MMM GRADUATE PRESENTATIONS

Moosa Baqar is working on the Implementation of Min-Max Inventory System at Raw Material Stores in CAE Ltd. The full-flight simulators which CAE manufactures cost $10-13 million USD on average and take 25-30 weeks to build. The main materials required are aluminum, steel and stainless steel. At times CAE has experienced excess inventories of materials not often required or else shortages of vital material. Moosa’s mandate was to formulate a new inventory policy and the decision was to stock with vendors using the Min-Max System. This is a simple inventory management tool which uses predetermined minimum and maximum quantities for a material. When quantity on stock drops to the minimum level, the reorder quantity will refill the stock to a defined maximum level. The system works by having the raw material stored in a single bin at the Raw Material Stores and each bin having a card attached with information about the raw material. The card indicates the min and max values of that material. As soon as the material reaches the minimum quantity, a signal is sent for re-ordering. By implementing this system, CAE has realized a 35-40% reduction in inventory and a 30% cost savings.

Soha Alsaleh’s project at CAE involved Supply Strategies for Assemblies in Visual Systems. Visual systems provide imagery to the simulator crew over a 40-60 degree vertical by 180-220 degree Field of View (FOV). For this project the focus was on the CAE MAXVUE Visual System. Visual systems are contract specific and, therefore, linked to the production schedule of CAE. Engineering Change Requests (ECR’s) occur constantly due to late customer specifications. As a result, parts often do not arrive on time to the visual cells or else, they accumulate at CAE stores. Recommendations included establishing a pull system to achieve on-time delivery of parts in required quantities as well as Kanban implementation between visual cells and suppliers for unique purchased and fabricated parts. There are main assemblies in each system and Soha’s project focused on Kanban implementation in two of them: alignment projector installation and autocalibration equipment installation. Because Kanban is a simple and understandable process, its implementation has resulted in reduced inventories, avoidance of shortages and the ownership of cell and responsibilities given to the workers. Kanban parts will remain connected to MRP, visual systems will be built and assembled in modules and all visual cells will be integrated into one area.

Lead Time Reduction (LTR) in the Gas Generator Line PD31 at Pratt & Whitney was the subject of Jud Kenney’s internship. The objective of the project was to reduce average lead time by 65% by year-end. His mandate focused on data collection, data analysis and implementation planning. Everything known and measured was collected: parts, work center, labour, demand and performance data. The second phase
involved analysis of lead time, routing, flow line, finance, performance, maintenance, labour unavailable time and capacity of work centers. The MPX model, a simple, steady-state model for manufacturing operations using a powerful solver technique, was used to quantify LTR improvements. Using MPX, the implementation plan focused on three areas: cell design, throughput improvement and out-of-area time reduction. Jud’s conclusions included the following: data is key and without an ERP system like SAP it would have been impossible to collect; queue time is the primary target for LTR; interdependent functional analysis is necessary for successful LTR; speed, simplicity and synchronization are the three basic principles which drive lead time reduction.

YanYan (Brenda) Hu worked on Breakthrough Lead Time Reduction within the framework of Achieving Competitive Excellence (ACE) at Pratt & Whitney. Current engine lead time is 40 weeks. In the ACE scenario, assessment and application merits a Bronze. 25% LTR is Silver and 65 LTR is Gold. YanYan defined two cells: Fishtail and Diffuser. She provided an analysis of the parts, lead-time waterfall charts, machine utilization charts and quality nonconformity tables. After data presentation and brainstorming sessions action plans were grouped into five categories: machine utilization, cell organization, process improvement, quality and suppliers. Main activities focused on capacity analysis and scenario actions of bottleneck workstations for the Fishtail Cell, the Paint Shop Cell and the F.P.I. cell as well as quality nonconformity tables for the Diffuser Cell. As of one week ago, the Fishtail and Diffuser cells had been certified with Silver, indicating a 25% LTR. The ultimate aim of this ongoing project is to achieve 65% LTR in the Diffuser Cell by December 2001. YanYan will leave this to someone else as she has already accepted a permanent position with P&W in another department.

