Engineering ENTERPRISE

THE ALUMNI MAGAZINE FOR ISyE AT GEORGIA INSTITUTE OF TECHNOLOGY

Winter 2003

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Enterprise Systems: Industrial and Systems Engineering Perspectives

Company Transformation: A Case Study of Lockheed Martin Aeronautics Company

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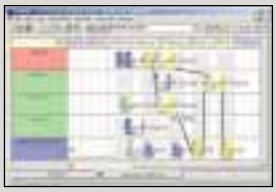

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the CHAIR

Summing Up and Looking Forward

by William B. Rouse

This issue marks the completion of the first year of *Engineering Enterprise*. This year has featured special issues on education, security, and enterprise systems. Articles on these themes and others have highlighted initiatives by faculty, alumni, and other leaders from academia, industry, and government.

I have received quite a bit of feedback on *Engineering Enterprise*. Many alumni – and other folks also – have been very positive about the orientation and content of the magazine. People also like the name, especially the term "enterprise." My article in this issue outlines why an enterprise orientation makes great sense for our engineering discipline.

Plans for the next year of *Engineering Enterprise* are well along. The Spring issue will focus on Natural Systems. In this issue, we will consider what can be learned from nature that can guide the design and deployment of engineered systems. One example will address how the new carpet in my office at Georgia Tech was designed on the basis of how nature designs floor covering in a forest.

The Summer issue will focus on Health Systems. Several of our faculty are leading research on improved clinical practices, consumer and medical decision making, health care informatics, quality assessment and management in health care, and evaluation of medical technologies. The articles in this issue will illustrate how our programs in these areas are thriving.

Knowledge Mining will be the focus of our Fall issue. This will include reviews of research on how best to address the increasing wealth of information available in corporate and transactions databases, as well as the immense flow of e-mail information. The issue will explore the nature of knowledge mining and how our statistics faculty are on the leading edge of these pursuits.

Our second year will conclude with a Winter issue on Supply Chain Management. This will include a discussion of the emergence and maturation of this area over the past couple of decades. The formation, accomplishments, and future directions of The Logistics Institute (TLI) will be reviewed. We will also feature interviews with several illustrious alumni whose companies are viewed as innovators in logistics and supply chain management.

You can see that we have quite a year planned for *Engineering Enterprise*. Our goal is to keep you apprised of leading-edge trends and developments in the many areas of Industrial and Systems Engineering. We will often highlight our own faculty, students, and alumni. In addition, as recent issues have exemplified, we intend to quite frequently showcase invention and innovation by others. Please let us know how you think we are doing.

William B. Rouse is the H. Milton and Carolyn J. Stewart Chair and Professor of the School of Industrial and Systems Engineering at the Georgia Institute of Technology.

Moving Beyond Number One

Where do you go beyond number one? ISyE has held the number one ranking in industrial/manufacturing engineering for the past 12 years, according to *U.S. News & World Report* rankings. School Chair Bill Rouse, making his third annual "State of the School" address, shared his ideas with alumni and friends at the October 2003 Alumni Assembly. The highlight was his "virtual tour" of the School's wide-ranging program areas and interests, the ISyE Portfolio (see side-bar below).

Below are additional highlights from Dr. Rouse's presentation:

- "We're fortunate in a tight economy to still be doing some modest hiring even though our budgets are very tight. Last year the Georgia state budget was decreased by five percent, and this year will also be five percent, and they think next year will be an additional five percent. That's happening all over the country. The average major public research university in the United States gets about 26 percent of its support from its state, which is roughly what Georgia Tech gets. The percentage is heading down."
- "Since DuPree College of Management moved to Technology Square, we now have two primary buildings – up until this time we were in seven buildings. To give you a sense of scope, we have roughly 100 faculty/staff and 1,200 students. We've recently gone through the process of moving 195 Ph.D. students into offices, allocating people among space. The courtyard between these buildings and the instructional center is all ours now, so we've had our first party in the courtyard. We got a big banner that said 'ISyE' on it."

The ISyE Portfolio

Today's ISyE has ambitious goals and an impressive portfolio of talent and expertise to accomplish those goals. School Chair Dr. Bill Rouse recently led the faculty through an exercise to determine the depth and breadth of ISyE's expertise. The result is ISyE's vision of strategic initiatives in the following areas:

Logistics and Global Supply Chains

Opportunity: Globalization, integration, and acceleration are shaping logistics innovation and enabling economic growth and job creation by development, evaluation, and dissemination of best practices.

Vision: Leading-edge research and education in land, sea, or air transportation and the supply chains of retail and manufacturing firms, focusing on areas of globalization, security, optimization, and increased productivity with fewer resources.

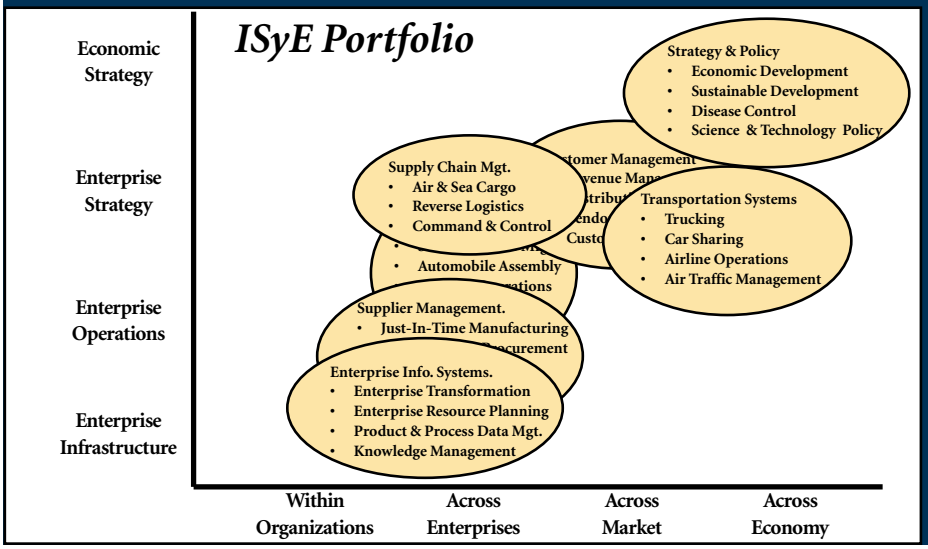
Large-Scale Optimization

Opportunity: Large-scale problems in design, manufacturing, operations, finance, and medicine involve allocation of discrete resources, the optimization of which can yield substantial economic benefits.

Vision: Ongoing world-class research and education in stochastic optimization, mixed-integer programming, dynamic programming, continuous (convex) optimization, global optimization, and simulation-based optimization applied in domains ranging from airline and marine operations to medical systems.

Manufacturing Systems

Opportunity: Creation of large-scale discrete flow systems that are efficient, adaptable, robust, environmentally benign, and sustainable using powerful tools for describing, analyzing, evaluating, and controlling.



Vision: Georgia Tech as *the* source of new industrial logistics system design and control technologies, including development of theory and methods, as well as realistically complex demonstrations.

Enterprise Systems

Opportunity: Continuous, radical change has become the norm for enterprises ranging from distributed global corporations to homeland security. Enterprise-oriented systems engineering can enable successfully addressing this challenge.

Vision: A process architecture including leadership, core values, and enabling processes; supported by systems engineering and statistical knowledge, methods, and tools transformed to address total enterprise environments to improve efficiency and effectiveness of enterprise operations and outcomes.

Human Systems

Opportunity: Supporting human performance in socio-technical systems requires that system design embody an integrated understanding of human, organizational, environmental and technological propensities, abilities, and limitations.

Vision: The Human Systems Institute provides intellectual focus, international visibility, and sustained support for research in human integrated systems; human-computer interaction; organizational simulation; enterprise systems; and information management in transportation, logistics, manufacturing, healthcare, education, and defense.

Health Systems

Opportunity: Advances in information, medical, and biomedical knowledge, coupled with rising healthcare costs, inequities in access, aging populations, legacy information systems, and increased consumer expectations require new methods for effective design, analysis, management, and decision making for health care planning and delivery.

- "We're in the beginning of the planning process for our new building. We'd like to be in the new building, say five or six years from now. We're trying to get it dovetailed into the next campaign for the campus. One thing we've learned from the current building process at Technology Square, and it's a principle we will apply: the probability of raising money for a new building is inversely proportional to its current height. In other words, before you build it is the time to raise the money. We'll need a mixture of alumni and other gifts, along with state funding. If you do a mixture you can get ahead in the process – otherwise, relying solely on state money can take you 20-25 years to get a building. We'll have more about that in the future."
- "We now have four Edenfield Executives. One has just joined us, Nathan Kaufman, who is a senior vice president in HealthCare Strategy at Superior Consulting Holdings Corp. Jeff Tew from General Motors is spending a year with us, and is actually helping us across campus, not just with ISyE, but also with all of the automotive related work across campus. Ken Boff of the U.S. Air Force Research Laboratory continues with us helping the systems area grow, and Bill Kessler of Lockheed Martin will continue with us for a second year."
- "The Executive Master's in International Logistics has been very successful. We just enrolled our third class of 30 executives who typically average 16 years experience at the director or vice president-logistics level at companies all over the world. What's interesting about this program is that we've had this weak economy over the past few years, and this program is going strong. This is the largest class yet."
- "One of our new initiatives is this magazine, *Engineering Enterprise*. It's a quarterly, and we hope to go to about six times a year and double the current size. So give us your feedback and give us your news."

ISyE Facts 2003

Student Body

1042	Undergraduates
274	Master's students
195	Ph.D. students

Degrees Granted

289	B.I.E.
229	M.S.
20	Ph.D.

Vision: The Health Systems Research Center provides intellectual focus, international visibility, and sustained support for research in biological and health systems with an emphasis on disease modeling, treatment, management, and control; modeling and analysis of delivery systems; and decision support technologies and methodologies for the creation, planning, and delivery of healthcare services.

