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The newsletter of the Massachusetts Institute of Technology
System Design and Management Program

sdmpulse

in this issue

SDM thesis asks: Starbucks cup—trash or treasure?

By Ellen Czaika, SDM '08

Editor's note: *Ellen Czaika received a master of science degree in engineering and management from MIT in 2010. She is currently pursuing a doctoral degree in MIT's Engineering Systems Division.*

Ellen Czaika
SDM '08

What do you do when 80 percent of your cups walk out of your store, yet you want to create a system to recycle them? Engage the whole value chain. At least that is what Starbucks has been doing for more than two years.

The situation is not as simple as the cup itself, though the cup is a good artifact on which to focus. Cups are made of paper fiber with a coating, and often have a plastic lid and a cardboard sleeve. Recycling the cup is not as easy as dropping it in a recycling bin. Though, that certainly is a first step. From the recycling bins, cups then travel to facilities that bale and sell recyclable materials, and finally the cups are made into new products. Several questions still exist: Can the cups get baled with an existing grade of paper, or should they be separated into a class of their own? If they are separated, is it possible to create a market for bales of used cup material?

In her SDM research, Ellen Czaika worked on creating a system to increase the useful end-of-life options for used hot beverage cups, such as the ones used by Starbucks.

This complex multi-stakeholder system is precisely the type of system we study in MIT's System Design and Management Program (SDM). I got my first opportunity to work on this project through Leadership Lab (L-Lab), a course I took as an SDM student. I continued working on the project for my SDM thesis.

To get started, my L-Lab student team and I spent three weeks at Starbucks' Support Center in Seattle, WA. We visited a materials reclamation facility, a composting facility, and many departments within Starbucks, including the cup purchasing department, the storefront design group, and the global responsibility division. In addition to the contextualized learning, we conducted numerous interviews with stakeholder representatives throughout the value chain and within Starbucks.

Creating a system to recycle post-consumer paper coffee cups requires meeting the needs and interests of its many stakeholders, such as:

- **Recyclers**. Recyclers often run materials reclamation facilities, which are an elaborate interweaving of conveyor belts, magnets, and gears that sort materials from a single stream

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MITsdm
celebrating 15 years
system design and management

sdmpulse

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Managing Editor: Kathryn O'Neill

Contributors: Ellen Czaika, Joshua Eaton, Howard Gerwin, Trinidad Grange-Kyner, Brian Ippolito, Dave Morgan, Tom Pelland, Daniel Wallance, Maria Yang

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

MITsdm
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system design and management

Welcome

Google Health launched in May 2008, with significant fanfare, to create an innovative electronic system for health records that would allow individuals to manage their own healthcare. The roll-out was positioned as a logical step for a company that led the industry both in search engine capability and data storage. The entry of a company like Google into the healthcare market forced traditional players to take a step back and evaluate their own offerings. They had to evaluate how they would compete with a company that didn't have healthcare experience, but brought a whole new spectrum of capabilities to the challenges faced in the field.

Then, about a month ago, Google Health exited the electronic medical record space as a mere footnote—the effort never gained any real traction. What happened? As David Shaywitz explained in *Forbes* (June 17, 2011: "What Silicon Valley Doesn't Understand About Medicine"), the challenge of healthcare innovation is a true systems problem. Not all challenges in the field are amenable to purely technological solutions. Rather, success here will require both the traditional, data-driven, problem-solving exercise, and an understanding of relationships and human nature. Compassion will be an important component of any solution.

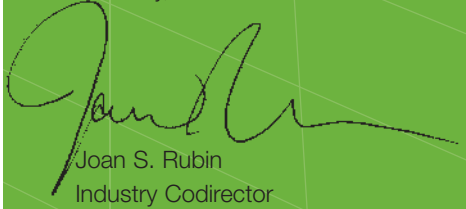
In SDM, we are seeing more and more students who are interested in helping shape the future of healthcare, and a rise in the number of companies that recognize that formal systems training is critical to future innovation. Systems challenges can be found in all industries today, and there is a common thread: solving part of the problem without considering the bigger picture won't provide the innovation necessary to move companies and industries forward.

As we publish this summer edition of the *Pulse*, we have just launched our recent graduates onto the next steps in their careers. Already many of our alumni are using their SDM experience to enhance system thinking within their companies. I encourage you to read the reflections of some of our early graduates (see pages 12-13) on the long-term benefits this program has afforded them. We also hear from Daniel Wallance on his use of system tools within the banking industry. His research and thesis work is being used to enhance the transformation process under way at Bank of America (see page 4).

SDM is also looking forward. The program recently joined MEMPC, the Master of Engineering and Management Programs Consortium. This is a group of top universities that have a similar focus on enhancing the education of technical leaders. Being part of MEMPC will help raise awareness of the SDM program and the value of engineering management careers.

In October, we will bring together 15 years of SDM classes, with leaders from both MIT and industry, for the MIT Conference on Systems Thinking for Contemporary Challenges (see page 3). This is a celebration of our program and an opportunity to hear more from world renowned speakers on the importance of using a systems-based approach to address complex challenges. We hope to see you on campus for this two-day event.

Sincerely,



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

Conference to highlight systems thinking, honor SDM's 15th year

By Lois Slavin, MIT SDM communications director

Each year, MIT's System Design and Management Program (SDM) sponsors a two-day conference on systems thinking. This event focuses on the importance of using a systems-based approach to address the complex challenges facing today's world—such as education, healthcare, energy, sustainability, and new product development.

The premise of the conference is that complex challenges require a new way of thinking, working, and leading that incorporates disciplines formerly seen as separate or, at best, linked. This conference is designed to provide information on applying a holistic, "systems thinking" approach to issues that integrates technology, management, and social sciences.

This year's event will also mark the 15th anniversary of the founding of SDM. The conference will include presentations from several SDM-affiliated MIT faculty members, senior executives, SDM alumni, and others who will share their experience, success stories, and lessons learned from applying systems thinking to real-world challenges.

Keynote speakers

Edward Crawley, SDM cofounder; Ford professor of engineering; professor of aeronautics and astronautics and engineering systems, MIT; and codirector, Bernard M. Gordon–MIT Engineering Leadership Program

Julian Goldman, MD, medical director of bioengineering, Partners HealthCare System, a principal anesthesiologist in Massachusetts General Hospital's "Operating Room of the Future," and director of the Program on Medical Device Interoperability at MGH and the Center for Integration of Medicine and Innovative Technology

Confirmed speakers

Devon Campbell, head of engineering and systems, Novartis Molecular Diagnostics

Steven Eppinger, SDM codirector; General Motors Leaders for Global Operations professor of management; professor of management science and engineering systems, MIT

Katharine Frase, PhD, vice president, IBM

Pat Hale, director, SDM Fellows Program; senior lecturer, MIT Engineering Systems Division

Sahar Hashmi, MD, SDM alumna and current MIT Engineering Systems Division (ESD) PhD candidate

John Helferich, SDM alumnus, former senior vice president of research and development, Mars Inc., and current ESD PhD candidate

Richard Larson, Mitsui professor of engineering systems; director, Center for Engineering Systems Fundamentals, MIT

Michael Little, PhD, global head of diagnostics development, Novartis Molecular Diagnostics

Joan S. Rubin, SDM industry codirector

Irving Wladawsky-Berger, PhD, chairman emeritus, IBM Academy of Technology, MIT visiting lecturer of engineering systems

In addition, a special anniversary celebration will be held on the evening of October 24 at the MIT Faculty Club for full registrants. For details, please visit sdm.mit.edu.