Lead Time Reduction in Airfoils Procurement at Pratt & Whitney was the topic of Jose Leonardo Diaz Montoya’s presentation. The objective was a 25% lead-time reduction in Quick Response manufacturing (QRM) in three product families: turbine blades, vane rings and vane segments. QRM is a focused application of Time Based Competition. Its main thrusts are quality in supplier selection and building partnership with a few key suppliers. As a result of identifying major deficiencies and taking key actions, the following has been achieved in the three pilot projects: 62% LTR for vane rings, 44% LTR for turbine blades and a 35% LTR for vane segments. To realize success, Jose feels that the following is necessary: the need to involve all suppliers in the supply chain; a top-down buy-in from each supplier; all suppliers must actively participate in the mapping session; a resultant LTR must be assigned for each action in the action plan.

Jesus Zepeda was also doing his work term at Pratt & Whitney and he was involved in Lead Time Reduction in Small Exit Ducts (SED). This is a small cell that produces 15 different part numbers. One of the part numbers represents 30% of the operations in the cell. Average throughput is around 35 parts per week. The project scope was to design an action plan to reduce lead time in the SED by 65%. The Action Plan included 63 actions in five sections: general management, external operations and vendors, machine utilization, start delay and quality. The first actions scheduled to be implemented were those that promised high time savings (main actions) and the easy-to-complete actions. The expected LTR for seam weld repatriation is 7%, 5% for vendor operations improvement, and 15% for detail availability increment. To date, only inspection optimization for welding has been completed and it has achieved the expected 7% of LTR.

Karim Azhar is working on an Operational Improvements Project in the VA/FVM Sector at Celestica. VA stands for Vendor Alias. Customer, subcontractor and FCC labels are attached to the cards which enable the customer to trace back the history of the card. FVM means Final Visual Mechanical. This is a visual inspection step which can detect defects such as missing components, bent or loose heat sinks, chipped-off edges, etc. Several problems were identified with this process: severe shortage of space, no SOP for handling labels, limited visual management, different processing steps causing confusion and a shortage of experienced operators. It was possible to expect only 1200 cards per shift. Karim came up with several recommendations which would eliminate waste, save time and money, standardize the work place, improve communications, reduce the movement of kanbans within the sector and provide job rotation. As a result, the capability to do VA/FVM would increase from 1200 to approximately 1500 cards per shift.

Roger Huang is also at Celestica working on SMT Evaluation and Upgrade Strategy. These days the industry trend is for electronics manufacturing services outsourcing and building the Virtual OEM. Celestica is experiencing capacity/pace and staffing pressures. The objective of Roger’s project is to recommend a solution for the urgent need to significantly increase capacity at the Toronto site within the existing space as it pertains to the Surface Model Technology (SMT) line configuration. After thorough analysis, Roger determined a way to achieve throughput improvement, better line balancing, floor space savings, higher quality and lower cost per placement. His recommendation: where the high-speed machines are not gated by fine-pitch placement or other equipment on the line/factory, then each Panasonic MV should be replaced by three or four Siemens S-25
machines. Also, to avoid gating on the SMT line, it may be necessary to upgrade the GSM1 to GSM2.

The topic of Shuqun Ma’s stage at GE Hydro was Effective Inventory Management and Reengineering of Replenishment Process in MRO. The objective of the project was extensive: to reduce 30% of inventory held in store; to reduce 50% of production interruption time that was spent by worker to get the shop and safety supplies from the central store; to enforce better inventory control on MRO materials, especially on tools and shop and safety supplies; to reduce the inventory replenishment time by 50-60%. GE Hydro purchases 406 stock items from 40 suppliers. In 1999, $2.5 million was spent on MRO supplies. Shuqun’s recommendations focused on an automated re-supply system incorporating consignment, Kanban, Bread-man and system contracts, using P-cards and the Internet. E-Business powers the Business Process Redesign. By implementing an automated re-supply system, GE would realize the most economical option to improve the current situation. Total savings and productivity gains would amount to $300K/p.a. The Supplypro Cabinet software would make a consignment program possible and would offer GE a hedging option before investing in the IM system from Oracle.

Jean Coupal made a presentation on Improving Cable Tray Profitability at Thomas & Betts. In the construction industry, cable trays are the parts that are installed immediately after the cement is poured. It is a simple product but with thousands of permutations and combinations because it is made to order. The price of aluminum is of primary importance because it accounts for 65-75% of total product cost. To improve profitability, Jean’s proposed solutions encompassed a combination of operational structure, marketing product and price initiatives, engineering support, sales initiatives and customer service. The results included numerous changes: the rationalization of the aluminum line to one design; moving O/E to the customer service coordination function; implementation of a Cable Tray Web site; finalizing regional sales margin reports; gaining financial control over credits and allowances. Jean’s next challenge will be to look for competitive advantage.