Revenue Management

Opportunity: Applying economics/finance to enterprise systems involves multiple agents, markets, and competitors, and provides many opportunities for optimizing uncertain revenues, costs, and profits across operations and systems.

Vision: Development of dynamic pricing, lead-time strategies, supply chain coordination schemes, contract and incentive mechanisms, investment models, and decision support tools.

Management of Uncertainty

Opportunity: Analyze and optimize performance metrics such as throughput, profit, on-time delivery to improve efficiency and quality of life in domains such as semiconductor manufacturing, yield management, healthcare delivery, e-business on demand, and water resources.

Vision: Understand, quantify, and manage variability in complex dynamic systems, such as manufacturing, communications, and service systems via probabilistic models and methods.

Quality and Reliability Engineering

Opportunity: Manufacturing, hi-tech, and service industries are under constant pressure to continuously improve products and processes. Innovative statistical methods coupled with substantive knowledge are key to the acceleration of improvement.

Vision: World-class research center in engineering statistics, experimental design, quality and reliability improvement, and total quality management; role model for interactions and synergies between cutting-edge research and immediate industrial applications.

Knowledge Mining

Opportunity: Strategies and techniques to discover and extract hidden, useful, and non-trivial knowledge from large-scale enterprise data through data mining, statistical modeling, and simulation methods.

Vision: Leading-edge data mining algorithms, activity monitoring, wavelet and multi-scale modeling, statistical design and modeling, ranking selection and variance reduction, simulation, graphics, and software development.

Modeling and Simulation

Opportunity: Large-scale efforts to reengineer processes and transform enterprises often require huge investments. Analysis, modeling, and simulation of such initiatives enable well-informed investments.

Vision: Foster and enable cross-disciplinary R&D activities and educational programs in modeling and simulation across Georgia Tech and the broader community.

Natural Systems and Sustainability

Opportunity: Needs to assess and mitigate environmental impacts, optimize interventions in biological systems, and glean design insights from nature and complex systems.

Vision: Employ industrial and systems engineering knowledge and skills to assess impacts upon the environment and biological systems. Apply concepts and methods from natural systems to human-made systems to assure efficiency, usability, and sustainability; and yield environmental, health, and economic benefits.

Homeland Security

Opportunity: The analysis, modeling, and design or robust and efficient stochastic-network systems in communication, transport, and security is critical. Image and speech recognition, feature-extraction and information collection, and synthesis techniques are essential to support various security initiatives.

Vision: Strong cross-disciplinary teams working together to make Georgia Tech a leading institute in security-related research, education, and outreach initiatives. Integrated systems engineering and mathematical science approach provides world-class solutions.

Educational Technology

Opportunity: The classroom of the future will be different from today, relying less on textbooks and lectures and more on web-enabled educational tools. Top educational programs will lead these developments.

Vision: To enable our graduates to succeed in enterprises of the future, we will create virtual industrial systems, i.e., computing environments in which students will be able to experience and analyze a system in real-time and will be able to apply and test their engineering skills to control that system.

Workplace Communication

Opportunity: Beyond having world-class engineering knowledge and skills, Georgia Tech graduates should also have world-class communications skills to assure success in the global professional marketplace.

Vision: An educationally oriented program that is based on unprecedented research in the workplace, enhances students' communications skills, advances students' abilities to continue learning communications skills throughout their careers and is integrated with the students' programmatic coursework.

Logistics, Supply Chain Systems, and Enterprise Transformation

By Chelsea (Chip) C. White III, *ISyE Chaired Professor in Transportation and Logistics and Executive Director of TLI*

In two other articles in this issue, Bill Rouse describes an exciting, newly emerging initiative, the enterprise systems initiative; and Bill Kessler presents an excellent example of how one large aerospace firm went through an extensive organizational transformation in response to a need for improved internal coordination. The intent of this article is to address two related questions: How is this new initiative connected to some of the core activities within ISyE, specifically, logistics, and supply chain analysis and management and their inextricably linked mathematical and optimization-based underpinnings; and how may the enterprise systems initiative be synergistic with these core activities? Let me begin with some background comments.

I suspect that as the enterprise systems initiative moves ahead, there will be much interest in understanding the exogenous forces that cause many, if not all, firms in an industry to pursue similar transformations at roughly the same time. Examples of the impact of these *industry* level forces include the downsizing and outsourcing in durable goods manufacturing that has been occurring in the last decade and the shift from vertically to virtually integrated firms that occurred in the computer industry in the mid-1980s.

One may claim, as I do, that the forces that are leading durable goods manufacturing to downsize and outsource are causing concomitant service industries, such as the freight transportation industry, to become more vertically integrated. Thus, as the auto industry outsources its freight transportation needs, transportation companies, e.g., trucking, rail, and shipping, are expanding their core competency set to include logistics, and more recently, supply chain management and design. In fact, in the auto assembly industry, we are witnessing off-shore in-bound transportation providers, which move auto parts from suppliers to assembly plants, with interest in acquiring first-tier suppliers and offering to move parts in-plant, directly to the assembly line.

Other examples of this transformation are the growth of supply chain solutions and services at firms in the transportation sector such as UPS, FedEx, J. B. Hunt, Schneider, and CNF. Thus, firm level transformations occurring in the manufacturing sector of the economy are causing, and are likely to continue to cause, firm level transformations within the service sector.

In response to these industry level dynamics, the TLI and related leadership have responded with two initiatives: John Langley's Supply Chain Executive Forum (SCEF), as described in yet another article in this issue, and John Vande Vate's Executive Master's in International Logistics (EMIL), where the "international" in the latter initiative is related to the forces supporting globalization, two of which are improved communications and improved freight transportation systems. Both initiatives represent an evolutionary expansion, with no diminution, of the aforementioned ISyE core activities. I might add that TLI-Asia Pacific, headed up by former ISyE Chair John Jarvis in Singapore, provides us with opportunities to better understand the implications of doing business and designing, managing, and analyzing supply chains in Asia Pacific. Both SCEF and EMIL represent an effort to segue toward the enterprise level from that part of the firm responsible for transportation, logistics, and supply chain analysis and management; and as such, a strong link with the emerging enterprise systems activity can be mutually supportive with the aforementioned core activities of the School. Furthermore, the enterprise transformation initiative potentially brings the ISyE faculty into closer contact with other disciplines and helps to provide a context for understanding the broader implications of our contributions.

There are, of course, forces that may not affect the fundamental structure of the firm but will affect the design and management of the firm's supply chains.

There are, of course, forces that may not affect the fundamental structure of the firm but will affect the design and management of the firm's supply chains. Examples include the growth of a superior supplier base off-shore and any new information technology that creates a higher level of asset visibility in the supply chain. And the fundamental tools and techniques used for analysis are likely to be different from those used by disciplines outside of ISyE that are involved with the enterprise transformation initiative. Thus, the core ISyE activities in logistics and supply chain analysis and management, and the underlying mathematical and optimization-based approaches to problem solving, will represent a distinct, complementary activity vis-à-vis the exciting, new enterprise transformation initiative.

Intel and EMIL Set The Stage For The Future Of Supply Chain Optimization

By Terri Herod, *EMIL Managing Director*

In a move that may transform how companies address supply chain management, Intel® Corporation has teamed up with Georgia Tech's EMIL program, a master's degree program that helps the world's leading companies develop creative, global logistics solutions by grooming their supply network executives. The objective of this collaboration: to create cutting edge supply chain modeling and simulation tools.

Intel and EMIL have a strong relationship that dates back to the program's inception in 1999. Intel executives have served on the EMIL Advisory Board and have sponsored executives as EMIL participants since 2000. "Intel has chosen to invest in EMIL because it helps us to have a world-class supply network and to take full advantage of changes in the economy and respond quickly to any and all opportunities," said Cindie Kienitz, Worldwide transportation Manager of Intel Corporation.

Now, Intel and EMIL are teaming to support global supply chain innovation and state-of-the-art research. In October 2003, the ***Intel © Innovation & Education Program*** granted Georgia Tech's School of Industrial & Systems Engineering (ISyE) $30,000 in computer hardware, including 3.06GHz Workstation 650s with Intel Xeon™ Processors, for use in the school's ongoing distributed supply chain research spearheaded by Dr. Leon McGinnis, Georgia Tech's Eugine C. Gwaltney Chair in Manufacturing Systems. In tandem, EMIL's Advisory Board approved funding through the ***EMIL Scholars Program*** to support faculty research on the same topic. By combining Intel's super-fast processors with Georgia Tech's mathematical and engineering expertise, this collaborative effort will explore the newest frontier in supply chain solutions.

As an established industry leader, Intel has always pushed the envelop with its "One Generation Ahead" strategy that gives corporations access to future Intel technology. This approach of staying one step ahead of its competitors has made Intel one of the most innovative and visionary corporations in the industry today. Applying this approach to supply chain management, Intel is committed to keeping itself and its customers "One Generation Ahead" in this arena as well. This recent grant and its associated research funding represent a critical step in fostering a quantum change in supply network optimization – made possible through the advent of Intel's faster processing technology.

"By increasing the depth of the relationship between EMIL and Intel, we are building new capabilities that will allow us to model our businesses as never before," stated Jim Kellso, Manager of Supply Network Research at Intel Corporation . "Georgia Tech excels in the engineering and mathematical expertise needed to analyze supply networks while Intel offers the advanced technology needed to make complex simulations possible."