Bob Smith
SDM '97

Honeywell VP Bob Smith, SDM '97, offers insight on innovation

By Kathryn O'Neill, managing editor, *SDM Pulse*

Innovation is the lifeblood of the aerospace industry, and MIT's System Design and Management Program (SDM) provides many of the tools needed to inspire and foster innovation, said Bob Smith, chief technology officer and vice president of engineering and technology at Honeywell Aerospace, in speaking to a gathering of SDM fellows this spring.

"[SDM] provides the foundational thinking on the interaction of business and technology and gives you insight into dealing with large, complex systems—which I would argue are most systems today," said Smith, SDM '97, who gave the keynote address during SDM's spring "business trip," a week of activities that brought on-campus and distance SDM students together for lectures, workshops, and networking March 7-11 at MIT.

In his presentation, "Innovating and Competing in the Aerospace Industry," Smith provided a brief history of innovation in aviation—and noted its continued significance at Honeywell Aerospace, an $11 billion unit of the $35 billion multi-industry conglomerate.

Smith told the SDM students that although Honeywell's legacy includes the first autopilot flight controller, the first flight management systems, the first business jet

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System tools applied to enterprise transformation at Bank of America

By Daniel Wallance, SDM '10

Daniel Wallance
SDM '10

Systems tools and methods developed at MIT helped Bank of America Corporation (BAC) evaluate and successfully enhance its approach for a multi-hundred-million-dollar integration impacting 12 million customers—as well as future large-scale initiatives. The integration initiative, which was driven by senior management's desire to reduce operational risk and to "deliver the full value of the organization to all customers," formed the basis of both a six-month consulting engagement and my master's thesis.

With a historic collapse of world financial markets—which MIT Senior Lecturer Ralph Katz would refer to as a "marshaling event"—and the nearly finished integration of the Merrill Lynch and Countrywide acquisitions, Bank of America found itself looking inward. It found a remainder from the 1998 merger between NationsBank and BankAmerica Corp.: the states of California, Idaho, and Washington, internally referred to as California Northwest (CANW), exist as separate banking platforms from the rest of Bank of America's retail banking platform.

As part of the Bank of America's internal evaluation, senior executives identified this region as the one with the greatest potential to both decrease the operational risk presented by multiple banking platforms and to simultaneously offer additional value and services to customers. Thus began a multi-year and multi-hundred-million-dollar integration initiative to "provide nationwide consistency and efficiencies in processing and servicing customers and clients" and to "migrate to standard processes and technology across the enterprise."

I was brought in as a consultant and asked to provide an outside enterprise systems perspective on both the California Northwest transformation initiative and on the overall large-scale change management practices at Bank of America. Using the CANW transformation as a case study, this six-month consulting engagement formed the basis for my MIT master's thesis. I applied key systems thinking principles, tools, and methods to ascertain whether the CANW initiative and BAC's transformation processes and procedures are "complete and effective" and to identify additional factors that should be considered. While I had unprecedented access to a substantial number of senior executives and internal documents, a major limitation of my work was that the CANW initiative was ongoing, which meant that not all material existed at the time of this project. My conclusions and recommendations are therefore based on the material I was able to review.

Research methodology

I based my approach on the Enterprise Strategic Analysis and Transformation (ESAT) methodology, which was developed by the MIT Lean Advancement Initiative (LAI), whose codirector, Deborah Nightingale, was my thesis advisor. ESAT is a holistic framework for enterprise transformation that focuses on enterprise-wide processes and end-to-end value streams, considering all stakeholders and their needs. The output deliverable of the ESAT methodology, which reveals areas for improvement and waste elimination, is an actionable enterprise transformation plan.

For my research, I sought to identify all the stakeholders affected by the CANW transformation and their needs.

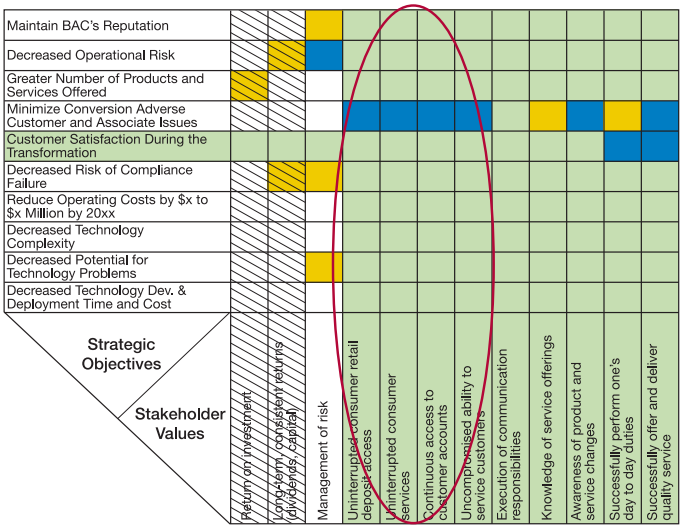

Figure 1. The first quadrant of the X matrix compares strategic objectives vs. stakeholder values.

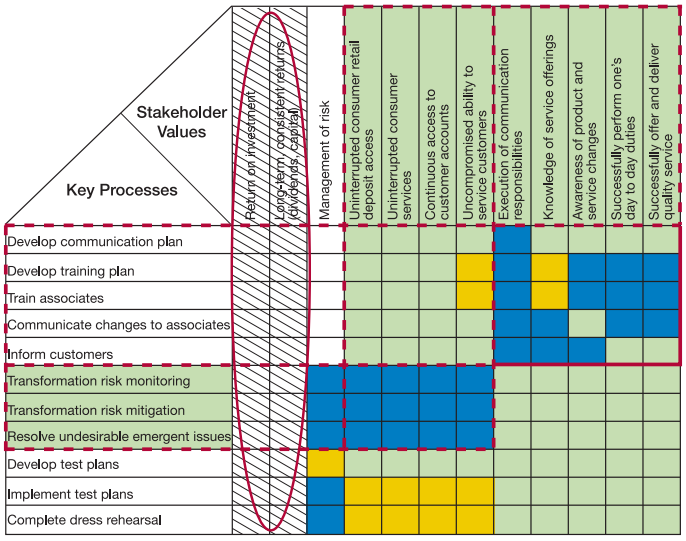

Figure 2. The second quadrant of the X matrix compares stakeholder values vs. key processes.

While the CANW material revealed that Bank of America had identified the usual stakeholders (including customers, associates, and stockholders) and considered their needs, applying the ESAT methodology and the systems principle taught in SDM uncovered other groups worthy of consideration. These stakeholders included rating agencies, the public, the change execution team, and regulatory bodies, all of which are affected by the CANW transformation.

