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New Ford Escape Hybrid

Ford Partnerships Drive Results Across MIT

By Nancy DuVergne Smith

The mutual commitment between the Ford Motor Company and MIT is larger than the sum of its financial commitment. The multimillion Ford-MIT Alliance begun in 1997 has connected academics and Ford partners on more than 80 research projects to date, spanning Institute interests from voice recognition to future energy sources.

to more than 30 projects at the Laboratory for Energy and Environment (LFEE) and affiliated programs. The globalization of economic, environmental, and security-related concerns has given the transport industry a vested interest in both competitive advantage and sustainable strategies like clean energy.

Ford-MIT Alliance initiatives are fostering more than great research, said John Heywood, SunJae Professor of Mechanical Engineering and co-director of the Ford-MIT Alliance. “First, in the highly interactive approach we are using to develop new research activities, MIT faculty, Ford engineers, and the Alliance management team work closely together to define high-impact potential projects. Second, we are developing really effective ways to communicate, back and forth, while the research is in progress.”

Beginning in 1996, Ford helped launch the MIT Consortium on Environment Challenges and a four-university consortium, the Alliance for Global Sustainability (AGS) with projects ranging from ultrasonic welding to traffic flows. With the founding of the MIT-Ford Alliance in 1997, the company established a fund to leverage projects emphasizing new technologies as well as needed economic, social, and organizational change. Projects included a Wells-to-Wheels study of green vehicle policy. Beginning in 2000, Ford representatives joined the AGS International board to help broaden the agenda and MIT participation in projects such as recycling end-of-life vehicles.

With Simon Pitts, the new executive director from Ford, joining MIT’s Executive Director Joseph Saleh on campus this fall, the Ford-MIT Alliance is advancing both new and established research projects. These four projects illustrate the breadth of Ford interests and influence.

In May, a team led by LFEE Director David Marks briefed Ford executives on MIT’s climate research, its implications for business, and on a new, large-scale initiative on near-term energy strategies. That conversation continues this fall focusing on topics such as emissions trading, carbon sequestration, infrastructure for a hydrogen economy, and energy security issues.

Boosting Energy and Environmental Efforts
Global problems – like sustainable energy – require bold approaches such as the Alliance’s commitment

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Sustainable energy options are critical to carmakers. Transportation and fixed energy plants each account for about half the world's petroleum use, Marks said. However, regulatory efforts are more likely to aim at the 20 or so global automakers that are easy to identify than the millions of facilities worldwide generating electricity.

"Ford needs to establish its strategic position about these issues and we are helping them, through MIT's many research approaches, see the broader implications of growing energy use, environmental impacts, and technological and regulatory advances. That's one way Ford is getting value out of this relationship. And we, of course, always get value out of the relationship. We can't prepare people to go into industry if we don't understand their problems. And the research product itself allows us to advance the debate about pathways to a sustainable future and the methods that will identify them."

Web Simulation Supports Holistic Design

In the Computer Aided Design (CAD) Lab, co-director David Wallace has been working since 1996 on a new modeling concept and software that allows product designers to share, integrate, and experiment with each other's computational models easily. While the World Wide Web allows users to navigate and contribute to a network of static documents, the Distributed Object-based Modeling Environment (DOME) allows users to dive into networks of dynamic computational simulations.

The difficulties are formidable whether

the product is an air conditioner or an automobile. Computer-based model making is embedded in software environments such as Mathematica or MATLAB. If designers are using different starting points, their models can't easily interact. Building new environments is time-consuming and, often, they are hard to change and hard to use. DOME creates a fast and flexible way to connect complex models using the Internet.

"We've had funding from Ford since 1998," Wallace said. "We wanted to test the idea on real problems because a lot of the complexities are due to the realities of the design environment. Every year we've done different types of applications with them. That allows them to explore the relevance of the technology in their environment and, hopefully, address a problem, for instance, in the supply chain or in assembly. For us in the lab, it allows us to test ideas at Ford with real users."

"What we've been able to do with Ford is show that this type of approach allows you to build the models much faster and more cheaply, to evolve and change them, and to reuse them flexibly. It removes the barriers that prevent integrated modeling from being practical."