The distributed simulation modeling approach under development with the Intel technology will enable companies to model and manage the unpredictability of their supply chain with greater ease, accuracy, and speed than ever before. In this research effort, individual supply chain elements are represented via independent simulation models capable of communicating with one another, much as factories and warehouses communicate. They can then pass material to one another through transport systems that are similarly modeled as independent simulations. These simulation models, while running on different computers, communicate with one another over the internet using High Level Architecture (HLA), a software infrastructure for support of distributed simulations.

The goal of the research is to create a means for testing diverse supply chain strategies and operational tactics under different scenarios in order to discover which strategy is likely to achieve the best performance. Eventually, the simulation methodology developed could be integrated with rough-cut analytic tools for faster analysis and decision-making.

"In the future, the simulation tools we develop will enable companies to make solid, informed supply chain decisions in real-time," said Dr. McGinnis. "Instead of reacting to unexpected events with 'back of the envelope' supply chain adjustments, managers will be able to simply 'plug in' various alternatives, run the distributed simulations and choose the most effective, affordable option."

Noted Economist Robert Barro Gives Tennenbaum Lecture

The United States economy is getting stronger, and deficits aren't necessarily a bad thing, Harvard professor and well-known economist Robert J. Barro told students, faculty, and friends gathered for the annual Tennenbaum Lecture in November.

While admittedly not the biggest fan of the Bush economic plan, Barro feels the growing strength of the U.S. economy is a positive long-term trend. Barrow is encouraged by the current economic numbers and stock market activity, and told the audience that the recent tax cuts and the war in Iraq are contributing to the economic boost. One reason is war spending – Barro noted that, historically, each dollar of military spending raises real gross domestic product by about 75 cents. As for the deficit, it's a good way to "starve the government of revenue and promote spending restraint," he says.

Unfortunately, job growth has been lower than expected during this recovery. Barro describes this pattern as "unusual," and suggests that we may be witnessing long-term change in the relationship between employment and the growth of the GDP.

Barro is the Robert C. Waggoner Professor of Economics at Harvard University, as well as a senior fellow at the Hoover Institution. Nominated numerous times for the Nobel Prize in Economics, he is best known for his work on macroeconomics, monetary policy, and public debt, in particular his 1974 paper, "Are Government Bonds Net Wealth?" It is perhaps the most commonly cited article on macroeconomics.

Barro has written extensively on macroeconomics. His books include *Determinants of Economic Growth: A Cross-Country Empirical Study* (MIT Press, 1997), *Macroeconomics* (MIT Press 1997), *Getting It Right: Markets and Choices in a Free Society* (MIT Press, 1996), and as co-author, *Economic Growth* (McGraw Hill, 1995). He is associate editor of the *Journal of Monetary Economics* as well as the *Journal of Economic Growth*. In addition, he is a regular columnist for *Business Week* and a frequent contributor to the *Wall Street Journal*.

In 1996, Barro was appointed a member of the Academy Advisory Board of the Congressional Budget Office. He has been a research associate at the National Bureau of Economic Research since 1978 and is a member of the Mont Pelerin Society. He is a fellow of the American Academy of Arts and Sciences and the Econometric Society. He has also served as president of the Western Economic Association and vice president of the American Economic Association.

The Tennenbaum Lecture endowment was established in 1977 by Michael E. Tennenbaum, BIE 1958, managing director of the Los-Angeles-based investment firm Tennenbaum & Co. The endowment allows ISyE to invite a prominent political economist to campus each year, with a goal to provide the Georgia Tech community a better appreciation of the relationship between political decisions and the economic consequences of these decisions for the U.S. economy.

Alumni Updates

Renee Butler, BIE 1996, MSOR 1999, Ph.D. 2003, has joined the University of Central Florida in Orlando as an assistant professor in the Industrial Engineering and Management Systems Department.

Jennifer Cistola, BIE 1981, has been named vice president of CableLabs in Louisville, Colorado. CableLabs is a nonprofit "think tank" and certification testing lab for the cable industry.

James C. Edenfield, BIE 1957, and **Martin Neil Kogon, BIE 1962**, have been named to the World Congress Center Authority in Atlanta by Georgia Governor Sonny Perdue. Edenfield currently serves as president and chief executive officer of American Software, a company he co-founded. Kogon is manager of Pull-a-Part, an Atlanta auto parts retailer.

Alan Nager, BIE 1982, co-founder of Operations Associates in Greenville, South Carolina, has sold his firm to the James N. Gray Company in Lexington, Kentucky. Nager will remain president of Operations Associates. The combined firm will offer integrated process design, facility master planning, engineering, and construction for manufacturing and distribution clients. Nager, his wife Rhonda, and their two sons live in Greenville.

Harold Reynolds, BIE 1982, has been reappointed to the Georgia State Board of Technical and Adult Education by Governor Sonny Perdue. Reynolds is chairman and chief executive officer of Citizens Union Bank. He and his wife Lesley have two children, and the family resides in Greensboro, Georgia.

Randy J. Thayer, MSIE 1980, has been named plant manager of General Motors' future Lansing (Michigan) Delta Township assembly plant. The plant is schedule to begin production in the fall of 2006. Thayer has been the plant manager of Lansing Fabrication for the GM Metal Fabricating Division since 2002. He began his career at GM as a Purdue University co-op student in 1973.

Marriages

Lorianne Williamson, BIE 1999, married Reed Rawson on September 27, 2003.

Births

Brynn Runkle Conover, BIE 1987, announces the birth of Erin Grater, born March 26, 2003, joining sister Alyson. Conover is president of Radical Logistics. The family resides in Athens, Georgia.

Faculty

John Langley Jr., ISyE professor and director of The Logistic Institute's Supply Chain Executive Forum, has been named to the board of directors of UTi Worldwide, an international, non-asset based supply chain management company.

Assistant Professor **Joseph T. Wu** has been named a Distinguished Cancer Scientist by the Georgia Cancer Coalition.

ISyE Alumni Receive COE Awards

The following ISyE alumni were honored at the fall College of Engineering Awards Banquet:

Lawrence K. Blystone, BIE 1980, was named to the Academy of Distinguished Engineering Alumni. Blystone is vice president of Electrical Products for GE Industrial Systems out of Rexford, New York.

Dana Bolstad, BIE 1991, MSMGT 1995, was named to the Council of Outstanding Young Engineering Alumni. Bolstad is supervisor of the Facilities and Technology division of Genentech, Inc. in San Francisco.

James C. Edenfield, BIE 1957, was named to the Hall of Fame. Edenfield is president and chief executive officer of American Software Inc., based in Atlanta.

Simon Hafeitz, BIE 1977, was named to the Academy of Distinguished Engineering Alumni. Hafeitz is president of Desarrollo Bahai, located in Panama City, Panama.

Peter Heffring, BIE 1982, as named to the Academy of Distinguished Engineering Alumni. Heffring is founder and president of Ceres, based in Raleigh, North Carolina.

James S. Thompson, BIE 1970, was named to the Academy of Distinguished Engineering Alumni. Thompson is president of Pacific Energy LLC; he resides in Great Fall, Virginia.

McGinnis receives Reed-Apple Award in Material Handling

Dr. Leon McGinnis, ISyE Eugene C. Gwaltney Chair in Manufacturing Systems, is the 2003 recipient of the Material Handling Education Foundation's prestigious Reed-Apple Award.

McGinnis has a long and significant record of service with the material handling industry and material handling and logistics education. He has worked in areas related to material handling for more than 30 years, mostly at Georgia Tech, where he is also associate director of the Manufacturing Research Center, and founding director of the Keck Virtual Factory Lab. During this time his work has had a tremendous impact on the field of material handling.

McGinnis served as a program manager in the Material Handling Research Center at Georgia Tech for ten years. He has led numerous research projects with direct benefits for the material handling industry. His impact continues through the numerous Ph.D. students who work in areas related to material handling, including many who are professors at other universities.

He has also been active in the industry, as a past president and member of the College-Industry Council on Material Handling Education. He served as co-organizer of the Material Handling Research Colloquium for more than a decade, helping grow it to a successful bi-annual international event.

"Having worked in material handling and related areas most of my career, I understand what a special honor it is to receive the Reed-Apple Award," says McGinnis. "I knew Jim Apple Sr., and I have known or worked with most of the previous award winners and think of them as the real superstars of our field. At Georgia Tech, I've been blessed to be around students who were destined to be stars, and colleagues who helped create an environment for excellence. This award is really a testimonial to the strategy of always working with people who are better than you."

McGinnis received his bachelor's in industrial engineering from Auburn University, and his master's and Ph.D.

(continued on page 20)

ENTERPRISE SYSTEMS

Industrial and Systems Engineering Perspectives

By William B. Rouse, H. Milton and Carolyn J. Stewart Chair and Professor

Much of engineering is associated with design, development, and deployment of tangible artifacts such as airplanes, automobiles, bridges, buildings, chemical plants, computers, factories, networks, roads, ships, televisions, and trains. Some have argued that industrial and systems engineering (ISyE) suffers from the lack of a primary tangible artifact. This, they assert, makes it difficult to explain what we do, and how we add value to the economy and society.

This lack is suggested as one of the reasons that entering freshmen in engineering do not choose ISyE as often as electrical or mechanical engineering. On the other hand, many graduating seniors are in ISyE. Many of Georgia Tech's 12,000 ISyE graduates – roughly 25 percent – have achieved top leadership positions (i.e., CEO, president, etc.) in their organizations. So, the lack of a tangible artifact, if that is the case, does not seem to hinder people's careers.

How do people achieve such notable success? After talking with many hundreds of successful ISyE graduates, it is clear what they do: they create and grow enterprises using the concepts, principles, models, methods, and tools they gained from their ISyE education. The whole enterprise is the purview of these engineers. Their artifact is the enterprise. Their focus is the breadth of things an enterprise does in pursuit of success, whether success is defined as corporate profits or delivery of public services. For this reason, ISyE graduates are, by far, the most diverse set of engineering graduates in terms of industries, positions, and career paths.

