



JETS

THE PRE-ENGINEERING TIMES

September 2006, Issue #50

JETS would like to thank Minitab for sponsoring this month's newsletter. For over 30 years, Minitab has delivered software and services for quality improvement, education, and research. [Click here](#) to learn more.



In This Issue

JETS Announces National Scholarship in Power Engineering	2
Coaches' Corner	2
Feature Story: Manufacturing Engineering	4
Extreme Engineer	5
Hot Topics	7
Engineering Pathway	8

Letter from JETS

It's the beginning of the school year. Let JETS help you make this an exciting—and productive—year for students considering a career in engineering and other science- and math-related technical careers.

JETS returns both the TEAMS and the NEDC competitions for 2006-07. Start now to build your teams and prepare for exciting hands on experiences. [Click here](#) for more information.

Both the [feature of the month](#) and the [extreme engineer](#) explore manufacturing engineering. Considered essential to our national security, manufacturing is turning high tech to compete in the global marketplace. Explore the exciting world of manufacturing engineering with Matt Hilgendorf, a very recent engineering graduate, who has gone from auto shop to auto U to his dream job with Caterpillar, Inc.

Our [Hot Topic](#) for the month takes you into a soft drink manufacturing facility for a look at the "softer side" of manufacturing—pun intended.

So don't delay. Make plans now to participate in the 2006-07 TEAMS and NEDC competitions, and to keep your wit sharp, check the JETS Web site each week for a new JETS Challenge problem. They're fun and entertaining!

If you know of students, educators, or engineers that would be interested in this kind of information please forward this newsletter and encourage them to subscribe.



JETS Affiliates, click on the logos below.

JETS Affiliates help increase awareness of and interest in engineering and technology-based careers to pre-college students, parents, teachers, and school counselors. To learn more about two of



To fit your organization's needs, JETS has created several ways to become a JETS Affiliate. To learn more about how your organization can participate as a JETS Affiliate and help JETS inform

and excite young people about engineering careers [click here](#).

This newsletter is a publication of JETS. JETS opens the world of engineering and technology to students, parents, and educators by providing career guidance and through programs and resources that illustrate real-life teamwork and problem solving skills.

Coaches' Corner— Resources for Educators



STUDENTS: GET READY TO “POWER” YOUR FUTURE...

The Next Generation Scholarship Fund is coming soon!

JETS is pleased to work with [Power Engineering](#) magazine to announce a new scholarship just for high school seniors.

This competitive scholarship application process will be open to all currently enrolled 12th grade students who are active participants in one or more of JETS programs – such as TEAMS or NEDC. Students expressing an engineering career interest in the power industry and planning to enroll in a four-year engineering program should apply. Students will have to submit an essay and application to be considered for the scholarship.

Stay tuned... more details available soon! Please visit JETS Web site for updates and application information: www.jets.org.

Pass it On!

Please encourage your students and their parents to subscribe to the Pre-Engineering Times! It's not only a great resource for the classroom, but also for students and their parents as they make career choices and learn about the world of engineering.

To sign up to receive the monthly Pre-Engineering Times, please go to <http://www.jets.org/programs/enewssignup.cfm>.

If you wish to unsubscribe, [click here](#) and include “REMOVE” in the subject line.



Looking for ways to unlock the mysteries of engineering to your students? Participate in JETS!

Educators are a driving force in making JETS programs available to students. With increased global competition, it is critical to prepare and equip the next generation of engineers and technicians.

Educator Benefits:

- Flexible programs requiring little or no preparation time.
- Augment your curriculum by participating in JETS—with ready-made resources and activities for classroom implementation and discussion.
- Motivate students to learn more with JETS programs and materials that combine math and science with practical applications.

How to Participate:

1. Get Active! Coach a [TEAMS](#) or [NEDC](#) competition. Represent your school as a coach for TEAMS or NEDC and give your students the chance to learn first hand how math and science are applied in engineering.
2. [Go Exploring!](#) Read about extreme engineers, various engineering specialties, learn about college engineering programs and download podcasts (coming soon) for your students.
3. [Face the Challenge!](#) Incorporate these into your classroom activities and watch your students solve a variety of problems.
4. [Go Shopping!](#) Visit JETS online store for brochures, books and other resources that help you further explore the world of engineering and technology.

TEAM+S

Make it Relevant... Make it Real... Make it Fun...
Make it Happen!

[Experience TEAMS 2007!](#)

Make it Relevant...