My findings revealed a disconnect between the importance of the stockholder to the enterprise vs. the value delivered to that stakeholder group. This indicates that Bank of America should focus on transformation initiatives that benefit BAC stockholders—a focus that is in line with Bank of America's stated CANW transformation goal to decrease operational risk for the benefit of its stockholders. However, when looking at the customer/client stakeholder group, the difference between the value delivered to the stakeholder and the value received by the enterprise is less than that for the stockholder. While room for improvement exists, my analysis indicates that perhaps there should be less of an emphasis placed on the customer/client stakeholder group for the CANW transformation.

Progressing through the ESAT steps, the X matrix is an enterprise system analysis tool developed by LAI that analyzes internal enterprise alignment to answer the question "do an enterprise's metrics, processes, strategic objectives, and stakeholder values align?" Once completed, the X matrix reveals areas of misalignment where elements need to be recognized or developed.

After extracting California Northwest strategic objectives, stakeholder values, key processes, and metrics from internal BAC documents, I populated an initial X matrix. I then used this X matrix to recommend the identification or creation of new CANW strategic objectives, stakeholder values, key processes, and metrics (Figures 1-4).

A key strategic objective is to ensure that any adverse customer and/or employee issues resulting from the transformation are kept to a minimum during and after the CANW transformation. However, I was unable to locate any corresponding stakeholder values. Due to the criticality of stakeholder values, my research suggests that Bank of America develop deeper measures that focus on customer service and uninterrupted consumer retail deposit access during the transformation.

Comparing stakeholder values with CANW processes, three areas stand out as worthy of consideration for the identification, addition, or removal of enterprise attributes. While numerous communication and training processes exist, I was not able to identify any suitable corresponding stakeholder values. To close this apparent gap, stakeholder values should be identified or developed that focus on execution of communication responsibilities and awareness

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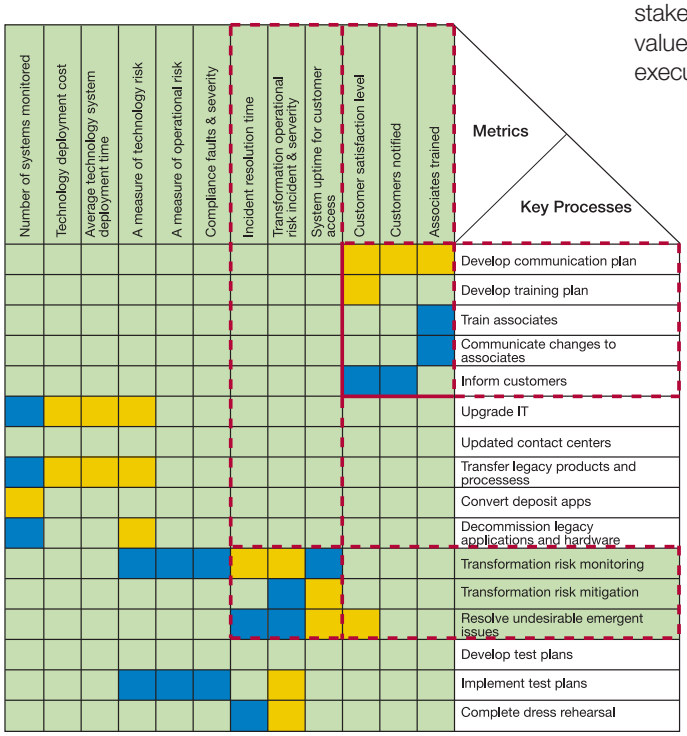

Figure 3. The third quadrant of the X matrix compares key processes vs. metrics.

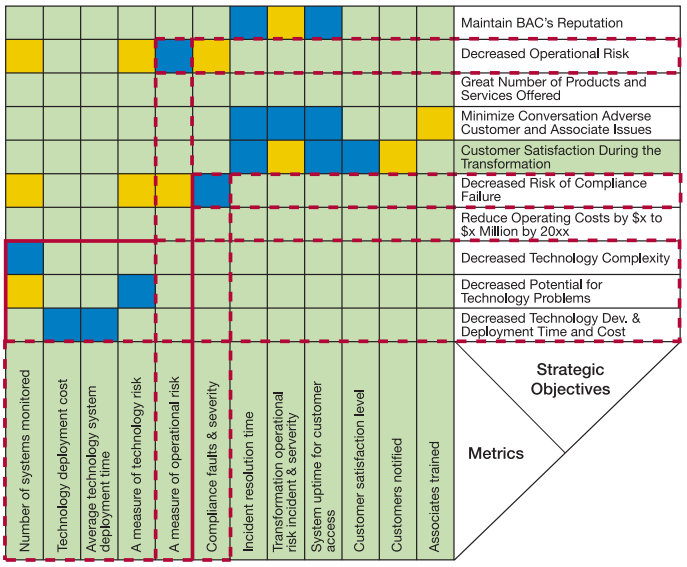

Figure 4. The final quadrant of the X matrix examines metrics vs. strategic objectives.

System tools applied to enterprise transformation at Bank of America

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of product and service offerings and changes. Further, in reviewing the X matrix and the stakeholder values, I found that return on investment and long-term, consistent returns are not critical for the CANW transformation; I therefore argue these should be removed. Finally, to complete one last gap, additional processes to monitor and mitigate the risk that the transformation poses to the bank should be identified or added.

Evaluating the key processes vs. metrics quadrant of the X matrix reveals significant deficiencies in the metrics used to track the key processes. This is partly due to the fact that at the time of my analysis the transformation was ongoing, therefore not all metrics had been developed by the California Northwest team. Two groups of metrics to add or identify are noteworthy. Possible communication and training metrics might include associates trained, customers notified, and customer satisfaction level. Metrics that track risk monitoring and mitigation processes worth considering include incident resolution time, transformation operational risk incident and severity, and system uptime for customer access.

The final quadrant of the X matrix examines the alignment between metrics and the CANW transformation strategic objectives. Again, while Bank of America admits that the CANW metrics have not yet been fully developed, two deficient metric groups—risk and technology—are worth noting. Possible risk-based metrics include compliance faults and severity and a measure of operational risk. Technology metrics worth considering include number of systems monitored, technology system deployment time and cost, and a measure of technology risk.

Recommendations

The ESAT analysis, X matrix examination, and overall systems thinking scrutiny allowed me to provide BAC with a number of insights and recommendations on its core transformation process. These include:

- Look beyond the usual suspects to identify and understand the needs of all stakeholders.
- Adopt a stakeholder-centric view to ensure that all stakeholders receive value, ensuring an "all hands on deck" mentality for transformation initiatives.
- Announce transformation initiatives publicly to create external accountability and an internal mandate.
- Back-check and ensure that all decisions made trace to specific stakeholder values and original research or analysis.
- Ensure that all strategic objectives are clear and concise and meet an industry standard framework such as that from the International Council on Systems Engineering.

Overall, while Bank of America's transformation process is effective, a systems-focused approach is needed to gain buy-in from all stakeholders and to ensure that no value is left on the table. System methods such as stakeholder analysis can ensure that Bank of America's transformation process is indeed "complete and effective."

Sponsoring SDM thesis pays off

By Lois Slavin, MIT SDM communications director

Jonathan Skvoretz

Jonathan Skvoretz, senior vice president and change management executive at Bank of America Corporation (BAC), learned about the opportunity to sponsor SDM thesis research from a BAC colleague—SDM alumnus Doug Hague, senior vice president for analytics.