Systems Vision Enables Change

A new role, closure systems integrator, was created last year by Ford to close a critical gap: creating high quality parts did not necessarily guarantee high-quality systems. The solution was to create a system-driven product development and manufacturing process to assure that interfaces between parts and the organizations that created them were coordinated to deliver top performance. Choosing closures such as doors, trunks,

FORD-MIT ALLIANCE SNAPSHOT

Executive Committee

Gerhard Schmidt, Ford Executive Champion, VP Research and Advanced Engineering
Phillip Clay, MIT Executive Champion, Chancellor
Sue Cischke, VP Environment and Safety Engineering
Will Boddie, VP North American Engineering
Al Ver, VP Advanced Manufacturing

Operating Committee

John Heywood, MIT Co-Director
Joe Saleh, MIT Executive Director
Elaine Savage, MIT ILP
Simon Pitts, Ford Executive Director
Ed Krause, Ford Alliance Coordinator

Scope

Five-year, \$25 million commitment begun 1997; renewed in 2002

Projects

More than 80 projects across the Institute to date

and hoods – a key aspect of the perceived quality of a car – provided a model of a business improvement that required more than a tune-up.

Ford leaders tapped both technical and organizational expertise at MIT. Janice Klein, senior lecturer at the Sloan School of Management, and Daniel Whitney, CTPID senior research scientist, took on the three-year project to understand the technical and organizational enablers and barriers to making the closure system integrators successful and to improve the design, production, and assembly of these complex systems.

“Ford needed an organizational change to rebalance the focus of attention,” Whitney said. “The excellence they put on the parts ought to be extended to the higher levels so you have an excellent door, for example, rather than a collection of excellent parts.”

Klein and Whitney’s team, including a System Design and Management student on leave from Ford, has conducted over 75 interviews and participated in Ford managers’ and engineers’ weekly Tech Club meetings to better understand the organization and culture. Two Leaders for Manufacturing interns at Ford are developing system-level design and analysis tools. One student has begun using Whitney’s Datum Flow Chain to track each part back to its producer and then describe the relationship of the producers across manufacturing and product development arenas.

“To use the tools and maps that Dan is developing requires more than a major organizational change,” said Klein. “Thinking about systems issues is a paradigm shift and requires a major recon-

ceptualization of the way closure systems are designed and manufactured.”

Talking to Cars – and Getting Results

Most people have talked to cars - often not very politely. At the Computer Science and Artificial Intelligence Laboratory (CSAIL), however, people are building the tools that will allow drivers to speak to their cars and get a useful response.

James R. Glass, head of CSAIL’s Spoken Language Systems (SLS) group, is working with Ford to explore the use of core technologies such as speech understanding and dialog modeling in realistic operating environments. MIT students have spent the past two summers at Ford road testing next-generation In Vehicle Conversational Interfaces and collecting data. A current activity is dynamic address recognition that will allow users to tell on-board navigation systems a destination, rather than having to enter it via keystrokes.

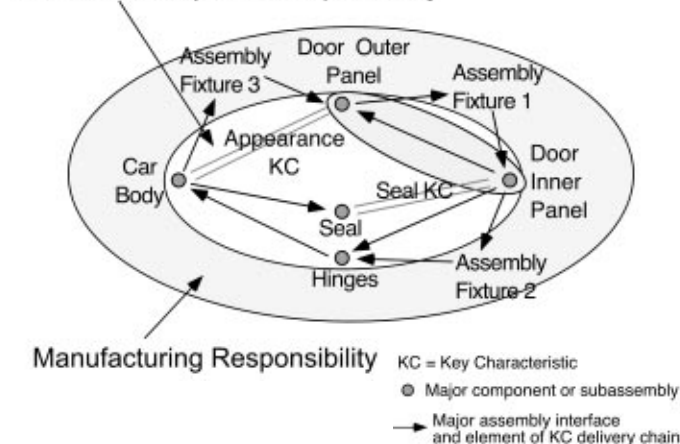
Using spoken language alone to direct an onboard navigational computer to identify one of the millions of U.S. street addresses is a formidable task. The proj-

ect begins with core tools: speaker-independent acoustic models of speech sounds, a large pronunciation dictionary combined with a letter-to-sound prediction capability, language models to predict spoken grammar and identify semantic concepts, all combined within a real-time search engine. SLS researchers are currently exploring the use of a multi-pass strategy to develop a compact search of a very large search space.

“The Ford project is interesting for many reasons,” Glass said. “The car environment presents an acoustic challenge because it can be extremely noisy. Because the driver’s hands and eyes are busy, we try to reduce the driver’s cognitive load. In addition, since the driver’s location is relatively fixed, it is a good environment to explore audio-visual processing methods.”