TEAMS challenges students to apply what they learn in the classroom to real-life problems focusing on today's hottest issues: environmental protection, flood control, air transportation, and more!

Make it Real...

TEAMS introduces students to engineering, both as a college major and as a profession, and to colleges, universities and corporations who may want to recruit them. Competitions are held across the country on university and college campuses, and engage students in college freshmen level problems, stimulating a student's analytical and problem solving skills.

Make it Fun...

TEAMS requires students to work as a team, fostering an environment where participants can learn from each other while at the same time having lots of fun. Students compete with peers from other schools locally and nationally, allowing them to meet people like themselves, and gain a sense of accomplishment.

Make it Happen...

TEAMS 2007 competitions are being held between February 3rd and March 11th at host sites across the country, but registration opens October 1st! Visit www.jets.org/programs/teams-home.htm to learn more about TEAMS and find a competition site nearest you!



NEDC registration is now open!

Explore Engineering, Make a Difference, Have Fun, and Win Prizes!

By participating in the JWOD/JETS [National Engineering Design Challenge – NEDC](#), high school students explore aspects of engineering — mechanical, electrical, biomedical, and rehabilitation engineering — and make a difference in their community and in someone's life! NEDC is a cross-curricular activity — that involves problem solving skills, math, science, research, writing, presentation skills, and drafting/design skills...and fun and prizes!!

Registration is **now open** for the 2006/2007 JWOD/JETS [NEDC](#). [Click here](#) to register your team online. The deadline is October 16th – don't delay.

In order to help NEDC teams with their designs, JETS has partnered with [SolidWorks](#) Corporation to provide the JWOD/JETS NEDC teams with a complimentary copy of [SolidWorks 3D CAD](#) software. Registered participants will have use of the software through the final round. NEDC teams may use the software to produce professional CAD drawings for their presentation. Sign up for your free copy on your registration form.

JWOD/JETS NEDC teams work with individual technical mentors, professionals in engineering, who volunteer their valuable time to pass on their expertise. JETS has partnered with the American Society of Mechanical Engineers (ASME) to help NEDC teams find technical mentors. [Click here](#) to search for engineers interested in working with NEDC teams.

[Click here](#) for complete NEDC program details.

Feature Story: Manufacturing Engineering

Manufacturing engineering is about converting ideas into reality. Every product we buy—whether it's toothpaste, cell phones, automobiles, computers, clothing, or toys—has to be manufactured.

Manufacturing engineers work with design engineers and a whole host of company specialists—from marketing to accounting to logistics to purchasing—to produce a finished product efficiently, cost-effectively, ergonomically, and safely, while complying with governmental safety and environmental standards. The goal is to produce a product at a quality level and price that the consumer will want. That's a tall order... but it's an exciting discipline and one that is tangible and hands on.

A Systems Approach

Manufacturing engineers deal with systems—including software applications, process planning, modeling, testing, numerical controls, and production equipment, to name a few—as well as quality, plant floor layout, safety, ergonomics, environmental compliance, and engineering tolerances—to produce a product.

All the Cool Toys—Including Robotics

Manufacturing engineers work with all aspects of manufacturing from production control to materials handling automation. Many companies now consider that manufacturing starts with product design. In those companies manufacturing engineers work with design engineers to ensure the design can be manufactured at high quality, effectively, and at the lowest cost possible. All forms of automation—from robotics to machine vision—are among the advanced technologies manufacturing engineers use to improve quality, increase efficiency, and lower cost.

Keeping U.S. Manufacturers Competitive

Manufacturing engineers are critical to keeping U.S. companies competitive in the world market. Many concepts such as Six Sigma decision making, ISO quality standards, Lean Manufacturing, and supply chain efficiencies have revolutionized manufacturing processes in recent years.

Lean Manufacturing—and Other Strategies to Improve Quality and Cut Cost

Key lean manufacturing principles include designing the manufacturing process to eliminate defects, minimize waste, provide constant process evaluation and improvement, minimize raw and finished goods inventories, respond quickly

to changes in production runs, and build and maintain long-term relationships with suppliers and customers. Supply chain efficiencies involve all companies—from raw materials suppliers to manufacturers to distributors and retailers—working together to take costs out of the system and deliver a high quality product at a low cost to customers where they want it and when they want it.

Why Manufacturing Engineering?