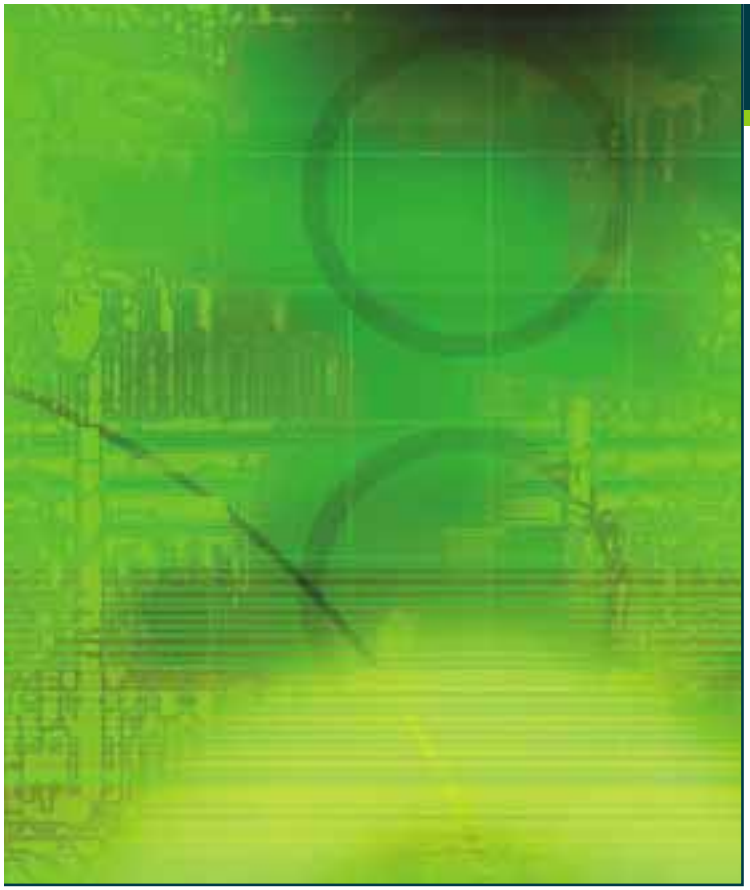
EVOLUTION OF ISyE

ISyE is the engineering discipline that deals with the whole enterprise from an engineering perspective with engineering methods and tools. Historically, our discipline focused on the shop floor with stopwatches, clipboards, and methods engineering. Our scope soon broadened to include manufacturing processes. ISyE methods and tools expanded to consider manufacturing systems in terms of elements of manufacturing processes and relationships among these elements.

More recently, our attention has broadened yet again to include logistics and supply chain management. This has led to focusing on processes both within and among production facilities, as well as upstream suppliers and downstream distributors. The optimization of supply chains to minimize costs and maximize profits has yielded very impressive results.

An even broader view is now emerging: the whole enterprise. Within a company, this often includes the end-to-end value stream from, for instance, business capture, to product development, to manufacturing and assembly, to product support, and finally infrastructure that includes finance, IT, human resources, etc. ISyE is now concerned with understanding how all of the elements of an enterprise play together, as well as how this understanding can be used to maximize value.

However, even this broader view is too narrow. The combined forces of networking and globalization are making the boundaries of enterprises much less crisp. Telecommuting and outsourcing results in people often being in different times and places, while also becoming partners rather than employees. Command and control



management is fading because there are fewer situations where this relationship makes sense.

The broader enterprise includes the company, its suppliers and distributors, customers, other stakeholders in the economic and social environment, and perhaps even competitors. Resources, incentives, and regulations become the fabric of business, rather than who reports to whom. The private and public sectors lose their crisp distinctions. Public policy influences important microeconomic decisions, with significant macroeconomic consequences.

ENTERPRISE SYSTEMS

A major new initiative within ISyE is enterprise systems. This initiative is focused on both looking at the enterprise as an overall system and understanding the nature of systems that support enterprises. We need to address both strategic and operational issues. Examples of strategic issues of interest include modeling uncertainties and risks associated with major strategic investments and large-scale transformation of enterprise processes and cultures. Operational issues include, for instance, supply chain characterization and optimization, as well as revenue management in highly volatile markets.

ISyE approaches to such issues are empirically based while also being axiomatically oriented. Real world data and case studies are central, both as sources of insights and as means to evaluate ideas and results. The axiomatic orientation revolves around the ISyE concepts, principles, models, methods, and tools that have long been our profession's "bread and butter" and distinguish us from business schools.

Enterprise Issues

A set of fundamental questions underlies this portfolio of strategic and operational issues, as well as our empirical and axiomatic approaches to addressing these issues. An overarching issue is *complexity*. Systems with many elements, many interconnections, many attributes, and many stakeholders are common domains of study and application for ISyE. A typical goal is to understand and model enterprise systems with these characteristics.

Another pervasive underlying issue is *uncertainty*. The current and future states of enterprise systems are usually uncertain, more so the further into the future one considers. Uncertainties can surround the nature, magnitude, and timing of relationships and variables. Identification of relationships (for example, competitive positions) and estimation of variables (for instance, market demands) are usually central concerns within enterprise systems endeavors.

Yet another pervasive issue is *control*. In general, this concerns assuring that relationships and variables have desirable characteristics. More specifically, control includes allocation of resources and management of incentives and regulations. Optimization of control is sometimes possible. In many cases, control is limited to measurement and feedback as a basis for human monitoring and decision making.

Agility is a pervasive enterprise goal: the ability to flexibly respond to and take advantage of opportunities and challenges.

Another overarching issue is *design*. In the context of enterprise systems, design is concerned with value streams and their relationships with market characteristics, product design, supply chains, manufacturing processes, service delivery processes, etc. This focus on value streams dictates an enterprise-wide perspective. Narrower perspectives will inevitably result in "suboptimization," whereby functions such as logistics or manufacturing may be optimized to the detriment of the broader enterprise.

Enterprise Goals

Agility is a pervasive enterprise goal: the ability to flexibly respond to and take advantage of opportunities and challenges. *Security* is an increasingly common goal, especially in the past couple of years. A related goal is *privacy*, which may be challenged by security pursuits, e.g., sensing technologies as well as our being connected all the time, everywhere. *Sustainability* as a goal is concerned with minimizing consumption of non-renewable resources and production of waste.

A central challenge for leaders is to design and manage agile, secure, and sustainable enterprises that create high value while not compromising privacy. To some extent, this challenge will be addressed by new technologies developed by a myriad of disciplines in science and engineering. However, the essence of this challenge is not technological.

Understanding the nature of organizations – how they can change, and how they are inclined to change – is the key to creating these types of enterprises. Much of the knowledge needed is coming from the behavioral and social sciences. From an engineering perspective, ISyE needs to create models, methods, and tools that can leverage the concepts and principles from these sciences. We need to translate basic knowledge into design practices.

We also need to infuse these design practices into engineering education. Topics that need to be integrated into the ISyE curriculum include:

- Modeling and design of enterprise value streams, including determination of how value flows can best be monetized
- Design of incentives, rewards, and regulations or policies (rather than organizational structure)
- Information system design, including decision support, for all stakeholders in the enterprises
- Financial modeling and optimization of portfolios of value options, including consideration of the "exercisability" of options

There are, of course, many other similar topics. This list serves to provide the "flavor" of the possible impact of enterprise thinking on ISyE education.

RESEARCH AND EDUCATION

An enterprise orientation has important implications for research and education in ISyE. This research focuses on the nature of enterprises as systems. Of particular interest is how enterprises can and should be transformed to leverage technology-based inventions – both products and processes – to create market innovations in private as well as public sectors.

Key to such transformation is understanding the nature of emerging enterprise technologies (i.e., collaborative tools, web services, etc.) and assessing their implications for organizational practices and policies. Short-circuiting the often very long adoption cycle for new technologies can provide strong competitive advantages. On the other hand, only a minority of technologies should be expedited into practice.

Research also must address the behavioral and social aspects of enterprise transformation. Organizational change can be quite difficult, especially if management does not realize that it is an underlying issue. Research needs to focus on the nature of organizational culture and how cultural change can best be fostered. Obvious components of this include incentives, rewards, training, and education. Clarity of vision – and sustained leadership commitment to it – is, of course, an overarching success factor.

All of the above need to be addressed with a portfolio of concepts, principles, methods, and tools of ISyE and a wide range of other disciplines. ISyE, with its systems orientation, is the natural "integrator" of these diverse perspectives. ISyE's methods and tools for formal modeling of systems are essential elements of in-depth understanding of enterprises in terms of such concepts as responsiveness, stability, observability, and controllability.

Our great facility with modeling and simulation also plays a central role. The ability to simulate organizational changes prior to committing to them is highly desirable. Also of great interest is the ability to experience organizational changes, via organizational simulation, prior to proceeding with these changes. Beyond modeling, this requires innovative approaches to visualization and interaction.

We also need to focus on the security of enterprises, in terms of physical, fiscal, and information security. This involves both understanding the nature of economic, social, political, and physical threats, and the ways in which countermeasures interact with enterprise practices and processes. It also involves recognizing and developing best practices for managing security – rather than assuming a solution can be "installed."

This brief summary of selected research areas represents a rich set of potential Ph.D. dissertations, as well as grist for numerous Ph.D. seminars. It is also easy to see a wealth of M.S. projects or theses. The results of this breadth of research will, over time, become integrated within B.S. education. We also see numerous avenues for offerings in professional and executive

education. Finally, we expect to experience a steady flow of staff members from our sponsors - including both private and public sectors - who will serve as visiting researchers and degree candidates within this overall endeavor.

