, if not all, MIT students. (SDM previously started in January.) As in the past, fellows in the newest SDM cohort come from a wide range of industries, including energy, healthcare, software, defense, information technology, consulting, automotive, aerospace, and several branches of the US military. This year’s cohort also contains the highest number of women in SDM’s history.

Demographics
• 44 men / 17 women

Sponsorship
• 17 company-sponsored / 44 self-sponsored

Average age / average previous work experience
• 33 / 8 years

Program option
• 31 full-time, on-campus students, including three in the dual master’s program with the Singapore University of Technology and Design (SUTD)
• 26 local commuter students
• 4 distance students

Citizenship
• Algeria, Canada, Chile, China, France, Germany, India, Italy, Japan, Korea, Mexico, Nigeria, Peru, Saudi Arabia, Singapore, Thailand, Turkey, United States

Ephraim Chen
Aerospace Engineer, Flight Controls and Flying Qualities, The Boeing Company

“My SDM education will equip me to synthesize various engineering disciplines for technically feasible systems and enable marketing and execution of these systems as viable, real-world customer solutions.”

Ryan Seekins
Satellite Design Engineer, US Air Force

“The SDM educational experience will enhance my effectiveness in overcoming technical challenges in highly complex systems.”

Sarah Nolet
Former Product Manager, Charles River Analytics

“SDM’s customizable curriculum and its diverse, brilliant cohort will enable me to cultivate the network and strategies to help change the world for the better.”

Delph Mak
Former Industry Development Executive, Singapore Public Utilities Board

Dual-degree MIT SDM and SUTD

“SDM is ideal for someone like me who has interests across both engineering and management disciplines.”

Employment Report: SDM Graduating Class of 2013

SDM prepares graduates to lead effectively and creatively by using systems thinking to solve large-scale, complex challenges in product design, development, and innovation. The SDM program is committed to working closely with self-sponsored students to ensure they find career roles that both challenge them and enable them to help companies achieve key goals and missions.

As in prior years, SDM’s 2013 graduates were hired into top-level technical and managerial positions across a wide range of industries. Employers recognize that these individuals bring a unique and powerful combination of attributes to the workplace, including:

• an average of 10 years prior work experience;
• a rigorous academic education from SDM, including coursework from MIT’s School of Engineering and Sloan School of Management; and
• leadership and teamwork skills that equip them to appreciate and cultivate the diversity of thought necessary to solve complex problems throughout business and technical domains.

SDM annually surveys graduates of the previous year’s class to produce an employment report. This document provides an overview of the program’s self-sponsored students and the world-class corporations that hired them.

Highlights of this year’s report include:

• 100 percent employment of SDM graduates who responded to the survey;
• Average base salary of $112,500—an increase of 55 percent over base salaries reported prior to entering SDM;
• The top job functions selected by the 2013 graduates were product design/management (26 percent) and consulting/strategy (17 percent).

Hiring employers included Amazon Web Services, Apple, Chrysler, McKthink, MIT, Microsoft, NVIDIA, Oliver Wyman, Oracle, Procter & Gamble, SanDisk, and VMware.

For additional information, please contact Jonathan Pratt, director of recruiting and career development, sdm_careers@mit.edu.
2014 SDM Tech Trek Report

Each year, the SDM program runs two tech treks—one in California’s Silicon Valley and the other in the Greater Boston area—to offer SDM fellows opportunities to engage with, and learn from, executives at best-in-class companies. Designed to build upon students’ coursework at MIT, the treks give fellows an opportunity to tour a wide range of facilities, view product demonstrations, and engage in lively question-and-answer sessions with industry leaders. They learn about companies’ strategic, operational, and tactical challenges, as well as how they are being addressed from both technical and business perspectives.

The spring 2014 SDM Tech Trek to Silicon Valley exposed fellows to eight companies from multiple industries in less than one week. The trek was led by SDM ’14s Jan-Cor Roos and Tobias Walters with organizational assistance from all the participants.

Goals:
- Expand students’ knowledge of complex challenges across several industries;
- Establish and/or strengthen relationships between SDM and companies’ senior leaders and recruitment professionals.

Companies visited:
- Google Ventures
- Palantir Technologies
- AppDynamics
- Salesforce.com
- Intuit
- Tesla Motors
- SanDisk Corporation
- Yelp

Trip highlights:
- At Google Ventures, product partners Ken Norton and Rick Klau covered with SDM fellows for a three-hour meeting. They began by giving an overview of Google Ventures and detailing the company’s mission and successful investments.
- At Palantir Technologies, employees gave a company overview, facilities tour, and product demonstration.
- At AppDynamics, employees gave a company overview, facilities tour, and product demonstration.
- At Salesforce.com, employees gave a company overview, facilities tour, and product demonstration.
- At Intuit, employees gave a company overview, facilities tour, and product demonstration.
- At Tesla Motors, employees gave a company overview, facilities tour, and product demonstration.
- At SanDisk Corporation, employees gave a company overview, facilities tour, and product demonstration.
- At Yelp, employees gave a company overview, facilities tour, and product demonstration.