The MMM program wishes to extend its sincere thanks to all corporate sponsors and their representatives who provided such interesting and comprehensive internships to this year’s students. All suggestions and observations for improvement are warmly welcomed. As you already know, the program is presently accepting confirmations of work terms for September 2001. Please submit your intentions for providing internships to the MMM program coordinator at the earliest opportunity.

**MMM PLANT TOUR**

From October 26 to 29 the MMM students, accompanied by Professor Vince Thomson, went on a tour of the manufacturing facilities of JDS Uniphase, Inco and Tembec.

**JDS UNIPHASE - HOSTS:**

Steve Bonham
Alli Olegario

JDS Uniphase is the market leader in the design, development, manufacture and distribution of fiber-optic products for the telecommunications and cable television industries worldwide. This high-tech firm employs 22,000 people in 11 countries. Thirty different manufacturing sites are located in the USA, Canada, Scotland, England, the Netherlands, Germany, Switzerland, Australia, China and Taiwan. Annual revenues are around $2.5 billion. The two largest customers are Nortel Networks and Lucent Technologies. JDS is the largest optical company in the world and it continues to grow, mainly by acquisitions.

The company manufactures both active and passive components of fiber optics modules. The designing process of a product is anywhere from 6 – 12 months. In terms of research, 10% of the profits are invested in R&D. Despite the very high technology involved in design and manufacturing, the manufacturing process itself is highly labour-intensive. Manual assembly of some components may take up to seven or eight hours. Most products are customized according to rigid customer specifications and, as a result, even more time-consuming. The company hires and trains up to 100 operators per week.

To ensure product quality, JDS performs 100% inspection at strategic locations of the production process. In fact, JDS manufactures much of its own testing equipment and also supplies it to their competitors. As a result, JDS sets many industry standards for testing. According to Steve Bonham, JDS has one of the most rigorous quality and reliability testing protocols in the industry. For example, the Mean-Time-
Between-Failures of some lasers is specified at 200 million operation hours. Some of the company’s equipment has been in operation since its inception in 1981. Most components have a 25-year warranty.

The company’s biggest concern and the direction of further development is automation of the manufacturing processes. JDS plans on increasing quality levels through automation. It is presently investing a lot of R&D money into automating the assembly processes and reducing intensive labour on the assembly lines.

**INCO LIMITED - HOSTS:**

Greg Baiden  
Peter Golde  
Andrew Young

Inco is a leading world producer of nickel, supplying about 24% of global demand. In 1999 alone, Inco sold over 569 million pounds of nickel worth nearly $1.7 billion USD. It was, therefore, very interesting for the MMM students to descend 2000 feet into the Stobie mine and get a first-hand look at a mining operation. They learned that not only was it very dark, but there was a problem of orientation because everything looks alike and there are few landmarks. There is a vast network of tunnels and distances are very far. Equipment breakdowns are frequent; therefore, all equipment is leased along with on-site service. A system of tubes and wires provides water and fresh air as well as a means of communication and positioning. In fact, the Global Positioning System (GPS) was specially redesigned to work below surface level. Above all, safety is of primary importance.

Inco is a technology-oriented company. Mining and processing operations are highly computerized. Certain loaders, drills and trackless traming units are being operated from the surface. This ability to mine remotely is termed telemining. Through the use of video technology, telecommunications, modems and PC’s, Inco has developed a positioning robot and robotic drifting systems and has installed telecommunications and intelligent drilling systems. The company uses monitoring and control systems, underground communications, positioning and process engineering to operate mining equipment and systems. By developing the process-control systems with the new positioning software, a central computer is now able to control and monitor many functions in the automated mining operation. The advantages of telemining are numerous: reduction in labour, lower production costs, increased speed and efficiency, exploration in areas deemed economically unfeasible in the past or less-than ideal environments or remote, wilderness locations and, finally, dramatically-increased mine safety.

Inco plans to introduce telemining to all the other mines they own. Currently in progress is a scheme for a long-distance route which redirects ores from various mines to one refining plant. Ultimately Inco envisions a future where all their mining operations will be controlled by one center. Even operations in remote parts of the world would be controlled by Sudbury.

**TEMBEC - HOSTS:**

Francis Dessureault  
Dave Cameron  
Eric Gendreau  
André Boucher  
Gerard Orlowsky  
Dave Tafel  
Serge Larochelle

Tembec is a forest products company, the largest pulp producer in Canada. In Temiscaming, the students visited four of the five facilities. These produce cellulose, temcell, temboard and a host of chemical derivatives. The company’s main advantage is the fact that it produces pulp from both hardwood and softwood.