ORGANIZATIONAL IMPLICATIONS

The breadth of this vision of enterprise systems is difficult to pursue within the confines of a single academic unit. Successful pursuit of this vision will require strong multi-disciplinary collaboration across academic units at school, college, and university levels. Anyone who has been immersed in academia knows that such collaboration is not necessarily a natural act.

Success will require collaborators ranging from engineering and economics to architecture and art. Of course, not all initiatives require all disciplines. Nevertheless, when the full spectrum of enterprise-level issues is considered, the range of potential collaborators is quite large.

The question of how to organize such diverse collaborations has led us to talk with a variety of people who have undertaken similarly broad initiatives. One lesson learned is to avoid over-organizing. The consensus is to create flexible, initiative-driven teams, making maximal use of concepts for virtual organizations. The incentive and reward structures for these teams need to be crisply aligned with the visions for each initiative.

Interestingly, successful pursuit of this organizational model within an academic environment will, to a great extent, be a transformational initiative for the academic enterprise itself. Using desired enterprise impacts to drive initiatives, as well as tailoring faculty incentives to these drivers, will be novel in a university setting. If all goes well, it may be transformational indeed.

CONCLUSIONS

The "bottom line" is simple to state, but nevertheless difficult to accomplish – an ideal challenge for ISyE. Enterprise systems in ISyE are concerned with understanding and managing the complexities associated with large-scale private and public enterprises. This includes characterizing and estimating uncertainties and risks. It also includes optimization and control to allocate resources, monitor their deployment, and assess consequences. Above all, enterprise systems involves seeing and addressing the system as a multi-disciplinary whole.

The benefits of this ISyE initiative will be broad and substantial. Our stakeholders include a wide range of private and public enterprises, as well as the economy and society more broadly. The benefits these stakeholders seek include high-value impacts on quality of life, including economic, social, and physical security. Our profession has long focused on providing these benefits. Now we have the opportunity to deliver these tangible and substantial benefits to a wide range of constituencies.

COMPANY TRANSFORMATION:

A Case Study of Lockheed Martin Aeronautics Company

By William C. Kessler, *Vice President, Advanced Enterprise Initiatives, Lockheed Martin Aeronautics Company (LM Aero); Edenfield Executive-in-Residence, School of Industrial and Systems Engineering at Georgia Institute of Technology*

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Lockheed Martin Aeronautics Company (LM Aero) was established in January 2000 from three separate Lockheed Martin Corporation aeronautics companies. The intent was to achieve one company, one team, and one vision that is built on the principles of customer focus and financial soundness.

This article describes:

- The intended "outcomes" from the transformation
- The company transformation approach
- Status and highlights of the company transformation – two years into process
- Methodological challenges for future large scale company transformation initiatives

Background

The realities of the defense business in the post-cold war period converged for Lockheed Martin Corporation in 1998-99. In this time frame, the benefit of continuing defense industry mergers and acquisitions was questioned by the U.S. Justice Department and by the U.S. Department of Defense. Additionally, business analysts were touting tech stocks and questioning if any defense company would ever be able to perform efficiently and on a basis consistent with "expectations of the street." Lockheed Martin Corporation's stock price plummeted.

A primary strategy of growth by merger and acquisition was replaced by a primary strategy of efficient and effective performance. The implications were significant.

In the winter of 1999, Dain Hancock was named president of LM Aero. LM Aero was the LM Corporation's consolidation of its three separate aeronautics companies: Tactical Systems in Fort Worth, Texas; Aeronautical Systems in Marietta, Georgia; and the Skunk Works in Palmdale, California. The consolidation established a company with a single profit and loss statement (instead of three). Mr. Hancock kicked-off the company transformation process in March 2000, at a two-day workshop in Fort Worth. Here are a few of the transformation relevant facts from that workshop:

- Only the "senior leadership" of the new LM Aero was invited to participate. This represented about 40 percent of the combined senior leadership of the three legacy aeronautics companies.
- The president, Hancock, laid out the specific intents and reasons for the transformation. The intents laid out that day in March 2000, are exactly the same today… with no expectation that they will change in the next few years.
- A full-up, structured "Concept of Operations" for the new LM Aero was presented. Ralph Heath, chief operating officer for the new LM Aero, prepared and presented the concept. The ability of the leadership to articulate how LM Aero would operate in the future (and why) has provided a very important framework for transformation. This is discussed in more detail later.
- A time span and schedule for the envisioned company transformation was provided. The early focus was on the "physical transformation" of three companies into one and the associated transformation of the organizations needed to run the business. This is discussed in more detail later.
- Visible and important roles of the president, CFO, COO,

and executive vice president for Programs made it clear to the entire leadership team that the top executives were all "on the same page" in their commitment to transformation and the urgency.
- Time was spent in small groups so that the LM Aero leadership team, drawn from across the three sites, could get to know each other by discussing the LM Aero concept of operations and the behaviors required to make LM Aero successful.

Transforming an Enterprise Starts with Clearly Describing the Outcomes

Our company transformation is centered on the following specific intents:

Intent 1: Restructure into one company, LM Aero, with a single vision and with exactly the right capabilities for the business of the new organization.

Intent 2: Deploy the LM Aero Concept of Operations that is driven by the principles of customer focus and financial strength.
- Create *focus* by establishing a one-company strategy, 5-year imperatives, and yearly company objectives that align all the work in the company.
- Meet or exceed our *customers'* expectations
- Perform on our commitments, each and every time
- Demonstrate our *operating values* while achieving our objectives

Intent 3: Establish an organizational structure that aligns with the efficient and effective conduct of work, assures clear accountability, and has no unneeded redundancies.

"*The Concept of Operations…How We Run LM Aero*" (Ref 1) is proving to be a very important tool in communicating the intents of our transformation and providing a framework for the change process. For example:
- Communications – The concept of operations was first presented by Ralph Heath at the March 2000, transformation kick-off meeting to the leadership team. We then took members of the new leadership team to all of our sites to hold a series of "question and answer workshops" on the concept of operations. A "frequently asked questions" web site was established to provide the opportunity for employees to ask questions. The publication of Reference 1 came nearly a year after we began the transformation, and the document was based on input from a series of focus group meetings.
- Framework – The Concept of Operation is a "what and why" document and not a "how to" document. Taking this approach has provided an excellent way to keep leaders and managers focused on "what we are going to accomplish and why." For example, the document provides our 5-year imperatives related to customers, workforce, business, and processes. These imperatives, in turn, drive the "how to" plans and the measures of progress and effectiveness.

The Company Transformation Approach

There are many excellent references (e.g. see References 2-7) related to the topic of enterprise transformation, often called corporate reengineering. All of these have been reviewed and all have influenced, in some way, the LM Aero transformation approach.

Figure 1 provides a summary of the input to and outcome of the LM Aero transformation. The outcome of the transformation is to be a company that operates to the clear outcome intents *(Indents 1-3 at left)* and a company that initially operates with a specified reduction in overhead and infrastructure. Key enablers included:
- Clear intents and requirements from the president ("complete the physical transformation to one company in one year; and achieve our customer, workforce, business, and process imperatives within 5 years")
- Commitment of the leadership team

Figure 2 illustrates the flexible transformation approach being used. The overall transformation approach spans the 5-

Figure 1

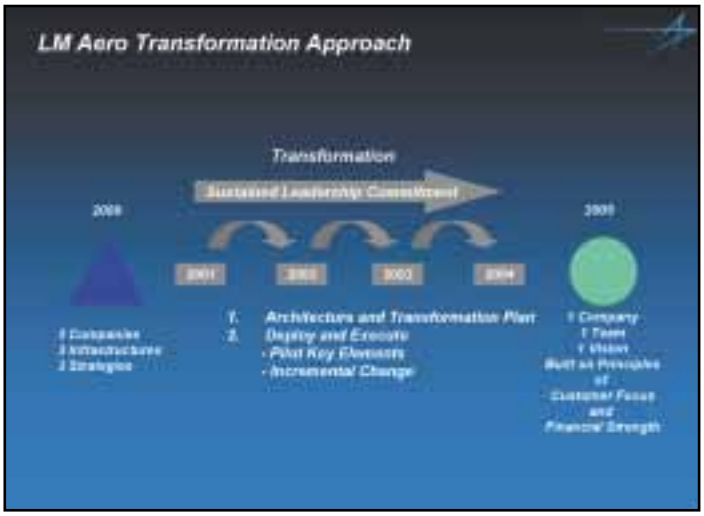

Figure 2

Figure 3

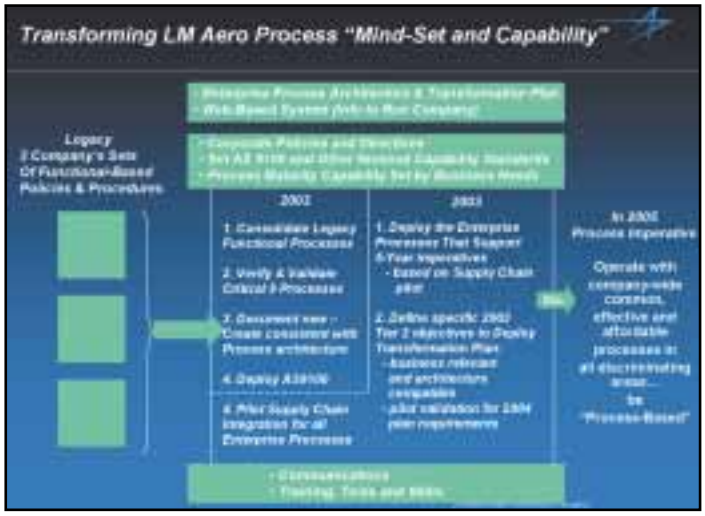

Figure 4

year imperative period as detailed in our Concept of Operations. The actual transformation has two significant elements:

1. *Architecture and Transformation Plan:* This involves the overall transformation architecture and plan to achieve the 5-year imperatives and the concept of operations. The plan reflects our transformation approach and includes the yearly priorities for transformation objectives deployment.
2. *Deployment and Execution Process:* The focus of this element is achieving the changes required by the transformation plan. In general, these change actions are deployed via our yearly company objectives. Concrete changes and measures of effectiveness are deployed via this objectives process. Additionally, we deploy, when appropriate, "pilot projects" to gather information on the best procedures to use in deploying the next significant steps in the transformation plan.