Skvoretz and Hague were discussing the need to measure the company's large-scale change process against industry benchmarks. "As an organization, we had grown through acquisitions, mergers, and integration, however we needed to shift our focus to internal operations, deepening customer relationships, and correcting legacy issues," Skvoretz explained.

He added that BAC executives believed the work would best be done by an outsider who "could give us a fresh perspective" on the inside. "Doug suggested that we speak with SDM Fellow Daniel Wallance about sponsoring his thesis research to tackle this project."

Skvoretz says that Wallance's research (see article above) "provided us with the latest in academic thinking in large-scale change management, with an emphasis on stakeholder engagement methods and tools." For example, Wallance showed how lean concepts are being applied beyond traditional areas, such as manufacturing, to the finance and services industries.

BAC is now using Wallance's research to document and ultimately enhance change management protocol. "We've found several MIT SDM tools and methodologies that can be used in service-based industries. BAC can apply these to new frontiers in finance and reap the benefits."

To learn about sponsoring SDM thesis research, contact Joan S. Rubin, SDM Industry Codirector, jsrubin@mit.edu, 617-253.2081.

SDM foundation course introduces product design and development

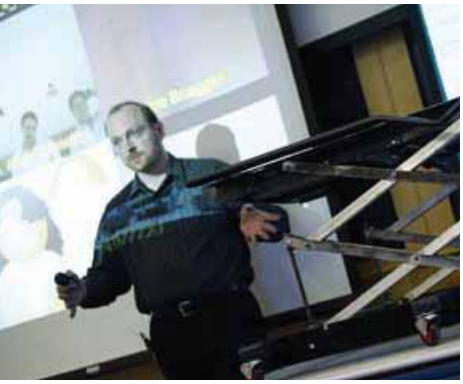
By Maria Yang, Robert N. Noyce assistant professor of mechanical engineering and engineering systems

Maria Yang

Editor's note: *Assistant Professor Maria Yang was this year's instructor for Product Design and Development, a foundation course in MIT's System Design and Management Program.*

One of the major advantages of MIT's System Design and Management Program (SDM) is that it emphasizes a systems approach to complex problems, allowing students to explore the product design and development process from beginning to end.

Product Design and Development (PDD), which I taught this spring, is a key element of the SDM curriculum, designed to familiarize students with each of the multiple functions involved in creating a new product, including marketing, industrial design, engineering, and prototyping, as well as finance and entrepreneurship.



Robert McKellar, SDM '10, demonstrates the Ant, which his PDD team designed to enable people to work more comfortably in confined spaces.

PDD class members Vivin Nath and Naveen Ranganath (both SDM '11) work on their presentation while teaching assistants Rutu Manchiganti and Avi Latner look on.

Our goal is to help SDM students come up with thoughtful, big-picture solutions that connect with customers and users. Whereas typical graduate-level engineering courses—and, indeed, engineering practice—often zero in on very specialized, technical issues, PDD asks students to also think about the broader aspects of the business. In this course, students consider such "front-end" questions as: What markets do we want to target? and How can we uncover and address user needs in a systematic way?

The course is practical, not just theoretical. Its centerpiece is a semester-long project in which teams of three to five students develop a marketable product. Each team must determine the market opportunities for their product, assess user needs, design and build a prototype solution, and develop a business case for design.

The goal is to come up with a solution that addresses a real need in the marketplace—not simply a technical solution that meets predetermined specifications. For that reason, the bulk of the first part of the semester focuses on helping students discover what people really want and need. They conduct interviews and surveys, but they also observe and take photographs—because people often say one thing and do another.

This point was brought home in a guest lecture by Danny Braunstein, a principal at Design Continuum, a Boston-area product design consultancy. At Continuum, all members of each design team begin with deep observation of their users' environment. So, if they were designing a new medical device, they visited hospitals, doctor's offices, and labs so they could see how users actually got their work done. Often, they found that people don't use devices they way one might expect.

To help the students focus their projects, we provided a theme for them to work with. This year's theme was healthcare and healthy living—and students chose to interpret this theme in a number of different ways, focusing on user groups as diverse as first-time expectant mothers, people who want to keep their teeth clean while on the go, and cyclists who commute to Boston.

Working from the needs they have identified, teams proceeded to generate concepts and solutions through brainstorming and other methods, for example, using Pugh Concept Selection to choose among alternatives. Although we do not expect exhaustive benchmarking studies, teams do some market research in order to discern what general solutions exist in the marketplace or if there is existing intellectual property. (The students conduct market research and user-need finding more or less at the same time.)

Once students have completed their market research and generated preliminary concepts, it is time for them to pick one product to pursue, then begin designing and protoyping. We emphasize the value of building fast, low-fidelity (less realistic), iterative prototypes that inform the team about specific aspects of their design. Each team must prepare a list of target specifications for the product, as well as a schedule of project work that includes design work, vendor interactions, prototyping, testing, redesign, and preparation of the final presentation. Throughout the design process, students are encouraged to consider, with the help of a practicing industrial designer, the product's aesthetics.

Finally, each team presents its product to a team of

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All-a-Board team comes out a cut above in PDD competition

By Joshua Eaton, SDM '11

Joshua Eaton
SDM '11

Editor's note: *Joshua Eaton and his teammates (all members of SDM's 2011 cohort) won this year's design competition in SDM's product design and development course.*

Product Design and Development (PDD) is a required course designed to give SDM students the full experience of designing and developing a new product. The class—one of the foundation courses in the SDM curriculum—is known for generating innovative ideas and launching startups. Our team was delighted to win the PDD competition for our all-in-one cutting board system. We hope this will be the first milestone on our way to becoming successful entrepreneurs.

PDD centers around one assignment—a semester-long project to conceive, design, evaluate, and prototype a physical product. Forming a project team was our first PDD task. Since a few of us had worked well together during SDM's January session robot design project, we decided to join forces again for the PDD design challenge. We then asked two more members of our SDM '11 cohort to join us to add breadth to the team.

The result was a diverse team with a range of skills—one we felt could tackle any task. I am a special forces officer in the US Army; Bassel F. Alsultan is a systems engineer working for Saudi Aramco; Scott McCarthy is a software architect with experience at Raytheon; Tomohiko Nakamura has seven years of experience designing mixed-signal circuits; Sergey Naumov has 15 years of experience in network and security operations; and Matt Renzi has a PhD in applied physics.

During the PDD course this spring, students were asked to focus their product on the theme of healthy living. Once our team was formed, therefore, we set to work evaluating several potential user groups, including members of MIT's Zesiger Center (the Institute's gym), the MIT Outing Club, the MIT biking community, and home cooks. After numerous user interviews, ethnographic research, and a more detailed market analysis, our team decided to target home cooks, a user group that appeared to us to have the most potential. Our thinking was, if the topic is healthy living, where better to focus our efforts than on a product that will facilitate preparing and cooking healthy meals?