The Temcell plant produces High-Yield Pulp (HYP) for the papermaking industry. Annual capacity is 270,000 tonnes. HYP is a result of maple, birch and aspen fibers. It provides paper makers with improved sheet formation, increased opacity, stiffness and absorbency in tissue and towel paper. It also improves print density and ink transfer for better print quality. Temboard manufactures bleached, coated paperboard. Its annual capacity is 150,000 tonnes. Students were extremely impressed by its three control centers which constantly monitor physical change during the production process and diagnose problems. One of the control centers is reserved strictly for the coating process. The Specialty Cellulose Mill produces cellulose pulp for use in textiles, pharmaceuticals, food additives and industrial chemicals. The Chemical Products Group is a manufacturing and marketing organization consisting of three profit centers: alcohol, lignin and resin. The focus of this group is to utilize the abundant supply of spent sulfite liquor and other forest by-products for the production of value-added products.

Throughout the company emphasis is placed on environmental impact. Tembec adheres to two environmental management programs: Forever Green and Zero Impact. The former is the integration of sustainable forest management criteria by the Canadian Council of Forestry Ministers. The latter is intended to minimize the environmental impact of fiber processing by the year 2005.
The company is always focused on quality, on-time delivery and price. It is utilizing the concepts of Just-in-Time and continuous improvement. Its R&D department focuses on cost reduction and the manufacture of technically innovative products (making better use of fiber, changing product characteristics due to customer needs, and developing new processes to meet impact Zero environmental objectives) that give a competitive edge in what is considered a commodity-oriented marketplace.

SEMINARS AND CASE STUDIES

Pierre-Hughes Routhier, Senior Value Engineer of Pratt & Whitney, provided the MMM students with a fascinating seminar and workshop on Market Feedback Analysis as performed at this company. The process is both horizontal and vertical: determine the problems, look at all the data, mobilize people across organizational boundaries to focus on high-priority problems and allocate resources. The tools to be used were all developed at P&W by company employees. The Russo Chart focuses resources by gathering and analyzing customer-based data about problems with existing products that cause customers to lose revenue or spend money unexpectedly. Elephant Charts provide a method for structuring data to get a clearer picture. This chart is a summary which easily and effectively shows how component parts are performing in a specific time period. It looks for trends and causes of problems by utilizing the subsidiary Quality Clinic Process Charts and Root Cause Charts. It also evaluates the effectiveness of In-House Acceptance Testing or other processes. And finally, Marciano Charts are a disciplined method of applying lessons learned from previous products to create superior new products. They provide structured reliability assessments, re-examine and redefine requirements, and streamline development by eliminating rework and re-engineering. Pierre-Hughes provided the students with exercises to see first-hand how all these methods work. This was a highly instructive and interesting seminar.

On December 1, Jean Rochon, Plant Manager, Bus Duct Operations, GE Hydro, gave a wonderful seminar on Value-added Initiatives at GE Bus Duct Operations in St-Augustin. He was accompanied by Réal Desroches, Black Belt in Six Sigma. Bus ducts are custom-made products which connect generators to transformers. They are necessary in hydro, steam, gas and nuclear plants. Originally the company only sold bus ducts to Hydro-Québec. Due to increased competition, it had to find ways to improve productivity and reduce costs. Because GE has a business mandate to double, Bus Ducts had to grow. The tool they chose was Projet a valeur ajoutée (PVA), translated as Value-added Project. The philosophy was to eliminate waste and improve response time in all aspects of manufacturing. The critical variable to manage was the manufacturing cycle. After a five-day PVA session, the results were incredible. Previously 100% of the shop had been dedicated to bus duct manufacturing, using all three bays. Now only one bay manufactures bus ducts and sales of this product have doubled. Because of the additional space, the plant is not only a world leader in bus ducts, it is also a main supplier of generator terminal enclosures (GTE’s). PVA’s have been successfully used in other areas: engineering, painting, shipping, GTE’s, drafting and coordination of engineering and manufacturing. As a result, sales have tripled in the year 2000, customer satisfaction has increased, product cycle is now a competitive advantage, there are no heavy stores, partnership with suppliers increased as did internal expertise.