As onboard electronic systems get more complex, spoken interaction will become more important. In the future, asking for Russian folk music or the Boston weather will be easier and safer than scanning thousands of options on satellite radio displays on the dashboard. ✚

Product Development Responsibility



Visually mapping the relations between car parts and their makers helps Klein and Whitney understand systems issues.

Columbia Group Digs into Safety Culture with Multidisciplinary Tools

By Nancy DuVergne Smith

The Columbia Group, a multidisciplinary collection of faculty, research staff, and graduate students based in the Engineering Systems Division (ESD), began meeting in fall 2003 to dive into safety culture questions surrounding the Columbia Space Shuttle accident. The emerging intellectual products include a best paper award from the System Safety Society, a book chapter, and an ESD symposium paper, now a popular download. These early works illustrate MIT's commitment to interdisciplinary collaborations.

Nancy Leveson, professor of Aeronautics and Astronautics and Engineering Systems and a member of the NASA Aerospace Safety Advisory Panel, convened this working group by calling on a colleague she'd met through ESD gatherings. She and Joel Cutcher-Gershenfeld, executive director of the Engineering Systems Learning Center (ESLC) and an expert in new work systems and large-scale systems change, invited a few colleagues to meet and the group was born. Sloan and ESD Professor John Carroll, a social psychologist, joined the group along with Betty Barrett, ESLC associate director and an organizational behavior expert, plus several of Leveson's graduate students.

The Columbia Group draws on years of research and study through its members as well as colleagues like former astronaut Jeffrey Hoffman, an Aeronautics and Astronautics professor of practice, Institute Professor Sheila Widnall, Paul Lagace, an expert in composite materials, and David Mindell, who focuses on the history of engineering and manufacturing. "I am interested in all the disciplines at the table, but it would take

"ESD gets us talking so we know who is there...and then people form these natural group interactions."

me years to do the reading just to catch up with one of them," said Leveson, who founded the field of software safety.

"One of the reasons I came to MIT was because of ESD and the opportunity to work with people in multiple disciplines," said Leveson. "It just doesn't exist at any other university. This is one of the few in the world that really encourages and houses a structure for promoting this kind of interdisciplinary work. ESD gets us talking so we know who is there, what they are interested in, and then people form these natural group interactions."

Building Robust Interdisciplinary Models

"In the first year, we started writing papers about the Columbia accident, generalizing it to safety culture from multiple viewpoints," Leveson said. "This year, we are looking at how to model and engineer safety culture so we prevent accidents."

The Columbia Group's challenge is to develop a robust model that will balance the need for quantifiable evidence with the need for capturing qualitative rela-

tionships and complex cultural dynamics. Their goal is a model that equally values these disciplinary strengths.

"Part of that involves developing sophisticated, rigorous, technical models that are understandable to the engineering community, but that are attentive to organizational and institutional dynamics," said Cutcher-Gershenfeld. "Our models won't be exactly the same as

existing technical models, but they will be mathematically based, technically rigorous, repeatable, and applicable in other settings."

Graduate Students Benefit

Leveson says her participating engineering students have broadened their research focus and begun taking management and social science classes. "This group was a tremendously important influence on my students and on their dissertations, which now have faculty from multiple schools. What they are doing uses a more interdisciplinary way of attacking problems."

Aeronautics and Astronautics PhD student Nicolas Dulac, an aerospace systems major and management theory minor, will apply what he learned in the group to research on the safety architecture of the new NASA Mars-Lunar space exploration system.

"Coming from a very technical background, I had a tendency to believe that technical problems have technical solutions," Dulac said. "My experience at MIT and with the Columbia Group



Columbia Group taps ESD's multidisciplinary talent: From left, Sloan Professor John Carroll, Joel Cutcher-Gershenfeld, CTPID-ESD, and from Aeronautics/Astronautics, Professor Nancy Leveson and graduate students Nicholas Dulac and David Zipkin.

helped me realize that soft problems are often more difficult to address than hard ones. What I like the most about MIT is the shared belief that a multidisciplinary systems approach is necessary to build and operate complex systems.”

Dulac says he's learned to speak a new language collaborating with experts in aerospace and safety engineering, political science, social psychology, history, and management. “We sometimes realize that in order to better understand the issues, we first have to make sure we understand each other. The language and approach used in engineering are very different from that used in organization theory or political science. In a sense, we use NASA and the Columbia organization as a map and look at it through different lenses. It is a tremendous learning experience.”