For example, within our "architecture and transformation plan" element we have set the baseline process architecture and are designing our company-wide processes. The process architecture is a required enabler for LM Aero to become a process-centered company (Ref 7). Being process-centered will allow LM Aero to align operating capability with business requirements and to rapidly respond to intentional (and unexpected) changes. These two key characteristics – meeting our commitments and being responsive – are, in turn, central to achieving our LM Aero 5-year imperatives.

The corresponding "deployment and execution process" currently centers, for example, on "activating" the enterprise process owners (these enterprise processes all cross multiple organizational boundaries), designing the top-level enterprise processes, converging existing legacy processes from the three legacy companies, linking the enterprise and legacy processes, and managing by the resultant enterprise processes. Additionally, we have a "pilot project" underway related to supply chain integration. This "pilot" is defining the new roles and responsibilities of suppliers in LM Aero as well as "piloting" the approach for deploying all of our enterprise processes.

What about our near-term transformation intent: "complete the physical transformation to a single company in one year?"

Figure 3 shows the organization transformation approach that was announced at the March 2000, kick-off workshop. The challenge was to move quickly to get the organizations in place to conduct the day-to-day business of the company. Speed was required, but the restructure needed to be done in a way that was consistent with the concept of operations and did not add significant barriers for the 5-year transformation process.

We used an approach and terminology that was familiar to our employees: system requirements review (SRR), preliminary design review (PDR), and critical design review (CDR). The basic intent at each of these review milestones was as follows:

- SRR: Understand the LM Aero concept of operations and use it to establish each organization's individual concept of operations; document any boundary condition or issue that affects the organization's ability to achieve its operating concept.
- PDR: Resolve major issues; illustrate the top-level organization design; define the roles and responsibilities of the organization leadership and management team; and provide specific response to company-level requirements for management layers, numbers of managers per layer, and three-company infrastructure reduction.
- CDR: Provide plan (no more than 6 months) to began full-operation within the new organization design; identify any remaining open issues and plan for resolution.

This rapid organization physical transformation provided the foundation for the full LM Aero transformation process. The following items were found to be important to enabling this physical transformation:

- Use of a structured organizational design process (SRR, PDR, CDR) that allowed interaction of the leadership team and which rapidly converged to organizational designs consistent with the company concept of operations.

- Use of common templates so the same type of information was obtained from each "organizational designer."
- Participation by the entire leadership team to ensure human-centered issues and organizational interface boundary conditions could be quickly resolved with all points of view considered in the "organizational design meetings."
- A supporting organizational integration design team that maintained a design room and focused on the overall integrated company design. This assured that the result was an integrated design and not just a collection of individually designed parts.

Transformation Status, Results and Highlights

Efforts involving enterprise transformation can lose focus if the process is allowed to extend for too long a period without providing visible results. Ralph Heath, the LM Aero COO, led the company transformation process for the president. Mr. Heath established concrete and measurable milestones for the critical early phase of the transformation. The following represent typical objectives measures:

- In three months, have the LM Aero top leadership in place and reduce executive positions by more than 50 percent
- By the end of the year (8 months), have the next three levels of management in place and realize a 30 percent reduction in company-wide overhead staff by end of year (8 months).
- By end of year, have new organizational designs in place and key positions filled.
- By one-year point, have critical organization design issues all resolved and declare the completion of the physical transformation. At this juncture, turn full attention to performance in the new LM Aero.
- The first year had, and each succeeding year has, specific objectives for reduction of inventory, facilities, property, and equipment.

Did we make any mistakes by pushing hard on organization designs before the process architecture was fully defined? Yes, but there are no detected organizational design flaws that are not being "cleaned up" as the organizational designs continue evolving in concert with the process architecture, 5-year imperatives, and specific yearly objectives. On the other hand, waiting until the process architecture was fully designed and vetted would have put the entire transformation initiative at risk. Most importantly, we must view transformation as being flexible and continually adjusting to new information…while keeping focused on the required outcomes (in our case, the concept of operations and our 5-year imperatives).

Were we finished at the one-year point? The physical transformation was complete. However, the "social transformation" was just getting started and the critical elements of the process architecture (consistent with the 5-year imperatives and concept of operations) were coming into a sharper focus.

Figure 4 and 5 illustrate, with specific and real examples, some highlights from the transformation approach. Our architecture design work and transformation plan are continuous and will span the 5-year transformation process. However, the transformation plan is converted to specific and measurable one-year company objectives as illustrated by Figure 4.

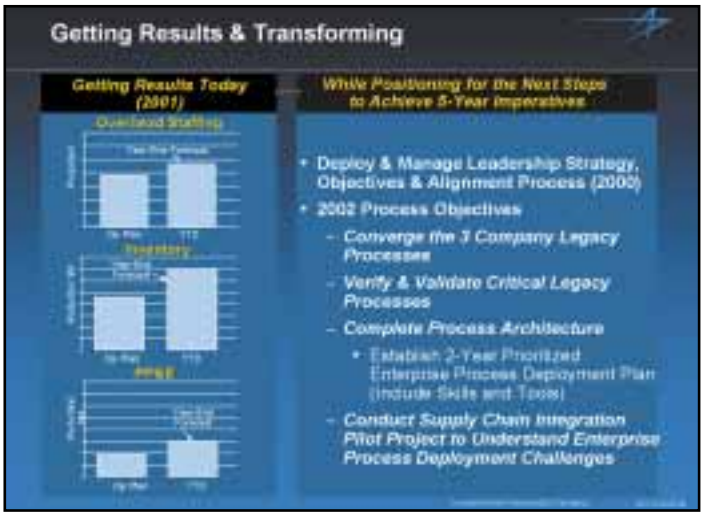

Figure 5

Figure 5 further illustrates highlights from the transformation approach. The approach is very specific for the current year's transformation objectives while all the while designing the next steps (the next year's company transformation objectives) in concrete terms.

The highlights provided by Figure 5 reflect this incremental approach:

- Focus on *today's transformation objectives* (left panel of figure) is accomplished by tracking specific yearly transformation objective metrics. Overhead staff reduction; inventory reduction; and reduction in plant, property, and equipment (PP&E) are examples of the objectives and measures for 2001.
- Designing and deploying the *next steps in the transformation plan* are focused on the movement to a process-centered company in this example (right hand panel) from 2001.

The objectives for 2001 (left panel) were achieved in 2001 and the next step plans (right panel) were converted into concrete, measurable objectives for 2002.

Complex, Large Scale Transformations Require Better Tools and Methods

LM Aero has long been designing and building complex aircraft and, as a result, we have a premier systems engineering capability. Due to this history, it should not be a surprise that we took an approach to "designing and building" a new company that parallels what we knew about designing and building of new aircraft (Figure 6). This is what we know best and the terms (like SRR, PDR, and CDR) are already familiar within the company. In fact, our yearly deployment of transformation objectives

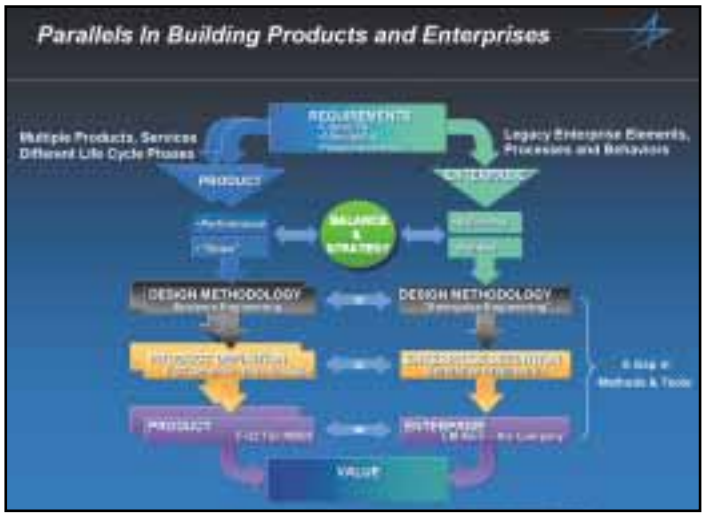

Figure 6

is very similar to an aircraft "block upgrade" approach or what is now being called "spiral development."

We started by defining the transformation outcomes for the new company. Next we focused on selecting and collecting the tools and methods needed for designing the needed organizational architecture and transformation plan. However, we came up empty when we looked in the "tool-box" for a version of systems engineering to use for "designing and building" an enterprise or an organization.

We found business "case studies," lists of "best practices," and many "special methods and tools" (balanced score cards, re-engineering, lean and Six Sigma, quality standards, maturity models, etc.)

We did not find any systematic methods for "designing and building" an enterprise to meet mission and design intents. One major barrier in establishing such a methodology is the inclusion of the qualitative aspects of all the people that comprise the enterprise. A second barrier is that business research seems to center on specific problems in an industrial sector, a company, or a part of a company. When applying these case studies and findings to a different company or enterprise, the result is often sub-optimized or not applicable.

Did we wait for new methods to be developed? No, of course not. We used our experience, our process architecture, and current literature (Ref 2-7) to guide the transformation approach and priorities. However, having a proven and systematic methodology would, most likely, have saved time and would have improved both our efficiency and effectiveness in the transformation.