The course taught us to look for user needs, both articulated and non-articulated, and to develop solutions for those needs. After selecting the healthy food preparation market, we chose three market needs based upon user feedback: easy food preparation, portion control, and simple cleanup. With these in mind, the team brainstormed possible ideas: a multi-function food preparation station, which addresses all three items, a food preparation kit for fast and easy home cooking, and a multi-function thermos for transporting food for children.

After further interviews of potential customers we decided to focus on the food preparation station. Initially, we planned a modular food dredging station (which would double as a cutting board holder) for coating foods before pan-frying or baking. However, we found that the modular cutting board portion of the solution was the feature that most resonated with home chefs. Therefore, we narrowed our focus to the needs of cutting board users.

Using ethnographic techniques studied in class, we observed cutting board users and found that typical cooks had a two-part process: chopping, then placing the chopped items into a container. The process is usually "complex" because it can involve several steps, such as sliding knives under the vegetables to lift them into bowls, using hands to lift them, and picking up the cutting board to slide the vegetables off. User surveys confirmed what we saw in the kitchen; besides a cutting board, the primary tools used were bowls for

Members of the All-a-Board team affix the cutting board to a router in the MIT Hobby Shop. They used the router to create grooves used to connect bowls to the cutting board. Team members from left: Sergey Naumov, Scott McCarthy, Matt Renzi, and Tomohiko Nakamura.

preparation and measuring. Through this research we identified an unmet user need: an easy way to slide chopped vegetables directly into a bowl—what we call the "no-lift process."

Further brainstorming on how to move vegetables to a bowl led us to evaluate multiple bowl connection techniques: magnets, clips, notches, and other creative solutions. Using a Pugh Concept Selection chart—a method for matching user needs to proposed solutions—helped us move toward our preliminary solution: a cutting board with clip-on bowls. The main Pugh criteria we used were aesthetics, cost, complexity, dishwasher-safety, size, and efficiency. We designed and built three early prototypes: one made of paper; one of foam; and one of foam, wood, and plastic. These provided valuable insight that informed the final prototype.

Ultimately, we created All-a-Board, a sophisticated-looking maple cutting board, with notches cut beneath the board for attaching ceramic bowls. A plastic chopping board overlay allows the cutting of meats on the same system. The prototype used commercial, off-the-shelf components; All-a-Board will eventually use bowls designed for specific sizes, (1-cup, 2-cup, 4-cup). The All-a-Board cutting system is a complete chopping solution: modular, attractive, and easy to use—for under $50.

The teams in the product design class identified a wide variety of ideas to meet the healthly living theme. Other products in the competition included a novel bike rack that provides helmet and accessory storage, an iPod holder that double as a gym wipe dispenser, a system to load a kayak onto the car, and a disposable toothbrush head for brushing on the go. Each solved significant user needs for healthy living and were all great product ideas. But, I think the user need we solved was universal; everyone who has cooked at home has developed a workaround for making the transfer from cutting board to bowl. Our solution provides an attractive kitchen product with an easy-to-use technique for healthy food preparation.

We are very proud that our design captured the jury's attention and won first prize in the PDD competition. But even better was the feeling we all had right after we had our final prototype made—"This is a great product!" Not surprisingly, some of our classmates and faculty members who saw our "works-like" and "looks-like" prototypes reacted by saying, "I'd buy it! How much will it cost?"

The jury's decision further bolstered our confidence and we look forward to continuing to work together in evaluating All-a-Board's long-term business potential.

MIT joins Master of Engineering Management Programs Consortium

MIT's System Design and Management Program (SDM) has announced it is joining the Master of Engineering Management Programs Consortium (MEMPC), a select group of forward-thinking professional graduate engineering management programs from Cornell, Dartmouth, Duke, Stanford, and Northwestern.

The MEMPC was chartered in 2006 to raise awareness of the master of engineering management degree and the skills developed through the combination of engineering and management coursework to prepare technology managers. The MEMPC member institutions share ideas, expertise, new curricula, and best practices.

"MIT's System Design and Management Program, which is celebrating its 15th anniversary this year, educates mid-career professionals to lead effectively and creatively by using systems thinking to solve large-scale, complex challenges in product design, development, and innovation. We are pleased to join the MEMPC," says Steven Eppinger, General Motors Leaders for Global Operations professor of management, professor of management science and engineering systems, and codirector of SDM. "We look forward to sharing ideas with the MEMPC member universities regarding the education of future technical leaders, and to collaborating with them to improve the quality and visibility of our programs."

"MIT's System Design and Management Program is welcomed into the MEMPC as another leading program in the field," says Robert Graves, director of the Master of Engineering Management Program at Dartmouth's Thayer School of Engineering. "The SDM program experience and direction will significantly strengthen the MEMPC in accomplishing its goals and promoting the profession."

As the engineering management programs in the MEMPC are growing and maturing, they are gaining popularity among students and employers. Job placement for MEM graduates, outpacing those of many other degree fields, suggests a growing awareness of the potential contributions that can be made by skilled engineers who understand the business of technology and can communicate and work effectively in interdisciplinary teams.

For more information about the MEMPC, please visit www.mempc.org. For more information about MIT's SDM Program, please visit sdm.mit.edu.

SDM thesis asks: Starbucks cup—trash or treasure?

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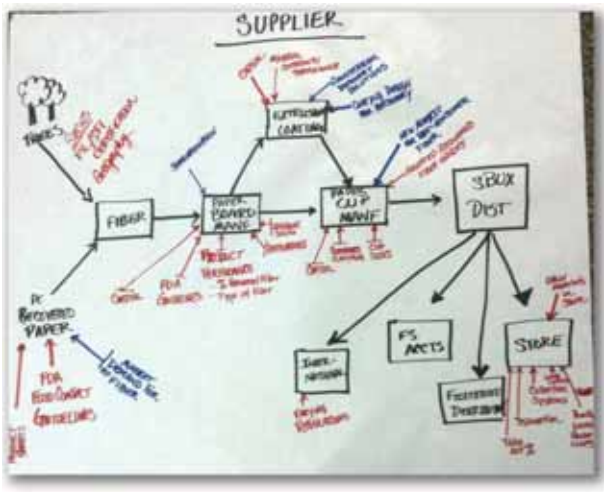
of recyclable goods into various materials to create bales for sale. Recyclers sell these bales to other entities, who use the materials in other products.

- **Customers**. Typically, customers drop cups into bins without pulling off the lid, taking off the sleeve, or washing out the coffee residue. More participation may be needed to separate cup materials before disposal—but customers, united only momentarily by purchasing coffee to go, are a diffuse and hard-to-represent group. Furthermore, not all customers place the same value on non-landfill end-of-life options for used coffee cups.
- **Companies that make paper cups**. These businesses earn revenue by volume of cups sold, and they want to update their business models to anticipate the growing customer trend toward less waste and less environmental impact.
- **Coffee retailers**. Starbucks and other retailers decide which cups to purchase. But, their primary focus is sourcing, roasting, and preparing the coffee that goes into the cups.
- **Municipal governments**. Governments typically enter into contracts for hauling waste, and they enact city ordinances and other regulations. They also earn tax revenue from coffee sales.
- **Haulers**. Haulers operate collection trucks, which they typically drive along established collection routes, contracted by municipalities (though the nature of this contracting potentially differs by region). Adding more specialized collections for separate materials would increase their operation and maintenance costs. They prefer to streamline their collection routes and minimize the number of drop-off locations.
- **Environmental nongovernmental organizations**. The mission of these organizations is to protect the environment; they can exert a great force within the system.