Why the Interdisciplinary Model Matters

An interdisciplinary model is needed to capture what really happens in complex human environments that rely on technological tools, the group holds. “When the health care industry first starting adding computers, they focused on the

technical aspects of getting the computers to run – and they were a total failure. They finally realized they had changed the way people worked and the way people interacted in the hospital. They weren't necessarily preventing errors; in fact, they were creating new ones. That was true sometimes when aircraft design introduced computers. They now realize they are not going to be successful in reaching their larger goals unless they take a larger, contextual view of problems and solutions.”

In this new model-building stage, the Columbia Group is evolving from sharing multidisciplinary perspectives to building a new problem-solving model based on a synthesis of relevant thinking.

“In this type of interdisciplinary work, people retain their areas of deep expertise but increase their ability to function at the intersection because that is where the real leverage is,” Cutcher-Gershenfeld said. “Eventually you develop a language that spans both, and sometimes that takes on a whole life of its own.” ✚

EMERGING WORK FROM THE COLUMBIA GROUP

Authors include Nancy Leveson, Joel Cutcher-Gershenfeld, John Carroll, Betty Barrett, Alexander Brown, Nicolas Dulac, Lydia Fraile, Karen Marais

“What System Safety Engineering Can Learn from the Columbia Accident,” won a best paper award at the 2004 International Conference of the System Safety Society.

“Systems Approaches to Safety: Sociotechnical Systems, High Reliability Organizations, Systems Engineering, and Engineering Systems,” chapter in the forthcoming *Learning from the Columbia Disaster*. Bill Starbuck and Moshe Farjoun, editors.

ESD Symposium Papers

Available: http://esd.mit.edu/Faculty_Pages/leveson/leveson.htm

- “Effectively Addressing NASA's Organizational and Safety Culture: Insights from Systems Safety and Engineering Systems”
- “A Systems Theoretic Approach to Safety Engineering”
- “Beyond Normal Accidents and High Reliability Organizations: Lessons from the Space Shuttle”

CARROLL IN PROFILE

John Carroll likes to study high-risk situations like nuclear power facilities, chemical plants, and hospitals. “And I’m most interested when there are disasters of one sort or another,” Carroll mused. He’s not macabre, but accidents like the Columbia shuttle disaster offer a unique opportunity to examine risk and response in organizations. With a SB in physics from MIT and a PhD in social psychology from Harvard, Carroll looks at safety cultures through an organizational lens, examining decision-making, self-assessment, and how learning occurs in groups. He uses this expertise at the Sloan School as professor of behavioral and policy sciences, researching and teaching about the relationships between leadership, management philosophies, teamwork, mental models, safety culture, and human performance improvement. Carroll, who works in an interdisciplinary context, is also a professor of engineering systems and co-director of the Lean Aerospace Initiative (LAI), based in CTPID. His recent projects include participating in the Columbia Group, an informal research team looking for interdisciplinary lessons from the NASA accident. He heads a team funded by the National Science Foundation to work collaboratively with the Sustainability Consortium, a cross-industry group developing business practices that support environmental and social sustainability. He is author of four books including *Applied Social Psychology and Organizational Settings* and *Decision Research: A Field Guide*.



John S. Carroll, Professor of Behavioral and Policy Sciences and Engineering Systems, Co-Director, Lean Aerospace Initiative

Learning the Organizational Lessons of Risk in Safety Cultures

What problems about decision-making interest you?

One issue is how a decision made within the group gets implemented outside of that group. We’ve been finding that just making a decision by itself doesn’t actually implement anything. Often in organizations, the group that makes the decision is not the same one responsible for implementation. In the research I did in nuclear power plants, they would form teams to study really pressing safety or performance problems to examine what went wrong and learn from it. That team writes a report, which gets sent to managers. The manager has to be persuaded by the report to do anything. So, what is a decision in this context? Is the team deciding or is the manager deciding or something else? There’s a chain of decisions involved and, in some sense, the whole organization is engaged in a learning and change process. One thing that interests me is understanding how to move across these levels from what the individual is doing, to what a team is doing, to what an organization is doing.

What characteristics make it possible for organizations to change productively?

On the productively side, I think the leadership of the organization has

to have a reasonable sense of the outside world and the inside world. Being productive means having capabilities to do something that the world values. For whom am I producing and why? And internally, what am I capable of doing? And if I really want to do a thing and I don't have the capabilities, then I've got to develop them or choose something else to do.

Change is intimately involved with leadership because it involves risk taking...