Reasons to study manufacturing engineering include:

- Core classes are typically less theoretical and more hands on than many other engineering disciplines.
- Many engineers wind up working in manufacturing anyway.
- Manufacturing engineers are among the highest paid engineering graduates.
- Many programs integrate coop work into the academic program—providing valuable experience and helping to pay for tuition.
- Manufacturing engineering typically is less math and physics oriented than many other engineering disciplines—and often provides the ability to take a range of electives.
- Manufacturing engineering is a great base to pursue a career in management or executive positions within a manufacturing company.
- Manufacturing engineering is people oriented.
- Manufacturing engineering is an exciting career with lots of variety.
- Industry needs more manufacturing engineers.

Related Links:

[Society of Manufacturing Engineers \(SME\)](#)

Certification as a CMfgT—<http://sme.org/cgi-in/certhtml.pl?cert/certification.html&&&SME&>

[Institute of Industrial Engineers \(IIE\)](#)

[Manufacturing Is Cool](#)

For a listing of ABET accredited manufacturing engineering programs, visit www.abet.org.

In addition to the Extreme Engineering featured in this issue of PE-Times, interviews with other recent graduates in industrial and manufacturing engineering can be found on the [California Polytechnic State University \(Cal Poly\) career services Web site](#).

Extreme Engineer of the Month

Profile: Matt Hilgendorf, CMfgT, Caterpillar Inc., Manufacturing Engineer



Education: Dual Major, B.S. in Manufacturing Engineering and a B.S. in Mechanical Engineering from Kettering University

Favorite Classes:

- Work design
- Applied controls—Manufacturing and Industrial Control Systems
- Leadership

Best Skills: Problem solving, project management, and communications.

Hobbies: Computers and, recently, reading and golf.

Role Model: His parents. As he says, they let him get into so much trouble, that it let him learn things. He defined “getting into trouble” as breaking things at home. There were no limits to learning, he says, there was only figuring things out.

Advice: “A four-year college degree may not be for everybody. It may not have been the best fit for me, but I pushed myself and made it work. There is a growing need for skilled trades such as industrial electricians, designers, manufacturing technologists, and engineering technicians. Look at all your options. Take advantage of job shadowing. Read career information. There are also a lot of tests that can help you figure out the best fit. For those who pursue an engineering degree, work hard and take advantage of professional organizations such as the Society of Manufacturing Engineering (SME) and the Institute of Industrial Engineers

(IIE). Student rates are inexpensive and you can learn a ton, plus they have scholarships you can apply for. A large part of my college was paid for by scholarships from SME.”

From Auto Shop to Auto U

Matt had an interest in criminal science and engineering in high school. After co-oping in an automobile dealership, all 16 mechanics said he needed to go to college. He applied to Kettering University in Flint, MI, because of its alliances with the automotive industry. He started out as a mechanical engineering major because it is considered to be very broad. “If you don’t really know what you want to do yet, and you’re not an electrical person, mechanical engineering appeared to be the place to start,” says Matt. He encourages future engineers to try to find their passion early and become a “specialized-generalist.”

Beyond Math and Physics—Manufacturing Engineering

He liked to learn but didn’t like the math and physics as much as he liked getting his hands dirty once in a while. He got through it at the top of his class, however, with lots of hard work. What he really enjoyed were his manufacturing classes, which weren’t all math and physics based. He got to work with machine tools, different materials, programmable logic controllers, sheet metal presses, robotics, computer-aided design and computer-aided manufacturing (CAD-CAM), work design, and some ergonomics—all practical stuff.

Hands On with Coop

For his co-op job, Matt worked for the Kohler Co. Engine Division, which makes small engines for lawnmowers and industrial/construction applications. Based on a one-year project he did for the company, he wrote his thesis for his bachelor’s degree “Low Volume Assembly Systems Design for a New Product Using New Product Development Process at Kohler.” His project was to design the whole assembly system—how you put parts together and ship them out the door. People may use his system to build engines for possibly the next 10 years. It was quite an opportunity that included presenting to vice presidents and the president. He enjoyed working as a member of a cross-functional team. He worked a lot with marketing and accounting. It also involved working closely with design engineers to change a few parts so they could be put together easier and at a lower cost.



A Call from Caterpillar

Matt excelled in the program and was awarded a couple of scholarships from the Society of Manufacturing Engineers. With a 3.97 GPA, he wasn't #1 in his class, but he was selected as the keynote undergraduate speaker. He started getting job offers in August of his senior year. In October he was recruited by Caterpillar. It was one of the hardest decisions he had to make. He enjoyed his co-op with Kohler, but he was attracted to Caterpillar because it had adopted 6 σ (Six Sigma) methodology—a disciplined, data-driven approach and methodology for eliminating waste and defects in any process. To Matt this meant that they had a serious focus on manufacturing, which included involving manufacturing from design conception on. He accepted their offer.