The stakeholder list above can vary by location. Because waste removal and processing facilities differ from region to region, the stakeholders also differ. For example, in areas with existing composting facilities, composters become a viable competitor for the used cup material. So, any system designed to recycle/compost must be able to accommodate local differences.

At the same time, many of the organizations involved operate on the national and/or global scale, so any approach taken also needs to be sufficiently coherent to allow these organizations to benefit from economies of scale. Furthermore, US governmental regulations and the regulations of other nations are pertinent in some cases. Therefore, the system to recycle/compost used beverage cups must be viable at local, national, and global levels of scale.



Participants in a workshop held by SDM students in January 2010 sketched out their view of the supplier system with constraints in red and incentives in blue.

The tools and methods taught in SDM are ideal to address the inherent complexity, nuances at different levels of scale, technical constraints, critical infrastructure issues, and diverse stakeholder interests of a system such as this cup system. Classes including System Architecture, System Dynamics, Product Design and Development, Negotiation and Dispute Resolution in the Public Sector, and Power and Negotiations have all been instrumental in my engagement with this project.

Toward the end of the three weeks in Seattle, my L-Lab team and I facilitated a workshop that assembled stakeholder representatives at the Starbucks Support Center in Seattle for a day focused on addressing the end-of-life options for hot beverage cups. We used facilitated systems thinking methods we had been learning in L-Lab and other SDM courses to help stakeholders better understand the system as it currently exists and to design means of achieving their goals of no cups in landfills.

The "MIT Workshop," as Starbucks called it, began *in medias res*, in the middle of things, between two larger and professionally facilitated "cup summits." The first summit was held in May 2009 in Seattle and the second was held April 22-23, 2010, at MIT.

Dr. Peter Senge of MIT and the Society of

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Human Side of Technology class gives SDM cohort practical insight

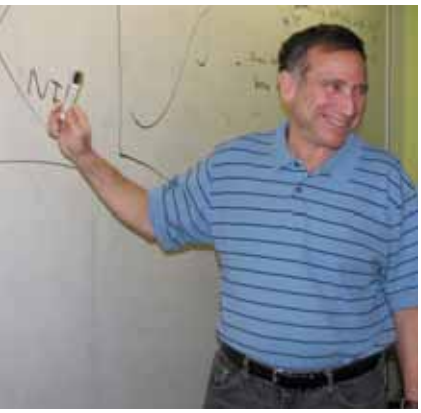
By Dave Morgan, SDM '10

Dave Morgan
SDM '10

Editor's note: *Dave Morgan is a colonel in the US Air Force and a Fellow in MIT's Lean Advancement Initiative.*

Each January, a new cohort enters MIT's System Design and Management Program (SDM) and begins the monthlong "SDM boot camp." As the new students start the program, Pat Hale, director of the SDM Fellows Program, explains that SDM's goal is to help students to think more holistically and to become better managers of technology and people. Fittingly, among the first steps we take as a cohort is to attend Senior Lecturer Ralph Katz's class, the Human Side of Technology.

Technology moves so quickly these days that it is easy forget that people make it all happen. Although humans develop technology, we are more complex than the technologies we develop. SDM's Human Side of Technology course hones in on the people behind the technology and how best to lead them.



Senior Lecturer Ralph Katz teaches the Human Side of Technology.

The first leadership lesson of the class was the "F word." I thought I had this one locked down until Katz pulled a fast one and explained he meant "Focus." One of the primary goals of leadership, he said, is to focus people. Most SDM students are engineers who will be leading technology projects—work that can involve hundreds or even thousands of people. A leader needs to focus his or her team and leverage the energy, expertise, and creativity of each member—as well as the synergies of the group—to put forth a product that will succeed in the marketplace.

For example, in my job as director of logistics and Support Products for the F-35, I am responsible for the training of pilots and maintenance personnel, providing support equipment for aircraft, information systems, fleet health management and technical data etc. The program is extremely busy, and it's important for all the engineers on the job to stay focused on their own phase of the project. Therefore, my job as leader is to field assignments and funnel them to the right person. I deal with other high-level managers, keep the big picture in mind, and work to reduce the stress of the day for those who report to me.

Focus also means the ability to zero in on issues phase by phase. While the leader may have to focus his energy on seeing through the entire concept from start to finish, the team must focus on each phase in turn—from concept to demo to market introduction. As Katz says, "Stay in the problem space." This simply means that you have to solve one problem completely before moving on to the next challenge.

Too often, technology teams are so eager to get the product to market that they speed through phases, which can lead to rework or even flawed products. While large companies such as Microsoft or Apple can withstand an occasional less-than-perfect product introduction, for most companies that can be a catastrophe.

Another lesson—one of the most important Katz discussed—involves reducing uncertainty. Although uncertainty is both ubiquitous and difficult to measure, a leader's job is to minimize uncertainty as much as possible. Katz explained that leaders can do this first by thinking about what generates uncertainty. He said that ambiguous communications are very often a root cause, because information is transferred through words, and organizations make critical decisions based on information they gather and synthesize every day. Therefore, leaders must be careful about the subjectivity and objectivity of the words they use. When communications are unclear, uncertainty spreads.

To illustrate this point, in class we watched a video re-creation of a real-life case in which a new team member, "Simon," joins a company. Simon is a technological whiz kid who quickly solves several of the company's longstanding problems, earning praise from his manager's boss. But this leads the manager to become uneasy about his place in the company. His boss' praise of Simon and a lack of communication leads him to believe he'll be fired—and so he takes a job at another company. The manager's job was never really in jeopardy; he was good at keeping people on track, while Simon had poor people skills. But the boss failed to reassure him and unfortunately the company lost a good manager through a lack of communication.

Another common cause of uncertainty is change, Katz says. People naturally do not like uncertainty and change can sometimes cause negative stress to an organization, making it less efficient.

Like professional athletes, organizations perform best when they are confident. In a technological organization, workers who are uncertain about the company's future will be afraid to create, because they're afraid to fail.

That's why 3M, for example, gives its engineers time for outside projects. While there is structure in the defined

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Alumni reflect on long-term benefits of SDM experience

Editor's note: *In honor of the 15th anniversary of MIT's System Design and Management Program (SDM), the Pulse recently asked some its alumni to reflect on their SDM experience, as well as describe how their formal learning at MIT has helped further their careers.*

Tom Pelland, SDM '98
Vice President and General Manager
Air Management Systems
Hamilton Sundstrand

About work

I run a multimillion-dollar business with products that are incorporated into virtually every large commercial and military aircraft in service today. I'm in charge of meeting financial results and customer commitments, as well as design and manufacturing activities. I have about 450 direct reports and am responsible for the work of approximately 1,800 within Air Management Systems.

Reflections on the SDM experience

I was looking at an MBA, but decided on SDM because it offered a much better fit with its technical and financial focus. The curriculum matched very well to the skill sets that I needed. The cross-section of industries represented in the SDM cohort was also important to me because it demonstrated that the challenges we have in aerospace aren't that different from those in other businesses. There are still folks I keep in touch with that I call on occasion to bounce around ideas.