And then to change, how do you get from here to there? We like to think that there's something called leadership that's involved in change. By leadership I don't mean there's a person at the top who says 'follow me,' but rather there are a lot of people throughout the organization who are exercising leadership. Change is really intimately connected with the leadership process because it involves risk-taking, organizing people, persuading people to do something they haven't tried before, innovating new things, and building relationships that can sustain all these difficulties.

What defines good leadership?

We have a Sloan Leadership Model that talks about sense-making, relating, visioning, and implementing. Sense-making means being aware of the world and your inside people, then having a frame to think about what a problem means. Relating means building strong relationships and an organization where people are willing to work hard and believe in what the organization is trying to do. Then there is visioning, which is like

painting a picture of where we're going and where people fit in. The last piece is innovating and implementing, which is finding new ways to do these things.

Is this organizational work involved in your role as LAI's Sloan co-director?

LAI is a great example of the interdisciplinary problems that we're dealing

with because the knowledge and progress we want to make goes beyond anybody's particular discipline. So, what LAI is doing now – enterprise transformation or enterprise architecting – raises the question, what is an enterprise? The answer is an enterprise goes well beyond what we usually call an organization. It's a whole – sometimes we use the word "system."

One political issue is that the organizations themselves are partly in competition, because you're dealing with the Air Force, its prime contractors Boeing, Lockheed, Raytheon, and others, and their subprime suppliers. So you have the bridge between the not-for-profit and the for-profit folks. So, if safety is a goal, how does that relate to money? LAI and the Air Force are organizations that are trying to do something that involves money, but that is not their goal. LAI's goal is knowledge and transformation of the aerospace industry. The Air Force is providing war fighters with the tools they need to secure a safe world if it comes to a fight. So, it's not about money, but still they have to be budget-

ed by the government and they have to spend their money wisely.

What attracts you to studying high-risk situations like nuclear power plants, hospitals, or NASA accidents?

I found it to be a place where people were trying to make things better, and there was urgency about what they were doing, a complex set of actors, and very visible problems.

How does the NSF-funded Sustainability Consortium fit into your work?

We have a team studying this new type of voluntary organization, which is mostly people from large corporations concerned with sustainable business practices. We thought that this might, in fact, be the sort of flexible, self-organizing entity that would see what's needed to tackle vague, interconnected, complicated, complex problems such as sustainability, world hunger, and global warming.

What are your conclusions about building such organizations?

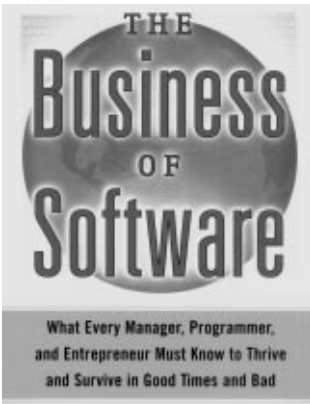
It took longer to understand than we thought it would. The first paper we are writing deals with how the consortium first created a relational space, where people could build relationships and trust and share stories. That seems to have been a very important initial step, prior to building an action space, where people come together for projects that have real, tangible outcomes. We think that this action space could not come into existence as it did without the prior formation of a trusting, peer relationship. Regardless of rank or organization, there's a sense that we are together working on this terribly important problem of sustainability. ✚

Reading Matters

New books, publications, and web pages by faculty and research staff

The Business of Software: What Every Manager, Programmer, and Entrepreneur Must Know to Thrive and Survive in Good Times and Bad

By Michael A. Cusumano, IMVP co-director
Free Press/Simon & Schuster, Inc., 2004



The peculiarities of the software business mean success is more than a precise series of ones and zeros. One company may achieve a 99 percent gross profit despite chronically late and over-budget projects, while another may fail despite having skilled people working on time and on budget. A successful software business must respond nimbly to the continuous need to innovate, adapt to customer requirements, and fight off competition – for starters. This new book, by Michael Cusumano, the Sloan Management Review Distinguished Professor of Management and co-director of the

International Motor Vehicle Program, offers core principles and practices that can help a company do just that.

The Business of Software shares lessons from Cusumano's decades of research and consulting in the software industry and studying Japanese production and quality management. The book aims at software professionals and entrepreneurs who want a larger view of this fast-paced industry.

Cusumano distinguishes three types of software companies by whether they focus on products, services, or a blend of both. Using case studies of company fortunes in good and bad economic eras, he ultimately recommends the software product model as the most likely to weather economic turmoil. Companies that fully exploit high gross margins by selling to mass markets, particularly targeting large, horizontal markets, are in the best position to generate substantial revenues. Product companies, of course, are not assured recurring revenues unless they issue new products that customers will buy, regardless of the economic weather. Being a platform leader, like Microsoft or Intuit, is the ideal position.