During the tour of Tembec, the MMM students were offered an absorbing case study under the supervision of Dave Cameron. Tembec produces about 595 metric tonnes per day of heavy liquor as a byproduct during the production of pulp. On average 110 tonnes per day are fed to a sodium conversion chamber which is used to produce a value-added product that has a high market price, sodium lignosulfonate. The remainder is used as fuel for the boilers to meet the plant's energy requirements. In the summer liquor production exceeds the mill’s required energy. In the winter, however, liquor production is not high enough to meet the mill’s higher steam requirements thereby forcing Tembec to purchase natural gas as a source of energy. Throughout the year the burning of bark from the sawmills and sludge from their wastewater treatment plant meets the remainder of energy needs. The lignin division of the chemical group possesses a sodium conversion column which is presently underutilized due to the lack of liquor available. This sodium column has the capacity to produce up to 70,000 MT per year if enough liquor was available. It is currently running at only 20,000 MT. The demand for and the selling price of the lignosulfonate are much higher in the winter months during which supply is at its lowest. The issue is whether it is a good idea to uncouple the production of sodium lignosulfonate from the operation of the mill via the building of a tank. This tank would hold liquor so that the sodium column would be able to run continuously. The question posed was whether it appeared profitable to build a tank to store the liquor so that it may be sold at higher prices during the period of increased demand in the winter. After extensive research and analysis, the students submitted their findings and proposals to Tembec in early December.
COMING IN 2001:

- Seminar on Risk Management by Pratt & Whitney
- Seminar on Simulation Software by MultiCIM Technologies
- Case Study on Strategic Planning for Biotech & Pharmaceutical Operations with Merck Frosst
- Case Study at IBM
- Case Study with Celestica during the April plant tour.

STAY TUNED!

NCML MEETING

On November 10, 2000, Professor Vince Thomson and Myrosia Cap, MMM Program Coordinator, attended the National Coalition for Manufacturing Leadership (NCML) Meeting and Recruiting Forum in Pittsburgh. There were two major topics under discussion:

Defining Manufacturing. After lengthy and detailed study, an NCML subcommittee reported on Manufacturing Terminology and what constitutes Big M Manufacturing. A number of interesting issues were raised. Product Design is vitally important in industry but Product Design and Development are not considered part of manufacturing. Supply Chain management is of prime importance in the current economy. One cannot be a manufacturing manager today without making use of supply chain and core competencies. There is also the whole issue of reverse logistics: recycling and reusing products. This results in an interesting dilemma: is supply chain a manufacturing asset or a competition to manufacturing? E-Commerce and Enterprise Management includes IT, financial services, distribution and transportation channels – none of them traditional components of manufacturing. On the other hand, there is the perceived value by industry: all the jobs and projects now are in SCM and e-Business. In conclusion, there was general agreement that manufacturing should be cradle-to-grave and that Big M should be all-encompassing. One possible definition was proposed: manufacturing is an endeavour which transforms material into a tangible product. It is comprised of enterprise-wide processes including order fulfillment, product life cycle management, supply chain management as well as resource (human, finance, realty, technology) management.

Leadership. On this topic there was a very interesting panel discussion consisting of two manufacturing management students and representatives from Intel, Dell and TRW. One of the best definitions of Leadership emanates from the US military: leadership is the sum of certain qualities, intellect, ethics and human understanding which command and inspire. On the strategic side there is intellect which can see a vision and set organizational goals. Ethics revolves around setting values. Human understanding communicates these values. No one can teach leadership. It can only be learned by doing and making mistakes. In the military, the most effective leader can jump from one style to another. This is called situational leadership and it involves collaboration. The panel recommended that NCML universities integrate the soft skills of leadership and communication into most of the program, virtually all courses. Professional ethics are for everyone. The most important aspects of leadership in a manufacturing curriculum should include the ability to influence others, communication and negotiating skills and emotional intelligence competencies. Universities should teach a Leadership & Ethics course by means of case studies, including both successes and failures. Alumni in leadership roles should talk about their experiences. CEO’s and leaders should provide seminars but the universities must integrate all the data and determine what the common profile is.

In the spring of 2001 there will be a follow-up meeting to provide closure to these discussions and to propose changes in curriculum which would incorporate these elements.