Long-term advantages of SDM

Without a doubt, systems thinking is becoming increasingly important. In a highly technical organization, managing interfaces in such a way that nothing gets left behind is difficult. SDM helped me to understand organizational dynamics and systems dynamics modeling, and allowed me to bring best practices back to my company. Having systems-level thinking is going to become more important in our industry as we seek more efficiencies in what we do.

Brian Ippolito, SDM '98
Chief Executive Officer
Orbis Technologies Inc.

About work

Orbis Technologies gives organizations the technological, architectural, and engineering know-how to build private cloud computing and semantic web platforms and applications. With about 50 employees, we provide highly specialized software development, technology assessments, planning services and even technology forecasting. All of our clients have near-Internet-scale data problems.

Reflections on the SDM experience

SDM prepared me for markets and market conditions that weren't even imaginable when I was in the program a decade ago. Back in the '90s, delivering software-intensive systems on schedule or within budget was extremely difficult, which is why I had very specific needs for graduate school. I thought a purely technical master's degree was too narrow and an MBA was too broad. What I was looking for was something that balanced both, which I found in SDM. It prepared me for a career path that wasn't even defined when I was part of the program.

Long-term advantages of SDM

The challenges in today's market are greater than they were a decade or even two years ago. Tight credit, difficulty securing funding, and market uncertainties compound the challenges of establishing a company in new, rapidly growing, billion-dollar markets. In the current economic environment, running a technology company requires a management team that understands the details of systems engineering, system architecture, and the product development process, as well as business operations and financials. The combination of technical knowledge and business acumen that SDM provides isn't just a competitive advantage, it's a necessity.

Trinidad Grange-Kyner, SDM '07
Senior Consultant
Deloitte Consulting

About work

My current assignment is to coordinate the transition to a new coding system for a major national health plan. The federal government has mandated that all entities in the healthcare industry make this transition by 2013. My role is to support the health plan as it manages this monumental transformation, which includes multiple projects across most of the enterprise. I also have an ancillary role in which I am leading the organization of an education summit as part of Deloitte's pro bono initiative to improve education outcomes.

Reflections on the SDM experience

SDM gave me the broad perspective needed to expand from a project/program manager of individual software projects to one who is able to manage much larger-scale projects. The experience has helped me give clients broad insights into any trouble areas that might impede their success. SDM has also enabled me to move from working solely in the software/telecommunications industry to a role in which I am gaining experience in a multitude of industries, including financial services, healthcare, and education.

Long-term advantages of SDM

Some key lessons continue to resonate with me, notably the whole system perspective I gained from system dynamics. I also acquired project management insight that helps me think outside of the siloed view clients usually have; that has been of great value. In my work as an engineer and later as a software project manager prior to enrolling in SDM, I never had a reason to understand enterprise financial matters. Now I remain hugely appreciative of the financial accounting class I took at SDM and how it enables me to serve my clients. Finally, the commitment MIT and SDM has to integrating technology into society is now something I am passionate about. In fact, my SDM thesis led to what is becoming my life's work, facilitating the growth of technology in the educational systems of developing nations.

Howard Gerwin, SDM '98
Manager, OEM Engine Programs
John Deere Power Systems

About work

I joined John Deere in July 2004 after 12½ years at Ford. I initially came to Deere to develop a strategy for emissions improvements on existing products. For the past six years, I have been managing engineering for the original equipment manufacturer (OEM) engine business. Our engines come from factories in Mexico, France, and Iowa. OEM sales represents 35 percent to 40 percent of Deere's engines annually. I have 4 managers and roughly 44 engineers, designers, and technicians working for me.

Reflections on the SDM experience

A couple of areas stick with me, particularly the lessons about how to look at an organization and how it functions. This was an eye-opener. Systems dynamics was really important. Looking at problems from a systems thinking perspective helps me better understand interactions, which gives me both strategic insight and an advantage over my peers. I went to SDM a long time ago, but all of these lessons have helped me become a more effective manager. Some are second nature now.

Long-term advantages of SDM

Systems engineering is even more important now than it was when I went to SDM. It's maturing as a field, and the value is becoming greater. Since I've come to John Deere I've been an evangelist for systems engineering in general and SDM in particular. Many Deere employees have gone through the certificate program, two have completed the MS program, and three more are currently enrolled! SDM has gone through a natural evolution and has consistently improved the curriculum. It's good and it's gotten better. I'm kind of jealous of today's students!

Human Side of Technology class gives SDM cohort practical insight

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program, the company gives people the space to think freely, without fear of failure. In contrast, putting employees in the position of simply reacting and fire-fighting spells doom for an organization. In the most exteme cases, uncertainty can not only lead to a loss of focus and creativity, it can lead the company to lose its best people. The leader's job, therefore, is to build confidence in the company's vision and to reduce uncertainty as much as possible to foster a more efficient and harmonious organization.

The last lesson I want to share is from my introduction to SDM back in January 2010. Leaders frequently ask questions to get the information they need to make decisions, but it's inappropriate to ask subordinates every trivial question. We were taught that each person must pick the right question to stimulate creative thought. So, the first task is to ask yourself: Is this question relevant—will it really help address the root issue? This process may save valuable time and give deeper insights into vexing problems.

Looking back on my 18-month SDM experience, the Human Side of Technology was one of my favorite classes. Katz has energy and style, and although I doubt *he* thinks he is entertaining, I suspect most of my cohort enjoyed more than a few chuckles in class.

Along the way, we also learned valuable lessons, as noted above. Katz made us remember that technology cannot happen without people and that technology companies must have leaders that focus the organization on its goals. Although uncertainty cannot be eliminated, leaders must try to reduce it as much as possible. In the end, success is about people, teams, and how you motivate them to reach their potential.

I've been in my current job almost three months now, and the benefits of some of Katz's concepts are very clear—particulary focus. I am responsible for leading six teams with more 100 people in approximately seven different locations. Keeping them focused is very difficult, but it is important to successfully completing key tasks. "Remaining in the problem space" is also vital. One of the reasons I believe failure occurs is rushing to completion without properly investigating the problem. I am now trying to apply SDM lessons to my team's operations every day.

January 2010 was 18 months ago but some lessons stay with you forever. Thanks Professor K!

Starbucks cup—trash or treasure?

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Organizational Learning facilitated both summits. I worked with Senge and the Starbucks steering team in designing the agenda for the Cup Summit 2, I led a participant activity in the summit itself, and I helped coordinate logistics.

The cup initiative is a "systems problem"—one having technical, management/organizational, and socio-political components—for several reasons: the performance requirements for the cup itself necessitate a combination of materials; infrastructures differ by location and are not easily or inexpensively changed; not all of Starbucks' customers place the same value on non-landfill end-of-life options for the cup; and local governments are experimenting with regulation for food container end-of-life options. Creating a system that incorporates the most important interests of all its stakeholders is essential to the system's success.

In my SDM thesis, I explored the role that facilitated systems thinking has played in this cup initiative. Using the MIT workshop we conducted as a pilot study to evaluate the methodology, I found evidence that facilitated systems thinking increased stakeholders' awareness of other value chain members' interests and of their own responsibilities and leverage points within the system.