NEW PUBLICATIONS

International Motor Vehicle Program

Available online:

<http://imvp.mit.edu/pub03.html>

Sako, Mari. "Supplier Development at Honda, Nissan and Toyota: Comparative Case Studies of Organizational Capability Enhancement." November 2003. (Forthcoming in *Industrial and Corporate Change*).

Shimokawa, Koichi. "The Truth about Nissan/Renault: An interview with Carlos Ghosn." *Nikkan Jidosha Shinbun (Daily Automotive Newspaper)*. Oct. 4, 2003.

Lean Aerospace Initiative

Available online:

<http://web.mit.edu/lean>

Ferdowski, Bobak. "Product Development Strategies in Evolutionary Acquisition." Thesis. 2004.

Lean Aerospace Research Agenda

Available online: <http://web.mit.edu/ctpid/lara/prodpub/index.html>

Barrett, Betty, Lydia Fraile, Adam Litwin, Joel Cutcher-Gershenfeld. "Strategies for Workforce Flexibility and Capability: The New Job Families at Boeing St. Louis." Case study. 2004.

Long, Kevin and Betty Barrett. "International Association of Machinists and Boeing Joint Quality Through Training Programs." Case study, Tukwila, Washington. 2004.

MIT Information Quality Program

Wang, Richard, et al. "Developing data production maps: meeting patient discharge data submission requirements." *International Journal of Healthcare Technology and Management*. Vol. 6, No. 2, 2004.

Technology & Law Program

Ashford, Nicholas A. "Major challenges to engineering education for sustainable development: what has to change to make it creative, effective, and acceptable to the established disciplines?" *International Journal of Sustainability in Higher Education*. Vol. 5, No. 3, 2004. ✚

News at the Center

ITC Joins Communications Futures Program

CTPID's Internet and Telecoms Convergence (ITC) program joined an Institute-wide coalition of research programs investigating the communications value chain July 1. ITC's director, David Clark, Senior Research Scientist at the Computer Science and Artificial Intelligence Lab, leads the Communications Futures Program (CFP) along with Sloan School of Management Professor Charles Fine, Media Laboratory Senior Research Scientist Andrew Lippman, and Media Lab Adjunct Professor David P. Reed.

CFP promotes growth and innovation across the communications value chain by conducting research and facilitating cross-industry interactions. This multi-disciplinary program provides insight by combining research on emerging and breakthrough communications technologies and architectures with development of industry roadmaps and models.

Key results include establishing the Communications Innovation Institute, sponsored by the Cambridge-MIT Institute, that engages Cambridge University and British industry in cross-industry interactions. British Telecom, France Telecom, and Intel also support CFP.

The program is convening industry and academic working groups to focus on security & privacy, edge-core dynamics, emerging technologies, and broadband. CTPID Principal Research Associate Sharon Eisner Gillett is director of the broadband group.

IMVP Launches Lean Locational Logic Project and Short Course

Choosing where to locate new plants or design operations is a high-risk decision for automotive suppliers. A new International Motor Vehicle Program (IMVP) effort – the Lean Locational Logic (L3) project – is partnering with suppliers to gather information on current choices, then to create a model to help companies improve their chances of a profitable decision.

IMVP's lean approach will extend the classic make/buy choice to a smarter way to decide whether to make/design here or elsewhere. The L3 project is developing a series of case studies that will factor in types of risk from competition to politics as well as manufacturing specifications such as product complexity, capital and labor intensity, and logistics.

Global Automotive Short Course

Leading IMVP researchers and Wharton School faculty are offering a high-level program to prepare automotive leaders to succeed. Managers supported by their executives may apply to attend the intensive four-day course plus daylong seminar offered at the University of Pennsylvania, Philadelphia, PA, April 18-22, 2005.

Visiting IMVP Researchers:

- Frits Pil, University of Pittsburgh associate professor and co-author of *The Second Century*, described the new

IMVP book's key message at a lunch presentation of the 2004 MIT Automotive Industries Conference, Oct. 14.

- Arnaldo Camuffo, professor of business strategy at the University of Padua, is a visiting scholar at ESD's Center for Innovation in Product Development this academic year.
- Sharon Novak, Northwestern University assistant professor, is a visiting assistant professor at the Sloan School this year teaching Operations Strategy and Intro to Operations Management.