Summary

The LM Aero physical transformation from three companies to one company was completed in one year. The transformation plan to achieve the company 5-year imperatives and to fully operate to the LM Aero concept of operations (Ref 1) is in place and is well underway.

The body of transformation literature and our own personal experiences indicate that two specific enablers are required for successful large-scale transformations:

1. An occurrence of a "significant emotional event" that makes the commitment to transformation clear.
2. The absolute, unwavering, and sustained commitment of the enterprise leader and the leadership team to communicating, leading, and supporting the transformation.

What has been accomplished in two years of the LM Aero transformation would have been impossible without having these enablers in place. One lesson we learned (again): conducting a transformation is hard work and must be tempered by realistic expectations and led by committed, experienced leaders. It is very easy to "draw up the transformation plan on paper" but it is extremely difficult to realize the plan's intent in actual practice. Why? Well, because human behaviors are involved in the process and the day-to-day business realities will challenge even the most "proactive" leadership as these realities compete for available time and other scarce resources.

- Such large-scale transformations are difficult to achieve and costly. Initiation and investment should only be undertaken when the outcomes provide truly substantial benefit, e.g.
- Sharpened strategic focus
- Altering solution completeness required by the customer
- Extending operating reach to suppliers, partners, and customers
- Enhancing process capability for reliability and responsiveness

Keeping the company engaged during a multi-year transformation process is very difficult. Our current experienced-based methodologies eventually get us through the lengthy process if the leadership is diligent and totally committed. But the time span required via our current process and methodologies can place the transformation initiative at risk.

Systematic methodologies for efficiently "designing, transforming and building" enterprises would be a most welcome addition to companies and enterprises where continuous organizational change and adaptation to external influences is now the "new normal" in business.

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Supply Chain Executive Forum Examines the Growing Role of Logistics in Industry

The challenges of today's business environment have underscored the need for expertise in supply chain management. Whether looking for new and innovative ways to meet and exceed the needs of customers, or just trying to survive in the midst of changing business environments, companies are trying to achieve success through application of the principles of supply chain management. Dealing with flows of product, information, and capital both with and between business organizations, expertise in supply chain management is fast becoming recognized as a key to efficiency, effectiveness, and differentiation.

In response to this increasing emphasis, The Logistics Institute at Georgia Tech, positioned within the School of ISyE, has founded the Supply Chain Executive Forum (SCEF), whose membership consists of a wide range of senior supply chain executives from throughout the business world. Members of the SCEF include prominent retailers, manufacturers, software firms and technology providers, and providers of transportation and third party logistics services, as well as leading academics from Georgia Tech and other major universities. The SCEF was founded to promote and stimulate thought, dialogue, and action in the evolving field of supply chain management. Its goal is to identify new and compelling ways for supply chain executives to streamline operations to enhance profitability, integrate supply chain strategy with corporate strategy, and grow professionally within and beyond their current organizations.

Dr. John Langley, Jr., SCEF director and professor of Supply Chain Management (SCM) at Georgia Tech, leads the Forum. "Georgia Tech has made this one of its major supply chain initiatives to establish a greater presence with executive level individuals who have supply chain responsibility – these are the people who are in the best position to identify priorities for change and to implement strategies that will succeed in leveraging the power of supply chain management to achieve corporate objectives and create maximum value for customers," he says.

Supply chain management (SCM) is becoming increasingly important every day.

"If you look at the composition of the membership of our SCEF, you can see people from all types of organizations that comprise today's supply chains. You will find retailers, manufacturers, material suppliers, component manufacturers, third party logistics companies, transportation companies, software and technology providers…essentially about any kind of company you would find in a supply chain," he continues. "And the underlying premise being if these companies convene in a university setting, to collaborate on their thinking, that when they leave the university they will go back to their day-to-day business life and stand a better chance of collaborating effectively and improving their supply chains."

"Supply chain management (SCM) is becoming increasingly important every day," says Langley. "SCM represents an integration of processes both within and between organizations that can lead to significant improvements in efficiency and effectiveness. In addition, a growing number of companies today are seeing ways to use the power of supply chain management to differentiate their product and service offerings from those of the competition." Examples of this include companies such as Dell Computer, The Home Depot, Philips Consumer Electronics, and Milliken & Company. In addition to leveraging the power of supply chain management to help drive company rev-

enues – the "top" line – the competitive advantage that can be created through differentiation is significant. "For example, if you are a retailer, and you are better at having product available when and where your consumers want to buy it, your sales will go up," he continues. "That sounds kind of simple, but effective logistics can actually increase your sales."

Effective supply chain management can actually help differentiate retailers from their competitors.

"Effective supply chain management can actually help differentiate retailers from their competitors", says Langley. "It is one thing to say that supply chain management helps to increase our company's sales, but it is even more powerful to say that one of the reasons our customers choose us is because of our logistics capabilities. That raises the level of the playing field, and with the information technologies companies are using today to improve their internal processes and their relationships with their supply chain partners, they stand a much better chance of achieving those objectives."

There are currently 23 member companies in the Supply Chain Executive Forum, and the original design for the SCEF is to have a total of approximately 30 leading organizations from all walks of supply chain life. An objective of the Supply Chain Executive Forum is to create an exclusive, "club" type atmosphere, one that fosters a sharing of problems and perspectives among people most capable of doing something about it. Plans are for the SCEF to meet twice yearly, and ultimately to have periodic meetings at member company headquarters sites. Currently, the SCEF meets at the new Georgia Tech Conference Center, located on the Georgia Tech campus in Technology Square. Each member company is also encouraged to bring one or two additional executives to each meeting. This assists greatly in making sure that the benefits of membership extend to a broader base of participants from the member companies: to those who are most able to benefit from the presentations, discussion, and dialogue that are part of every meeting.

Among the 21 founder members of the Georgia Tech Supply Chain Executive Forum is Atlanta-based UPS. "The Forum is a great place for people who have common challenges to talk about issues that face them internally and externally," says Joseph Pyne, senior vice president of UPS's Supply Chain Group. "This is important today because a lot of companies are seeing supply chain as a way to change the battleground. It's a way to reduce costs and streamline the process," he says. UPS's supply chain expertise spans the globe. "We're among the thought leaders in design and implementation," he says, adding that Forum members have interests in design and implementation, global transportation, packaging, and warehouse management.

Rick Jackson, senior vice president of Limited Brands Logistics, says his organization joined because of the Forum's emphasis on the retail channel. "The mix of retailers and third party providers provides an opportunity for a good interchange of ideas, and the format we utilize, presentation then discussion, is a good learning environment," Jackson says. Most of those attending the Forum lead logistics for their organizations, and Jackson believes that is the essential element in the group dynamics. "Senior level attendees are a key to making this work."

Bill Turner, vice president of Logistics and Customer Service for Hershey Foods Corporation, agrees with Jackson. "The Supply Chain Executive Forum is a good place to ensure we are keeping pace as an organization on leading edge practices," he says, "but it is also very important to be in touch with other senior executives from a networking perspective. The Forum provides the opportunity for establishing contacts that can be further developed outside the meetings. Having someone like John Langley leading this initiative gives it immediate credibility to attract the top corporate leadership and keep momentum."

Intel is another founding member of the Forum. "Intel is serious about improvements in our supply network, and accordingly, we strive to find the best leading edge technologies, approaches, and industry contacts," says Jim Kellso, manager of Supply Network Research for Intel Corporation. "Georgia Tech is well recognized as a premier School of Industrial and Systems Engineering, and attracts many of the 'best in class' industrial sponsors. We find association with the 'best in class' companies helps us find new approaches and techniques which assist in improvements in our systems and processes."

SCEF held its first meeting in April 2003. The two-day discussion examined such areas as the "curse of complexity," the benefits and drawbacks of technology, security, and issues surrounding communication, collaboration, standardization, outsourcing, customer service, globalization, and maturation of the technology component. The meetings build in time for networking and small group discussions made up of participants from within similar industries.

The group came together again in October 2003 to discuss corporate success through supply chain management. Rick Jackson opened the event with a presentation on "What the CEO Wants from Logistics and Supply Chain Management." It is about building brands, building capabilities, and building talent, he says, adding that the supply chain will never be seen as a glamorous department within an organization. Challenges facing supply chain executives include:

- clearly articulating the contribution of logistics management to a firm's financial results, not only reducing costs, but driving revenue
- focusing on the ultimate customer and not just the next customer in line
- developing tools and methodologies for linking logistics to corporate strategies, and
- recognizing that supply chain management can't be one of this year's top three objectives or initiatives for any corporation

"The bottom line is, a CEO is not going to adopt SCM as a strategy on their own. For us, it is a retrenching. We need to dream up a lexicon to excite the CEO," says Jackson.

Today's supply chains are more complicated than those in the past; and Professor Kevin Hendricks of the University of Western Ontario says today's managers need to be prepared for the inevitable glitches that come from the globalization of supply chains, an increased reliance on outsourcing and partnerships, single sourcing, little slack in the supply chain, and competition. Supply chain glitches affect both shareholder value and profitability because they can lead to personnel turnover, negative publicity, excess inventory, and poor asset utilization. Hendricks' analysis of average stock market returns in relation to glitches shows that the type of event is not important; whether it is a development problem, a part shortage, or changes by customers, there is a loss of shareholder value. "It doesn't matter who is responsible for the event," says Hendricks. "Your supplier or customer can do as much damage to you as you can do yourself."

"The unexpected will happen, so today's supply chain managers must be resilient," says Roger Kallock, former Deputy Under Secretary of Defense for Logistics and Materiel Readiness and now chair, Chagrin Consulting Associates. His term for it is "falling smartly." Kallock says, "You can't anticipate everything. But you can set the foundation for good communication."