I am continuing this work at the doctorate level, in the Engineering System Division doctoral program. I anticipate that facilitated systems thinking and/or consensus building principles will become a very useful addition to the system architecture and design processes because they will give architects and designers more information about stakeholders' wants and needs and, ideally, involve stakeholders more directly in designing their own systems. This may be especially beneficial for systems that span organizational and industry boundaries and where technical expertise and knowledge about stakeholder interests are dispersed.

So, what do you do with the paper cup you just enjoyed coffee in? Follow the signs on the bins in your local area, and as you are placing the cup in the bin, design options to remake used cup material into other products. Your idea could be the next big thing.

Honeywell VP Bob Smith, SDM '97, offers insight on innovation

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turbofan, and other firsts—the company doesn't rest on its laurels. "All of our customers pay us for innovation," he said. "Within the aerospace industry, you either innovate or you die."

Smith said Honeywell works hard to keep its product pipeline fresh by employing three types of innovation:

Product innovation—The simplest kind of innovation, Smith said, is making an existing product better. He used examples from other industries to illustrate his point and cited the Swiffer dust mop as a great one. "It's basically a paper towel on a stick, but it's a wonderful piece of innovation," he said, improving on the traditional mop by enhancing both its usability and convenience.

Market innovation—More sustainable than product innovation, this kind of innovation is about discovering and fulfilling needs the customer didn't even know he had, Smith said, calling Starbucks a case in point. "It really wasn't the coffee that brought everybody to Starbucks," Smith said. "They are paying $4 for the experience—because they like the jazz and the café environment. Otherwise they're going to Dunkin' Donuts."

Business model innovation—This is the real game changer, Smith said, citing the iPod. "[Apple] didn't invent the mp3 player," Smith noted. "They changed the market distribution channel for legal and profitable digital music by inventing iTunes to go with the iPod."

How does one replicate such success? Smith suggested that cultivating diversity in your thinking—a skill SDM encourages—is critical. "The reason a lot of senior managers fail is that that they've succeeded by doing the same things in the same ways for a long time, and then a situation occurs in which that doesn't work," he said. "The multi-industry aspect of the SDM academic program is great because it helps highlight blind spots in your own industry" so you can avoid this trap.

Smith noted that when he was at SDM one of his fellow students worked at a camera and film company, and at the time the company was most concerned about the threat posed by other film companies. "We kept telling him, 'You need to be thinking about image [not film] as your business,'" but the student was convinced that film was king. "He was trapped within his own organization's thinking."

In contrast, Smith said Honeywell has continually profited by thinking about old products in new ways. The company currently has a high market share in inertial gyros because it has historically stayed on top of advances in measuring orientation. Similarly, the company's success in selling centrifugal compressors can be traced to past efforts to find new ways to apply that technology.

Smith urged SDM students to use the program fully to broaden their thinking. "Spending time with your [SDM] colleagues and understanding their business models, as well as the trends they have to address worldwide, is very important," Smith said.

Smith also praised SDM for offering invaluable skills in business analytics, giving him insight into the importance of systems interactions, and providing "inordinately helpful" lessons in organizational design. Organizing for innovation is challenging, he said, but Honeywell works hard to give employees a sense of ownership over their work and to provide a reward system that keeps people engaged.

"Ideation can be guided by models and methods, but inspiration, great ideas, and a great environment are essential," he said. "You have to organize around [innovation], reward people for it, and celebrate it when it's done well so that everybody understands why it's important."

SDM foundation course introduces product design and development

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judges drawn from industry. An effective presentation includes a live demonstration of the hardware or software and mirrors the kind of presentation a team would make to persuade management or a venture capitalist to fund its final development and launch.

It's always tremendously satisfying to watch the final presentations because you can see the teams go from literally nothing to a prototype in just a few months. Even more, these presentations evoke compelling visions for each product, including branding, graphic design, logos, and future product lines. The prototype is just the starting point.

SDM students come away from PDD with a broader understanding of product development than they had as engineers working to meet a set of design requirements. What we ultimately hope to teach in PDD is that by being part of the upstream process, you can come up with better requirements and better, more successful products.

Massachusetts Institute of Technology

SDM calendar summer–fall 2011

If you or your colleagues are interested in attending any of the events listed, please contact SDM Industry Codirector Joan S. Rubin at jsrubin@mit.edu or 617.253.2081

July 11, 2011
MIT SDM Systems Thinking Webinar Series
Transformation at Bank of America: An Enterprise Systems Analysis
Daniel Wallance, SDM alumnus
Location: Virtual
Time: Noon–1 pm

July 25, 2011
MIT SDM Systems Thinking Webinar Series
Five Capabilities for Enterprise Change: Approaches for Integrating Continuous Improvement and Strategic Change across Organizations
George Roth, Principal Research Associate, MIT Sloan
Location: Virtual
Time: Noon–1 pm

August 8, 2011
MIT SDM Systems Thinking Webinar Series
SDM alum John Helferich, former senior vice president for research and development, Mars Inc., and ESD PhD student
Location: Virtual
Time: Noon–1 pm

August 22, 2011
MIT SDM Systems Thinking Webinar Series
Solar-Powered Refrigeration Systems for Cold Food Distribution
Sorin Grama, SDM alumus, and Sam White, cofounders, Promethean Power Systems
Location: Virtual
Time: Noon–1 pm

September 19 & 26, 2011
MIT SDM Systems Thinking Webinar Series
SDM alum Jean-Claude Sagbhini, CTO, Wavemark
Location: Virtual
Time: Noon–1 pm

October 23, 2011
SDM Alumni and Student Mixer
Location: MIT Faculty Club
Time: 6–9 pm

October 24-25, 2011
2011 MIT Conference on Systems Thinking for Contemporary Challenges

Keynote speakers:

Ed Crawley, SDM cofounder; Ford professor of engineering; professor of aeronautics and astronautics and engineering systems; codirector, Bernard M. Gordon-MIT Engineering Leadership Program

Julian Goldman, MD, medical director of bioengineering, Partners HealthCare System; Principal Anesthesiologist, Massachusetts General Hospital "Operating Room of the Future"

Confirmed speakers:

Devon Campbell, head of engineering and systems, Novartis Molecular Diagnostics

Steven Eppinger, codirector, SDM; General Motors Leaders for Global Operations professor of management; professor of management science and engineering systems, MIT

Katharine Frase, PhD, vice president, IBM

Pat Hale, director, SDM Fellows Program; senior lecturer, MIT Engineering Systems Division

Sahar Hashmi, MD, SDM alum and current ESD PhD student

John Helferich, SDM alum, former senior vice president of research and development, Mars Inc., current ESD PhD student

Richard Larson, Mitsui professor of engineering systems; director, Center for Engineering Systems Fundamentals, MIT

Michael Little, PhD, global head of diagnostics development, Novartis Molecular Diagnostics

Joan S. Rubin, SDM industry codirector

Irving Wladawsky-Berger, PhD, chairman emeritus, IBM Academy of Technology; MIT visiting lecturer of engineering systems

Location: Wong Auditorium, MIT
Time: 8 am–5 pm

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