MITIQ Hosts 9th International Conference at MIT

The innovative International Conference on Information Quality (ICIQ2004), set at MIT Nov. 5-7, provided a forum for both researchers and practitioners to exchange IQ knowledge and ideas. Hosted by the MIT Information Quality Program, the MIT TDQM program, and UC Berkeley, the 9th annual conference included presentations on IQ concepts, IQ management, case studies, best practices, cost/benefit analysis IQ and data warehousing, IQ and e-business, policies, and standards.

Harris Addresses Air Force Sustainment at National Conference

Lean Sustainment Initiative (LSI) Director Wesley L. Harris spoke at a national conference on Maintenance, Repair & Overhaul For Aerospace sponsored by IQPC, a commercial research organization, and the Institute for Defense and Government Advancement (IDGA), a military-focused research institute, in Miami in June. Harris, Department Head and Charles Stark Draper Professor of Aeronautics and Astronautics, presented key ideas about Air Force

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Textron employees play the Game to learn lean enterprise strategies.

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sustainment drawing on LSI research in three areas: enterprise goals, objectives and metrics; design of aircraft subsystems for enhanced sustainment; and cost/benefit of component cannibalization of U.S. Air Force assets.

LAI's Business Simulation Sharpens Textron's Sensor Fuzed Weapons Program

Lean Aerospace Initiative (LAI) members and partners huddled with Textron Systems last summer to develop a fresh approach to understand and improve the production of Sensor Fuzed Weapons (SFW), which are designed to destroy multiple moving targets. Using LAI's Lean Enterprise Value (LEV) Business Simulation (aka the Game), the workshop showcased how a collaborative engagement can benefit all – not just some – of the stakeholders in an enterprise relationship.

LAI's newly released LEV simulation used in the Aug. 24-Sept. 10 workshop held at Textron's Wilmington, Mass., facility is a flexible, game-style model of a complex enterprise. The game plunges participants into the decisions and strategies necessary for lean improvement throughout the value chain – not just their own sector. This

historic collaborative effort to map the SFW enterprise value stream made Textron the first consortium member to use the entire simulation in a workshop involving all stakeholders — Air Force customers, suppliers, and Textron.

"The true power of the simulation lies in its integration," said co-facilitator Tom Bednar of Rockwell Collins. "It demonstrates how efficiencies in one functional area do not necessarily translate to improvements to the enterprise. The need for a big picture view and coordination among all stakeholders within the enterprise is demonstrated very well during the simulation."

Key simulation benefits include the ability to unite stakeholders in a mutually beneficial process, make lean strategies an enterprise priority, accelerate the development of meaningful outcomes, and discover ways to eliminate waste across the enterprise, not just in production.

By the workshop's end, the 30 participants had developed Enterprise Value Stream Maps (EVSMs) and identified lean improvement actions to close the gap between current program practices and desired improvements. Goals set in a one- to two-year timeframe resulted in a realistic plan.

"These Value Stream workshops provide the foundation for formulation of a lean implementation strategy that is based on data and linked to customers' needs and expectations," said Jeff Picard, Textron's vice president for Lean Acceleration. "I like to think of this process as providing us fact-based insight so that we are 'lean with a purpose.'"

LAI Welcomes Greg Butler to Lead Educational Efforts

Dr. Gregory Butler has joined the LAI research staff to coordinate and lead curriculum development, the LAI Educational Network (EdNet), and the LAI Lean Academy™, as well as participate in LAI's tool development efforts. Butler has held systems development positions at Hanscom, Peterson, and Hill AFBs and taught business reengineering and change management at Utah State and Regis universities.

LAI Researcher Keynotes ICSE/INCOSE 2004 Conference

Principal Research Engineer Donna Rhodes presented LAI's systems engineering initiatives as the keynote speaker at the International Conference on Systems Engineering (ICSE) & International Council on Systems Engineering (INCOSE) 2004 Conference, held Sept. 15-16 in Las Vegas, Nev.

LARA Co-Directors Lead Labor-Management Survey Team

Labor-management relations across the country have become increasingly polarized creating a greater need for mediation and conflict resolution services, according to Thomas Kochan and Joel Cutcher-Gershenfeld, co-directors of the Lean Aerospace Research Agenda. They presented these findings of a survey conducted for the U.S. Federal Mediation and Conciliation Service in a keynote address June 4 at the group's National Labor-Management Conference in Chicago.