Key takeaways:
- Visiting companies in rapid succession provided valuable insight into the different cultures, strategic approaches, and challenges of each business, as well as a real-time opportunity to contrast and compare them.
- Interactive team-based design exercises developed by various companies gave SDM fellows an opportunity to apply systems thinking to specific challenges, demonstrate their high level of technical expertise, and rapidly develop prototype solutions. It also provided company leaders with a first-hand view of systems thinking in action and how it could be applied within their organizations.
- Meeting and engaging with SDM fellows enabled company executives, hiring managers, and recruiting personnel to experience the unique perspectives and skills SDMs acquire at MIT and to identify future graduates to recruit.
- SDM fellows acquired an expanded sense of the versatility and applicability of their SDM education across industries.

Upcoming Tech Treks

Each year, MIT SDM fellows, faculty, and staff visit best-in-class companies to discuss global business challenges and to learn various ways of addressing them directly from business leaders. In the 2015 academic year, SDM will hold two treks:

**Fall 2014**

- **October 14:** SDM fellows will visit top technology-based companies in the Greater Boston area, including The MITRE Corporation.

**Spring 2015**

- **March 23-27:** This five-day trek to California’s Silicon Valley will feature visits to companies in a wide variety of industries.

If your company would like to participate, please contact Joan S. Rubin, SDM industry codirector, at jsrubin@mit.edu, 617.253.2081, or Jonathan Pratt, director of SDM recruitment and career development, at jonpratt@mit.edu, 617.327.7106.
SDM Conference Centers on Emerging, Evolving, Established Leaders

The MIT System Design and Management (SDM) program’s annual Conference on Systems Thinking for Contemporary Challenges provides practical information for technical professionals on how to apply systems thinking to their most complex and pressing challenges. Each year’s event focuses on a single area, such as big data, healthcare, energy, finance, sustainability, or services. The theme for the October 8, 2014, conference is systems thinking for emerging, evolving, and established leaders.

“Systems thinking is increasingly a competitive imperative for leaders at all stages of their careers,” said Joan S. Rubin, SDM industry codirector and conference convener. “Not only must they understand how to apply systems thinking to address complex challenges, but their companies must be able to apply this approach to develop the systems-based thinkers that will become their future leaders.”

To help organizations succeed, the conference will focus on best practices for leaders at all levels. Speakers will include emerging, evolving, and established leaders (many of whom are SDM alumni) from a range of industry and government sectors. Companies represented include Intuitive Surgical, The MITRE Corporation, NASA, MIT Hacking Medicine, the US Air Force, Endeavour Partners, and more. Speakers will discuss:

- How to use systems thinking to align and lead functionally and geographically dispersed teams that are tackling complex challenges;
- Ways to monitor progress and results;
- Benefits achieved, lessons learned, and next steps for developing leadership within organizations and individuals; and
- How systems thinking has advanced their organization’s objectives and benefited their personal careers.

In addition, Matthew S. Kressy, director of SDM’s new Integrated Design & Management (IDM) track, will give a brief overview of this new offering, which will admit its first cohort in 2015.

The conference will include ample time for question-and-answer sessions following presentations as well as for networking with fellow attendees at a special reception that will take place immediately following the formal event. Attendees are also invited to the SDM Information Evening scheduled after the conference to learn more about SDM and IDM. Details can be found at sdm.mit.edu.

Head Back to the Classroom!

This year, SDM will offer preconference back-to-the-classroom sessions delivered by two of SDM’s best and brightest faculty members. This event, slated for the afternoon of October 7, will include:

- What is Systems Thinking and Why Is It Important? presented by Qi Van Eikema Hommes, lecturer, Engineering Systems Division, MIT; senior staff engineer, Volpe National Transportation Systems Center.
- A New Era in Project Management: Viewing Projects as Systems, presented by Bryan R. Moser, Ph.D., lecturer, System Design and Management, MIT; researcher, Design Engineering Laboratory, University of Tokyo; president and CEO, Global Product Design.

For details, please visit sdm.mit.edu or contact Joan S. Rubin, SDM industry codirector: jrubin@mit.edu.