The SCEF is a project of The Logistics Institute (TLI). TLI was established in 1992 in partnership with the National Science Foundation and more than 25 corporations and governmental agencies known as *Leaders in Logistics*. TLI conducts in-depth research pertaining to new logistics concepts and processes while offering a comprehensive logistics educational curriculum. For more information, visit www.tli.gatech.edu.

For more information about membership in the Supply Chain Executive Forum, contact John Langley at (404) 894-6523 or John.Langley@isye.gatech.edu. Further information about the Georgia Tech Supply Chain Executive Forum is available at www.tli.gatech.edu/scef.

Supply Chain Executive Forum Membership Fall 2003

- Andersen Corporation
- BAX Global
- Caterpillar Logistics Services
- Hershey Foods Corporation
- Intel Supply Network Group
- IKEA
- Limited Brands Logistics Services
- Manhattan Associates
- Manugistics
- Meridian IQ
- Milliken & Company
- Newell Rubbermaid
- Oracle Corporation
- Philips Consumer Electronics
- Recall Corporation
- Robert Bosch Corporation
- Russell Athletic
- Ryder
- Schneider National
- Transentric
- Transplace
- UPS
- Yellow Transportation

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in industrial engineering from North Carolina State University.

The Reed-Apple Award was established in 1981 as a permanent tribute to the memory of Drs. Ruddell Reed Jr. and James M. Apple, renowned material handling educators and innovators. It is presented to those nominees who have made an extraordinary, continuing contribution to material handling and material handling education. Past recipients include the late Dr. Paul Eaton of ISyE, and Dr. John A. White, former Dean of Georgia Tech's College of Engineering and now Chancellor of the University of Arkansas.

Future of U.S. Air Transportation in Peril, says ISyE Professor

An ISyE professor, who helped develop the findings of a recent National Research Council report on the state of air transportation in the U.S., says the system is in danger, as is the nation's dominance in world aviation.

The report, called "Securing the Future of U.S. Air Transportation: A System in Peril," was released in September 2003 and looks at a broad range of problems in the aviation industry, from safety and security, to the capacity of the air transportation system, to consumer satisfaction.

Amy Pritchett, an associate professor with a dual appointment at ISyE and the School of Aerospace Engineering, was a member of the report committee. The group was charged with helping to plan the nation's aviation strategy for the next 50 years.

"While the European Union, China, and India all have ambitious aerospace agendas, the United States is falling behind, without a clear, long-term plan and without a broad base of basic research to support long-term innovation," says Pritchett. "While air transportation is a vital part of our growing economy, the capacity of our air traffic control system is reaching fundamental limits to growth. These limits can't be solved by technology alone, and there is no one 'silver bullet' solution."

Instead, Pritchett says she believes the nation needs to change the underlying operational concepts, economic structures, and role of humans and machines used in air transportation, while maintaining a safety level unique to aviation.

The report committee concluded that the government should institute a focused national leadership for aviation, guided by a strategic vision that will enable the airline industry to meet increased travel demand in the future.

"While capacity may not seem to be a pressing issue today, as recently as the summer of 2001 extremely high demand for travel caused record delays at airports and dramatically lowered customer satisfaction," says David Woods, a member of the report committee and a professor in industrial and systems engineering at The Ohio State.

He continues, "As painful as the present economic situation is for the industry, the current travel slump provides breathing room to step back and coordinate changes across the different parts of the industry and government, before demand for air travel increases again."

The report illustrated the need for strategic coordination among the airlines, as well as all the other stakeholders in air transportation. Such strategic coordination will require new technology – specifically, computer networks that coordinate decisions among the stakeholders. One of Pritchett and Woods' areas of expertise – how people interact with computers to make decisions in high-risk environments – will be critical in carrying out the committee's recommendations.

Pritchett says, "Making the system function as an efficient whole is a complex issue, especially when decisions will impact many different airlines and customers in ways that they may not have chosen for themselves. We cannot do this without computers – but we can't automate it completely, either. Instead, we need to develop collaborative, human-interactive technologies that enable operating concepts that we haven't even conceived of yet."

Woods says computer systems will have to be designated so that airline employees can monitor what is happening in the entire United States air travel system and accurately project the consequences of certain actions.

"As daunting a task as that sounds, such a system is necessary for the airlines to make appropriate decisions that affect safety and performance. Say weather in one area begins to delay a few flights. If I'm in charge of dispatching for an airline, I can make certain changes that will help my aircraft minimize delays and schedule disruptions. But what helps me could create bottlenecks for other aspects of the overall system," says Woods.

To make good decisions, he says, dispatchers must be able to see the big picture, such as what is happening at the other airlines. The system must then be able to adapt to maintain capacity.

The National Research Council is part of the National Academies, which also comprise the National Academy of Sciences, National Academy of Engineering, and Institute of Medicine. They are private, nonprofit institutions that provide science, technology, and health policy advice under a congressional charter.

Pritchett and Woods' colleagues on the Council committee included researchers from the Massachusetts Institute of Technology and Texas A&M University, as well as members of the military and the aviation industry.

ISyE Professor Named to New Shuttle Safety Advisory Panel

ISyE professor Augustine Esogbue is among nine safety, management, and engineering experts tapped by NASA to lead its Aerospace Safety Advisory Panel (ASAP). All former members of the panel resigned in September 2003 after being criticized by the Columbia Shuttle investigators and members of Congress for being ineffective.

The new panel is expected to play an important role in the ongoing safety assessment and review of the Space

Shuttle program as it prepares to return to flight.

Esogbue, who also serves as director of the Intelligent Systems and Controls Laboratory, is one of only two members selected to the panel who hold academic appointments. The rest were selected from the military and private industry. The U.S. Congress chartered the panel in 1967, after the tragic fire aboard Apollo I, to act as an independent body advising NASA on the safety of operations, facilities, and personnel.

Esogbue has been at Georgia Tech since 1972. In 1976, he founded Georgia Tech's chapter of the National Society of Black Engineers, and he now serves as its faculty advisory. His research interests include dynamic programming, fuzzy sets, decision making and control in a fuzzy environment, and operations research with applications to socio-technical systems such as health care, water resource management, and disaster control planning.

As director of the Intelligent Systems and Controls Laboratory, Esogbue is currently investigating a hybrid approach to intelligent control via fuzzy sets, neural networks, and reinforcement learning theories, as well as its application to various large-scale nonlinear and uncertain dynamic systems.

Student Profile

Nothing is Routine at The Weather Channel: Student Co-op Assignment

The Weather Channel may not be the first place you think of as an industrial engineering cooperative education assignment. But IE students and alumni have long recognized the diversity of an industrial engineering degree. Now, other industries are beginning to appreciate the IE experience.

Bernardo Franco, a 23-year-old senior in ISyE, co-oped at The Weather Channel Companies (TWCC) from January 2002 to August 2003. The position was originally available only to management majors, but Franco saw it as "the perfect opportunity for me to use my IE skills in a management-focused setting."

Franco, a native of Bogotá, Columbia, began his industrial engineering studies at Los Andes University in Bogotá. The Columbian university places a heavier focus on management, as opposed to production/manufacturing, so Franco transferred to West Virginia University in 1999. He left for Atlanta in 2001, because "Georgia Tech offers a very good undergraduate curriculum and we are number one in the nation."

At TWCC, he was assigned to the Strategy and Development (S&D) department. "As a long-term task I was in charge of researching competitors, maintaining the competitors' database, and publishing a bi-monthly newspaper on competitors' new technologies and ventures," says Franco. "I spent most of my time helping my supervisors in different projects that would arise each semester. One could think of the S&D department as a small consulting firm within TWCC. We would work together with all the strategic business units, helping them and guiding them with their ideas and products."

"My team was a problem solver group," he continues. "We had to deal with competitor threats; we had to figure out new revenue streams; we had to review and/or enhance our current business models; and we had to plan or forecast technology trends in order to guide our management strategies."

He feels that the experience was different from that of other IE co-op programs. "In traditional co-op assignments, students usually learn how to improve processes, how to analyze and interpret data, and how to make wise decisions based on prior analysis," explains Franco. "However, at our level, co-op students, we usually learn how to make operational decisions that become routine with experience. At TWCC, nothing was a routine as every project was completely different."

"I also learned that we (IEs) can apply our skills in non-manufacturing settings as well. I think it is important, as the United States has partially shifted from a manufacturing economy to a service economy, that we start using our skills across all platforms and start being creative," he continues.

"Finally, and most important of all, I understand why Dr. (Jane) Ammons used to tell us in class: 'we don't just want you to learn how to solve problems, but to learn how to think about them.' And she was right. I was able to think about the different problems that I faced at TWCC and from there generate possible scenarios.

Franco is a well-rounded student, with a passion for sports, fun, and his family. In his childhood, he learned self-discipline through swimming and tennis. Now, he prefers soccer, a regular pursuit. He also admires the literary works of Albert Einstein and Leonardo Da Vinci. "I try to apply their thoughts in my personal life," he says.

At Georgia Tech, Franco has received several scholarships, and he is a member of The Helvetia Honor Society, the National Society of Collegiate Scholars, Golden Key Honor Society, and the Society of Hispanic Professional Engineers.

After completing his co-op assignment, Franco spent Fall Semester 2003 in France, studying at the Sorbonne and the American University of Paris, with the goal of learning French, his third language (after Spanish and English). He will graduate Summer Semester 2004 and has plans to earn a master's in International Logistics at Tech. His long-term goals include an MBA from Harvard before returning to Columbia to start his own business. "I see myself operating throughout Latin America and leveraging new opportunities there," he says. "I want to be able to generate employment and help my people, as I am conscious that not all Columbians have had the same opportunities I had."

ALUMNI NEWS

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