Why Educators Care about Learning Objects

Just what is a learning object, and why should educators care? Experts in educational technology and pedagogy broached such questions with Engineering System Division faculty June 1 at Endicott House. The Engineering Systems Learning Center (ESLC) definition – documents, illustrations, audio or video clips, and other items organized to achieve a desired learning outcome – was just the beginning.

The Cambridge-MIT Institute's Knowledge Resource Network (KRN), ESLC, and Delft University of Technology jointly sponsored the daylong workshop titled "New Frontiers in Developing, Dis-

tributing, and Utilizing Electronic Learning Materials." In 2003, the group met to discuss intellectual property issues surrounding electronic sharing of learning materials. This year, participants pondered the state of the art in tools for authoring and exchange, their use, and potential.

ESLC Executive Director Joel Cutcher-Gershenfeld, co-director of CTPID's Lean Aerospace Research Agenda, moderated the program including presentations by Ed Walker, CEO of the IMS Global Learning Consortium; Paul Lefrere, Microsoft's Executive Director of e-Learning; and Delft Professor Simon Peerdeman. Given the state of electronic learning materials, Walker said, effort would best be focused on creating and applying new materials, rather than on transferring them from one context to another.

New Impact Design Launched

CTPID's five-year-old newsletter *Impact* debuts a new graphic look this issue. In keeping with MIT economies, the new design by Ink Design, Boston, will produce a less expensive and more readable newsletter. ✚

CTPID News Update:

web.mit.edu/ctpid/www/

Tom Shields flew both combat and peacetime missions in the A-6E Intruder, pictured left.

Staff Snapshot



MEET JOHN THOMAS SHIELDS, LEAN AEROSPACE INITIATIVE PROGRAM MANAGER

Tom Shields moved 12 times as a child following his father's Air Force assignments and 12 more as a career Naval officer rotating between aircraft carrier flights and management assignments. That fleet footwork is a solid background for his role as Lean Aerospace Initiative (LAI) program manager.

After 24 years in the Navy, Shields arrived in 1994 to join the new program begun by the U.S. Air Force, MIT, labor unions, and defense aerospace businesses. Shields stepped in to help shape the new organization by solidifying collaborative teams and developing tools and metrics to assess manufacturing efficiency.

A U.S. Naval Academy graduate, Shields earned master's degrees in aeronautical engineering at California Institute of Technology and engineering management at George Washington University. Shields puts this expertise to work running the program from budget to sponsor engagement. He also has served as co-lead of a research team in manufacturing systems where he oversaw a series of aerospace sector studies and contributed to LAI's award-winning book *Lean Enterprise Value*. ✚

Simon Pitts Joins Ford-MIT Alliance Leadership



Simon Pitts with the world's only hybrid SUV – the new Ford Escape Hybrid.

London-born Simon Pitts joined the Ford Motor Company in 1976 because it was a global automaker long before that was fashionable – and because the company's products excited him. Now Pitts is putting his international career to work as Ford's Executive Director of the MIT-Ford Alliance, bringing the automaker's perspectives to campus and delivering MIT insights to Dearborn.

"Over the last three years, as director of product development operations for the Ford, Volvo, Jaguar, and Land Rover brands, I've been working with the Ford-MIT Alliance looking after the product development process," Pitts said. "That really piqued my interest in getting some synergy between a very commercial automotive business

and their advanced research work and harnessing the parallel work that MIT is doing."

At MIT since August, Pitts is targeting new strategic connections between faculty, researchers, students, and Ford participants from vice presidents to engineers. "My goal is to take the individual pieces of the Alliance and holistically drive them forward. The trick to maximizing the benefit for MIT and Ford is to really look between the individual elements for opportunities – not consider just one project or education program or student at a time. It's the way we put the package together that really drives the benefits for both entities." ✚

CENTER FOR TECHNOLOGY, POLICY, AND INDUSTRIAL DEVELOPMENT

Research Programs

- > Communications Futures Program (CFP/ITC)
- > Cooperative Mobility Program (CMP)
- > Ford-MIT Alliance > International Motor Vehicle Program (IMVP) > Lean Aerospace Initiative (LAI) > Labor Aerospace Research Agenda (LARA) > Lean Sustainment Initiative (LSI) > Material Systems Laboratory (MSL)
- > MIT Information Quality Program (MIT IQ)
- > Technology and Law Program (T&L)

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Emerging Work from CTPID

Massachusetts Institute of Technology
Building E40-231
77 Massachusetts Avenue
Cambridge MA 02139-4307
617-253-7243
<http://web.mit.edu/ctpid/www>
ctpidcom@mit.edu

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