During the test, the system demonstrated nearly 50 percent end-to-end energy transfer efficiency (i.e. amount of energy collected by the system that raised the water temperature divided by the theoretical maximum of energy available from the sun). The team was able to identify areas of further improvement to help the system move closer to the theoretical maximum efficiency of 90 percent. (Current marketed products for heating hot water using solar energy are about 60 percent efficient. Solar photovoltaics are only about 20 percent efficient.)

The AE team plans to offer a low-profile solar thermal collector that:

- lowers the barriers for entry to solar power use;
- immediately provides homeowners with savings on hot water heating bills;
- provides a maximum energy benefit using a minimum of space; and
- offers a platform that will be able to grow as the homeowner’s needs increase and change.

On top of all this, AE’s system, when installed in place of an electric water heater, will displace 3 tons of CO$_2$ from the Earth’s atmosphere over 10 years. Avalanche Energy believes that combining all these benefits into one product will change the landscape of sustainable energy for this generation and empower homeowners to achieve the solar future today.

For additional information visit AE’s website at www.avalanche-energyinc.com.

http://
The results: By using a CAST analysis to assess the accident at both the physical and hierarchical control structure levels, while considering coordination and communication contributors as well as dynamics in the control structure over time, the following findings were generated that considered the full system impacts.

- Initial determination that human error caused the USCG’s lack of response to a distress call was likely based on hindsight bias and missed many other systemic factors involved.
- Although the NTSB provided a detailed list of findings and recommendations that proved useful in guiding the USCG’s policy and capability changes in SAR communications, it did not take into account some of the higher level systemic factors that contributed to the day’s events, such as identifying gaps in feedback control structures inherent to the system and between those who developed USCG policies, training, and other capabilities and the end users of the system.

Improvements to NDRS implemented by the USCG, both through policy changes and capability upgrades via Rescue 21, helped correct many of these deficiencies. However, several feedback loop gaps noted in this CAST analysis still remain, warranting further investigation. Most notable are gaps between end users and system developers. The results of these findings are presented in Figure 4.

In summary, CAST is an extremely valuable tool for examining the ways that an entire system contributed to an accident. This form of analysis helps to identify and correct deficiencies and may therefore prevent similar accidents from occurring in the future. It can be very useful in determining sound technology and policy improvements in a constrained budget environment.
Annual MIT SDM Conference on Systems Thinking for Contemporary Challenges and Related Events

**October 7-8**

*Systems Thinking for Emerging, Evolving, and Established Leaders*

Wong Auditorium, MIT Details: See page 16

**MIT SDM Information Sessions**

Learn about the MIT master’s of science degree in engineering and management, the new Integrated Design & Management track, and the MIT-SUTD dual master’s degree program. Discuss career opportunities and network with SDM alumni, faculty, students, and staff. Details/registration: [sdm.mit.edu](http://sdm.mit.edu)

**October 8**

*MIT SDM Information Evening*

Bush Room, Building 10, Room 105, MIT

**November 19, 2014; January 14, 2015; February 25, 2015**

*Live Virtual SDM Information Sessions* (Recordings will be available on demand.)

Details/registration: [sdm.mit.edu](http://sdm.mit.edu)

**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 p.m. and are free and open to all. Details/registration: [sdm.mit.edu](http://sdm.mit.edu).

**October 20**

*The 2014 Midterm Elections: Voting to Surmount Financial/Political Barriers and Achieve Systemwide Change*

Nicholas Ashford, Ph.D., J.D., professor of technology and policy, MIT

**November 3**

*When Bad Designs Happen in Good Companies: A New Approach to Product Success*

Matthew S. Kressy, director and senior lecturer, Integrated Design & Management, MIT SDM

**November 17**

*The 2014 Midterm Election Results: A Systems Approach to Effective Collaboration*

Nicholas Ashford, Ph.D., J.D., professor of technology and policy, MIT

**December 1**

*System Theoretic Value Analysis of the US Coast Guard Search and Rescue Communication System*

Steven F. Osgood, captain, US Coast Guard and SDM alumnus. Details: See page 4

**February 9, 2015**

*Conceptual Modeling of Cyber-Physical Systems: Risk Management, Decision Making, and the Physical-Informatical Gap*

Dov Dori, Ph.D., professor of information and systems engineering, Technion—Israel Institute of Technology; visiting professor, Engineering Systems Division, MIT

**February 23, 2015**

*The Era of Makers: Why Gatekeepers Are No Longer Necessary for Creative and Financial Success*

Ali Almossawi, data visualization engineer, Mozilla, and SDM alumnus

Event information contains all details available at press time. Final details are available at [sdm.mit.edu](http://sdm.mit.edu) two weeks prior to each event.