NEW MMM Student

The MMM program is pleased to welcome a new, part-time student, Mathieu Proteau, starting in January 2001. Mathieu holds a B.Eng in Industrial Engineering from École Polytechnique. Upon graduation he was initially a Production Engineer at JWI Group – Filtration Division. He managed the ISO 9002 Quality Assurance System and improved the weaving process while supervising eight unionized employees. He was responsible for reorganizing plant layout, standardizing working procedures in every process, reducing raw material scrap by 50% and successfully completing three external audits. Since June 1998 Mathieu has been with PPG Canada in Hawkesbury as Line 4 Process Engineer. Here he is responsible for improving line 4 speeds and yields, supervising two process technicians, providing management assistance to the line superintendent and being the Sigma Logic (Six Sigma) Accelerator. His accomplishments include a 10% increase of line 3 lehr speed, lehr 3 downtime reduction from 20% to 12% and a new Sungate windshields process start-up with yield improvement from 30% to 75% in a year. Mathieu has constantly been furthering his education with special courses such as a Sigma
Logic course in Tennessee, the Fanuc Robot Course in Michigan and Essential Management Skills at McGill. He is well versed in computer programming languages such as Karel, PLC and Pascal as well as specialized software such as JMP, Autocad LT and CATIA. In his spare time Mathieu enjoys golf, hockey, tennis and skiing. Welcome aboard!

In this issue, the MMM program is pleased to feature the following article contributed by Professor Angelo Segall. This is the first time that a faculty member has submitted an essay to the MMM Newsletter. We also thank Professor Segall for his extensive involvement with the students and the program throughout the fall semester.

**MMM Program is up to the challenge of training students for success.**

By Angelo Segall Ind. Eng. MBA
Adjunct Professor MMM Program

One of the biggest challenges faced by academic institutions around the world is to maintain up-to-date courses that resemble real-world applications. Engineering curricula need to combine strong traditional engineering education with the latest techniques being applied in industry.

A major requirement is that students can experience working in a Product Design area with utmost realism. Concurrent Engineering [CE] Environment simulation as an education tool provides a learning-by-doing approach characterized by moving from passive perception to active experience.

As educators not only do we have to teach the latest developments in the field of CE but more importantly we must focus on teaching how to do CE. Hence, there is a strong need for new approaches in training and education of engineers to practice CE.

However, there are not enough real life situations that can be used for education or training, since in many real life situations the occurrence of errors/ mistakes - which are natural in learning situations - are not acceptable. However, the fundamental requirements of CE are cooperation, parallelism, goal sharing, customer focus and continuous process improvement, etc. These principles must be applied in a multidisciplinary, multifunctional, multicultural and a highly competitive and dynamic global industrial environment and often it has to be done in a physical or virtual co-located environment.

In the MMM program, the new course “Product Design and the CE Environment”, the CE modules are increasingly used to demonstrate these interactions. A typical CE module structure comprises principles of CE and application of tools & techniques like QFD [Quality Function deployment], DFMA [Design for Manufacturing & Assembly], Six Sigma Quality and IPD [Integrated Product Development] teamwork. Class simulation of CE environment combined with HBS case study, organizes students in cross-functional teams and by simulating and using advanced information and communication technology is a substitute to meet this need.

To practice that, from day one our class was divided into 4 “Integrated Product Development ” [IPD] team, and each team selected a team leader. The team leader ensured that the class exercises were prepared throughout each stage and were ready for class presentations. Then, each IPD team had to select, design and introduce a new product to the market, prepare a kick-off meeting, assign the CE core team and plan the project/product development. The members of the team were assigned specific tasks [role-playing] and each team gave presentations in front of the class. Each presentation was followed by a Q & A period.

Throughout the sessions, as we advanced with the course material, the design chosen by the 4 teams was logged, maintained, and built upon. At the last session, each team handed in a final Proposal Research Report for their selected product.

The main learning goals of role playing and simulation were to transfer basic knowledge and principles to students; to acquire best practices in new domains; improve skills in existing domains; to master solutions before a real product is available; to develop the ability to make decisions in a complex context (identification of complex situations and problem solving developments); to develop the ability to communicate with others on the basis of a common understanding.

The rationale for this teaching course is based on the fact that students entering a university engineering course usually have little, if any understanding of industrial and business practices. The Education curricula offered by the MMM Program provides the opportunity to train students in one of the most widely used tools in industrial and business practices.

This Fall session a group of 32 students from Industrial Engineering, Mechanical Engineering, and MMM Program have successfully completed the above described course. The enclosed pictures show the students in some of the activities that took place during class.
“Product Design and Concurrent Engineering Environment”
The Class of Fall 2000