Manufacturing Begins with Design

"Manufacturing people are going to be key people in driving cost and waste out of the process—including the design process—because they know what

costs more and what is difficult to produce," says Matt. "Manufacturing needs to be involved from the conception of a design. Companies that fail to do that can wind up with products that can be outsourced and manufactured differently abroad for less cost." Matt estimates that about 80 percent of product cost is determined by the product design. "If you wait to reduce cost until you're in manufacturing, you're hoping to reduce cost by 20 percent at best," he says.

Manufacturing R&D

Matt has been on the job at Caterpillar about five months, and he's already sunken his teeth into some pretty meaty tasks. He's currently working in manufacturing research and development. They are trying to push the cutting-edge of manufacturing. He's working on a team that is conceptualizing very broad things to fix problems—such as the wall between design and manufacturing and how to eliminate waste, optimize manufacturing, and eliminate things that don't add value. A specific task he's working on is using off-the-shelf computers rather than paper as the manual to instruct employees on the shop floor.

Keeping the Business Running

Matt loves the manufacturing environment. He's driven by the fast pace of the job. He's never bored. There's always something to do. With responsibility for day-to-day operations, there are always problems to solve. You have to be able to very quickly troubleshoot and problem solve on your feet. "You may be called down to an assembly area early in the morning with a major issue," he says. "You have to figure out how to keep business running safely and still produce a high quality product." That sense of urgency is very appealing to Matt. Matt thrives in the fast-paced environment.

"Manufacturing Engineers Got It Made"

Matt's enthusiasm for manufacturing engineering is boundless. Like the slogan from one of Matt's favorite t-shirts, he feels "Manufacturing Engineers Got It Made."





Hot Topic

In most established markets around the world, soft drinks now rank first among manufactured beverages, surpassing even milk and coffee in terms of per capita consumption.

Including ready-to-drink, packaged products and bulk mixes for fountain dispensing, soft drinks are available in almost every conceivable size and flavor and in virtually every channel of retail distribution. Complementing this universal availability, much of the soft drink category's growth can be attributed to convenient packaging. As consumers have become increasingly mobile, they have opted for easier-to-carry packaged goods. With the advent of the aluminum can and, more recently, the resealable plastic bottle, soft drink packaging has become lighter and more portable.

Stringent quality-control standards and state-of-the-art water treatment processes also have afforded the soft drink industry a high degree of confidence regarding product purity. Moreover, the manufacturing or bottling plants that produce soft drinks have evolved into highly mechanized, efficient and spotlessly clean food-processing facilities.

As early as the 1960s, most bottlers were producing beverages through machinery that ran at 150 bottles per minute. As product demand has continued to skyrocket, soft drink manufacturers have shifted to faster machinery. Thanks to advances in production technology, filling lines now are able to run in excess of 1,200 containers per minute, with minimal downtime except for product or flavor changes.

Soft drink bottling or manufacturing involves five major processes, each with its own safety issues that must be evaluated and controlled:

1. treating water
2. compounding ingredients
3. carbonating product
4. filling product
5. packaging

Manufacturing Engineering—What It Is and What It's Not

Name an industry, and it's a good bet manufacturing engineers will be there—from clothing to pharmaceuticals to candy to equipment manufacturing—and everything in between. To provide additional insight into this exciting field, here's Matt's list of what manufacturing engineering is and what it's not.

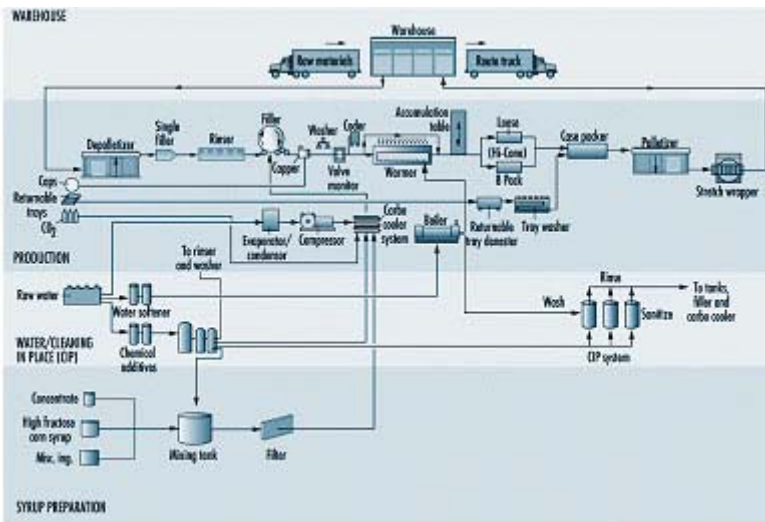
Manufacturing Engineering is:

- Understanding geometric dimensioning and tolerancing (reading drawings)
- Working with shop-floor associates
- Understanding CAD models
- Appreciating human factors such as fatigue and ergonomics
- Working with product and equipment suppliers
- Understanding the cost to manufacture
- Working with all disciplines of engineering including electrical, quality, materials, design, safety, and others depending on the product

Manufacturing Engineering is not:

- Sitting behind a CAD station all day
- All about calculus
- Meetings all day
- Always dirty, dark, and hot
- Only tool and die work
- Just for men

Flow chart of basic bottling operations



Soft drink manufacturing starts with water, which is treated and cleansed to meet exacting quality-control standards, usually exceeding the quality of the local water supply. This process is critical to achieving high product quality and consistent taste profiles.

As ingredients are being compounded, the treated water is piped into large, stainless-steel tanks. This is the stage at which various ingredients are added and mixed. Diet beverages are mixed with artificial, non-nutritive sweeteners such as aspartame or saccharin, whereas regularly sweetened drinks typically use liquid sugars like fructose or sucrose. It is during this stage of the production process that food coloring may be added. Flavored, sparkling waters receive the desired flavoring at this stage, while plain waters are stored in the mixing tanks until the filling line calls for them. It is common for bottling companies to purchase concentrate from other firms.

In order for carbonation (absorption of carbon dioxide [CO_2]) to occur, soft drinks are cooled using large, ammonia-based refrigeration systems. This is what gives carbonated products their effervescence and texture. CO_2 is stored in a liquid state and piped into carbonation units as needed. This process can be manipulated to control the required rate of beverage absorption. Depending upon the product, soft drinks may contain from 15 to 75 psi of CO_2 . Fruit-flavored soft drinks tend to have less carbonation than colas or sparkling water. Once carbonated, the product is ready to be dispensed into bottles and cans.

The filling room usually is separated from the rest of the facility, protecting open product from any possible contaminants. Again, the highly automated filling operation requires a minimal number of personnel. Filling room operators monitor the

equipment for efficiency, adding bulk lids or caps to the capping operation as necessary. Empty bottles and cans are transported automatically to the filling machine via bulk material-handling equipment. Stringent quality-control procedures are followed throughout the production process. Technicians measure many variables, including CO_2 , sugar content and taste, to ensure that finished drinks meet required quality standards.

Packaging is the last stage prior to warehousing and delivery. This process also has become highly automated. Meeting various marketplace requirements, bottles or cans enter the packaging machinery and may be wrapped with cardboard to form cases or placed into reusable plastic trays or shells. The packaged products then enter a palletizing machine, which automatically stacks them onto pallets. Next, the loaded pallets are moved—typically via fork-lift—to a warehouse, where they are stored.

Excerpts from Article: **Soft Drink Bottling and Canning**

Author: [Matthew Hirsheimer](#)

Part: [PART X. INDUSTRIES BASED ON BIOLOGICAL RESOURCES](#) Chapter: [65. Beverage Industry .](#)

[Lance A. Ward, Chapter Editor](#)

For more information, please visit: <http://www.ilo.org/encyclopedia/?d&nd=>

[857200039&prevDoc=857200038](#)

[Click here to take a virtual tour of a Coca-Cola bottling plant.](#)

Engineering Pathway

Beginning with the October issue of the Pre-Engineering Times, JETS will provide a hands-on engineering activity you can use to bring math and science to life in the classroom.

This activity will be provided by [Engineering Pathway](#) — a portal to high-quality teaching and learning resources in applied science and math, engineering, computer science/information technology and engineering technology — for use by K-12 and university educators.

Until then, feel free to browse the [TeachEngineering Collection](#), which includes some of the K-12 content that will be a part of the Engineering Pathway. The Engineering Pathway will officially launch in October with a new interface creating the engineering “wing” of the National Science Digital Library (NSDL) at www.engineeringpathway.com.